Brazil Country study

Skills development for the green economy with a focus on decarbonisation of the construction and cement industry

October 2025

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

This country study was conducted by independent external experts. The opinions expressed herein represent the views of the authors and are not necessarily shared by GIZ, its partners, or country representatives.

GIZ country studies in green skills and jobs

This project was commissioned by GIZ in March 2025 to develop in-depth country case studies on skills for a green and just economy in Brazil, Kenya, and Pakistan. Findings are integrated into a flagship document, which will be presented at the COP 30 in Belem, Brazil in November 2025.

Paeradigms

The research was carried out by Paeradigms, an NGO and social enterprise focused on transformational outcomes that lead to social change and economic impact. Paeradigms' work focuses on four thematic areas: (1) Education, (2) Renewable energy & climate change, (3) Gender, diversity & inclusion, (4) Communication & advocacy.

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PÆRADIGMS

Executive summary

This case study, prepared as part of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) contribution to the Global Initiative on Jobs and Skills for the New Economy: An Action Agenda for a Human-Centred Climate Transition, explores a critical link between skills development and climate action in Brazil. It examines how Brazil integrates decarbonisation policies, promoting green jobs and skills development, focusing on the construction sector and the cement sub-sector. The analysis considers key challenges and opportunities that shape a just transition to a low-carbon economy.

Methodology

The analysis uses a mixed-methods approach: Following the initial systematic literature review, priority sectors were selected based on economic significance (Gross Domestic Product (GDP) contribution), workforce size, growth potential, climate vulnerability, green transition priorities, and skills ecosystem maturity, and input from country partners. A desk review and stakeholder interviews were then conducted to identify and assess existing green transition solutions and opportunities within selected sectors. Findings were validated through an in-country workshop with local partners.

Context

Brazil has a complex climate, economic, and social landscape, with both opportunities and challenges. It is a **climate paradox:** On the one hand, the country stands out for its high share of renewables in electricity generation, with 87% coming from hydropower, solar, and wind. On the other hand, when considering overall energy use, fossil fuels still dominate, with oil accounting for 37%, natural gas 9.3%, and coal 4.7% of consumption. This reliance on fossil sources, combined with land-use change – particularly deforestation in the Amazon – and agricultural practices such as livestock farming, places **Brazil among the world's top greenhouse gas (GHG) emitters** (IEA, 2024). Despite these challenges, Brazil maintains one of the cleanest energy mixes globally, with 48% of total energy derived from renewables, compared to a world average of only 14% (MME/EPE, 2024). Yet Brazil's renewable achievements offer little protection against climate impacts, with droughts and floods intensifying, threatening food and water security and deepening inequality (Caretta et al., 2022).

Economically, **Brazil is the largest and most diversified economy in Latin America,** but is constrained by low productivity and dependency on commodities. Inequality remains high, with a Gini index of 0.52 and 27% of the population in poverty (IBGE, 2024), particularly in the Northeast. Social protection programmes, such as **Cash Transfers for Families** *(Bolsa Família),* which provides cash transfers conditional on school attendance and health checkups, and **Emergency Aid** *(Auxílio Emergencial),* which delivered rapid income support to informal workers and unemployed individuals during COVID-19, have been vital. However, structural disparities persist.

Despite these disparities, Brazil is a**ctively integrating green skills strategies** into its climate and transition policies, although implementation varies across initiatives. The government has **revived its climate commitment** through an updated Nationally Determined Contribution (NDC) targeting **carbon neutrality by 2050** and the restoration of the **Amazon Deforestation Prevention and Control Plan** (PPCDAm). **The Ecological Transformation Plan** (PTE) reinforces this momentum with five core strategies that d**irectly link climate action to green job creation.** Box 1 presents several key policy frameworks launched between 2023 and 2025 that explicitly connect climate action with green employment.

Box 1. Policy frameworks

National Strategy for the Dissemination of Building Information Modelling (BIM) in Brazil. Government strategy promoting digital transformation in the construction sector, creating demand for green building skills and sustainable construction practices.

