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Greening the Steel and Cement Used in China's Global Infrastructure Projects

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EXECUTIVE SUMMARY

China's development finance institutions (DFIs), primarily the China Development Bank (CDB) and the Export–Import Bank of China (CHEXIM), have become central players in global infrastructure development. These DFIs have contributed to economic growth in host countries by unlocking infrastructure bottlenecks, increasing trade and improving infrastructure and energy access (Gallagher et al. 2023). At the same time, China's overseas infrastructure projects have come under scrutiny for their climate impact. While attention has often focused on their role in financing fossil fuel versus renewable power projects, this report highlights another critical dimension of climate impact: the massive volumes of steel and cement, both carbon-intensive materials, used in Belt and Road Initiative (BRI) projects. These materials are indispensable for roads, railways, bridges, ports and power plants, yet their production accounts for nearly one-fifth of global CO_2 emissions. The BRI, spanning more than 140 countries, therefore not only shapes energy systems and transport but also locks in material-related emissions for decades.

Steel and cement demand is expected to remain strong in developing economies, especially in Asia and Africa where most BRI projects are located. With Chinese domestic demand for steel and cement plateauing, BRI infrastructure also provides an outlet for China's industrial production overcapacity in these sectors, which exceeds domestic consumption levels. Against this backdrop, green procurement can be a powerful tool to reduce embodied emissions by embedding low-carbon requirements into the sourcing of cement and steel. In this report, we quantify the material demand and associated emissions in key BRI transport and energy projects, explore green procurement scenarios and discuss implementation pathways that could align Chinese-financed infrastructure with global climate goals.

China's overseas development finance, representing public and publicly guaranteed loans by CDB and CHEXIM, has provided over US$472 billion in loans since 2008, making it the largest bilateral lender for global infrastructure and development. While this model has expanded economic opportunities abroad, it has also directed vast sums into carbon-intensive sectors. The energy sector is the largest recipient, with $184 billion since 2008, much of it for fossil fuel extraction, coal power and large hydropower. Transport is the second-largest recipient sector, spanning roads, railways, airports and ports, all highly material-intensive.

Steel and cement are at the core of these projects. For example, steel is essential for boilers, turbines and transmission towers that underpin electric power systems, while cement reinforced with rebar forms the foundations of dams, roads and bridges. These materials ensure durability, but they are among the most carbon-intensive to produce. The climate implications are magnified by China's historic focus on fossil fuels: Chinese-financed power plants around the world already emit 287 million tons (Mt) CO_2 per year, with another 53 Mt likely if planned projects proceed.[1] Lifetime emissions from coal plants with Chinese backing could reach 11 Gt CO_2, about one-third of Asia's total. Beyond direct emissions, BRI projects often drive deforestation, biodiversity loss and land-use change while also facing climate risks such as floods, typhoons and water stress. This dual dynamic makes it an urgent need to reduce embodied and operational emissions while at the same time improving climate resilience, a central priority for many host countries.

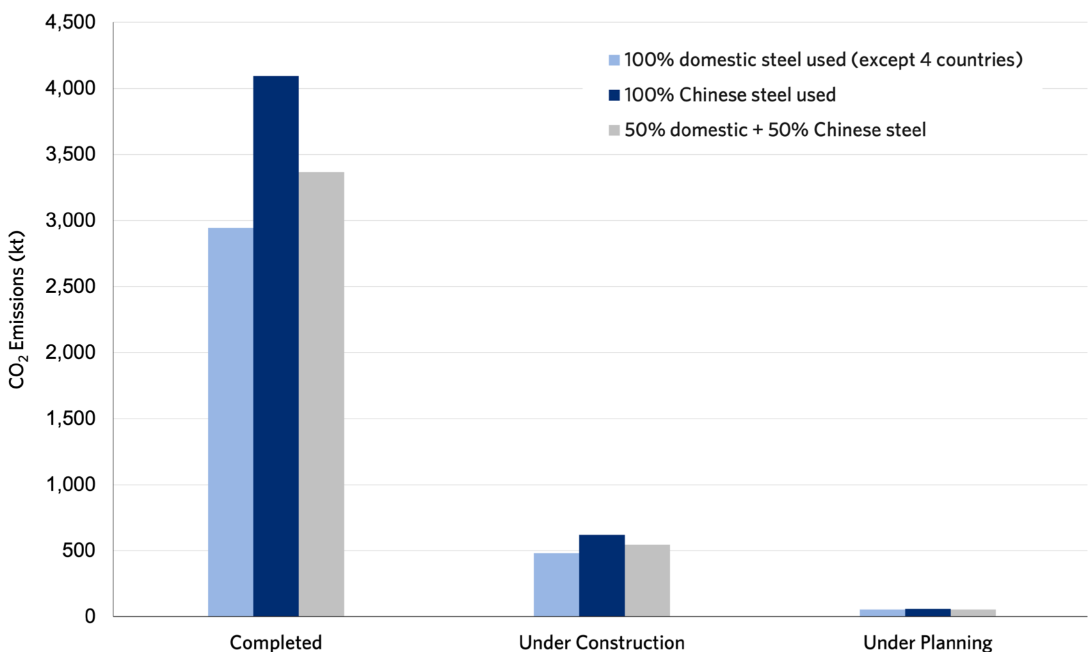
Cement use in energy and transport projects financed by China's DFIs is estimated to generate 2,452 kt CO_2, assuming all cement is sourced from within the country where the project is located. Completed projects account for the majority, at 1,988 kt CO_2, while projects under construction contribute 406 kt CO_2 and planned projects just 58 kt CO_2. Emissions are highly concentrated, with

[1] All uses of "ton" throughout this report refer to metric tons.

South Africa, Indonesia, Argentina, Ethiopia and Angola together responsible for about 977 kt CO_2, or 40 percent of the total. This shows that a small number of countries drive a large share of cement-related embodied emissions, and that completed projects dominate the footprint due to the decline in new overseas development finance in recent years.

Steel emissions vary more depending on sourcing assumptions. If all steel were produced domestically in BRI partner or host countries (with China supplying only those countries lacking local steel industries), emissions would total about 3,480 kt CO_2, compared with 4,772 kt CO_2 if all steel came from China. We also modeled a scenario with a 50/50 split between domestic and Chinese supply, for which emissions were an estimated 3,966 kt CO_2. In all scenarios, completed projects account for most embodied emissions, with over 2,900 kt CO_2 under the domestic case and more than 4,000 kt CO_2 under the Chinese-supply scenario. The top five countries, Argentina, South Africa, Indonesia, Ethiopia and Angola, make up about 62 percent of steel-related emissions under the domestic case. These results underline that sourcing choices matter: relying on Chinese steel raises emissions by 37 percent due to its higher carbon intensity, while even a mixed approach increases them by 14 percent. Green procurement strategies, therefore, play a crucial role in reducing the carbon footprint of BRI infrastructure projects (see Figure ES1).

Figure ES1: CO_2 Emissions Associated with Steel Used in China's Overseas Development Finance in the Energy and Transportation Sectors



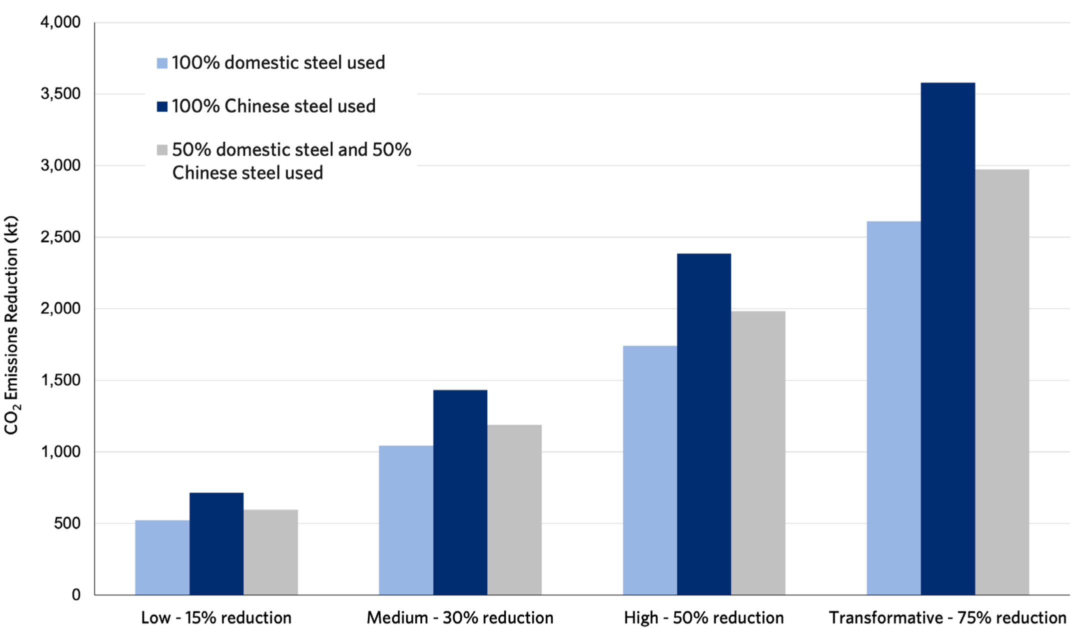
Source: Authors' elaboration.

Note: Projects covered in this study include only key transport and energy sectors receiving development finance from China, see Section 3.

For cement, the analysis shows that green procurement could significantly cut emissions from Chinese-financed transport and energy projects. Total cement-related emissions in the dataset amount to about 2,452 kt CO_2, with nearly 2,000 kt CO_2 already locked into completed projects. Applying procurement standards that progressively reduced CO_2 intensity could have delivered meaningful savings: around 368 kt CO_2 in a low-reduction (15%) case, 735 kt CO_2 in a medium case (30%), and over 1,226 kt CO_2 under a high-reduction pathway (50%). The most ambitious scenario, aiming for a 75 percent cut, could have achieved a reduction of 1,840 kt CO_2. While completed projects dominate the footprint, applying such policies to projects under construction and planning would still secure reductions. Beyond direct savings, these policies would create strong market signals for host-country producers to invest in efficiency, clinker substitution and innovative technologies such as Limestone Calcined Clay Cement (LC3), thereby accelerating broader decarbonization.

For steel, the emissions reduction potential depends on both the level of procurement ambition and the sourcing mix. Under a low-reduction (15%) target, green procurement could cut 522–716 kt CO_2 depending on sourcing, or about 595 kt CO_2 if steel is split equally between domestic and Chinese supply. These savings grow to 1,044–1,432 kt CO_2 under a medium (30%) target, 1,740–2,386 kt CO_2 under a high (50%) target and 2,610–3,579 kt CO_2 under a transformative (75%) target, with mid-mix projects achieving 1,190, 1,983 and 2,974 kt CO_2 reductions respectively. Most of this potential comes from completed projects, though projects under construction (70–349 kt CO_2) and under planning (8–38 kt CO_2) still add meaningful reductions. The results underline two levers: ambitious procurement targets and smart sourcing. Domestic steel, where electric arc furnace (EAF) routes dominate, generally lowers emissions, while requiring low-carbon standards for imported Chinese steel can drive deeper overall cuts and stimulate decarbonization in both supply regions (see Figure ES2).

Figure ES2: CO_2 Emissions Reduction Potential from Steel Used in Analyzed Transport and Energy Projects under Different Sourcing Scenarios



Source: This study.

Note: The Chinese development–financed projects covered in this study include only projects in key transport and energy sectors.

The implementation of green procurement for cement and steel in BRI projects faces major challenges. These include gaps in governance frameworks across Chinese and host-country institutions; limited emissions data and reporting capacity; higher costs of low-carbon materials; cost constraints for certain decarbonized steel and cement production technologies; and varying levels of political support for stricter standards. However, strong enablers can support adoption. These include alignment with global green procurement policies; the leverage of Chinese DFIs and state-owned enterprises (SOEs) in driving supply chain shifts; capacity-building for host-country producers; partnerships to scale innovations such as LC3 cement and hydrogen-based steel; and synergies with development goals such as lower energy costs, competitiveness and cleaner air.

Developing a green procurement framework for China's overseas development finance is essential to reducing the carbon footprint of BRI infrastructure projects. By setting clear standards for low-carbon steel and cement, China can align its global investments with climate goals, support industrial modernization in host countries and maintain competitiveness in increasingly climate-conscious markets. The recommendations summarized in Table ES1 highlight actions for ministries, DFIs and SOEs, along with cross-cutting mechanisms to enable effective implementation.

Table ES1: Policy Recommendations for BRI Green Procurement

Actor	Key Recommendations
Regulatory ministries: Ministry of Commerce (MOFCOM), National Development and Reform Commission (NDRC), Ministry of Finance (MOF), Ministry of Housing and Urban-Rural Development (MOHURD), Ministry of Industry and Information Technology (MIIT), Ministry of Ecology and Environment (MEE)	• Jointly issue overseas green procurement guidelines with carbon intensity benchmarks for steel and cement • Mandate Environmental Product Declarations (EPDs) or verified carbon data in tenders and project approvals • Establish tiered carbon intensity thresholds (Basic, Advanced, Best-in-Class) aligned with global standards • Leverage domestic experience (e.g., MOF procurement catalogs, MOHURD green building standards) to inform overseas guidelines • Integrate green standards into outbound investment approvals and oversight
Development finance institutions: China Development Bank (CDB), Export-Import Bank of China (CHEXIM)	• Require green procurement plans (with sourcing strategies and emissions data) in loan applications • Provide financial incentives for low-carbon material use • Establish internal scoring systems to rate projects on procurement performance • Publish technical guidelines and case studies for borrowers • Collaborate with international financial institutions (IFIs) to align standards and recognize EPDs
State-owned enterprises (SOEs), overseen by State-Owned Assets Supervision and Administration Commission (SASAC)	• Incorporate low-carbon criteria (EPDs, thresholds, life-cycle assessments/LCAs) into supplier contracts and procurement rules • Pilot demonstration projects for low-carbon steel and cement procurement. • Align SOE performance metrics with climate goals by adding green procurement key performance indicators (KPIs) • Build technical capacity and data systems for procurement officers and project managers
Cross-cutting implementation mechanisms	• Harmonize with international standards (ISO 14040/44, ResponsibleSteel, Global Cement and Concrete Association) • Build capacity in host countries through training, technical assistance, and South–South learning. • Establish strong monitoring, reporting and verification (MRV) systems, including third-party audits and digital tracking tools • Create a centralized green materials registry for steel and cement used in overseas projects

China. Photo by V1r7zZ via Unsplash.

INTRODUCTION

China's development finance institutions (DFIs) play an important role in global infrastructure development. Empirical research has shown that these DFIs have provided financing for liquidity and development finance at a level that has led to significant economic growth in host countries. As a result of their focus on infrastructure lending, Chinese DFIs have unlocked infrastructure bottlenecks and increased energy access more than traditional DFIs such as the World Bank. They have also supported South-led alternative institutions in global economic governance and helped increase the scale of additional and alternative financing, further providing opportunities for host countries (Gallagher et al. 2023).

However, given the worsening effects of climate change and global commitment to energy transition, these DFIs, namely the China Development Bank (CDB) and the Export–Import Bank of China (CHEXIM), are increasingly aware of the need to align investment portfolios with the global low-carbon energy transition. Much recent attention has focused on the composition of Chinese DFIs' lending for power generation projects, particularly coal-fired power plants, which are a major source of CO_2 emissions (e.g., Kong and Gallagher 2021; Springer 2022).

While the shift in China's overseas lending from fossil fuels toward renewable energy is a critical step in meeting climate goals, there is another major driver of emissions embedded in China's global infrastructure push: the use of carbon-intensive construction materials. Steel and cement are at the heart of nearly all infrastructure, bridges, ports, power plants, railways and roads. They are essential inputs, but they are also among the most carbon-intensive materials produced globally. For China's DFIs and contractors engaged in the Belt and Road Initiative (BRI), addressing the embodied emissions of steel and cement is an equally important frontier of climate action.

Global demand for steel and cement has grown sharply in recent decades as countries industrialize and urbanize. This demand is projected to remain strong in developing economies, where BRI projects are concentrated, especially in Asia and Africa. Yet, the production of steel and cement accounts for some of the largest shares of industrial greenhouse gas (GHG) emissions worldwide. Cement alone is responsible for over seven percent of global CO_2 emissions, while steel contributes around 11 percent (Hasanbeigi 2021, 2025).

China dominates both sectors, producing more than half of the world's steel and cement. As domestic demand has begun to plateau and, in some cases, decline, particularly in construction, raising concerns about the long-term economic competitiveness of these industries in China. The BRI has helped Chinese companies access new markets, with Chinese firms exporting steel and cement, investing in overseas production facilities and supplying materials for large-scale infrastructure abroad. Thus, BRI projects not only embody large amounts of material-related emissions but also influence the trajectory of global steel and cement production.

The BRI is the world's largest transnational infrastructure finance program, spanning more than 140 countries and mobilizing hundreds of billions of dollars in finance. Many participating countries are highly vulnerable to climate change and are under pressure to balance development needs with sustainability objectives. For example, Angola and Ethiopia, which this study finds are two of the top five countries by amount of steel and cement in BRI infrastructure projects, are in the bottom 20^{th} percentile of all countries ranked by climate vulnerability (University of Notre Dame 2024). Infrastructure financed and built under the BRI will shape energy use, transport systems and industrial development for an extended period of time. If constructed with conventional, carbon-intensive materials, these projects risk undermining both host-country climate commitments and global net-zero targets.

Introducing green procurement standards for China's overseas energy and transport projects offers one pragmatic pathway to reduce this risk and generate shared benefits for both host countries and China. By embedding environmental performance requirements into the sourcing of steel and cement, Chinese financiers and contractors can reduce the carbon footprint of projects while creating demand for lower-carbon materials, including those sourced from China (especially steel). This demand-side signal could accelerate decarbonization in both host-country industries and China's domestic steel and cement sectors, where producers increasingly seek green export markets.

Unlike in the power sector, where renewable alternatives are commercially available, steel and cement decarbonization is technologically and economically challenging. Process emissions from cement calcination and the dependence of steel on carbon-intensive blast furnaces mean that achieving deep cuts requires multiple levers, from energy efficiency to alternative materials, hydrogen-based direct-reduced iron and carbon capture. Many of these solutions are available but not yet deployed at scale.

Green procurement can bridge this gap by creating predictable, large-scale demand for lower-carbon products. Public procurement programs in the EU and US states have already shown how setting carbon-based product standards can shape industry behavior (Hasanbeigi et al. 2019). Applying similar principles to BRI projects could achieve two outcomes simultaneously: reducing embodied emissions in infrastructure and stimulating innovation and investment in cleaner production technologies across supply chains. BRI projects can serve as demonstration platforms for innovative low-carbon cement and steel technologies. By embedding low-carbon requirements in procurement, China can help scale up technologies that are critical for long-term decarbonization.

This report quantifies the potential carbon footprint of cement and steel used in BRI transport and energy projects, and the emissions reduction opportunities that could result from the adoption of green procurement standards. Using project-level databases, we estimate the scale of material demand, apply country-specific assumptions for production routes and clinker ratios and model emissions across multiple procurement scenarios. These scenarios range from modest reductions (15%) to transformative pathways (75%) that align with net-zero targets.

The analysis serves three purposes. First, it highlights the significance of embodied emissions in BRI infrastructure, a topic that has received far less attention than fossil fuel finance. Second, it demonstrates the potential role of procurement policies in driving emissions reductions in hard-to-abate sectors. Third, it provides evidence to inform policymakers, DFIs and industry stakeholders in both China and BRI host countries on how procurement choices today can influence long-term decarbonization pathways.

The remainder of the report is organized as follows. Section 2 reviews the scale of BRI infrastructure investment and its implications for material demand. Section 3 outlines our methodology for estimating cement and steel use and associated CO_2 emissions. Section 4 presents baseline results for emissions embodied in BRI projects. Section 5 explores emissions reduction potential under different green procurement scenarios for cement and steel, including domestic, Chinese and mixed sourcing cases. Section 6 discusses international best practices in green procurement for development financing. Section 7 concludes with policy implications and recommendations for BRI stakeholders.