National Energy Transition Plan (PNTE). Policy for Brazil's transition to a low-carbon energy matrix.

National Climate Change Fund (Fundo Clima). Brazilian Development Bank (BNDES)-managed fund supporting renewable energy, mobility, waste, and low-carbon technology projects while generating green employment opportunities.

New Growth Acceleration Programme (Novo PAC). Infrastructure investment programme (BRL 1.7 trillion) supporting sustainable growth and green transition.

Success in Brazil's ecological transition hinges on the availability of skilled labour, making the role of Technical and Vocational Education and Training (TVET) increasingly strategic. Box 2 showcases skills development initiatives across government and the private sector. Brazil's TVET system is **decentralised and diverse,** encompassing federal institutes, state and municipal schools, and the employer-led **System-S** network (Sistema S). While it offers a broad range of programmes and delivery formats – including mobile and distance learning – its reach remains limited relative to the size of the youth population. Only 6.2% of upper secondary students are enrolled in vocational programmes, and access for vulnerable groups is constrained by structural inequalities and high dropout rates. Nevertheless, targeted initiatives such as the **Programme for the Development of Renewable Energy and Energy Efficiency in Federal Education Institutions** (EnergIFE), which promotes energy transition skills, and the National Programme for Access to Technical Education and Employment (PRONATEC), which expands access to formal technical education, are breaking down structural inequalities and creating equitable pathways to green employment for vulnerable groups.

Brazil's 100+ federal institutes and universities must **urgently modernise curricula** to meet the demands of the green economy. Researchers estimate that the country could **generate 7 million green jobs by 2030** (Saget et al., 2020), particularly in renewable energy, agriculture, and construction. This educational transformation becomes essential not only for equipping workers with relevant skills but also for ensuring that the **green transition drives inclusive economic growth** and supports Brazil's climate commitments.

Box 2. Skills development integration

PRONATEC. Ministry of Education initiative expanding free technical training in green sectors, like bioeconomy and renewable energy, to support Brazil's decarbonisation goals.

EnergIFE. A collaborative initiative between enterprises and technology institutes promoting innovation in smart grids, renewable energy, and energy-efficient vehicles through grants and soft loans.

Future Professionals. GIZ and the Ministry of Education initiative implementing green economy TVET courses aligned with climate policies; has trained 10'000+ professionals, including women (58%), Indigenous, and rural workers.

National Service for Industrial Training (SENAI, System S). Technical and vocational training for industrial workers; key partner in green skills development for industry decarbonisation.

Sector analysis

The green transition in Brazil's construction and cement sectors is advancing through policy initiatives, industrial innovation, and job creation. These sectors are strategic due to their high GHG emissions and significant potential for green employment.

Construction

Construction represents 6% of Brazil's GDP (IBGE, 2023) but carries enormous environmental responsibility. Compounded by industrial emissions from cement production (23.5%) and additional emissions from construction-related materials and machinery, it is estimated to contribute approximately 25-30% of Brazil's industrial GHG emissions (SEEG, 2022; World Resources Institute, 2024).

The industry is pivoting towards decarbonisation through **bioclimatic design, low-carbon materials, circular economy approaches, and sustainable infrastructure.** Energy efficiency certification programmes, like the Federal Savings Bank's (Caixa Econômica Federal) sustainable housing label, and sustainable public housing criteria are reshaping industry standards. Investments through **the New Growth Acceleration Programme** (Novo PAC) **and** the **National Bank for Economic and Social Development** (BNDES) are supporting job creation in retrofitting, clean transport, and urban regeneration.

Despite this promising progress, regional disparities persist. The analysis also found that higher illiteracy and inequality in the Amazon reduce green job creation, stressing the importance of **investment in education and regional development.**

The sector faces a critical skills gap: a lack of workers trained in energy retrofitting and solar photovoltaic (PV) systems, perpetuated by outdated curricula with little environmental content. Interviews suggest that the green transition can improve wages, job stability, and safety, although access to skills development remains unequal for informal workers, those in remote areas, and those with low educational levels.