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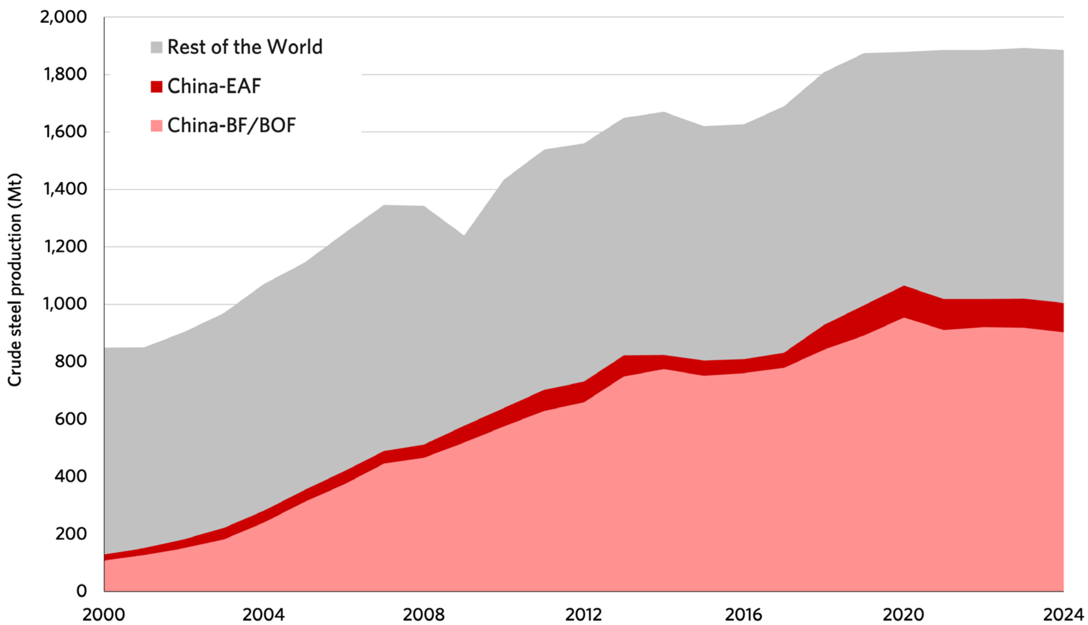
Steel Production and CO_2 Emissions

Global steel production has more than doubled since 2000, driven by a dramatic increase in steel production in China. China now produces 53 percent of the world's steel (worldsteel 2025; see Figure 1). Steel production in China is projected to decline significantly over the coming decades, driven by structural changes in its economy and shifts in domestic demand. Several studies forecast that the country's annual steel output will fall to a range of 600–750 Mt by 2050 (Hasanbeigi et al. 2023), down from over 1 Gt in 2024. The decline is largely attributed to a slowing real estate sector, weak growth in manufactured exports and the completion of major infrastructure buildouts in energy, transport and sanitation systems.

Figure 1: Crude Steel Production, China vs. Rest of World, 2000–2024



Source: worldsteel (various years).
Note: BF-BOF = blast furnace – basic oxygen furnace; EAF = electric arc furnace. These routes are discussed further below.

Despite the slowdown of steel production in China, global steel demand is expected to increase from 1,884 Mt in 2024 to as much as 2,500 Mt by 2050 (IEA 2020), with demand driven by emerging markets in South Asia, Africa and the Middle East. Without significant interventions to decarbonize steel production, this increase will also drive greater energy use and CO_2 emissions from the steel industry.

Steel production is a complex industrial process that involves several distinct pathways, each with varying energy requirements and associated CO_2 emissions. The most common methods for producing steel are the Blast Furnace-Basic Oxygen Furnace (BF-BOF) route and the Electric Arc Furnace (EAF) route, with emerging alternatives including direct reduction of iron (DRI) and smelting reduction technologies.

The BF-BOF route accounts for around 70 percent of global steel production (worldsteel 2025). In China, the BF-BOF route accounts for 90 percent of current steel production, with coal being by far the dominant primary fuel. The BF-BOF route begins with the preparation of raw materials through sintering and pelletizing, where iron ore fines are agglomerated into larger particles suitable for use in the blast furnace. These preparation steps emit CO_2 from fuel combustion.

Next, metallurgical coal is heated in the absence of air to produce coke, a porous carbon-rich material that acts as both a fuel and a reducing agent in the blast furnace. This process emits CO_2 from both the combustion of coal and the release of by-product gases. In the blast furnace, iron ore, coke and limestone are layered and subjected to hot air blasts. The coke combusts, producing the heat and carbon monoxide needed to reduce iron oxides into hot metal (molten iron). This step is highly carbon-intensive, emitting large amounts of CO_2 from both coke combustion and the chemical reduction of iron ore.

The molten iron is then transferred to the BOF, where pure oxygen is blown into the metal to oxidize and remove excess carbon. Although the BOF itself uses relatively little energy, the process emits CO_2 from reactions between oxygen and carbon in the hot metal. Overall, a new integrated BF-BOF steel plant in a country that primarily uses coal emits about 2.3 tons of CO_2 per ton of crude steel (worldsteel 2025).

The EAF route accounts for 29 percent of global steel production and primarily relies on recycled steel scrap, although it can also use pig iron and DRI as feedstock. EAFs use electricity to generate an arc between carbon electrodes and the scrap metal, melting it into liquid steel. Energy use in EAFs is significantly lower than in BF-BOF operations. Because EAFs do not require coke or iron ore reduction (if using scrap), direct CO_2 emissions are lower, though emissions still occur from the combustion of fossil fuels used in auxiliary processes, the electrodes and electricity generation, especially in regions with fossil fuel–based grids.

DRI involves chemically reducing iron ore in the solid state using natural gas, coal or hydrogen. The most common technology, MIDREX™, uses a shaft furnace where a mixture of hydrogen and carbon monoxide (from reformed natural gas) flows counter to the iron ore pellets, stripping away the oxygen and producing DRI or "sponge iron." DRI can then be used as a feedstock in EAFs. While this route avoids the energy-intensive coke and blast furnace steps, it still emits CO_2 from the use of fossil-based reducing gases. However, if green hydrogen is used, this route has the potential to significantly reduce CO_2 emissions. The DRI-EAF route currently accounts for around only 0.5 percent of global steel production (worldsteel 2025).

After steel is produced in either a BOF or an EAF, it undergoes casting, rolling and finishing, which involve reheating and shaping the steel into final products. These steps also generate some CO_2 emissions from the consumption of electricity and/or fuel for heating.

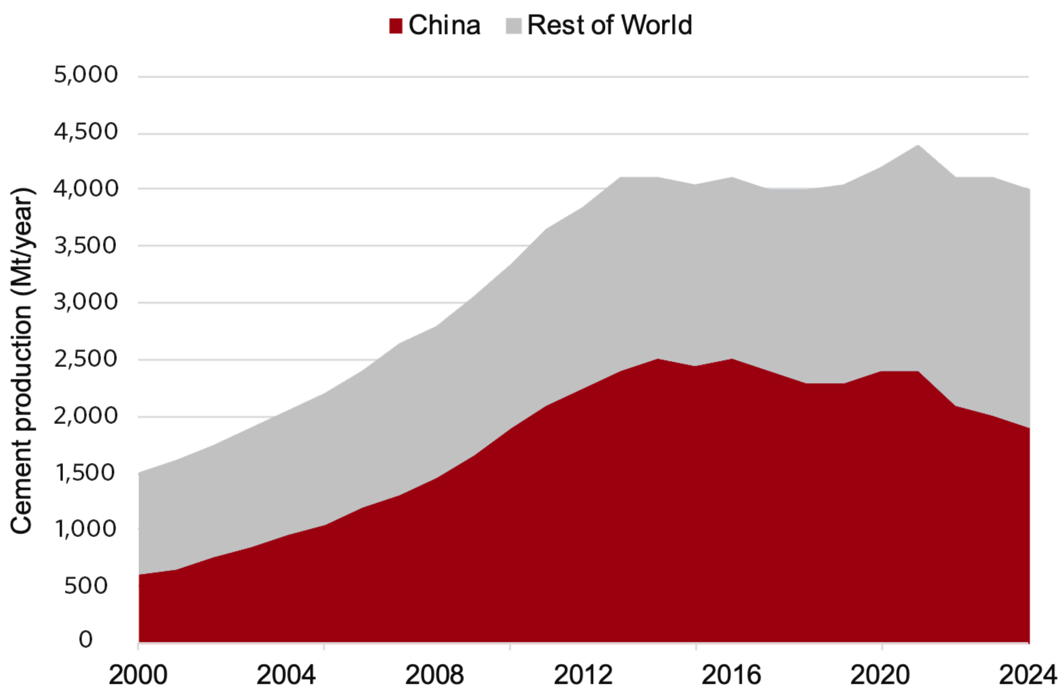
Given the carbon intensity of the BF-BOF steel production route and its dominance globally, CO_2 emissions from iron and steel production make up a significant portion of total global CO_2 emissions, 11 percent (or 7% of global GHG emissions).

The carbon intensity of steel production varies widely from country to country due to a combination of structural, technological, regulatory and resource-related factors. One of the most important determinants is the share of BF-BOF versus EAF production, since EAF production typically has lower CO_2 emissions. Countries such as the US, Turkey, Mexico and Italy have a high share of EAF production, allowing them to achieve lower average carbon intensities. In contrast, China and India rely heavily on the more carbon-intensive BF-BOF route. Other influential factors include the fuel mix, the carbon intensity of the electricity grid (critical for EAF-heavy producers) and the age and efficiency of steel plants. Environmental regulations, capacity utilization and local energy prices also affect carbon intensity. Thus, the carbon footprint of steel production is shaped not just by technology choice but also by broader national industrial and energy contexts (Hasanbeigi 2022). These differences play a role in the total carbon embodied in infrastructure projects, depending on where the steel was sourced from.

Cement Production and CO_2 Emissions

Global cement production has grown even more than steel production since 2000, with production nearly tripling between 2000 and 2024 (Figure 2). Cement is the key binding material in concrete, which is the most common manufactured product in the world. China is the largest producer of cement, producing over half of the world's cement and accounting for most of the demand growth since 2000, largely fueled by rapid urbanization and large-scale infrastructure investment. Nearly all the cement produced in China is used to meet domestic demand, a key difference from steel, around seven percent of which is exported.

Figure 2: Cement Production, China vs. Rest of World, 2000–2024



Source: Hasanbeigi et al. (2024).

Global cement demand is expected to grow unevenly across regions, reflecting different paths of economic development, urbanization and population growth. China's demand is projected to decline significantly as its economy matures and infrastructure expansion slows. Cement demand in Organisation for Economic Co-operation and Development (OECD) countries is expected to steadily decrease by nearly 50 percent by the end of the century, reflecting aging infrastructure and slower growth. Urbanization and population increase in Africa, Asia and the Middle East are projected to drive cement demand upward. Africa, in particular, is expected to become the world's largest cement producer by the end of this century despite having lower per capita consumption, due to its rapidly growing population. Based on Rhodium Group projections, across regions, cement production is expected to continue to grow year on year through a peak in 2040, after which it will decline and plateau (Rutkowski et al. 2024). The continued increase in production over the next 15 years will also mean an increase in the GHG emissions associated with cement production, unless significant decarbonization measures are taken.

The cement production process is both energy and emissions-intensive, generating GHG emissions at nearly every stage. The process begins with mining and quarrying, where raw materials (primarily limestone) along with clay and shale are extracted, typically near the cement plant. While this stage contributes only around five percent of total CO_2 emissions, it is a necessary first step that anchors cement production to specific geographic locations due to the availability of limestone.

Next, raw material preparation and grinding involve crushing and milling the mined materials into a fine powder or slurry, depending on whether a dry or wet process is used. Dry processing is more energy-efficient, with moisture content of around 0.5 percent, while wet processing uses significantly more energy due to higher moisture levels (up to 40%). This stage consumes substantial electricity.

The most carbon-intensive stage is clinker production, where the ground raw materials are heated in rotary kilns at temperatures exceeding 1,500°C. Clinker is the intermediary material in cement production. This stage is responsible for over 90 percent of total energy use in cement production and nearly all fuel consumption. It is also where calcination occurs. This is a chemical reaction in which calcium carbonate ($CaCO_3$) is converted into calcium oxide (CaO), releasing CO_2 in the process. This step alone accounts for about 60 percent of the total CO_2 emissions from cement manufacturing, releasing approximately 520 kg of CO_2 per ton of clinker produced.

After the clinker is formed and rapidly cooled to preserve its properties, the process moves to finish grinding, where clinker is mixed with small amounts of gypsum and possibly other supplementary cementitious materials (SCMs) such as fly ash or slag to produce the final cement product. This step also uses electricity according to the material hardness and desired fineness. Although the CO_2 emissions from electricity use are relatively modest (around 5–10% of total emissions), they vary by region depending on the carbon intensity of the local power grid.

Finally, cement is used in the production of concrete, which consists of cement paste mixed with fine and coarse aggregates. Though cement makes up only a small share of concrete by volume, it is responsible for the vast majority of concrete's carbon footprint.

The carbon intensity of cement production varies significantly across countries, due primarily to differences in how much clinker is used in the final product (because clinker production is the most emissions-intensive step in cement production). Countries such as China and India have some of the lowest CO_2 emissions intensities per ton of cement because they incorporate a high share of SCMs, reducing the amount of clinker required. In contrast, the US, and especially California, have among the highest emissions intensity, largely due to their very high clinker-to-cement ratios. Additional factors contributing to this higher intensity include older cement plants, the specific types of cement produced and the fineness of clinker grinding, all of which influence energy use and emissions. While fuel mix also plays a role since different fuels have varying carbon intensities, the clinker ratio remains the dominant factor in explaining national differences in cement-related emissions. These differences play a role in the total carbon footprint of infrastructure projects based on where the cement was sourced from.

Given the carbon intensity of steel and cement production, policies incentivizing greener procurement for infrastructure projects can play a significant role in decreasing the overall emissions impact of a given project. China's DFIs are well poised to play a transformative role in setting standards for green procurement of steel and cement for internationally financing infrastructure projects, thanks to their development mandate and role as first movers in new markets.

The Role of Cement and Steel in Global Infrastructure Projects

Steel is a fundamental material in infrastructure development globally due to its strength, durability and versatility. The properties of steel, such as its ability to withstand tensile and compressive forces, resistance to corrosion (when treated) and ease of fabrication, make it a key material for large-scale infrastructure projects (Kadezabek 2023). In general, steel used in infrastructure projects can be produced via any production route (e.g., BF-BOF or scrap-EAF). Some applications require specialty or high-grade steel that can only be produced by BF-BOFs; however, for the purposes of this analysis, we assume that steel used in China's overseas infrastructure projects can be sourced through any production route. It should be noted that 90 percent of China's steel production is via the BF-BOF route.

Steel is a necessary material in the sectors that have received development finance from China's DFIs, particularly in energy and transportation. In the energy sector, steel is essential for constructing power plants, where it is used for boilers, turbines, generators, pressure vessels and supporting infrastructure. It is also a key part of energy transmission and distribution systems, including transmission towers, substations and the cores of power lines for electricity. In fossil fuel extraction, steel is used in drilling rigs, pipelines and storage tanks. In the transportation sector, it is fundamental to the construction of roads, railways, bridges and airports. For example, steel reinforcement bars (rebar) are critical in road and bridge construction for added durability, while steel rails are indispensable for rail infrastructure. Steel is also used in the construction of port facilities, including cranes, docks and terminals, as well as in the development of subways and light rail systems, where steel frames and tracks form the backbone of the infrastructure.

Because this report focuses on steel and cement use in power plants, roads and railways receiving Chinese development finance, we next lay out how steel is used in these types of projects. Steel is important for the electric power sector because it provides structural integrity, resistance to high temperatures and pressures and durability in harsh operating conditions. In virtually all of these energy systems, steel is used for structural support and reinforcement. It is often used as reinforcement in concrete foundations and structural components to ensure stability and resilience against forces such as pressure, weight and environmental stress. Steel is also necessary for systems involving mechanical movement or energy conversion, such as turbines and generators across all energy types (TIANJIN POSCO Group 2025).

China has provided development finance for global thermal, hydropower, nuclear and geothermal power plants, and for wind and solar. In thermal power plants, which generate electricity by burning fossil fuels such as coal, natural gas or oil, steel is used to construct boilers, heat exchangers, pressure vessels and turbines. The boiler is one of the most critical components in a thermal plant, and it requires high-quality steel to withstand the internal pressure and the heat produced during combustion. Common materials include carbon steel and alloy steel, with some high-alloy grades used for components exposed to extreme heat such as superheaters and reheaters. Steel pipes and tubing are also vital for transporting steam and water throughout the system. Hydropower plants rely heavily on steel especially for the construction of dams, turbines, penstocks and generators. The penstock, a large pipe that directs water from the reservoir to the turbine, is typically made of carbon steel to handle the immense pressure of the water flowing through it. Geothermal power plants rely on steel primarily in piping and turbine components. The piping system carries hot geothermal fluid from the Earth's surface to the plant's power generation system. Steel pipes, typically made from carbon steel or stainless steel, are used to handle the high temperature and pressure of this fluid.

In nuclear power plants, steel is used extensively in critical areas such as the reactor vessel, steam generators, cooling systems and containment structures. The reactor pressure vessel, where the nuclear fission reaction takes place, is made from high-strength alloy steel or stainless steel to withstand the extreme pressure and temperature conditions inside the reactor. Similarly, stainless steel and alloy steels are used in the steam generators and cooling systems to ensure long-term durability and resistance to corrosion, as these components come into contact with both high-pressure steam and potentially radioactive substances. The containment building, a reinforced steel structure designed to prevent the release of radiation, uses a combination of carbon steel, stainless steel and reinforced concrete.

In wind farms, steel is primarily used in the construction of wind turbine towers and foundations. The towers are usually made from carbon steel or high-strength steel to provide the necessary support for the heavy rotor and blades while withstanding extreme wind forces and environmental conditions. Steel is also used in the substructures and reinforced foundations to ensure stability, especially in areas with high winds. Steel is also an essential material for the gearbox, brakes, and other moving parts in the turbine's mechanical system.

Although steel is less prevalent in solar panels or utility-scale solar plants, it is used in the structural frames for mounting solar panels and in supporting infrastructure such as solar tracking systems. Solar panel mounts must be made from corrosion-resistant galvanized steel or stainless steel to withstand outdoor exposure. Steel beams and columns are used in the construction of the plant's support structures, while steel piping may be used for water-based cooling systems. Steel is also used in the construction of inverters, which convert the DC electricity generated by the panels into AC electricity for the grid.

Steel is an essential material in the construction and reinforcement of roads, providing strength, durability and the ability to withstand heavy loads and environmental stresses. In the construction of concrete roads, it is primarily used in the form of reinforced steel rebar and steel mesh, which are embedded in the concrete to enhance its tensile strength and prevent cracking. Concrete, while strong under compression, can be weak under tension, so the inclusion of steel provides much-needed support to handle the stretching and bending forces that can otherwise cause damage. Steel is also integral in the construction of bridge decks, overpasses and culverts within road networks, where steel beams, reinforced steel trusses and steel supports ensure that these structures can carry substantial weight and resist wear from constant traffic and harsh weather conditions. However, it is important to note that asphalt roads are the most common type of road built in many Chinese-financed infrastructure projects overseas, and these roads do not require significant quantities of steel.

Steel is the foundational material in the construction of railways, particularly in rail tracks, rails and rail ties. The rails themselves are typically made from high-carbon steel or alloyed steel to allow them to withstand the heavy loads and stresses of trains while maintaining a smooth and durable surface for safe travel. Rail ties (or railway sleepers) are either made entirely of steel or feature steel reinforcements, to anchor the rails to the ground and maintain proper track alignment. Steel is used in the construction of bridges, viaducts and tunnels as well. These structures require steel beams, reinforced steel trusses and steel supports to provide the necessary strength, flexibility and resistance to environmental stress.