Cement

Brazil's cement industry presents a critical decarbonisation opportunity: although it contributes less than 0.5% of GDP, it generates 23.5% of industrial GHG emissions (SEEG, 2022). The sector is already **using biomass and waste fuels for low-carbon infrastructure,** positioning it to achieve the Cement Industry Roadmap's target of cutting emissions by 33% by 2050 (BNDES, 2024). Priorities include accelerating clinker substitution, carbon capture technologies, and implementing efficiency improvements, measures that will also create substantial green job growth.

Low-carbon technologies in cement may reduce demand for low-skilled labour and raise barriers for untrained workers, **especially in regions with limited educational infrastructure.** Higher cement production costs could lead to increased construction prices and exacerbate inequalities, **unless strategic public procurement policies are implemented to ensure local hiring and adherence to sustainability standards.** Stakeholder interviews indicate that the cement sector, while more technically established, lacks specialists in low-carbon technologies and faces regulatory misalignment issues. The green transition demands both technical and transversal green skills, including life cycle analysis, digital tools, and systems thinking. Addressing these gaps requires updated training programmes that bridge technical and environmental competencies, supported by regulatory frameworks that facilitate the low-carbon transition.

Solutions assessment

Brazil is advancing its green transition through **key national policies that integrate environmental goals with economic and social development.** Four flagship initiatives stand out for aligning climate action with industrial and fiscal reform, with two selected examples presented here to illustrate how integrated policy approaches can simultaneously drive decarbonisation, economic growth, and social inclusion.

Ecological Transformation Plan (PTE). Established to align Brazil's NDC commitments with economic development through green job creation, the plan targets training in key sectors such as sustainable construction, low-impact cement production, and renewable energy, while prioritising the inclusion of vulnerable groups to ensure a just transition (Ministry of Economy, 2023; OECD, 2024).

The plan equips workers across construction, cement, bioeconomy, technology, and circular economy sectors through integrated public-private financing. Funding mechanisms include sustainable sovereign bonds, climate-focused credit lines, a restructured Climate Fund, and a sustainable finance taxonomy. These tools link funding to both environmental benefits and skills development, promoting emissions reduction, green industry growth, and workforce upskilling and reskilling.

Estimates suggest that implementing the plan could boost gross domestic product (GDP) by 6.5% (BRL 1.3 trillion) and create 9.5 million green jobs by 2030, accounting for approximately 9% of Brazil's current workforce. Additional projections include reducing annual carbon dioxide (CO_2) emissions by one gigatonne, increasing tax revenue by BRL 121 billion, and raising the income of the poorest population by over 130% relative to 2020 (Ministry of Finance, 2024). By 2050, the economic impact is projected at BRL 772 billion, with skills development embedded across technology hubs and bioeconomy clusters in sectors affected by the transition, providing a replicable model for integrating green finance, NDC targets, and labour market transformation (Ministry of Finance, 2024; Ministry of Economy, 2023).

New Brazil Industry Plan (NIB) aims to modernise Brazil's industry while achieving environmental outcomes, particularly in high-emission industries such as cement and metallurgy. The plan aims to accelerate "reindustrialisation" through strategic missions directly linked to decarbonisation, digital transformation, and the bioeconomy. This involves cross-sectoral integration and encourages the adoption of cleaner production methods and technologies.

As industries modernise and adopt cleaner technologies, demand for new occupational profiles increases. NIB anticipates this workforce transformation by promoting comprehensive skills development, including initial training, upskilling, and reskilling, as well as creating green jobs across sectors (MDIC, 2025). It also introduces new financial tools designed to attract private capital into green sectors, including the development of credit lines and a regulated carbon market to support the transition to a low-carbon economy.

Implementation results demonstrate significant impact: NIB has mobilised BRL 472.7 billion across more than 168'000 projects, transforming regional potential into engines of sustainable development and job creation. This integrated approach – combining cross-sectoral modernisation, workforce development, and green finance – provides a scalable model for industrial transformation that simultaneously addresses climate goals and economic competitiveness.

Brazil Building Information Modelling Strategy (BIM). Reducing the environmental footprint of construction projects while improving productivity and sustainability is a critical challenge for Brazil's construction sector. BIM is a digital construction technology that promotes sustainable building practices and energy efficiency by integrating data across the entire building lifecycle, enabling more efficient planning, reduced waste, and lower emissions. However, the sector's green transition is hindered by a shortage of professionals with the necessary digital and technical skills.

To address this, the Brazilian government launched the National Strategy for the Dissemination of BIM. This policy promotes digitalisation and sustainability by mandating BIM in public procurement, developing standards and platforms, and offering free training via the "Democratise BIM" programme. Over 14'000 professionals have already participated, although clearer targets would strengthen monitoring and evaluation. Implementation relies on coordinated efforts among federal ministries and agencies, supported by public funding for research, training, and innovation. Technical committees

and digital platforms ensure policy coherence. Distance learning expands access, especially in underserved regions, making the strategy scalable and inclusive. BIM's integration into public works positions Brazil to lead in sustainable construction and digital transformation.

Women in Construction (Marias na Construção). Advancing gender equity in Brazil's construction sector while equipping the workforce with green technical skills is a dual challenge, especially as the sector undergoes transformation driven by sustainability and low-carbon infrastructure demands. Women remain underrepresented in construction, and those in vulnerable situations face additional barriers to employment and training.

The Women in Construction programme was launched in Salvador in 2019 to address this challenge. It is a regional initiative led by the Municipal Secretariat for Policies for Women, Children and Youth (SPMJ), in partnership with the National Service for Industrial Training (SENAI) Bahia. It offers free vocational training to socially vulnerable women, including survivors of violence, with courses in sustainable construction trades such as photovoltaic system installation. The programme promotes financial independence and inclusion in strategic sectors of the green economy.

Implementation involves coordinated efforts among municipal bodies, skills providers, and industry partners. SENAI delivers courses in underserved areas, while the Civil Defence Authority (CODESAL) and the Brazilian Micro and Small Business Support Service (SEBRAE) Bahia provide safety training and self-employment guidance. Municipal funding supports operations, and public procurement policies reserve 5% of construction jobs for women. Recognised internationally, the programme's scalable model links gender equity, technical training, and green workforce development.

Recommendations

Stakeholders involved in implementing all recommendations include policymakers, industry – both public and private enterprises – and skills providers.

General recommendations

1 **Develop a national green skills strategy.** Address Brazil's fragmented approach to green skills development. Current siloed policies create training gaps across green economy sectors, limiting coordinated competency development and regional equity. A comprehensive strategy would mobilise strategic stakeholders, align private sector skills development with job creation, integrate green skills into existing policies, and establish sustainable funding mechanisms.

2 **Introduce a green jobs indicator** within the Brazilian Occupation Classification (CBO). Integrate green job classification tags into the existing CBO framework, using ILO and O*NET standards, to distinguish between green jobs and conventional jobs. This would enable the systematic tracking of workforce transitions towards environmental objectives, providing essential data infrastructure for evidence-based policymaking and targeted resource allocation during the green economic transition.

3 **Mainstream green jobs into the Novo PAC and My House My Life Programmes.** Brazil's significant infrastructure investments through these programmes currently underutilise green skills opportunities and lack alignment with NDC climate commitments. Implementing mandatory green job quotas for programme contractors, with defined green job criteria and realistic percentage targets, would mobilise industry transformation while leveraging existing public investment.

Sector-specific recommendations

Construction

4 **Establish green procurement mandates** with regional oversight. Implement certification requirements for specific construction roles on public infrastructure projects. Establish minimum thresholds for certified workers, link certification compliance to contract eligibility and financing schemes, and make green skills certification a prerequisite for professional licensing. This mobilises enterprises to support worker certification and incentivises workers to obtain qualifications.