Like steel, cement is one of the most essential materials in infrastructure development, especially within the energy and transportation sectors. As the primary binder in concrete, it is vital for constructing foundational elements in most types of infrastructure projects. Its strength, durability, resistance to environmental degradation and versatility make it necessary for projects requiring long service lives and resilience against natural and mechanical stresses (American Cement Association 2025).

Cement is used extensively in all types of power plants to provide foundational support and containment structures. In thermal power plants, it is essential in turbine halls, boiler foundations, cooling towers and flue gas stack linings, ensuring stability and thermal resistance under intense conditions. Hydropower plants rely on massive cement structures, including dams, spillways and water conveyance channels, which must withstand hydrostatic pressure and erosion. Cement is used for building turbine foundations for both onshore and offshore wind farms, designed to keep the turbines anchored and stable under high wind loads. Solar power projects use a small amount of cement in the form of precast panel footings, mounting systems, and foundations for electrical equipment (Clinker Production 2025). In nuclear power plants, cement is used in containment buildings, reactor bases, radiation shielding walls and other barriers requiring exceptional structural integrity, longevity and safety.

Cement is fundamental to the construction and durability of transportation infrastructure, particularly roads and highways. It is the key ingredient in concrete pavement, lending compressive strength and longevity to surfaces that bear heavy vehicle loads and need to withstand constant friction. Concrete roads can last 30 to 50 years with proper maintenance, reducing life-cycle costs and minimizing disruption from repairs. Cement is also used for curbs, retaining walls, bridge decks, median barriers, and precast elements that join various structural components. Again, however, it is important to note that most road projects receiving Chinese development finance are asphalt roads, which use a minimal amount of concrete/cement.

Railway systems depend heavily on cement for both track construction and supporting infrastructure. Cement is used in the production of concrete railway sleepers (ties), platform bases, bridge supports, culverts and tunnels, offering superior compressive strength to withstand the dynamic loads of passing trains and the environmental stresses of outdoor exposure. Cement-based concrete is also favored for its sound and vibration-dampening properties, important for track stability and passenger safety. The use of precast cement structures speeds up construction and enables better quality control on essential elements such as station buildings, maintenance facilities and retaining walls along the railway corridor.

Luanda, Angola. Photo by Shawn Clark via Unsplash.

CHINA'S GLOBAL INFRASTRUCTURE PROJECTS AND DEMAND FOR STEEL AND CEMENT

Overview of China's Global Development Finance and Sector Destinations

China finances overseas infrastructure projects through a combination of state-directed, commercially structured mechanisms that leverage its policy banks, SOEs and increasingly its commercial banks, special purpose vehicles and other entities. Chinese development finance offers a unique model of blending commercial and private sector financing. To help Chinese finance and firms go global, China's DFIs created coordinated credit spaces for China's commercial financiers, SOEs and other firms to participate as investors or service providers (Chin and Gallagher 2019). China's DFIs have been able to provide lower-cost yet non-concessional financing for developing-country governments, helping to de-risk the financing landscape for Chinese investors and exporters seeking markets abroad.

The financing model for Chinese overseas infrastructure projects is often structured as sovereign loans, export credits or project finance. Much of this financing is debt-based, typically provided in the form of loans to foreign governments or state-owned entities. In addition to loans, China's financing includes other types of finance, such as equity finance. China's overseas development investment funds are dedicated to key development-oriented infrastructure sectors such as energy and resources, general infrastructure, manufacturing and agriculture (Moses et al. 2022). Increasingly, China has experimented with public–private partnerships (PPPs) and build-operate-transfer models. These models allow Chinese companies to invest in and operate infrastructure for a fixed period, recovering costs through user fees or tariffs before transferring ownership to the host country. Additionally, Chinese banks have supported syndicated lending with multilateral institutions or local banks in co-financing arrangements to mitigate risk.

China's overseas infrastructure financing is driven primarily by two policy banks: CDB and CHEXIM. The largest of China's DFIs, CDB provides long-term financing for strategic overseas projects and has been heavily involved in energy, mining and large infrastructure projects globally. CHEXIM specializes in export credits and preferential buyer's credits. It plays a critical role in facilitating trade and infrastructure deals involving Chinese companies.

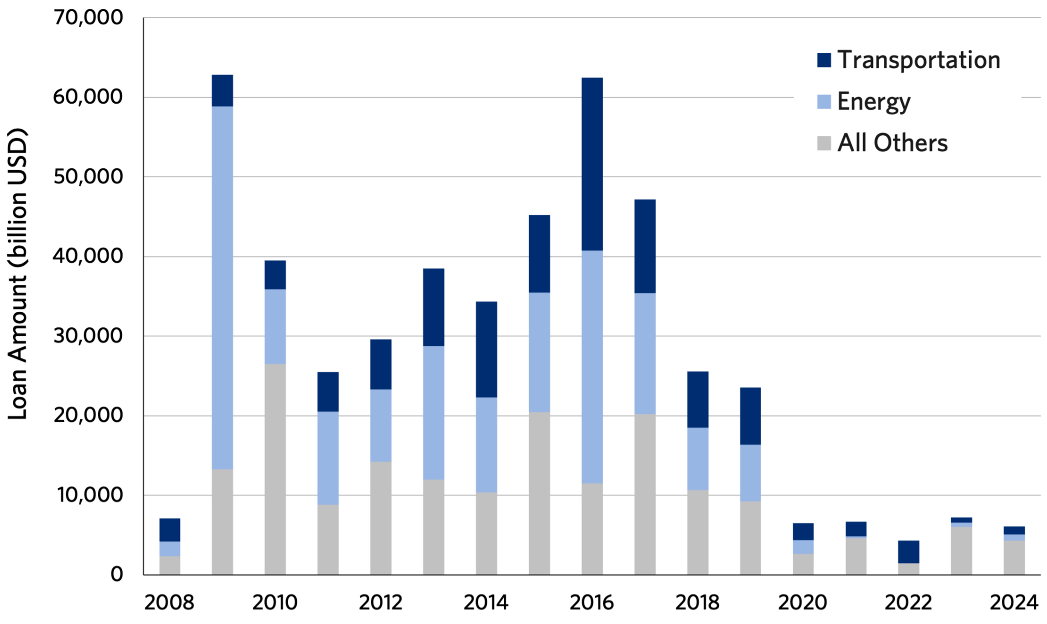
In this report, we define our scope as infrastructure projects financed by loans from these two DFIs, with public borrowers (also known as public and publicly guaranteed, or PPG, lending).

Since 2008, China's DFIs have committed US$472 billion in PPG loans to a myriad of infrastructure and development projects around the world (Ray et al. 2025) in sectors such as energy, mining, transportation, telecommunications, water and sanitation, finance, education and health.

Energy has been the largest sectoral destination for China's overseas development finance, receiving US$184 billion since 2008, with most of this amount committed between 2008 and 2019. Within the energy sector, fossil fuel extraction is the subsector that has received the most finances, followed by electric power generation and then energy transmission and distribution. Within electric power generation, overseas coal and hydropower represent the largest shares of financing from Chinese DFIs.

Transportation is the second-largest sectoral destination for China's overseas development finance. Transportation-related projects include roads, railways, airports, bridges, subways, light rails and ports. As shown in Figure 3, the energy and transportation sectors together account for the majority of China's overseas development finance over time.

Figure 3: China's Overseas Development Finance by Year and Sector, 2008–2024



Source: China's Overseas Development Finance (CODF) Database, Boston University Global Development Policy Center, 2025.

Note: This study does not analyze all energy and transport projects in the CODF database, but rather a specific subset described below.

Not all projects receiving Chinese development finance have a physical footprint. China's DFIs provide general budgetary support to public institutions and on-lend to national and regional development banks and other national government finance programs. Such projects are not directly associated with construction or physical infrastructure, do not directly consume steel and cement, and are outside the scope of this analysis.

Climate Implications of China's Global Infrastructure Development

While China is supporting renewable energy abroad, most China's historical financing in the global energy sector has supported fossil fuels. China's DFIs committed US$184 billion in overseas development finance for the energy sector from 2008 to 2024, around two-thirds of which was for fossil fuel infrastructure (Boston University Global Development Policy Center 2025b). In the power sector, coal-fired power plants make up the largest share of Chinese-financed generating capacity to date.

This fossil fuel infrastructure contributes to a significant amount of GHG emissions. Annual emissions from operating Chinese-financed power plants around the world total roughly 287 Mt CO2 (Boston University Global Development Policy Center 2025a). If power plants receiving Chinese finance and foreign direct investment (FDI) that are under construction or planning all come online, this could add 53 Mt CO2 emissions per year. From a lifetime emissions perspective, coal plants in Asia (outside of China) with Chinese parent or engineering, procurement and construction companies are projected to emit 11 Gt CO2 over their remaining lifetimes, representing 31 percent of total lifetime emissions from coal plants in Asia (Springer et al. 2021).

China's overseas infrastructure also contributes to climate impact through several indirect channels that go beyond the direct emissions from infrastructure operation, or embodied emissions in materials such as steel and cement. For example, clearing of forested areas, such as tropical rainforests in Southeast Asia, Africa or Latin America, to make way for roads, railways, pipelines or hydropower dams results in the loss of critical carbon sinks, releasing large amounts of stored carbon and reducing future carbon absorption capacity. Hydropower plants with dams, while often categorized as "clean energy," can contribute to emissions through the decomposition of submerged vegetation, which releases methane, a potent GHG.

Infrastructure investment in fossil fuel exploration and extraction can increase the global supply of fossil fuels, thereby lowering prices and incentivizing continued consumption, which undermines global climate change mitigation efforts. A similar effect can occur as a result of support for other carbon-intensive industries, such as mining and manufacturing, which are often enabled or expanded by improved transport or energy infrastructure.

Finally, inadequate environmental and social safeguards may lead to poor implementation of mitigation measures, exacerbating these indirect effects and reducing the overall climate resilience of the infrastructure.

In addition to being direct and indirect sources of CO2 emissions, China's global infrastructure projects also face risks related to climate adaptation and resilience. Projects receiving Chinese FDI around the world are more exposed to water stress, floods, hurricanes and typhoon risks associated with climate change than is the case for those receiving other sources of FDI (Li and Gallagher 2022). Therefore, climate mitigation and adaptation are both important considerations in the planning and construction of global infrastructure projects receiving Chinese development finance.

SCALE AND SOURCES OF STEEL AND CEMENT PROCUREMENT IN KEY ENERGY AND TRANSPORT PROJECTS FINANCED BY CHINA

Estimated Volumes of Cement and Steel in BRI Construction Projects

Among China's overseas development–financed projects (recorded by the CODF database), transportation (33.1%) and power generation (23.2%) stand out as the two largest sectors, together accounting for more than half of both the total number of projects and the total loan amount in CODF (see Table 1). Given that they are also highly construction-intensive and the heaviest users of cement and steel, our analysis focuses primarily on these two sectors.

Table 1: Breakdown of CODF Projects and Financing, 2008-2024

Sector	Projects (N)	% of Total Projects	Loan Amount (USD million)	% of Total Loan Amount
Transportation	432	33%	109,658	23%
Energy	302	23%	183,855	39%
Others	570	44%	178,583	38%
Total	1,304	100%	472,096	100%

Source: Authors compilation.

Among our selection of BRI projects in the transportation and energy sectors, we chose to focus on roads, railways and power generation (power plants). These subcategories represent the majority of steel and cement use, and they also have better data on material use requirements than some other subsectors such as ports, transmission lines or pipelines.

For the 233 projects that fall into these categories,[2] we estimate total use of cement and steel (Table 2 and Figures 4 and 5). Overall, China's global development–financed projects in this dataset are estimated to require about 3.6 Mt of cement and 2.5 Mt of steel for lending commitments made between 2008 and 2024,[3] with cement demand concentrated in energy projects and steel demand nearly evenly split between energy and transport projects. The cement use in BRI projects substantially exceeds steel use overall.

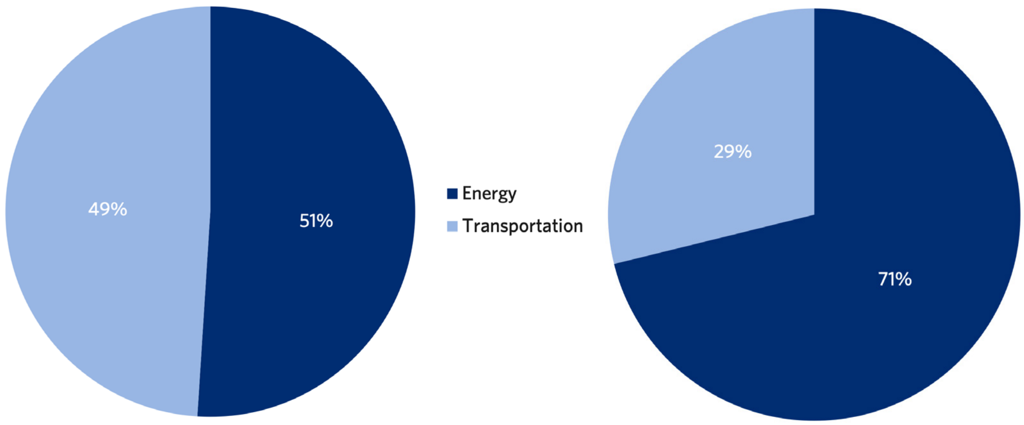
[2] Analysis is limited to new projects in CODF and the China's Global Power (CGP) Database with geolocated length or capacity data. Retrofit and rehabilitation projects are excluded due to high variability and the lack of reliable material intensity estimates. Projects at all stages (completed, under construction and under planning) are included. Detailed breakdowns and summary statistics are provided in the Appendix.

[3] Project construction can take place years after a lending commitment, as discussed later in the paper when we categorize projects based on their construction status (completed, under construction and under planning) as opposed to the year of their lending commitment.

Table 2: Steel and Cement Use by Sectors Included in This Study

Sector	Total Steel Use (Mt)	Total Cement Use (Mt)
Energy	1.29	2.57
Transportation	1.23	1.04
Total	2.52	3.61

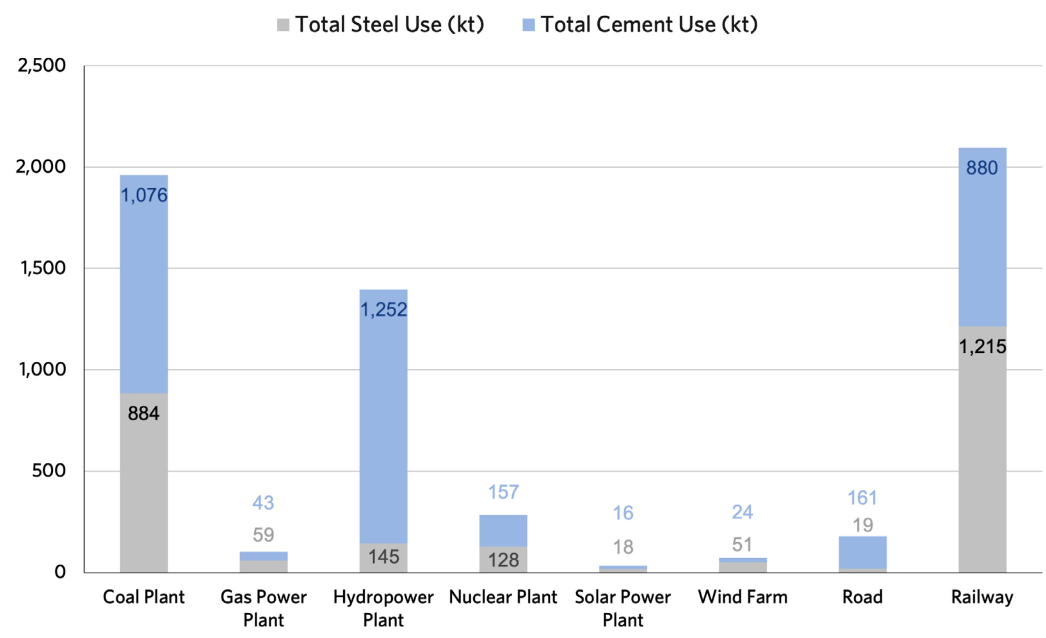
Figures 4 and 5: Steel (left) and Cement (right) Use by Sectors Included in This Study



Source: Authors compilation.

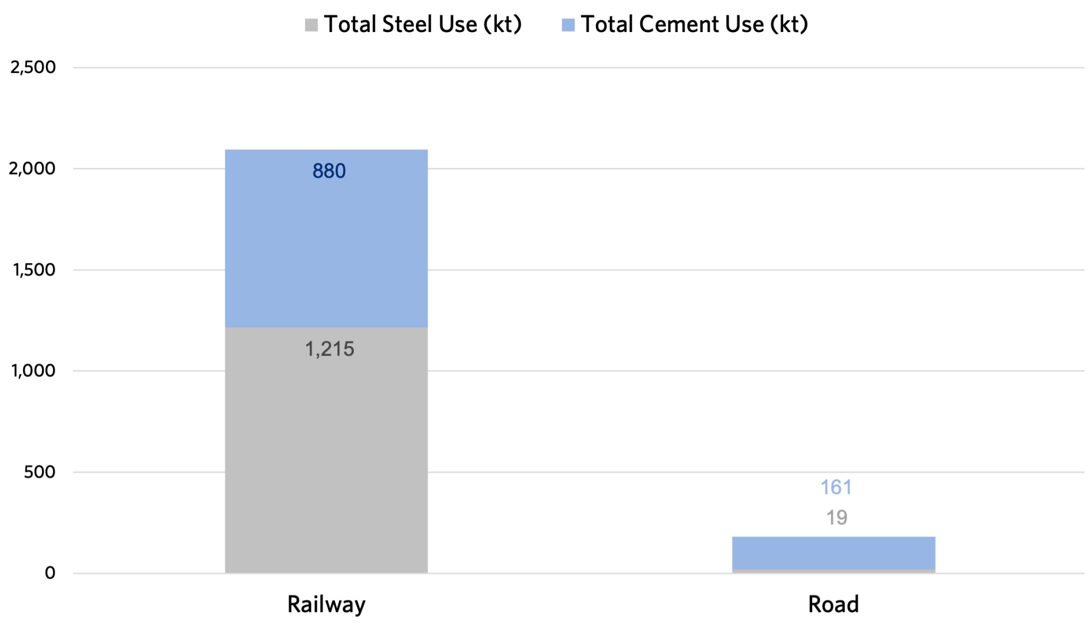
Breaking down subsectors, there are significant differences in cement and steel use across infrastructure types. Railways account for the largest share of steel demand, using about 1.2 Mt, followed by coal plants (884,000 tons). In terms of cement, hydropower plants dominate with more than 1.25 Mt, exceeding the combined cement use of coal plants (1.08 Mt) and railways (880,000 tons). This is driven by the significant quantities of cement needed to build dam-based hydropower plants, which are prevalent in China's overseas hydropower projects. Other sectors contribute much smaller volumes: gas plants, nuclear, wind and solar together account for less than 10 percent of total cement and steel use. Roads, while numerous, contribute relatively little to overall volumes (about 19,000 tons of steel and 161,000 tons of cement) compared with large-scale energy and transport projects due to the prevalence in China's global infrastructure projects of asphalt roads, which do not use significant amounts of steel or cement (see Figures 6 and 7).

Figure 6: Cement and Steel Use by Power Plant Type in China's Overseas Development-Financed Projects



Source: Authors' elaboration.