5 **Develop green construction certification programmes** to support procurement mandates. Create technical consortia to develop and institutionalise comprehensive green construction certification programmes to operationalise procurement mandates. Design three-year renewable certification programmes tied to procurement requirements, partner with TVET institutions for delivery, and create flexible pathways for informal workers through modular training and skills-based assessment.

Cement

6 **Expand access to green upskilling for informal workers** in Brazil's cement sector. Brazil's cement sector faces high levels of informality and structural exclusion in economically deprived areas, limiting access to green skills. Deploy SENAI mobile training units to deliver targeted green construction skills training directly to communities. Identify target regions, mobilise financing, coordinate local stakeholder engagement, and monitor outcomes to scale effective models nationwide.

7 **Establish a Green Regional Development Investment Fund.** Current regional development policies underutilise green jobs and skills despite their potential to address socio-economic disparities. Create a dedicated financing mechanism that repositions green investments as viable alternatives to traditional approaches, with a focus on job creation and income opportunities. Implement pilots in Bahia/Northeast, São Paulo, and Minas Gerais, leveraging existing institutional frameworks and expertise.

Conclusion

Brazil's green transition presents significant opportunities to achieve climate commitments while addressing persistent regional economic disparities. The construction and cement sectors offer substantial potential for decarbonisation and inclusive job creation, but success depends on recognising skills as both socio-economic tools and strategic economic assets that drive productivity, innovation, and competitiveness in emerging green sectors. Implementing comprehensive green skills strategies, establishing certification frameworks, and creating targeted financing mechanisms can transform these sectors into drivers of sustainable growth while benefitting underserved communities.

However, key gaps persist in integrating green skills into education strategies, inconsistent data systems, and limited sustainability training for educators. Therefore, it is important to coordinate action between employers, trade unions, and skills providers through procurement mandates, regional investment funds, and inclusive training programmes. Brazil can achieve its NDC targets while reducing economic disparities and creating quality employment opportunities across all regions through socially equitable and economically resilient green transition policies.

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Abbreviations

Acronym	English and Portuguese Name
ABC	Low-Carbon Agriculture Programme *Programa Agricultura de Baixo Carbono*
ABDI	Brazilian Agency for Industrial Development (ABDI) *Agência Brasileira de Desenvolvimento Industrial*
Amazon Fund	Amazon Fund *Fundo Amazônia*
ANEEL	Brazilian Electricity Regulatory Agency *Agência Nacional de Energia Elétrica*
AQUA	High Environmental Quality *Certificação AQUA (Alta Qualidade Ambiental)*
BIM	Building Information Modelling *Building Information Modelling no Brasil*
BIP	Brazil Climate and Ecological Transformation Investment Platform *Plataforma Brasil de Investimentos Climáticos e para a Transformação Ecológica*
BNDES	Brazilian Development Bank *Banco Nacional de Desenvolvimento Econômico e Social*
CBIC	Brazilian Chamber of the Construction Industry *Câmara Brasileira da Indústria da Construção*
CBO	Brazilian Occupation Classification *Classificação Brasileira de Ocupações*
CCS	Carbon Capture and Storage
CECarbon	Energy Consumption and Carbon Emissions Calculator for Buildings *Calculadora de consumo energético e emissões de carbono para edificações*
CNDI	National Industrial Development Council (CNDI) *Conselho Nacional de Desenvolvimento Industrial*
Cofiex	External Financing Commission *Comissão de Financiamento Externo*
ENAP	National School of Public Administration (ENAP) *Escola Nacional de Administração Pública*
ENEC	National Circular Economy Plan *Estratégia Nacional de Economia Circular*
EnergIFE	Programme for the Development of Renewable Energy and Energy Efficiency in Federal Education Institutions *Programa para Desenvolvimento em Energias Renováveis e Eficiência* Energética nas *Instituições Federais de Educação*

EPE	Energy Research Company *Empresa de Pesquisa Energética*
Estratégia BIM BR	National Strategy for the Dissemination of BIM in Brazil *Estratégia Nacional para Disseminação do BIM no Brasil*
Finep	Funding Authority for Studies and Projects *Financiadora de Estudos e Projetos*
Fundo Clima	National Climate Change Fund *Fundo Nacional sobre Mudança do Clima*
Future Professionals	Future Professionals for the Green Economy (GIZ Project) *Profissionais do Futuro para a Economia Verde (Projeto GIZ)*
GHG	Greenhouse gases *Gases de Efeito Estufa*
GIZ	German Agency for International Cooperation *German Deutsche Gesellschaft für Internationale Zusammenarbeit*
GND-BR	Green New Deal Brazil
IBGE	Brazilian Institute of Geography and Statistics *Instituto Brasileiro de Geografia e Estatística*
IDB	Inter-American Development Bank *Banco Interamericano de Desenvolvimento*
IEA	International Energy Agency *Agência Internacional de Energia*
IFC	International Finance Corporation *Corporação Financeira Internacional*
ILO	International Labour Organisation *Organização Internacional do Trabalho*
IMF	International Monetary Fund
INEP	National Institute for Educational Studies and Research *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*
IPCC	Intergovernmental Panel on Climate Change *Painel Intergovernamental sobre Mudanças Climáticas*
KII	Key informant interview
LEED	Leadership in Energy and Environmental Design *Liderança em Energia e Design Ambiental*
MDIC	Ministry of Development, Industry, Trade and Services *Ministério do Desenvolvimento, Indústria, Comércio e Serviços*
MEC	Ministry of Education *Ministério da Educação*
MME	Ministry of Mines and Energy *Ministério de Minas e Energia*
MTE	Ministry of Labour and Employment *Ministério do Trabalho e Emprego*

NDC	Nationally Determined Contributions *Contribuições Nacionalmente Determinadas*
NIB	New Brazil Industry Plan *Nova Indústria Brasil*
Novo PAC	New Growth Acceleration Program *Novo Programa de Aceleração do Crescimento*
OECD	Organisation for Economic Co-operation and Development
PBE Edifica	PBE Edifica *Programa Brasileiro de Etiqueta de Eficiência Energética – Edifica*
Plano Mais Inovação	More Innovation Plan
PNDBio	National Bioeconomy Development Plan *Plano Nacional de Desenvolvimento da Bioeconomia*
PNMC	National Climate Change Plan (known as Plano Clima) *Plano Nacional sobre Mudança do Clima*
PNTE	National Energy Transition Plan *Plano Nacional de Transição Energética*
PPCDAm	Amazon Deforestation Prevention and Control Plan *Plano de Prevenção e Controle do Desmatamento na Amazônia*
Procel	National Program of Electricity Conservation – Procel *Programa Nacional de Conservação de Energia Elétrica – Procel*
Pronatec	National Programme for Access to Technical Education and Employment *Programa Nacional de Acesso ao Ensino Técnico e Emprego*
ProNEA	National Environmental Education Programme *Programa Nacional de Educação Ambiental*
PTE	Ecological Transformation Plan *Plano de Transformação Ecológica*
SEBRAE	Brazilian Micro and Small Business Support Service *Serviço Brasileiro de Apoio às Micro e Pequenas Empresas*
SENAC	National Service for Commercial Training *Serviço Nacional de Aprendizagem Comercial*
SENAI	National Service for Industrial Training *Serviço Nacional de Aprendizagem Industrial*
SENAR	National Rural Learning Service *Serviço Nacional de Aprendizagem Rural*
SESCOOP	National Service for Cooperative Learning *Serviço Nacional de Aprendizagem do Cooperativismo*
SESI	Industry Social Service *Serviço Social da Indústria*
SEST-SENAT	Social Transport Service and National Transport Learning Service *Serviço Social do Transporte e Serviço Nacional de Aprendizagem do Transporte*