Figure 7: Cement and Steel Use by Transportation Infrastructure Type in China's Overseas Development-Financed Projects



Source: Authors' elaboration

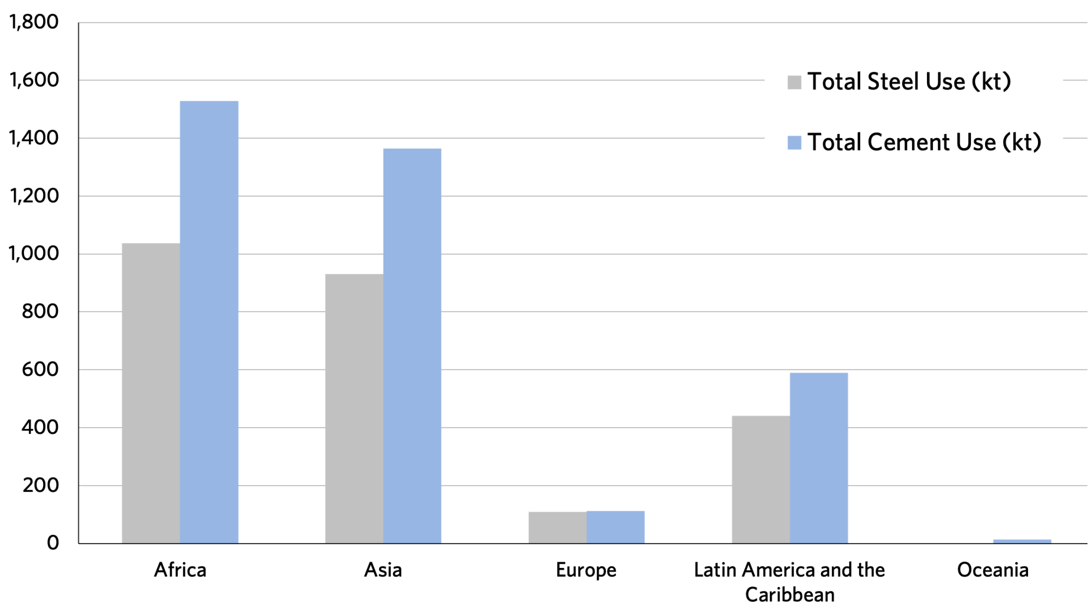
Regional Distribution of Material Use across Countries Receiving Chinese Development Finance

The regional distribution of material use reflects broad patterns in China's overseas development finance, which is concentrated in Asia and Africa (Figure 8). The breakdown of steel and cement use reflects the variation in sectoral composition of China's global development finance projects and the industrial characteristics of host countries (Figures 9 and 10).

Africa emerges as the largest consumer overall, likely due to numerous road and hydropower projects. In Asia, South Asia and Southeast Asia are leading consumers of steel and cement, driven by extensive hydropower and railway construction. In particular, South Asia accounts for the highest cement demand, reflecting large-scale hydropower and coal projects, while Southeast Asia has comparatively higher steel demand, tied to railway infrastructure. Central Asia shows a more balanced profile, with significant steel demand from railway construction, alongside cement-intensive hydropower dams. By contrast, Europe and the Middle East contribute relatively little to overall totals, reflecting a smaller number of large-scale construction projects in the dataset.

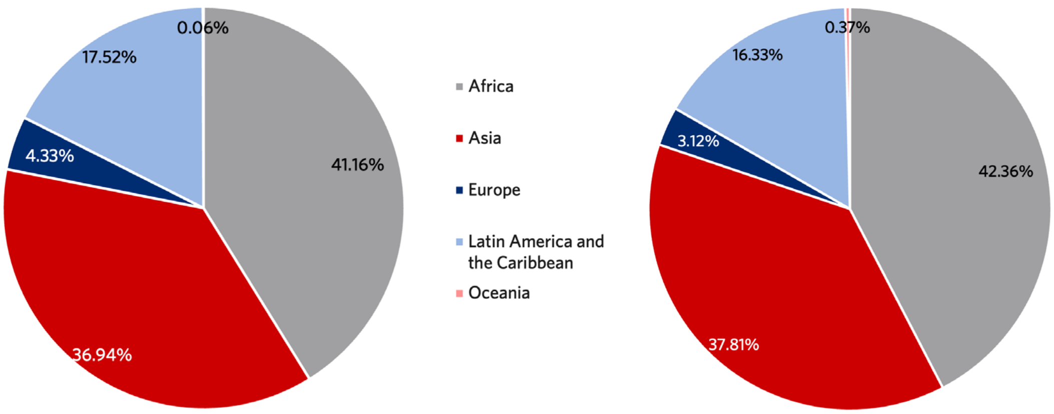
Overall, while both materials are required across regions, the distribution shows clear patterns: cement demand is concentrated in hydropower-heavy regions (South Asia, Africa), whereas steel demand is highest in transport-heavy regions (Africa, Southeast Asia, Central Asia).

Figure 8: Total Steel and Cement Use Across Continents



Source: Authors' elaboration.

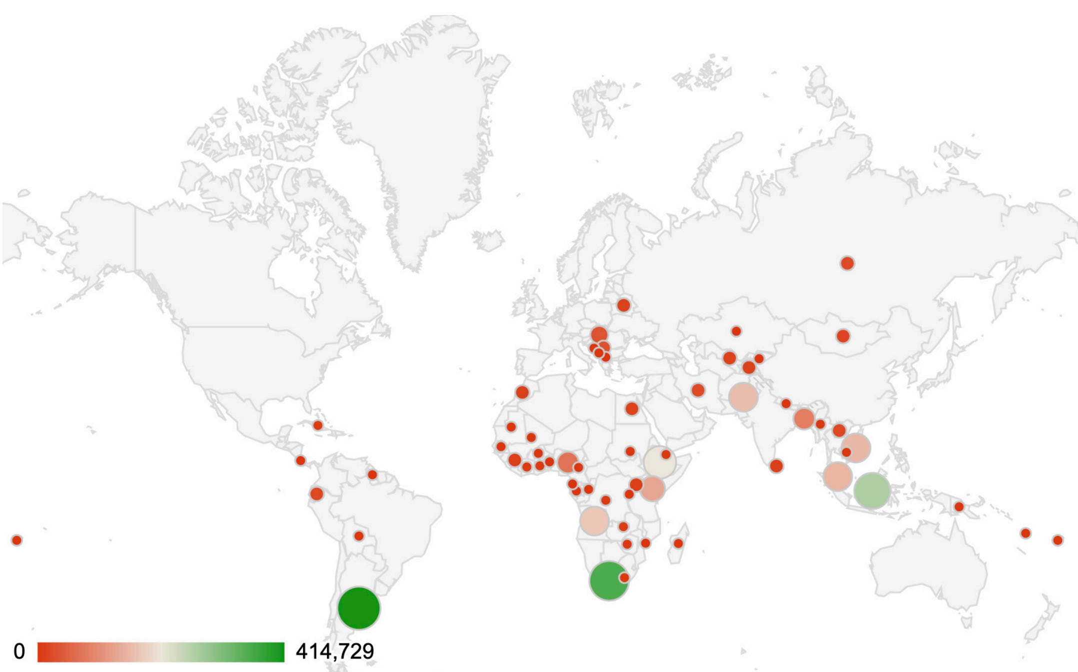
Figures 9 and 10: Share of Total Steel (left) and Cement Use (right) Across Continents



Source: Authors' elaboration

At the country level, the distribution of steel use is highly concentrated, with a handful of countries accounting for most demand. Argentina, South Africa and Indonesia stand out as the top three consumers, together responsible for roughly one-third of total steel use among the top 20. Other large users include Ethiopia, Angola, Pakistan, Vietnam and Malaysia, each with over 150,000 tons, reflecting significant investments in transport and power projects. In Africa, Kenya, Nigeria, Ethiopia and Angola collectively represent a substantial share of demand, highlighting the intensive material use of Chinese development–financed projects on the continent. In Asia, Pakistan, Vietnam, Malaysia, Bangladesh and Laos also feature prominently, while in Europe, Hungary and Serbia stand out due to large railway projects. The remaining countries, including Iran, Russia, Ecuador, Mongolia, Egypt and Uzbekistan, contribute smaller volumes, generally under 25,000 tons each (see Figure 11).

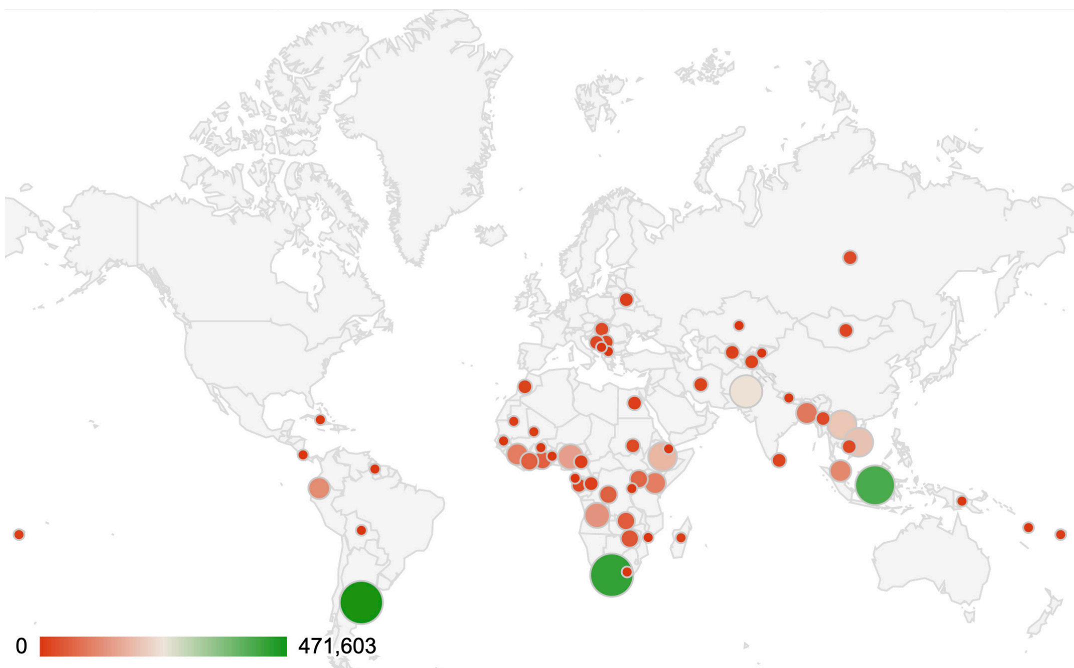
Figure 11: Global Distribution of Steel Use in Selected Energy and Transport Projects Receiving Chinese Development Finance, by Country, Tons



Source: Authors' elaboration.

Cement demand among BRI projects is also highly concentrated, with Argentina, South Africa and Indonesia leading by a clear margin; each exceeds 400,000 tons and together they account for nearly one-third of total use in the top 20. Other major consumers include Pakistan, Laos and Vietnam (180,000–230,000 tons each), likely as a result of large hydropower and coal projects. In Africa, a large set of countries, Ethiopia, Nigeria, Angola, Kenya, Guinea, Uganda, Ghana, the Democratic Republic of Congo, Côte d'Ivoire, Zambia and Zimbabwe, collectively drive significant cement demand, though most individually fall below 150,000 tons. Overall, compared with steel, cement use is more broadly distributed across African countries, with multiple mid-sized users, while Asia still has just a few countries requiring the majority of cement quantified in this analysis (see Figure 12).

Figure 12: Global Distribution of Cement Use in Selected Energy and Transport Projects Receiving Chinese Development Finance, by Country, Tons

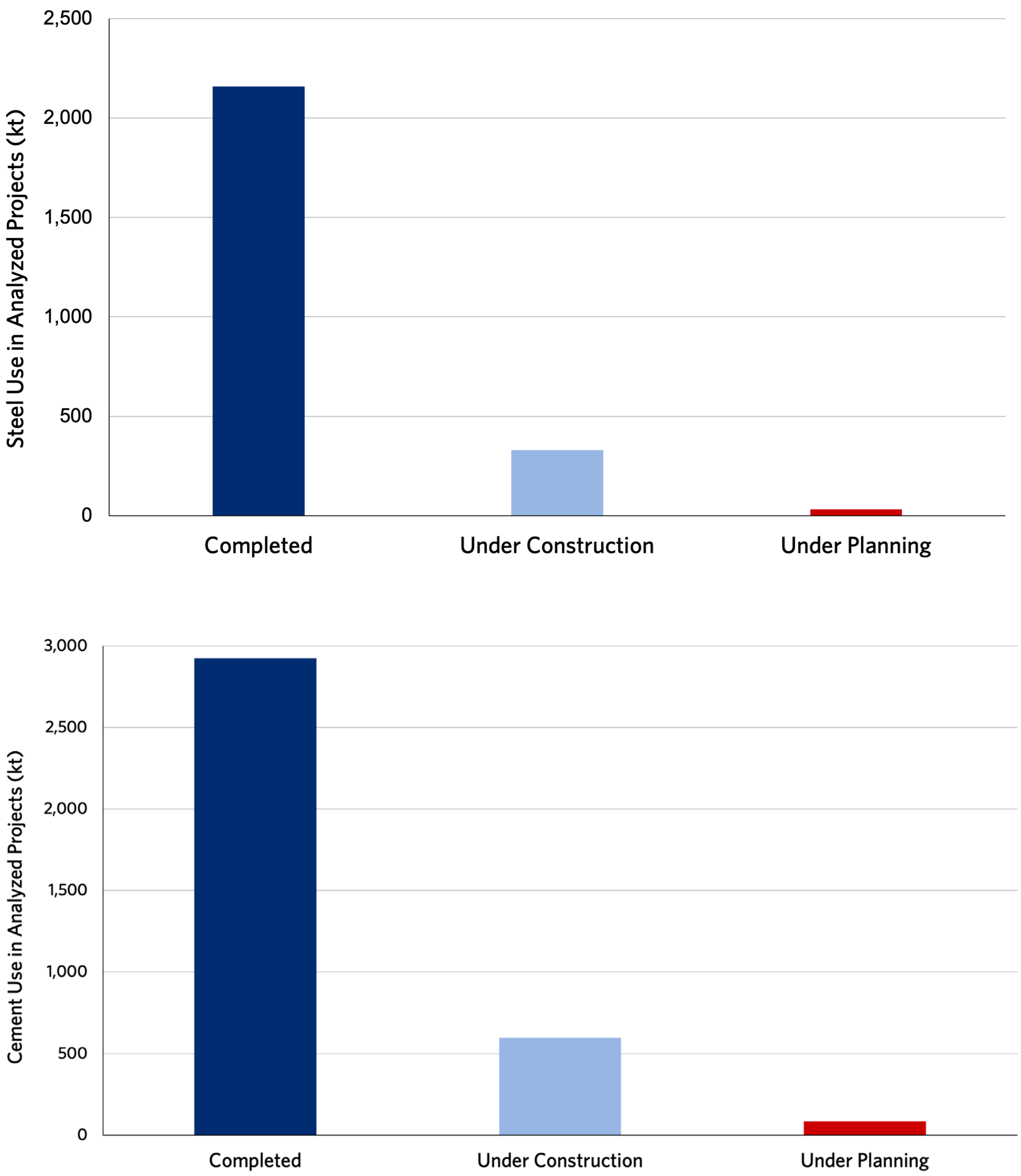


Source: Authors' elaboration

In summary, the regional and country-level patterns of cement and steel use are different. Cement demand is spread across a wide range of BRI countries, particularly in Africa and South Asia, where hydropower and coal projects drive large volumes. Steel demand, in contrast, is more concentrated in a handful of countries such as Argentina, South Africa, Indonesia and Ethiopia, likely reflecting the material intensity of key railway and other transport investments.

We also divided cement and steel use in the analyzed projects into project status categories (Figures 13 and 14). Of the three project status categories (operational, under construction, under planning), the vast majority of use to date has been in projects that are already operational, representing the historically higher flows of Chinese overseas development finance and large-scale infrastructure lending prior to 2020. Although infrastructure projects can take many years from the start of construction to commissioning, China's overseas development finance declined year-on-year from 2016 to 2022.

Figures 13 and 14: Steel (Top) and Cement (Bottom) Use in Analyzed Projects, by Project Status



Source: Authors' elaboration.

Sources of Cement and Steel Procurement for China's Global Infrastructure Projects

Cement for construction projects within a given country is typically procured locally, given high transport costs and the weight of cement. In addition, global cement production is relatively more distributed across countries than steel production, which requires more substantial capital investments.

Several case studies of Chinese-financed infrastructure projects suggest that they follow this trend, with cement typically procured from domestic suppliers. This reflects both the high transport costs and, in many cases, local content requirements. In contrast, steel, particularly for railway projects, is more often imported from China due to quality standards and technical specifications (Yang 2022). For example, in the Karot Hydropower Project in Pakistan (2016–2022) cement was sourced locally (CGTN 2021), while in Cambodia's Phnom Penh–Sihanoukville Expressway (2019–2022) the 500,000–600,000 tons of cement required came from domestic factories such as Kampot Cement (a joint venture with Siam Cement Group) but the steel was imported, likely from China, given the absence of large domestic steel mills (The Phnom Penh Post 2019). Similarly, in Nigeria's Lagos–Ibadan Standard Gauge Railway (2017–2020), the 156 km of track used rails imported from China, while concrete was likely procured from local suppliers, including Dangote and Lafarge (Abolarin 2017; Lewis 2017).

To demonstrate the importance of the origin of steel for overall carbon footprint, we describe the sources of steel for the top countries in our dataset. The top five countries in terms of the amount of steel used in Chinese development-financed projects are Argentina, South Africa, Indonesia, Ethiopia and Angola. All of these countries except Ethiopia are domestic steel producers that make significantly more steel than is used in Chinese-financed projects. For the purposes of our analysis, we assume that Ethiopia imports steel from China for Chinese development-financed projects, as has been the case in the examples discussed above.

Argentina, South Africa and Indonesia produce a significant amount of steel via the BF-BOF route, making the carbon intensity of steel produced in these countries only slightly lower than that of steel made in China. Angola, however, produces steel via the scrap-EAF route, leading to significantly lower-carbon steel from domestic sources as opposed to steel from China. Therefore, steel procurement decisions in Angola are a starker choice, in terms of embodied carbon, between domestic steel and steel imported from China.

Given potentially large differences in the carbon intensity of steel depending on its source, for our emissions reduction analysis below, we developed three steel procurement scenarios, (1) 100 percent domestic steel; (2) 100 percent imported Chinese steel; and (3) 50 percent domestic steel and 50 percent imported Chinese steel, with the carbon intensity of steel used in each country calculated accordingly. For countries with no domestic steel production, such as Ethiopia, we assumed steel was imported from China and no scenarios were applied.

For cement, the domestic production of all countries in our dataset is significantly larger than the amount of cement used in projects receiving Chinese development finance. Therefore, we assumed that cement for Chinese-financed projects would be sourced domestically. The carbon intensity of cement production across the countries in our dataset is not expected to vary widely. Most cement-producing facilities use similar clinker-based processes and rely heavily on fossil fuels. Additionally, the dominance of process emissions from limestone calcination and the limited use of low-carbon alternatives contribute to relatively consistent carbon intensity of production across countries.

Abuja, Nigeria. Photo by Baqeer Gashua via Unsplash.