SETEC	Secretariat of Professional and Technological Education *Secretaria de Educação Profissional e Tecnológica*
SIMM	Municipal Labour Mediation Service *Serviço Municipal de Intermediação de Mão de Obra*
SNIC	National Cement Industry Union *Sindicato Nacional da Indústria do Cimento*
SPMJ	Municipal Secretariat for Policies for Women, Children and Youth *Secretaria de Políticas para Mulheres, Infância e Juventude*
TVET	Technical and Vocational Education and Training *Educação e Formação Técnica e Profissional*
UFRJ	Federal University of Rio de Janeiro *Universidade Federal do Rio de Janeiro*
UNESCO	United Nations Educational, Scientific and Cultural Organization *Organização das Nações Unidas para a Educação, a Ciência e a Cultura*
UNFCCC	United Nations Framework Convention on Climate Change *Convenção-Quadro das Nações Unidas sobre Mudança do Clima*
UNICA	Brazilian Sugarcane Industry Association *União da Indústria de Cana-de-Açúcar*

01

Introduction

- Purpose of the study and structure of the document
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1 Introduction

The accelerating impacts of climate change and the urgent need to shift towards low-carbon development models are the primary drivers of the global transition to green jobs and green skills (ILO, 2018; Young et al., 2019; Saget, Vogt-Schilb, Luu, 2020). This shift reflects growing recognition that climate action must be integrated into economic and social policies to achieve sustainable development. Such integration is not only an environmental imperative but also economically and socially strategic.

In countries like Brazil, the transition to a green economy presents an opportunity to meet climate targets while simultaneously addressing persistent socioeconomic inequalities, informal labour markets, and limited access to quality jobs. Achieving this requires a comprehensive approach that ensures the economic transformation is socially inclusive and equitable, equipping workers with skills for emerging clean technology sectors and providing reskilling and upskilling opportunities for those in traditional industries, leaving no one behind. The related key concepts and definitions used in the case study are outlined in the **Green skills terminology** insert, which follows this chapter.

Green jobs, as defined by the International Labour Organisation (ILO), are those that contribute to environmental preservation or restoration while promoting decent work and inclusive growth (ILO, Navigating the Future: Skills and Jobs in the Green and Digital Transitions – Scenario-based insights., 2024). The value of this transition in terms of green job creation is considerable. Global estimates by the ILO suggest a net gain of approximately 37 million green jobs by 2030 (ILO, 2024). In Latin America and the Caribbean, this transformation could result in a net increase of 15 million jobs, with Brazil expected to contribute approximately 5.5 million of these (Saget, Vogt-Schilb, Luu, 2020). Key sectors driving this growth include agriculture, renewable energies, transport, and civil construction. In particular, the civil construction sector stands out due to its labour-intensive nature and its central role in sustainable infrastructure development. This underscores the potential of the green economy not only to reduce emissions but also to serve as a major engine of inclusive employment opportunities, particularly when supported by targeted policies, skills development offers, and investment in green technologies and practices.

Despite these opportunities, the green transition presents challenges, particularly the risk of displacement in high-emission industries. Estimates by the ILO and the Inter-American Development Bank (IDB) suggest that 22.5 million new positions could be generated in Latin America by 2030 across sustainable agriculture, renewable energy, clean manufacturing, and civil construction. However, approximately 7.5 million occupations are expected to be lost, namely from polluting fossil-fuel extraction and livestock farming (ILO, 2020). These dynamics underscore the importance of planning for an inclusive economic transformation, ensuring that workers in carbon-intensive industries receive reskilling, social protection measures, and pathways into emerging green economies.

Green skills are globally recognised as essential for enabling the shift to environmentally sustainable economies, serving as the foundation to align labour markets with climate and development goals. These skills encompass a broad range of competencies necessary for both new green occupations and for greening existing jobs. Technical expertise includes specialised knowledge in areas such as renewable energy, sustainable construction techniques, and emissions monitoring. Equally important are transversal skills such as collaboration, critical thinking, problem-solving, resilience, and adaptability, which are vital across all sectors. Additionally, transformative capabilities including systems thinking, coalition building, and valuing Indigenous knowledge are necessary to drive systemic change during economic transformation. As outlined in international frameworks, such as ILO's Guidelines for a Just Transition and the UNESCO-ILO definition of green skills under the Sustainable Development Goals (SDG 4.4 and SDG 8), this diverse competency set facilitates the implementation of sustainability across educational and economic domains, ensuring that individuals and institutions can address complex environmental challenges and meaningfully contribute to the environmental, economic, and social dimensions of a climate-resilient society.