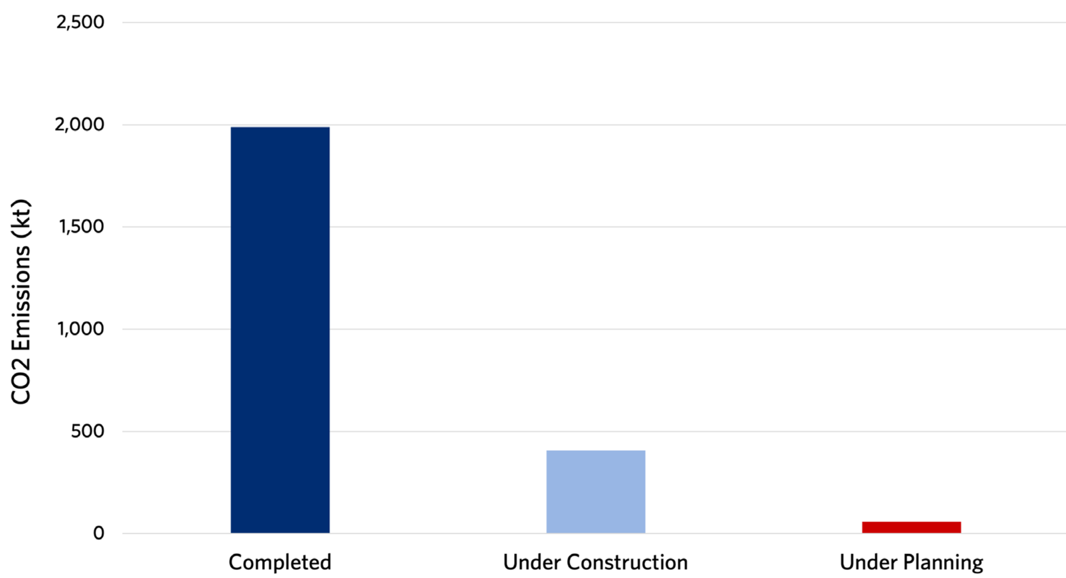
TOTAL CO_2 EMISSIONS FROM STEEL AND CEMENT USED IN KEY ENERGY AND TRANSPORTATION PROJECTS WITH CHINESE DEVELOPMENT FINANCE

Cement

Total CO_2 emissions from cement use in the energy and transport projects in our dataset are estimated at 2,452 kt CO_2, assuming 100 percent domestic cement is used. Most of these emissions are associated with completed projects, which account for 1,988 kt CO_2, while projects under construction contribute 406 kt CO_2 and those under planning add only 58 kt CO_2 (Figure 15).

The distribution is highly uneven across countries. The top five countries (South Africa, Indonesia, Argentina, Ethiopia and Angola) together account for about 977 kt CO_2, or roughly 40 percent of total cement-related emissions. This small group of countries thus drives a significant share of the cement emissions footprint for China's overseas infrastructure development. Completed projects dominate overall emissions, with ongoing and planned projects making up a much smaller share, driven in part by low levels of China's overseas development finance in recent years.

Figure 15: CO_2 Emissions Associated with Cement Used in China's Overseas Development Finance in the Energy and Transportation Sectors



Source: Authors' elaboration.

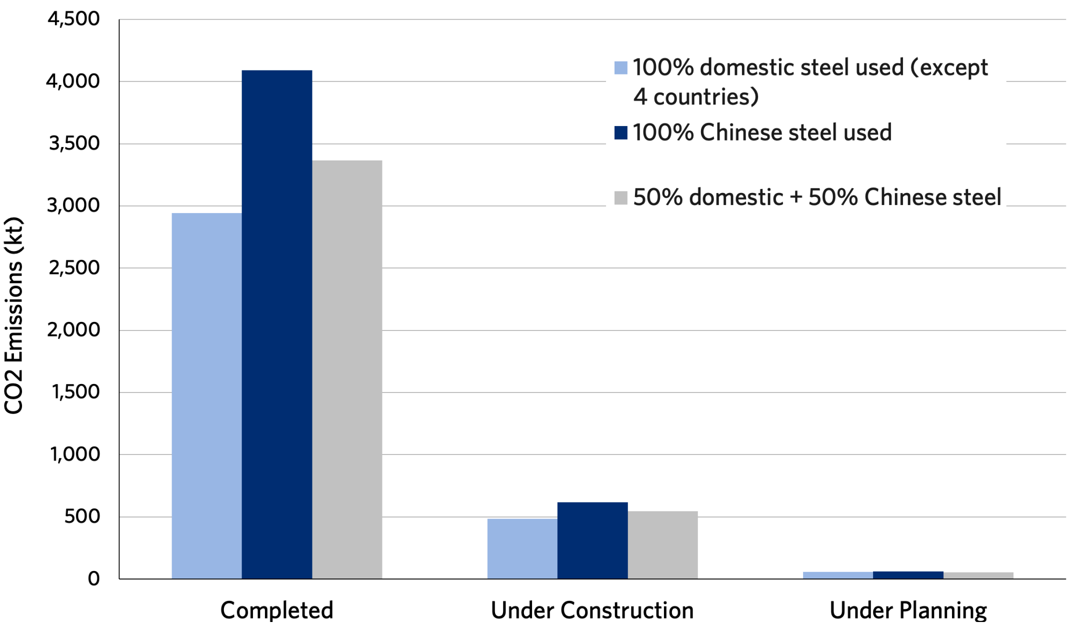
Steel

Total CO_2 emissions from steel used in the energy and transport projects in our dataset vary significantly depending on the sourcing scenario. If all countries used 100 percent domestic steel (excluding four countries that do not have a domestic steel industry, for which we assume Chinese steel is used), the total emissions would be about 3,480 kt CO_2, with the majority (2,942 kt) coming from completed projects, 483 kt CO_2 from projects under construction, and 56 kt CO_2 from those under planning. If instead all steel were supplied from China, the estimated emissions would rise to 4,772 kt CO_2. Under this scenario, completed projects alone account for 4,092 kt CO_2, while projects under construction and planning contribute 619 kt and 61 kt respectively. The 50/50 scenario, where half the steel is sourced domestically and half from China, results in intermediate emissions of about 3,966 kt CO_2, with 3,364 kt from completed projects, 547 kt from projects under construction, and 55 kt from projects under planning (Figure 16).

The top five contributors to CO_2 emissions from steel used for projects in our dataset are Argentina, South Africa, Indonesia, Ethiopia and Angola, which together account for about 2,155 kt CO_2 under the domestic steel scenario (all of these countries are steel producers). This represents roughly 62 percent of total steel-related emissions from the transport and energy projects in our dataset.

The comparison across the three scenarios highlights the sensitivity to sourcing decisions of steel-related emissions in China's global infrastructure projects. Relying fully on Chinese steel increases total emissions by around 37 percent compared with using only domestic steel, driven by the higher carbon intensity of steel production in China compared with that of many other countries that use lower-carbon production routes, especially scrap-EAF. A balanced 50/50 sourcing approach still raises emissions by about 14 percent relative to the domestic-only case. Figure 16 shows that completed projects make up most emissions under all scenarios, but the choice of steel source makes a substantial difference in their carbon footprint. These results underscore that procurement strategies, particularly the balance between domestic and imported Chinese steel, are a critical lever for reducing the climate impact of BRI infrastructure investments.

Figure 16: CO_2 Emissions Associated with Steel Used in China's Overseas Development Finance in the Energy and Transportation Sectors



Source: Authors' elaboration.

POTENTIAL EMISSIONS REDUCTION FROM GREEN PROCUREMENT OF CEMENT AND STEEL IN CHINA'S OVERSEAS INFRASTRUCTURE PROJECTS

Green Procurement for China's Global Development Finance: Creating Demand for Low-Carbon Cement and Steel

Green procurement, also known as Buy Clean, is a powerful policy tool that can be applied to China's overseas infrastructure projects to address the large carbon footprint of energy and transport infrastructure projects. Cement and steel are among the most carbon-intensive construction materials, and they make up the bulk of material demand in transport and energy projects. Introducing procurement requirements that favor low-carbon cement and steel would leverage China's massive scale of global investment to shift markets toward more sustainable production.

In practical terms, green procurement in China's global transport and energy projects would mean that Chinese development banks, SOEs and host-country governments integrate carbon performance criteria into their bidding and contracting processes. Instead of simply focusing on cost and delivery, tenders would require suppliers to demonstrate the CO_2 intensity of their cement or steel, using EPDs or other credible reporting standards. Thresholds could be set for maximum allowable CO_2 intensity, with preferential scoring or mandatory requirements for products that stay within these limits. Over time, the thresholds would tighten in line with decarbonization pathways. This approach would create a predictable and growing demand for low-carbon materials in international markets where Chinese development banks are lending.

For cement, such policies could incentivize producers in host countries to invest in efficiency upgrades, increase the use of SCMs and pilot technologies such as LC3. Many host countries lack strong domestic climate regulations, and Chinese procurement standards could fill this gap by establishing a market signal that rewards lower-carbon practices.

For steel, green procurement is especially important because some of the steel used in China's overseas infrastructure (transport and energy) projects are likely sourced from China. By requiring lower CO_2 intensities in steel supplied for transport and energy projects, Chinese mills would face stronger incentives to increase scrap use in EAFs, accelerate the deployment of hydrogen-based DRI (H_2-DRI) and reduce reliance on high-emitting BF-BOF routes. In cases where host countries produce steel domestically, procurement standards would also encourage local producers to modernize and decarbonize.

The benefits of applying green procurement to China's overseas projects extend beyond individual projects. By generating steady demand for low-carbon cement and steel, the policy would help build economies of scale for emerging technologies and reduce costs over time. It would also align BRI projects with global climate goals and reduce the risk of stranded assets as international carbon regulations such as the EU's Carbon Border Adjustment Mechanism (CBAM) become stricter. Importantly, applying these policies in relation to China's global development finance could support both host countries and China to meet their climate targets by creating a self-reinforcing cycle: procurement standards stimulate demand, demand drives innovation and investment and innovation reduces the carbon intensity of production.

Scenario Analysis of Emissions Reduction Potential

SETTING GREEN PROCUREMENT TARGETS

To estimate the potential impact of green procurement on CO_2 emissions associated with cement and steel consumption in China's overseas transport and energy projects, we developed four scenarios with different procurement targets, representing different percentage-based reductions in CO_2 intensity (Table 3). The current CO_2 intensity of production were estimated based on locally production for cement, and under the three previously described sourcing scenarios for steel.

The green public procurement (GPP) targets used in this study are industry-level targets and not for a specific cement/concrete or steel product. In actuality, a green procurement policy could set product-specific intensity targets. However, because of a lack of information and the existence of so many different concrete and steel products, it is not possible to do an impact estimation such as this using product-level targets. We therefore used industry-level intensity targets to show the potential impact of green procurement of cement and steel.

Table 3: Green Procurement Target Scenarios for Cement and Steel Used in Global Chinese Infrastructure Projects

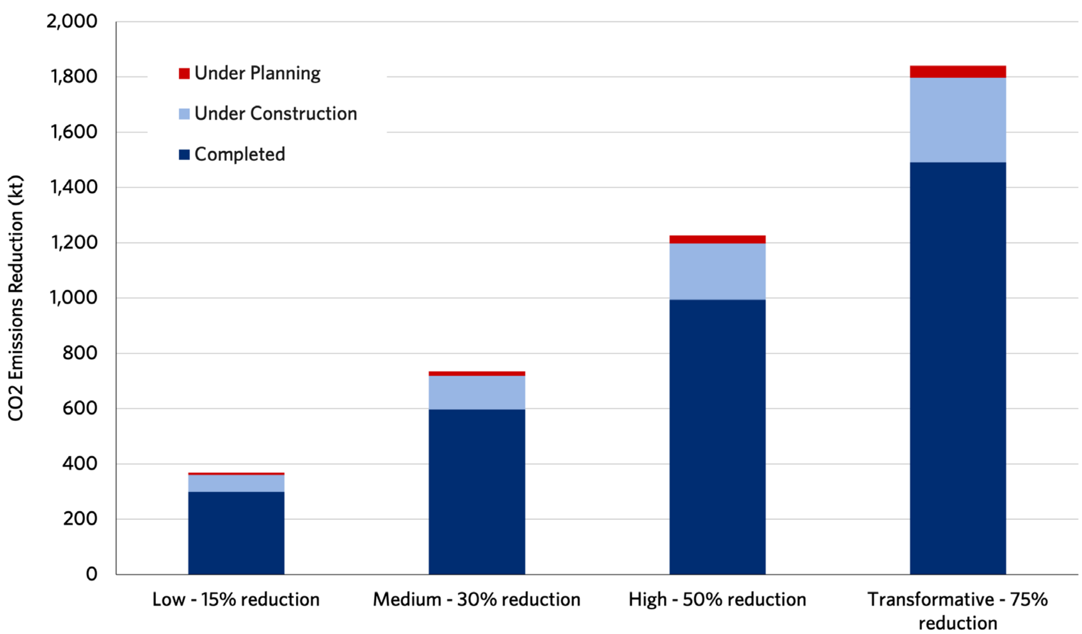
GPP Target	% Reduction in CO_2 Intensity from Baseline	Potential Actions for CO_2 Emissions Reduction for Cement	Potential Actions for CO_2 Emissions Reduction for Steel
Low	15%	Moderate effort in energy efficiency improvement, fuel switching to lower-carbon fuels, and a small increase in use of SCMs instead of clinker.	Moderate improvements in energy efficiency and fuel switching with a small increase in RE electricity use, as well as increase in the share of EAF steelmaking.
Medium	30%	Maximizing energy efficiency improvement, more aggressive fuel switching to lower-carbon fuels, and greater use of SCMs instead of clinker.	Higher improvements in energy efficiency and fuel switching combined with more switching to the EAF steel production route with decarbonized electricity.
High	50%	Maximizing energy efficiency improvement, substantial phaseout of coal and switching to lower-carbon fuels, and substantially greater use of SCMs instead of clinker.	Significantly higher energy efficiency improvement, more aggressive fuel switching to lower-carbon fuels, substantially higher scrap-based EAF steelmaking, high share of RE electricity, and some use of transformative technologies such as green hydrogen DRI-EAF.
Transformative	75%	Carbon capture, utilization and storage (CCUS), along with innovation in and adoption of transformative technologies.	All of the above, with more aggressive adoption of transformative technologies such as green hydrogen DRI-EAF and 100% use of RE electricity and a high (>50%) share of EAFs.

POTENTIAL IMPACT OF GREEN PROCUREMENT FOR CHINA'S GLOBAL INFRASTRUCTURE PROJECTS

CEMENT

Using the annual CO_2 emissions associated with cement used in the analyzed projects presented in the previous section and the targets set in Table 3, we estimated the CO_2 emissions reduction potential resulting from green procurement of cement for BRI transport and energy projects. Applying green procurement to cement in BRI projects could deliver significant CO_2 reductions depending on the level of ambition. Under a low-reduction scenario (15%), emissions savings reach about 368 kt CO_2, with most of this (298 kt) coming from completed projects. This reflects a counterfactual case in which completed projects had used green cement. At the medium level (30%), reductions rise to 735 kt CO_2, and a high-reduction pathway (50%) avoids about 1,226 kt CO_2. The transformative case at 75 percent delivers the largest savings, reaching 1,840 kt CO_2. Figure 17 shows that completed projects hold the largest share of potential reductions, even though their cement use is already locked in. This helps illustrate the scale of emissions that could have been avoided had green procurement been applied earlier. Projects under construction also add meaningful additional savings.

Figure 17: CO_2 Emissions Reduction Potential from Cement Used in Analyzed Transport and Energy Projects



Source: Authors' calculation

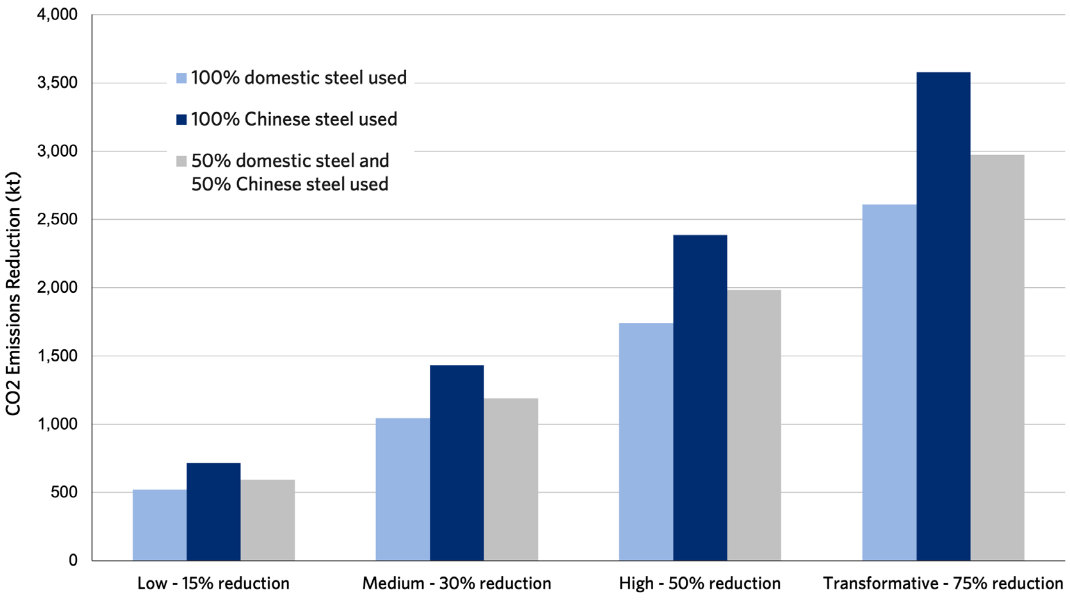
These results highlight the pivotal role that ambitious procurement standards could play in shaping the carbon footprint of China's overseas cement use. Even modest reductions would deliver measurable benefits, but the transformative scenario shows the scale of impact possible if Chinese institutions require deep cuts in cement emissions. Such policies would not only reduce emissions from current and future projects but also send a strong market signal to producers, encouraging investment in low-carbon technologies such as clinker substitution, efficiency improvements and carbon capture. In this way, green procurement can help accelerate the broader decarbonization of cement production in both host countries and global supply chains.

STEEL

Using the annual CO_2 emissions associated with steel used in the analyzed projects presented in the previous section and the targets set in Table 3, we estimated the annual CO_2 emissions reduction potential resulting from green procurement of steel for Chinese-financed transport and energy projects. Figure 18 shows the potential reductions under different sourcing scenarios and ambition levels.

Under a low-reduction pathway (15%), savings range from 522 kt CO_2 when using domestic steel to 716 kt when all steel is sourced from China, with the 50/50 mix achieving 595 kt. At the medium level (30%), reductions increase to 1,044 kt with domestic steel and 1,432 kt with Chinese steel, while the mixed case yields 1,190 kt. In the high-reduction scenario (50%), cuts rise to between 1,740 kt and 2,386 kt, with the midpoint at 1,983 kt. The transformative scenario (75%) delivers the largest reductions, from 2,610 kt CO_2 when sourcing domestically to 3,579 kt when using Chinese steel, with the 50/50 case reaching 2,974 kt.

Figure 18: CO_2 Emissions Reduction Potential from Steel Used in Analyzed Transport and Energy Projects under Different Sourcing Scenarios

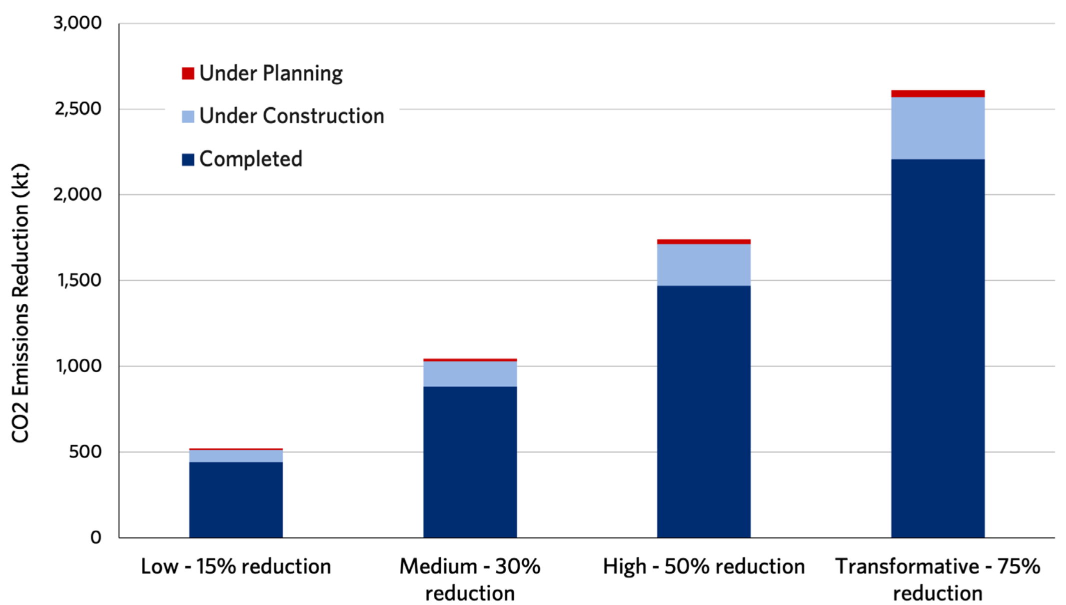


Source: Authors' elaboration.

Figure 18 shows that more ambitious reduction targets deliver the largest savings, while steel sourcing also shapes the overall climate impact. Because Chinese steel has a higher average carbon intensity than domestic steel in many host countries, shifting it toward lower-carbon pathways provides greater absolute reductions. Still, even in the domestic or mixed-sourcing scenarios, strong procurement standards can achieve meaningful cuts. This underscores the dual role of green procurement: (1) directly lowering the emissions of Chinese-financed infrastructure projects and (2) creating a strong demand signal for both Chinese and domestic producers to accelerate decarbonization of the steel industry.

Figure 19 shows the potential CO_2 emissions reductions from steel used in the studied projects, assuming 100 percent domestic steel sourcing and broken down by project stage. Completed projects account for most of the potential, with reductions ranging from 441 kt CO_2 under the low (15%) scenario to 2,207 kt CO_2 under the transformative (75%) case, representing emissions that could have been avoided through green procurement. Projects under construction contribute an additional 72–362 kt CO_2 reduction, while projects under planning add 8–42 kt. This indicates that most emissions are locked in to already completed projects but that applying stricter green procurement standards to ongoing and future projects could still bring meaningful additional savings.

Figure 19: CO_2 Emissions Reduction Potential from Steel Used in Analyzed Transport and Energy Projects for Different Project Stages with 100 percent Domestic Steel Sourcing



Source: Authors' elaboration.

Role of Decarbonization Levers in Achieving Green Procurement Targets for China's Global Infrastructure Projects

STRATEGIES FOR DECARBONIZING CEMENT IN BRI PROJECTS

In BRI transport and energy projects, most cement is sourced domestically from host-country producers, making local cement industries central to project emissions. Cement production is highly carbon-intensive, with about half of total CO_2 emissions coming from the calcination of limestone rather than fuel use. This means that energy efficiency and fuel switching alone cannot deliver deep reductions. To achieve meaningful decarbonization, green procurement by Chinese institutions for their overseas projects can create strong demand signals for cement producers in host countries to adopt advanced measures such as clinker substitution, circular economy practices and eventually carbon capture. By embedding carbon performance requirements in procurement, projects can not only lower their own footprints but also stimulate upgrades in local cement industries that might otherwise lag in decarbonization.

Energy efficiency: Many cement plants in host countries are older, smaller-scale and less efficient than global best practice. Green procurement requirements for lower-carbon cement can drive the adoption of well-proven efficiency measures such as waste heat recovery, modern clinker coolers, efficient grinding mills, improved kiln controls and digital monitoring systems. These upgrades would reduce energy demand and fuel-related emissions while also lowering production costs, making them attractive if demand is guaranteed through procurement contracts.

Material efficiency and circular economy: Reducing the demand for virgin clinker and cement is one of the most effective strategies available in emerging contexts. Optimized concrete mixes, better design standards and the reuse and recycling of construction and demolition waste can cut the overall cement requirement in projects. Studies show that such measures can reduce emissions by 8–30 percent, while global estimates point to a 20 percent or greater reduction by 2050 through improved material efficiency (GCCA 2022, IEA 2019). Procurement criteria that reward efficient material use can push local construction sectors toward circular practices that are currently underdeveloped in many host countries.

Fuel switching and electrification: Coal remains the dominant fuel for cement kilns in many host countries. Switching to lower-carbon alternatives, such as biomass, waste-derived fuels or renewable natural gas, where available offers immediate opportunities to cut emissions. In the longer term, renewable electricity or green hydrogen could be used for high-temperature heating, though these options are not yet widely commercialized. By prioritizing cement suppliers that demonstrate fuel diversification or pilot low-carbon fuels, green procurement for China's overseas projects can encourage experimentation and build local experience of alternatives.

Clinker substitution and alternative raw materials: Clinker is the most carbon-intensive part of cement, and the clinker-to-cement ratio is often higher in BRI countries than in advanced economies. Replacing clinker with SCMs such as fly ash, blast furnace slag, calcined clay, ground limestone or natural pozzolans can substantially cut emissions. A particularly promising option is LC3, which combines abundant clay and limestone resources available in many BRI countries and can replace up to 50 percent of clinker in some applications while maintaining performance. By setting procurement standards that reward low clinker-to-cement ratios, China's global infrastructure projects can create reliable demand that encourages local producers to expand SCM use and adopt new binder technologies.

Carbon capture, utilization and storage (CCUS): Because calcination emissions cannot be avoided through efficiency or fuel substitution, CCUS will be necessary for deep decarbonization in the long term. While currently expensive and at pilot scale, CCUS can eventually be applied to cement plants in host countries to capture and either store or reuse emissions. Utilization options, such as using CO_2 in concrete curing or aggregate production, could be especially relevant in emerging construction markets. In the near and medium term, green procurement should prioritize more accessible levers such as efficiency and clinker substitution, while still recognizing CCUS as a critical future option.

STRATEGIES FOR DECARBONIZING STEEL IN BRI PROJECTS

The decarbonization of steel supplied for China's overseas projects must consider both the Chinese steel industry, which provides a large share of material for overseas construction, and the domestic steel industries of host countries. Many BRI host countries rely primarily on EAF production, often with smaller capacities, while China's industry is still dominated by the BF-BOF route. This distinction shapes the available strategies for reducing emissions: in host countries, decarbonization relies heavily on energy efficiency and the use of renewable electricity, while in China, deeper transitions such as scrap expansion, green H_2-DRI and CCUS are essential. Green procurement policies in China's overseas projects can create strong demand for low-carbon steel in both contexts, encouraging suppliers to adopt these levers more quickly.

Energy efficiency: Both Chinese and host-country producers can improve energy performance, but the priorities differ. In China's BF-BOF plants, technologies such as waste heat recovery, Top-Pressure Recovery Turbine plants, coke dry quenching and smart digital controls can deliver significant savings. Advanced digitalization tools, including predictive maintenance, digital twins and process analytics, are increasingly applied to optimize energy use. In host countries, where EAF plants dominate, the opportunities are more focused on reducing electricity use per ton of steel, improving furnace efficiency and modernizing rolling and finishing lines. Green procurement that prioritizes low-carbon steel would push both Chinese and host producers to scale up such measures, thereby lowering energy-related emissions.

Fuel switching and electrification: For China's BF-BOF industry, coal and coke remain the backbone of steelmaking, but gradual substitution with lower-carbon fuels, such as natural gas, biomass or hydrogen, can reduce emissions. Over time, electrification of certain processes, such as reheating furnaces or induction-based melting, will play an increasing role. A key opportunity in China is the expansion of EAF steelmaking, which currently accounts for less than 10 percent of production but could rise as domestic scrap availability grows. For host countries, which already rely heavily on EAFs, the main pathway is through ensuring that electricity supplied to these furnaces comes from renewable sources rather than fossil fuel–based grids. Electrifying auxiliary processes in rolling and finishing, when powered by renewables, can further reduce the footprint. By requiring or rewarding lower CO_2 intensity, China's overseas procurement policies can encourage both scrap-based production and renewable electricity sourcing.

Transformative technologies: Breakthrough technologies will be required to achieve deep decarbonization in steel. Chief among these is H_2-DRI, which can replace natural gas in DRI plants and eliminate nearly all fossil fuel use. China is already piloting this approach: Hebei Iron and Steel Group (HBIS) is testing hydrogen-rich DRI and Baowu Steel is constructing a new DRI facility in Zhanjiang. If BRI procurement creates demand for lower-carbon steel, it can help accelerate such pilots into large-scale commercial deployment. For host countries, while H_2-DRI may not be immediately viable, procurement could signal long-term demand and attract investment partnerships to bring these technologies into developing economies over time.

CCUS: Given the heavy reliance on BF-BOF in China, CCUS will be an important part of long-term decarbonization. Post-combustion capture technologies can be retrofitted onto blast furnaces, though costs remain high. Captured CO_2 can be stored underground where geology allows, or utilized for chemicals, fuels or even building materials. CCUS is less relevant in the near term for host countries, since EAF production dominates, but it could become important in regions where BF-BOF plants still operate. Procurement frameworks could recognize CCUS in the longer term while emphasizing nearer-term measures such as efficiency, scrap use and renewable power sourcing.

Material efficiency and circular economy: On the demand side, reducing the need for virgin steel is another powerful lever. Optimized design, lightweighting in construction and higher recycling rates can all lessen steel demand. For host countries, strengthening scrap collection systems is particularly important to supplying EAFs with clean, high-quality scrap. In China, rising urban demolition and industrial scrap availability will expand the role of recycling, reducing pressure to build new blast furnaces. By embedding requirements for recycled content and efficient material use, China's overseas procurement can amplify these circular economy strategies.

In summary, decarbonizing steel in China's overseas projects requires a dual approach: in host countries, the focus should be on improving EAF efficiency, using renewable electricity and strengthening recycling; in China, deeper structural shifts toward scrap-based steel, H2-DRI and CCUS are critical. Green procurement can link these two pathways by creating stable demand for low-carbon steel, ensuring that both Chinese suppliers and host-country producers are incentivized to accelerate the transition.

The Hague, Netherlands. Photo by Fer Troulik via Unsplash.

INTERNATIONAL BEST PRACTICES IN GREEN PROCUREMENT

Globally, most green procurement policies to date have been implemented at the national level. For example, the US federal government launched a Federal Buy Clean Initiative in 2021 via Executive Order 14057, marking the first nationwide effort to prioritize lower-carbon, US-made construction materials in federal procurement. In particular, the initiative focused on construction materials and products with the highest embodied carbon concerns, such as steel, cement/concrete, asphalt and flat glass, to prioritize lower embodied carbon consideration in federal procurement and federally funded projects (Office of the Federal Chief Sustainability Officer n.d.). It also set out requirements for EPDs and guidelines to favor products with lower embodied carbon. Given uncertainty in the federal implementation of Buy Clean, it is important to note that state-level Buy Clean initiatives are also happening in California, Washington state, Colorado and New York.

Since 2008, the EU has been promoting "Public procurement for a better environment" (European Commission 2008), with the European Commission (EC) developing voluntary GPP criteria for several product groups. Following the adoption of the 2020 Circular Economy Action Plan, the EC has also proposed minimum mandatory GPP criteria and targets in sectoral legislation (including construction) and begun phasing in compulsory reporting to monitor uptake. For EU member states, GPP promotion is mostly done through voluntary national action plans. Some countries now mandate low-carbon purchasing. For example, in Italy, national rules require environmental criteria for certain product groups, such as buildings and roads (Casier and Strömgård 2025). Ireland requires limits or reductions on the embodied carbon of materials (such as concrete) in public construction projects (Department of Enterprise, Tourism and Employment 2025).

At the EU level, the EC has adopted voluntary GPP criteria for road and office building design, construction and management. Its tendering award criteria for road construction focus on integrating life-cycle and carbon considerations into material choices. They include: (1) LCA of the main road elements; (2) carbon footprint evaluation of the global warming potential of extraction, manufacturing and transport; (3) minimum thresholds for recycled or reused content; and (4) reduced-emissions requirements for the transport of heavy materials, rewarding lower CO_2-e outcomes. Thus, EU road tenders combine LCA and carbon footprint analysis with recycled-content and low-emission transport requirements, making embodied carbon visible and actionable within procurement decisions.

In 2024, the EU and the US published the Joint US–EU Catalogue of Best Practices on Green Public Procurement (US–EU Trade and Technology Council Working Group on Climate and Clean Tech 2024). This catalogue summarizes GPP best practices across different stages: strategic planning, pre-procurement, procurement itself and finally the post-contract award stage.

In Canada, some elements of the Buy Clean policy are already in place (Hasanbeigi et al. 2022). The federal Greening Government Strategy announced in 2017 established a goal of net-zero emissions by 2050, including in the procurement of goods and services. The government will reduce embodied carbon by 30 percent starting in 2025 through the use of recycled and lower-carbon materials, material efficiency and performance-based design standards, and it will conduct a whole-building life-cycle analysis by 2025 for major projects. As of 2026, embodied carbon requirements have been operationalized through federal construction standards and procurement guidance. However, government performance reports have not yet published portfolio-wide data confirming the extent to which the 30 percent reduction target has been met. In service of this, the government is building a repository of reliable emissions data through the Low Carbon Assets through Life Cycle Assessment (LCA2) initiative.

In the Netherlands, a recognized frontrunner in GPP, the government achieved its ambitious 2005 target of 100 percent green procurement for the central government by 2010 and extended the same target to all other public authorities by 2015. In the construction sector, the Dutch Rijkswaterstaat has developed specific guidelines to strengthen sustainable procurement, where tenders are evaluated not only on price but also on quality criteria, including the CO_2 emissions performance of a design (Hasanbeigi et al. 2022).

The authors of this paper have previously profiled GPP programs in over 20 countries, focused on efforts by those countries to source greener materials for domestic projects (Hasanbeigi and Bhadbhade 2023; Hasanbeigi and Sibal 2024; Hasanbeigi et al. 2019; Hasanbeigi et al. 2023; Hasanbeigi et al. 2024). However, given that our focus here is on internationally financed infrastructure projects, this section focuses on green procurement policies at institutions that engage in international development financing, including multilateral development banks and bilateral development agencies.

Multilateral Development Banks

Multilateral development banks (MDBs) are uniquely positioned to promote green procurement through the creditor–debtor relationships they establish with borrowing countries. By controlling financial flows, MDBs can shape borrower behavior via funded programs, procurement guidelines, capacity-building and knowledge transfer (Erizaputri and Bechauf 2024; Mendez and Houghton 2020; Ocampo and González 2024).

At the core of MDBs' approach is value for money (VFM), which has evolved from a narrow focus on monetary cost to a broader concept that also incorporates factors such as environmental and climate impacts into procurement evaluations (IDB 2024). Recently, there have been coordinated joint efforts among MDBs to expand and encourage green procurement practices. For example, in 2023 the Heads of Procurement at Multilateral Development Banks launched the Joint Statement on Sustainable Procurement Initiative, indicating a "collective intent on mainstreaming sustainable procurement" with the objective of supporting governments to decarbonize their economies and achieve climate goals (Heads of Procurement at Multilateral Development Banks 2023). Individual MDBs have accordingly adopted and updated their procurement policies and strategies to support sustainable procurement (UNEP 2022), aligning procurement processes in funded projects with these regulations. Notably, in 2023 the World Bank released a series of four Procurement Guidance documents on sustainable procurement (World Bank 2023). Similarly, the Inter-American Development Bank (IDB) published a research report aiming to guide the adoption and implementation of green procurement (Cota et al. 2018). The Asian Development Bank (ADB) (2021) provided its own *Sustainable Public Procurement: Guidance Note on Procurement*, outlining its approach to sustainable public procurement and its incorporation at various procurement stages. The African Development Bank (AfDB) released a Sustainable *Public Procurement Guidance Note* in 2020. All these guidelines emphasize including rated factors such as environmental and climate impacts in procurement evaluation criteria to achieve VFM (AfDB 2020).

Going beyond policy and regulation, MDBs have implemented sustainable procurement practices on the ground, achieving concrete outcomes. For instance, the ADB financed a US$200 million project, Uttarakhand Integrated and Resilient Urban Development, in India, incorporating sustainable procurement practices by prioritizing green cement and energy-efficient equipment to reduce GHG emissions (Taylor 2024). Similarly, the World Bank's project to reconstruct small industrial estates in Turkey following the 2023 earthquakes mandates the use of low-carbon steel from recycled scrap and blended cement with reduced clinker content in all new construction (Ministry of Industry and Technology 2024).

Nonetheless, despite efforts in rulemaking and piloting projects, MDBs have not played a direct role in monitoring or enforcing the implementation of sustainability criteria, viewing these criteria as voluntary and contingent on the agreement of borrowing countries. While MDBs support member countries by providing technological expertise to modernize and reform national and regional public procurement frameworks (UNEP 2022), their role remains primarily supervisory and facilitative. MDBs have not formally required borrowing countries to utilize comprehensive assessment tools such as the CO_2 Performance Ladder, which has been widely adopted in the Netherlands. Consequently, there is limited understanding regarding the actual (environmental and climate mitigation) effects, and particularly CO_2 reduction, achieved through these sustainable procurement practices.

Large-scale construction projects (of infrastructure in particular) and their material procurement are particularly significant for green procurement at MDBs due to the substantial investments involved and the potential climate and environmental impact of building materials, critical to VFM. MDBs and governments actively seek to regulate the materials used in their funded projects. In its 2023 guideline, the World Bank highlighted the climate implications of using carbon-intensive construction materials such as cement and steel, suggesting that a significant share of the Bank's project expenditure was on these built materials. At the EU level, construction ranks among the top-priority sectors, emphasizing materials such as concrete and steel. Common practices include using eco-labels and green building certifications, such as LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method, utilized by EBRD), to regulate carbon-intensive construction materials. However, all these guidelines focus on a general level rather than project level, and there is no requirement regulating the carbon intensity of specific materials such as cement or steel.

Bilateral Development Agencies

Like MDBs, bilateral development agencies (BDAs) also play a significant role in using procurement rules to influence the projects and countries they finance. Yet each BDA adopts a unique approach, reflecting unique institutional priorities and mandates. Here, we use major BDAs such as the Japan International Cooperation Agency (JICA) and KfW Development Bank as examples.

JICA has embedded green procurement into its corporate policy and project processes. Since 2010, its "Guidelines for Environmental and Social Considerations" (ESC) have aligned with international standards to minimize project impacts (JICA 2022). The ESC guidelines are described as a "prerequisite for JICA's assistance," serving as the foundation for categorizing projects based on their potential environmental and social risks. Depending on the level of adverse impact, projects are classified and subjected to varying degrees of environmental and social due diligence. A major 2022 revision introduced climate change measures, for example, JICA now requires the estimation and disclosure of total project GHG emissions as part of the environmental impact assessment. These guidelines ensure that ESC considerations are integrated early in the project cycle, beginning with feasibility studies and appraisals, and allow JICA to halt or alter projects if serious legal or environmental violations occur, reflecting a commitment to accountability and continuous improvement. Impacted populations may also file complaints through JICA's "Review and Concurrence" procedures or the public "Objection Procedures" mechanism in cases of ESC guideline violations.

Germany's KfW Development Bank has emerged as a leader in formalizing green procurement within development finance, aligning its practices with internationally recognized standards such as the World Bank's Environmental and Social Standards, the Equator Principles and the International Finance Corporation (IFC) Performance Standards. All bidders are required to sign declarations of adherence to these standards and to implement any environmental and social risk mitigation measures identified for a project. A distinctive feature of KfW's approach is its integration of life-cycle thinking into procurement: bids are evaluated not only on upfront price but also on life-cycle cost, which accounts for operation, maintenance and end-of-life disposal. This method makes it possible to incorporate environmental externalities, such as the costs of GHG emissions or pollution, into financial assessments where feasible. To support consistent application, KfW has developed a "Toolbox" on sustainable procurement that provides staff and partner countries with practical methods to embed sustainability throughout the tender process, from planning and specifications to contract clauses (KfW 2014). As KfW emphasizes, "sustainable procurement links ecological, economic and social aspects" in award criteria, ensuring that procurement simultaneously advances environmental protection, safer working conditions and local development benefits alongside VFM.

Other major BDAs have also upheld GPP. For example, the Swedish International Development Cooperation Agency (Sida) emphasizes "The sustainable use of natural resources and protection of the environment" as one of the six fundamental objectives of Swedish international development cooperation (Sida 2002; see also Openaid n.d.). Its sustainable procurement guidelines require environmental impact assessments and promote LCA, while prioritizing goods and services that are energy-efficient, durable, recyclable or safely disposable and made from renewable or sustainably sourced materials. Since 2021, Sida has also supported capacity-building programs on sustainable procurement, particularly for partners in East Africa and Latin America. In addition, the UK's Foreign, Commonwealth and Development Office (UK FCDO), the country's main bilateral aid agency, incorporates sustainable procurement into its development projects, aiming to "achieve value for money while minimizing environmental damage and waste" (UK FCDO n.d.).

Lessons for China and BRI Financing Institutions

China's DFIs are at an earlier stage than MDBs in developing and implementing green procurement policies. Given that China's overseas development finance is concentrated in infrastructure, requiring substantial procurement of construction materials, incorporating sustainable procurement practices is especially crucial for climate mitigation efforts. Even beyond China's development finance, the country's cumulative overseas engagement in construction contracts has reached US$1.175 trillion since its inception in 2013, with contracts awarded in 2024 alone amounting to a record high of $70.7 billion (Wang 2025). Thus, even infrastructure projects that are not directly financed by China's DFIs may involve Chinese firms that could be subject to green procurement policies in China, depending on policy design. Given this financial scale and the environmental implications of construction material use, integrating carbon intensity factors into procurement decisions can be a major lever for China in driving steel and cement decarbonization globally.

To date, green procurement has been mentioned in general terms within Chinese overseas investment policies but there is a lack of detailed attention proportional to its potential impact. For instance, the 2021 "Green Development Guidelines for Overseas Investment and Cooperation" issued by China's MOFCOM and MEE broadly encourages adoption of green procurement practices alongside purchasing of environmentally friendly products and services. The 2022 "Guidelines for Ecological Environmental Protection of Foreign Investment Cooperation and Construction Projects," issued by the same ministries, emphasizes green procurement ("*绿色采购*") and prioritizes environmentally friendly products. However, these policies broadly target overseas investment without specific details on how green procurement should be practically implemented.

While there is consensus and commitment to making the BRI greener and more sustainable, there remains no clear definition or practical guidance on how to implement green and low-carbon procurement in practice. Some documents reference benchmarking against high standards set by global green building certifications, but it remains unclear what these references specifically entail. It also appears challenging for scholars to quantify the impact. Limited existing research suggests that

Chinese-funded procurement contracts are often awarded to Chinese companies, and there is less transparency in Chinese institutions' procurement process compared with MDB practices (Ghossein et al. 2018, 2021). This lack of transparency makes it difficult for researchers to assess the technical details of contracts, especially the sustainability level of the materials used, thereby complicating the evaluation of climate impacts and potential emission reductions achievable through GPP.

Chinese institutions financing infrastructure abroad can draw several lessons from international best practices in green procurement to enhance sustainability outcomes and align with global climate goals. MDBs such as the World Bank and ADB have shifted procurement strategies from a narrow focus on cost to a broader VFM approach that includes environmental and climate considerations, embedding sustainability across project stages and materials selection. Such an approach aligns with recent policy statements made by China about focusing on "high-quality" development and a "small is beautiful" approach abroad, although implementation of these principles is yet to be determined.

BDAs such as JICA and Germany's KfW have made voluntary commitments toward mandates for environmental and social safeguards. Other features of best practice green procurement programs include integrating life-cycle thinking into procurement decisions and building tools and accountability mechanisms to monitor implementation. National-level policies in e.g. the EU and Canada are increasingly mandating low-carbon materials, publishing EPD requirements, and setting embodied carbon reduction targets. In contrast, Chinese DFIs have thus far adopted only high-level commitments to green procurement, without detailed implementation frameworks or enforceable standards. To catch up with international leaders, Chinese institutions could prioritize the development of concrete green procurement guidelines for overseas projects, introduce material-specific carbon criteria (particularly for cement and steel), strengthen transparency and disclosure requirements and adopt performance-based procurement tools such as LCAs. These recommendations and possible policy designs are explored further in the next section.

From these two examples, several policy lessons emerge for China. Successful GPP tends to rest on four factors: the establishment of clear and ambitious quantitative targets with firm policy backing; the adoption of well-defined and regularly updated criteria; the promotion of transparency through systematic tracking and monitoring; and the development of practical tools, platforms and capacity-building activities to support implementation. Clear, ambitious targets anchored in law or policy have been critical to driving progress: the Netherlands' commitment to 100 percent sustainable procurement and the EU's voluntary goal of at least 50 percent stand in contrast to France's 30 percent and Austria's vague national targets and have proven more effective in securing results.

Equally important are criteria that are both precise and dynamic. As the EU experience shows, when standards lag behind market or legislative developments, they lose effectiveness, while in the Netherlands, minimum criteria are reviewed annually and tightened as needed, continually raising the bar for suppliers. Transparency also matters, with Korea demonstrating how media scrutiny can heighten competition and strengthen accountability across government departments. Finally, the consistent and credible application of GPP is enhanced by the availability of tools and supporting activities: the Netherlands' DuboCalc LCA tool, the CO_2 Performance Ladder certification system, Finland's JUHILAS carbon footprint tool and Germany's Berliner Energieagentur exemplify technical resources that aid implementation, while platforms, networks and training programs in Austria, Italy and Germany provide procurement officers with the knowledge and support necessary to embed sustainable practices.

POLICY RECOMMENDATIONS FOR BRI GREEN PROCUREMENT

Implementation Challenges

The successful introduction of green procurement for cement and steel in China's global infrastructure projects will depend on how effectively challenges are addressed and enabling conditions are created. While the potential for emissions reductions is substantial, reforms targeting at addressing institutional, technical, financial and political barriers are required.

INSTITUTIONAL AND GOVERNANCE CHALLENGES

One of the main challenges is the absence of established green procurement frameworks within Chinese institutions. Compared with MDBs, which have begun introducing environmental performance standards in their procurement rules, Chinese DFIs and SOEs have limited experience with low-carbon procurement. Host-country governments also often lack regulatory frameworks, capacity or legal mandates to require carbon-based procurement criteria. This creates a fragmented governance environment where no single institution has clear authority to implement low-carbon procurement policies. Aligning procurement rules across multiple actors (e.g., Chinese financiers, contractors and host-country agencies) will therefore be difficult.

In addition, many BRI projects involve complex supply chains with multiple contractors and subcontractors, making it challenging to track the carbon intensity of cement and steel. Limited transparency, weak data systems and the lack of harmonized standards for reporting CO_2 intensity in many host countries further complicate monitoring and enforcement. Without clear accountability and strong governance, green procurement requirements are at risk of being diluted or ignored.

TECHNICAL AND DATA CHALLENGES

A significant barrier is the lack of reliable, country-specific data on the carbon intensity of cement and steel production in many host countries. This study had to rely on standardized assumptions (e.g., average clinker-to-cement ratios, benchmark CO_2 intensities for steelmaking routes) because data at plant or industry level was not available for most developing economies. Without accurate baseline data, it is difficult to set realistic yet ambitious procurement thresholds.

Another technical challenge is the limited capacity of producers in host countries to measure and disclose their carbon footprints. EPDs, LCAs and other reporting tools are not widely used. Many small and medium-sized cement and steel producers lack the technical expertise and resources to prepare such disclosures. This makes it harder for procurement agencies to evaluate bids on carbon performance and raises the risk of inconsistent or unverifiable reporting.

FINANCIAL AND MARKET CHALLENGES

Introducing green procurement can raise concerns about cost. Low-carbon cement and steel products may carry higher upfront costs, especially where they require investment in new technologies such as clinker substitution systems, EAFs powered by renewables or carbon capture pilots. For host-country producers with limited access to finance, meeting stricter procurement standards could be seen as a barrier to market entry. For Chinese suppliers, transitioning from BF-BOF to lower-carbon routes such as EAF or H_2-DRI requires substantial capital investment. Without mechanisms to share costs and risks, both Chinese and host-country producers may be reluctant to commit.

Another market-related challenge is the limited availability of low-carbon alternatives in some regions. For example, SCMs may not be accessible in large quantities in certain countries, while renewable electricity to power EAFs remains scarce in others. If procurement standards are set without considering such constraints, they risk creating compliance difficulties or unintended supply shortages.

POLITICAL AND STRATEGIC CHALLENGES

Green procurement for BRI projects must navigate complex political dynamics. Host-country governments may prioritize rapid project delivery and low costs over environmental performance, especially in contexts where infrastructure gaps are large. In some countries, local cement and steel industries may resist stricter requirements such as green procurement standards out of concern for competitiveness, since these firms may have higher costs of abatement compared with Chinese or other overseas producers and could be less competitive in green procurement-oriented tenders. On the Chinese side, development banks and SOEs may be cautious about introducing procurement rules that could slow project approvals or increase financing costs. Furthermore, the BRI operates across a wide range of countries with different regulatory environments, economic capacities and political priorities. This diversity makes it difficult to design a one-size-fits-all procurement framework. Balancing flexibility with ambition will be a central challenge in implementation.

Framework for a Green Procurement Policy for China's Overseas Investment

Developing green procurement guidelines and standards for China's overseas development finance is a strategic move that aligns with China's broader goals of promoting green development, enhancing global leadership in climate governance and ensuring the long-term sustainability of overseas strategies such as the BRI. By incorporating guidelines requirements for lower-carbon steel and cement, China can reduce the environmental footprint of its future international projects while simultaneously supporting the global decarbonization agenda. Such standards would also help Chinese firms stay competitive as international markets and financiers increasingly demand climate-aligned infrastructure.

China can build on a nascent green procurement policy landscape governing domestic procurement. Over time, green procurement has been integrated into national strategies, including the 12th and 13th Five-Year Plans. A major advance for carbon-intensive materials came in 2019 when four ministries jointly issued a notice mandating the procurement of energy-saving and environmentally labeled products based on updated certification systems, explicitly including building materials such as cement and concrete. More recent carbon peaking implementation plans (2022) emphasize life-cycle carbon footprint accounting, including for raw materials such as steel and cement (Hasanbeigi et al. 2024).

Although China does not currently impose mandatory national-level CO_2 intensity thresholds for these materials, the green procurement framework increasingly supports such goals through voluntary standards, databases and technical guidance. This green procurement framework can be expanded to apply to international procurement. At the same time, existing domestic frameworks should not constrain the development of international procurement policies: there is a precedent for China's overseas environmental standards advancing ahead of domestic policies, such as in the phaseout of coal-fired power plants (Springer 2022).

Policies related to green procurement of low-carbon steel and cement for China's overseas development finance projects could be set by multiple institutions, from ministries to DFIs to SOEs. Each of these institutions has a unique role to play in the development of global infrastructure projects and potential green procurement policies.

MINISTRIES

China's key ministries, such as the NDRC, MOFCOM and MOF, play a central regulatory role in overseeing and guiding the country's overseas development finance activities. Many are also involved in domestic green procurement policies and implementation.

Domestically, MOF manages China's overall public procurement budget and oversees the centralized government procurement catalog, including the lists of Energy Conservation Products (ECPs) and Environmental Labeling Products (ELPs). MOF plays a key role in developing and enforcing policies that guide GPP, including co-issuing major GPP policy notices such as the 2019 directive that adjusted the mechanism for procuring ECPs and ELPs. In the context of overseas infrastructure financing, MOF is responsible for shaping the financial and fiscal policies that underpin China's development finance system. It often sets the regulatory framework for lending and oversees funding mechanisms used by institutions such as CHEXIM, especially for projects supported by government subsidies or guarantees. MOF can also influence whether and how green standards are attached to financial instruments used in outbound infrastructure investment. These complementarities in MOF's role in both domestic green procurement and international financing make it a key ministry for formulating international green procurement policies.

In domestic green procurement, MOHURD is the key body responsible for setting technical standards for green buildings and building materials. It manages the Green Building Materials Information Application database and leads pilot programs to promote the use of low-carbon construction products. Internationally, MOHURD is less directly involved in development finance but influences the technical standards and specifications used in Chinese construction projects abroad. Through its oversight of large SOEs in the construction sector and its technical guidance, MOHURD has the potential to shape green design criteria and material choices in overseas infrastructure projects, especially if domestic standards are exported into foreign projects led by Chinese firms.

Within China, MIIT supports green procurement by setting technical guidelines and developing evaluation methodologies for industrial products, including construction materials such as steel and cement. It provides the criteria used to certify whether products qualify as energy-saving or environmentally labeled. In terms of overseas infrastructure development, MIIT plays an indirect role by setting industrial policy for sectors such as steel and cement. MIIT's policies influence the production standards and technological upgrades of Chinese manufacturers, which affects the carbon intensity of materials used in foreign infrastructure projects.

Domestically, MEE is central to developing and issuing environmental labeling standards. It certifies products for their environmental performance and has supported the creation of LCA methodologies. MEE also partners with other ministries to support GPP by integrating environmental indicators into procurement policy. While MEE is not a lead actor in China's overseas development finance, it plays an increasingly influential role by shaping China's environmental governance standards. These can be extended to outbound investment through policies such as the "Green Development Guidelines for Foreign Investment and Cooperation" (2021).

The NDRC co-manages the ECP list with MOF and has authority over major investment planning, including sustainability assessments for large-scale projects. It plays a coordinating role in implementing China's broader green transition, including supporting life-cycle-based carbon accounting for key materials and sectors. In the international arena, the NDRC is one of the most powerful actors in regulating China's outbound investment and infrastructure development, particularly through its role in approving overseas projects and issuing policy guidance under the BRI. Its support is essential for setting green procurement standards in international projects, and it has the authority to require any low-carbon procurement-related standards as part of outbound project approval processes.

To promote the procurement of low-carbon steel and cement in China's overseas development–financed infrastructure projects, China's regulatory ministries can design and implement targeted policy measures. These ministries already serve as gatekeepers for outbound investment, procurement policies and financial oversight, making them uniquely positioned to set standards and mandates that align China's international infrastructure footprint with its climate ambitions.

First, the three ministries could jointly issue a guidance document establishing a foundational framework for overseas low-carbon procurement in development–financed overseas projects, specifying that steel and cement used in such projects must meet clearly defined carbon intensity benchmarks.

Second, ministries can make the submission of EPDs a formal requirement in tendering and project approval processes. The NDRC, which is responsible for approving major overseas infrastructure investments, could include EPD submission as a prerequisite for project clearance. This would enhance transparency and accountability in material selection and would help normalize life-cycle carbon analysis in procurement procedures. MOFCOM, which manages international economic cooperation, can incorporate EPD requirements into contractual templates and bidding documents for projects involving Chinese companies and financiers.

Finally, the ministries could establish enforceable carbon intensity thresholds for steel and cement, using a tiered system (e.g., basic, advanced, best-in-class) to allow for a gradual but progressive shift toward lower-emission materials. These thresholds could be updated over time in line with technological advances and sectoral decarbonization trajectories, encouraging material producers to innovate and differentiate themselves through lower-carbon processes.

DFIS

As key providers of loans and credit for overseas infrastructure, the financial policies and due diligence processes of China's DFIs have significant influence over what materials are used and what environmental standards are followed in large-scale projects. One of the most direct ways that DFIs could incentivize greener procurement is by integrating low-carbon material use into their project appraisal and risk assessment frameworks. For example, CDB and CHEXIM could require borrowers or implementing firms to include a green procurement plan as part of the loan application or environmental and social risk assessment. This plan would need to demonstrate how key construction materials, such as steel and cement, will be sourced in a way that minimizes life-cycle GHG emissions, supported by documentation such as EPDs. Projects that fail to meet minimum green procurement standards could be flagged to undertake additional mitigation measures.

Beyond risk management, DFIs could also create financial incentives for the use of low-carbon materials. These incentives would mirror practices seen in green credit and sustainability-linked loans globally and would align with China's broader push to green its financial system. CDB and CHEXIM could develop internal scoring systems that awarded points or favorable treatment to projects based on their procurement of lower-emission construction materials, using tiered carbon intensity thresholds to evaluate performance.

In addition, the DFIs could contribute to market transformation by developing green material procurement guidelines and technical assistance tools for borrowers. This would help standardize expectations across projects and provide practical support for project sponsors in host countries who may not have access to the expertise or data needed to identify and evaluate low-carbon construction materials. Another aspect of technical assistance would be to incentivize knowledge and technology transfer for low-carbon steel and cement production technologies to producers in host countries to enhance their competitiveness for green procurement. DFIs could offer incentives for projects that source low-carbon materials locally through verified technology transfer partnerships.

SOES

China's SOEs are the primary implementers of the country's overseas development finance projects, often playing a central role in the planning, construction and delivery of large-scale infrastructure projects across the Global South. These firms, particularly in sectors such as transport and energy, often serve as the project contractors or engineering, procurement and construction providers for projects financed by China's DFIs. Prominent SOEs such as the China Railway Construction Corporation, the China State Construction Engineering Corporation and PowerChina are involved in designing material specifications, sourcing construction inputs and overseeing supply chains.

To promote low-carbon procurement, SOEs can incorporate environmental performance criteria into their internal procurement policies and supplier contracts. This could include requiring EPDs for steel and cement, setting carbon intensity thresholds for materials or creating preferential sourcing lists for low-emission suppliers. Pilot projects or corporate-level procurement policies could serve as testing grounds for integrating carbon accounting into sourcing decisions.

However, for this to happen at scale, SOEs need incentives that align environmental performance with their broader commercial and political objectives. Currently, many SOEs are evaluated primarily on cost-efficiency, delivery timelines and geopolitical considerations, which can discourage the selection of lower-carbon materials if they are perceived to be more expensive or logistically complex to procure.

One challenge is that SOEs often operate in highly competitive international markets where margins are tight and host-country requirements for environmental performance are minimal. In such cases, without clear regulatory or financial incentives from Chinese authorities or financiers, SOEs have little reason to prioritize low-carbon procurement. Moreover, the fragmented state of global carbon labeling and the limited availability of EPDs for many Chinese steel and cement products make it difficult for project managers to confidently select greener materials.

China's SOE regulatory authorities could play a major role in addressing these gaps. SASAC, which oversees China's centrally administered SOEs, can revise SOE performance evaluation criteria to include green procurement targets or emissions-related KPIs. For example, SASAC could reward SOEs that consistently procure lower-carbon materials in overseas projects with higher internal performance ratings or access to policy support. SASAC could also direct SOEs to incorporate local joint production and training requirements directly into project bids and contracts, working to help make host-country low-carbon production more competitive.

Implementation Mechanisms

Effective implementation of green procurement policies for low-carbon steel and cement in China's global infrastructure projects requires a coordinated set of mechanisms. Across policy-setting institutions, there are a number of cross-cutting mechanisms that can address the technical challenges of emissions data and certification, build capacity in host countries and ensure that project developers have financial and institutional incentives to prioritize low-carbon materials. Key implementation pillars include harmonization with international standards, capacity-building and robust monitoring and reporting systems.

Policymakers should work to harmonize China's green procurement requirements with established international standards for emissions accounting and environmental product certifications. Internationally, GPP and Buy Clean initiatives are becoming more common. Carbon intensity benchmarks for steel and cement should be calculated based on full life-cycle emissions and supported by EPDs or equivalent third-party verified documentation. Aligning China's standards with international frameworks, such as those of the Global Cement and Concrete Association, ResponsibleSteel and the ISO 14040/44 LCA standards, would help ensure environmental credibility and facilitate interoperability with MDBs and host-country regulatory regimes.

This harmonization would also reduce transaction costs for project developers and material suppliers, who would otherwise face inconsistent or conflicting certification requirements. To advance this, China's DFIs could partner with international financial institutions (IFIs) such as the ADB or Asian Infrastructure Investment Bank (AIIB), as well as with technical organizations such as the IFC or the UN Environment Programme (UNEP). These partnerships could support mutual recognition of certification schemes, co-development of green material databases and joint training programs for evaluating EPDs and carbon performance metrics.

Many countries lack the regulatory frameworks, data systems or market readiness to support green procurement. Chinese DFIs, construction SOEs and government agencies can help bridge this gap by integrating capacity-building components into project planning and implementation. For example, project agreements could include provisions for technical training in carbon accounting or procurement of certified low-carbon materials. China's DFIs could also support knowledge-sharing by publishing case studies of successful green procurement practices in overseas projects. These case studies could highlight the use of low-carbon steel and cement, detailing material selection processes, supplier engagement strategies and environmental outcomes.

To ensure the credibility and effectiveness of green procurement policies, a strong monitoring, reporting and verification (MRV) system is essential. MRV frameworks should be applied at both project and material level, tracking whether commitments to low-carbon procurement are upheld throughout the project life cycle. This could involve third-party audits, standardized reporting formats and digital platforms for real-time material tracking. China's regulatory ministries could mandate MRV protocols for overseas projects financed or approved under official development finance channels. Digital solutions, such as blockchain-based traceability tools or material passports, could be piloted to track the provenance and carbon footprint of steel and cement used in international projects. Over time, a centralized green materials registry for overseas infrastructure could be developed to record verified data on procurement practices and environmental performance. Table 4 summarizes our recommendations.

Table 4: Summary of Policy Recommendations for BRI Green Procurement

Actor	Key Recommendations
Regulatory ministries: MOFCOM, NDRC, MOF, MOHURD, MIIT, MEE	• Jointly issue overseas green procurement guidelines with carbon intensity benchmarks for steel and cement • Mandate EPDs or third-party verified carbon data in tenders and project approvals • Set tiered carbon intensity thresholds (basic, advanced, best-in-class) aligned with global standards and update them periodically • Leverage domestic experience (e.g., MOF procurement catalogs, MOHURD green building standards) to inform overseas procurement • Integrate green standards into outbound investment approval and oversight (e.g., through NDRC)
DFIs: CDB, CHEXIM	• Require borrowers to submit green procurement plans with sourcing strategies and emissions data for steel and cement • Develop financial incentives for procuring low-carbon materials • Establish internal green scoring systems to rate projects on procurement performance • Publish technical guidelines and best practice case studies to support borrowers and contractors • Collaborate with international institutions (e.g., IFIs) to align standards and recognize EPDs
SOEs (overseen by SASAC)	• Integrate low-carbon criteria (EPDs, thresholds, life-cycle assessments) into procurement policies and supplier contracts • Pilot low-carbon procurement demonstration projects • Align SOE performance metrics with climate goals by including green procurement KPIs • Build technical capacity and data systems for procurement officers and project managers
Cross-cutting recommendations and implementation mechanisms	• Harmonize with international standards (ISO 14040/44, ResponsibleSteel, Global Cement and Concrete Association) • Build capacity in host countries via training, technical assistance, and South–South learning • Establish strong MRV systems at both material and project level • Create a centralized green materials registry to track steel and cement carbon intensity and support transparency

CONCLUSIONS

China's DFIs, led by CDB and CHEXIM, have emerged as central players in global infrastructure investment, providing more than US$472 billion in loans since 2008. Much attention has focused on whether this finance supports fossil fuels or renewables, but an equally important dimension is the massive use of steel and cement, carbon-intensive materials, in BRI projects. These materials are indispensable for roads, railways, ports, bridges and power plants, yet their production contributes nearly one-fifth of global CO_2 emissions. With the BRI spanning more than 140 countries, China's financing not only shapes energy and transport infrastructure but also embeds material-related emissions for decades to come.

Energy and transport dominate China's overseas finance, together accounting for the bulk of loans and the greatest climate impacts. Energy alone has received US$184 billion in loan commitments between 2008 and 2024, much of it for fossil fuel extraction, coal power and large hydropower. Transport projects include roads, railways, ports and airports, sectors highly dependent on steel and cement. These materials provide structural integrity for turbines, pipelines, bridges and dams but are among the most carbon-intensive to produce. Chinese-financed power plants abroad already emit 287 Mt CO_2 annually, with another 53 Mt likely if planned projects proceed. Over their lifetimes, Chinese-backed coal plants in Asia could emit 11 Gt CO_2, about one-third of the region's total coal-related emissions. Alongside these operational impacts, projects often cause deforestation, biodiversity loss and land-use change, while also facing increasing climate risks (floods, typhoons, water stress). Reducing embodied emissions from steel and cement is therefore a critical complement to shifting away from fossil fuels.

Although our findings show that the volume of embodied carbon in steel and cement is smaller relative to direct emissions from highly carbon-intensive infrastructure (such as coal-fired power plants), it still represents a non-negligible and largely unregulated source of CO_2. In some cases, embodied emissions could make up a substantial share of lifetime project emissions. Our analysis covered 233 projects with physical footprints, mainly power plants, roads and railways, out of more than 800 projects in the CODF database that have physical footprints. Better data on ports, airports and fossil fuel extraction infrastructure, which also consume large amounts of steel and cement, would have increased our totals. Moreover, we analyzed only development finance, excluding the much larger pool of Chinese commercial lending and FDI. For instance, the projects we reviewed include 45 GW of power capacity while the CGP database tracks 106 GW supported by Chinese FDI, none of which is captured in our estimates. This means the actual scale of embodied carbon in Chinese-financed infrastructure is significantly larger, and it is likely to grow as overseas development finance begins to rebound after several years of decline. Without new policies, emissions from steel and cement use in BRI projects could expand into a major source of overlooked climate impacts.

Our estimates show that cement use in Chinese-financed transport and energy projects has generated about 2,452 kt CO_2, almost 2,000 kt of which is from completed projects. South Africa, Indonesia, Argentina, Ethiopia and Angola account for 40 percent of this footprint. Steel emissions vary with sourcing: if produced domestically, they total 3,480 kt CO_2; if imported entirely from China, they rise to 4,772 kt CO_2, reflecting China's higher carbon intensity. A 50/50 mix yields 3,966 kt CO_2. In all cases, completed projects dominate emissions. Argentina, South Africa, Indonesia, Ethiopia and Angola together account for 62 percent of steel-related emissions under the domestic case. These findings highlight how sourcing decisions significantly shape outcomes, with Chinese steel raising emissions by 37 percent compared with domestic supply.

Green procurement policies requiring the use of low-carbon steel and cement offer a pathway to reducing these impacts. For cement, procurement standards could have cut emissions by 368 kt CO_2 under a modest 15 percent reduction scenario, 735 kt CO_2 at 30 percent and 1,226 kt CO_2 at 50 percent. The most ambitious 75 percent scenario could have seen a reduction of 1,840 kt CO_2. For steel, green procurement could reduce emissions by 522–716 kt CO_2 at 15 percent cuts, 1,044–1,432 kt CO_2 at 30 percent and 1,740–2,386 kt CO_2 at 50 percent. A transformative 75 percent cut could achieve savings of 1,190, 1,983 and 2,974 kt CO_2 respectively. While completed projects dominate, stricter standards for projects under construction and planning would still yield meaningful reductions and, importantly, send market signals that incentivize efficiency upgrades, clinker substitution in cement and scrap or hydrogen-based steelmaking.

The implementation of green procurement in BRI projects faces governance, technical and political barriers. Chinese and host-country institutions often lack frameworks for carbon-based procurement, and emissions data and reporting remain weak. Low-carbon alternatives may cost more upfront or face supply constraints, such as limited SCMs or renewable electricity for EAFs. Political priorities in host countries may emphasize cost and speed over sustainability. However, China has several options to help align its overseas practices with green procurement frameworks. It can leverage its DFIs and SOEs to reshape supply chains, build host-country capacity for emissions accounting and lower-carbon production and pilot innovative technologies such as LC3 cement and hydrogen-based steel. Green procurement would also support industrial modernization and economic development in host countries by lowering energy costs, improving competitiveness and reducing air pollution.

To achieve this, a coordinated policy framework is needed. Regulatory ministries (NDRC, MOFCOM, MOF, MOHURD, MIIT and MEE) should jointly issue overseas green procurement guidelines, mandate EPDs in tenders and set tiered carbon intensity thresholds for steel and cement aligned with global standards. DFIs including CDB and CHEXIM should require green procurement plans in loan applications, introduce financial incentives and publish technical guidance. SOEs, as primary implementers, should integrate carbon criteria into contracts, pilot low-carbon procurement and align performance metrics with climate goals, supported by SASAC. Cross-cutting measures should include harmonization with international standards, capacity-building in host countries, strong monitoring and verification systems and a centralized green materials registry.

China's overseas development finance is already shaping the carbon trajectory of global infrastructure. Embodied emissions from steel and cement are smaller than direct plant emissions but remain an overlooked, unregulated and growing source of CO_2. By embedding green procurement into BRI projects, China can reduce embodied emissions, drive innovation in material industries and align its global investments with international climate goals.

Buenos Aires, Argentina. Photo by Gabryel Alcantara via Unsplash.

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APPENDIX 1: METHODOLOGY FOR ESTIMATING MATERIAL PROCUREMENT AND EMISSIONS

The goal of this study is to estimate the total volume of construction materials (cement and steel) procured for overseas infrastructure projects financed by China's DFIs and the associated emissions. The methodology consists of two primary steps: calculating material procurement volumes and estimating related emissions.

Given the limited literature on estimating global-scale material procurement volumes and the sparse, uneven data available for developing countries, we developed a mass-based calculation method specifically focusing on material intensity:

Total Material Procurement (cement/steel) = Material Intensity × Unit of Infrastructure Constructed

The material intensity is based on literature estimates of steel and cement per unit of infrastructure (e.g. MW for power plants or kilometers for roads and railways).

Our analysis is structured in two phases: identifying projects and identifying material intensity.

Identifying Projects

We defined the study's scope using project-level data from two databases managed by Boston University Global Development Policy Center, the CODF (updated 2025) and CGP (updated 2025). By linking these datasets via unique identifiers, we were able to have a comprehensive overview of China's overseas infrastructure projects, capturing details such as project capacity, length, financing details and implementation status.

We particularly leverage the newly available project status data (August 2025) from the CODF, categorizing projects as under construction, under planning or completed. This categorization enables us to provide targeted policy implications, focusing especially on projects that are currently under construction or in the planning stages, where improvements in GPP practices could decrease embodied emissions in future construction.

The analysis concentrates on two infrastructure sectors: transportation (roads and railways) and electricity generation (thermal, hydropower, renewables and nuclear). These sectors were selected due to their predominant share in China's overseas infrastructure investments and significant cement and steel usage. Insights from these sectors can be broadly applied to infrastructure procurement practices in other areas.

Within transportation, the focus is specifically on road and railway projects because of their dominance. For the energy sector, the analysis targets new construction of power plants, including thermal (coal and gas-fired), hydropower, renewable (solar, wind) and nuclear projects but excludes geothermal, biomass and oil-fired plants, which represent only a small number of projects (1–2).

Retrofit and rehabilitation projects were excluded from the analysis despite their significant representation in China's overseas investments (e.g., 40% in transportation projects). This decision was based on two factors: geospatial datasets do not clearly distinguish new constructions from expansions, potentially leading to biased outcomes; and focusing solely on new projects ensures methodological precision.

Table A1: Summary Statistics

Category	Subcategory/Type	N (Projects)	Share (%)
Total projects	–	233	100.00%
By sector			
	Energy	101	43.30%
	Transport	132	56.70%
By status			% of total
	Completed	187	80.30%
	Under construction	40	17.20%
	Under planning	6	2.60%
Energy	Hydropower	54	53.50%
	Thermal power	44	35.60%
	Others	11	10.89%
Transportation	Road	114	86.30%
	Railway	18	13.60%

Source: Authors' elaboration

Identifying Material Intensity

Material intensity data (cement and steel usage per infrastructure unit) was obtained through an extensive literature review. This included peer-reviewed academic studies, MDB project reports, self-reported data from construction companies and industrial association reports. From this literature, material intensity ranges were established and final intensity values selected. Due to variations in material intensities, certain infrastructure categories required further subdivision. For instance, hydropower projects were categorized into run-of-river and dam-based facilities, while road projects were classified based on pavement type (asphalt vs. concrete).

Table A2: Summary of Material Intensity for Analyzed Projects

Sector	Project Type	Steel Multiplier (t/unit)	Cement Multiplier (t/unit)
Transportation	Road (concrete)	79 t/km	653 t/km
	Road (asphalt and concrete)	4.9 t/km	45.71 t/km
	Railway	232 t/km	168 t/km
Energy	Hydropower (dam)	14.5 t/MW	140 t/MW
	Hydropower (run-of-River)	7.5 t/MW	47.376 t/MW
	Coal-fired power plants	37 t/MW	45.024 t/MW
	Gas-fired power plants	14 t/MW	10.08 t/MW
	Wind farms	130 t/MW	60.34 t/MW
	Solar farms	50 t/MW	44 t/MW
	Nuclear power plants	43 t/MW	52.752 t/MW

Source: Authors' elaboration based on Alves Dias et al. 2020; Antonio 2024; Asian Development Bank (ADB) 2023; Bechtel 2025; BHP 2022; China Energy News 中国能源报 2017; City of Springfield 2025; Cooperman et al. 2023; Eberle et al. 2023; Engel 2022; Hou et al. 2024; Jean et al. 2015; Malafaia 2019; METINVEST 2021; Miatto et al. 2017; Mumba 2015; Nguyen et al. 2019; Peterson et al. 2005; Pieters et al. 2021; Polimex Mostostal S.A. 2025; RWE 2020; Shi et al. 2012; Spath et al. 1999; State-owned Assets Supervision and Administration Commission of the State Council 2020; STRABAG 2019; Sullivan 2006; Underwood et al. 2023; UNECE 2022.

With project identification and subcategorization complete and type-specific material intensity multipliers compiled from the literature, we matched each project type to its corresponding multiplier and calculated the estimated use of cement and steel. The results are presented in Section 4 of the main text.

APPENDIX 2: CO_2 EMISSIONS AND IMPACT ANALYSIS

CEMENT

Since the amount of cement used in China's global development–financed transport and energy projects is a small fraction of total annual production of cement in each country (less than 10% in the majority of BRI countries), we assumed all cement consumption for projects in our dataset was sourced in the country where the project was located. This also makes sense because cement is bulky, heavy, and expensive to transport for long distances. Therefore, we used the average CO_2 emissions intensity of country's domestic cement industry as the baseline for the target setting for cement GPP.

Because country-specific CO_2 intensity data for cement production was not available for many of the BRI countries, particularly those that are developing economies, we applied a standardized assumption to estimate emissions. We used an average clinker CO_2 intensity of 0.85 t CO_2 per ton of clinker combined with an average clinker-to-cement ratio of 0.8. This results in an estimated carbon intensity of 0.68 t CO_2 per ton of cement, which we adopted for all countries in this study. This consistent value provides a reasonable basis for comparing cement-related emissions across infrastructure projects in the absence of detailed country-level data.

STEEL

To estimate the potential CO_2 emissions associated with steel consumed in China's overseas infrastructure projects, we developed several scenarios regarding the sourcing of steel. The amount of steel used in Chinese development–financed transport and energy projects in each country as a share of total annual production of steel in the country varies substantially across BRI countries. In some countries the share is less than 10 percent; in others it is between 30 and 85 percent. Therefore, for our analysis , we developed three procurement sourcing scenarios as follow:

1. 100 percent of steel use in BRI project is sourced domestically
2. 100 percent of steel use in BRI project is sourced from China
3. 50 percent of steel use in BRI project is sourced domestically and 50 percent from China

The source has significant implications for the carbon footprint of the steel used in BRI transport and energy projects in each country. This is because the different structure of the steel industry (EAF vs. BF-BOF production ratio) across countries results in differences in carbon intensity of the steel produced in the country versus carbon intensity of the steel produced in China.

Because country-specific CO_2 intensity data for steel production was not available for many of the host countries, particularly those that are developing economies, we applied a standardized assumption to estimate emissions. We first identified the share of steel production coming from BF-BOF, scrap-based EAF and natural-gas direct-reduced-iron EAF (NG DRI-EAF) routes in each country. We then applied average CO_2 intensities of 2.3 t CO_2 per ton steel for BF-BOF, 0.7 t CO_2 per ton steel for scrap-EAF, and 1.4 t CO_2 per ton steel for NG DRI-EAF (worldsteel 2025). Using these benchmark values, we calculated a weighted average CO_2 intensity for each country based on its production route mix. These country-level averages were then applied in our analysis to estimate steel-related emissions from BRI transport and energy projects.

APPENDIX 3: DATA GAPS AND UNCERTAINTIES

Estimating steel and cement use across BRI projects inevitably involves significant data gaps and uncertainties. At the project level, direct information on construction material procurement (such as bidding documents, tenders or contracts) is rarely disclosed. Consequently, we rely on indirect estimation methods, using geolocated project attributes such as the length of a road or railway or the installed capacity of an energy facility. These measures are then multiplied by material intensity multipliers from the existing literature to approximate total use of cement and steel. The uncertainty therefore arises from three components: (1) the accuracy of project-level attributes, (2) the variability of material intensity multipliers and (3) the number of projects included in the analysis.

For project-level attributes (including geolocated data, capacity and project stage completion status), we base our analysis on the 2025 version of the CODF and CGP databases. These sources provide high-quality and widely used datasets, so the uncertainty here is relatively low.

The second potential limitation relates to material intensity, which varies widely. Within each project category (e.g., power generation and transportation), estimates can differ substantially depending on local context, construction standards and measurement approaches. Finally, a key limitation relates to the number of projects screened out. Our methodology works best for categories where the literature provides relatively consistent estimates of material intensity, such as roads, railways and power generation infrastructure, so only sectors with published material intensity estimates that can be reasonably applied across cases are included. More complex facilities, such as ports and airports, had to be excluded due to their heterogeneous design and the lack of standard intensity data, which makes reliable estimation far more challenging. Based on our criteria, (1) projects with geolocated length or capacity data available, (2) new construction rather than retrofitting and (3) availability of material intensity data, we excluded a large number of projects. Ultimately, we retained only 101 of 302 energy projects and 132 of 432 transportation projects. This represents a small share of all 1,304 CODF projects, but it helps ensure greater accuracy and confidence.

Country-specific CO_2 intensity data for cement and steel production was not available in most BRI host countries. To address this, we used average CO_2 intensities and applied them to country-specific EAF production shares for steel and an average clinker-to-cement ratio for cement. While this approach provides a consistent basis for comparison, it introduces some uncertainty into the results.

APPENDIX 4: LIST OF ACRONYMS

Acronym	Definition
ADB	Asian Development Bank
BDA	Bilateral development agency
BF-BOF	blast furnace – basic oxygen furnace
BRI	Belt and Road Initiative
CODF	Chinese Overseas Development Finance Database
CGP	China's Global Power Database
CDB	China Development Bank
CCUS	carbon capture, utilization and storage
CHEXIM	Export–Import Bank of China
CO_2	carbon dioxide
DFI	development finance institution
DRI	direct reduction of iron
EAF	electric arc furnace
ECP	Energy Conservation Product
ELP	Environmental Labeling Product
EPD	Environmental Product Declaration
FDI	foreign direct investment
GHG	greenhouse gas
GPP	green public procurement
Gt	gigaton
GW	gigawatt
IFC	International Finance Corporation
IFIs	international financial institutions
ISO	International Organization for Standardization
KPI	key performance indicator
kt	kiloton
LC3	Limestone Calcined Clay Cement
LCA	life-cycle assessment
MDB	multilateral development bank
MEE	Ministry of Ecology and Environment
MIIT	Ministry of Industry and Information Technology (China)
MOF	Ministry of Finance (China)
MOFCOM	Ministry of Commerce (China)

MOHURD	Ministry of Housing and Urban-Rural Development (China)
MRV	monitoring, reporting and verification
Mt	million tons
MW	megawatt
NDRC	National Development and Reform Commission (China)
OECD	Organisation for Economic Co-operation and Development
PPP	public–private partnership
RE	renewable energy
SASAC	State-Owned Assets Supervision and Administration Commission (China)
SCM	supplementary cementitious material
SOE	state-owned enterprise
t	ton (All uses of "ton" throughout this report refer to metric tons)
VFM	value for money

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