Brazil exemplifies both the challenges and opportunities of a just transformation. As one of the world's largest greenhouse gas emitters, primarily due to deforestation and land-use change, the country faces urgent decarbonisation imperatives alongside persistent socioeconomic and regional disparities. At the same time, Brazil possesses significant advantages, including a diversified economy and an energy mix in which renewable sources account for nearly half. This context makes the environmental transition particularly strategic, offering pathways to align climate goals with inclusive economic development and poverty reduction.
The civil construction and cement sectors serve as critical examples. These sectors are both major sources of emissions and important drivers of green job potential. The construction sector, which employs around 2.5 million workers, demonstrates these dual dynamics: high levels of informality and emission intensity, alongside substantial potential for sustainable job creation due to its labour-intensive nature and role in infrastructure development. Similarly, the cement sector plays a strategic role in decarbonisation and innovation, employing nearly 17'700 workers while increasingly adopting practices such as waste co-processing and clinker substitution (ILO, 2018).

The Brazilian government has responded to these interconnected challenges and opportunities with ambitious climate targets, industrial sustainability strategies, and efforts to modernise key sectors such as construction and cement. Commitments include reducing greenhouse gas emissions by 59-67% by 2035 and achieving carbon neutrality by 2050, with initiatives like the Ecological Transformation Plan (Plano de Transformação Ecológica – PTE) aligning climate action with job creation and skills development (SECOM, 2024). Success in these areas requires addressing structural challenges through targeted training programmes and inclusive policy frameworks that can unlock sustainable economic growth.

1.1 Purpose of the study and structure of the document

This case study focuses on the intersection of green jobs, green skills development, and climate action in Brazil, with a specific emphasis on the construction and cement sectors. The construction sector is traditionally a major generator of employment and a significant consumer of natural resources, while cement production, which is a fundamental input for construction, accounts for a considerable portion of global industrial CO_2 emissions. Advancing sustainability in these sectors is therefore a strategic priority. Not only does this support Brazil's climate commitments but it also creates opportunities for inclusive green job growth through sustainable construction practices, energy efficiency, and low-carbon technologies.

The structure of this report begins with a contextual overview of Brazil's economy and climate challenges, policy frameworks and the Technical and Vocational Education and Training (Educação e Formação Técnica e Profissional, TVET) system, followed by a detailed sectoral analysis of the construction and cement industries. It then presents a solutions-oriented assessment. The report concludes with a set of recommendations aimed at policymakers and at the construction and cement industries, providing potential strategies and interventions for a green transformation.

1.2 Methodology

This study employed a mixed-methods approach to provide comprehensive insights into the green transition context, identifying opportunities and risks that could potentially arise from the transition. The research design was structured around four sequential phases, each building on the findings of the previous phase, prioritising stakeholder engagement and knowledge co-creation. This approach aims to make the research findings relevant, actionable, and aligned with the practical needs and experiences of sector practitioners, researchers, policymakers, and training institutions.

1.2.1 Research questions

The key research questions include the following:

01

How can Brazil align climate action with employment generation and skills development in high-emission sectors?

02

What are the main challenges and opportunities in fostering a just and inclusive transition in the construction and cement industries?

03

What policy, educational, and financial frameworks are necessary to support the growth of green jobs and ensure workforce readiness for low-carbon development?

1.2.2 Systematic Literature Review

A comprehensive systematic literature review (SLR) was conducted following established PRISMA protocols to establish an evidence base on green skills and green jobs globally and within national contexts. The SLR utilised Web of Science as the primary repository due to its comprehensive coverage of high-impact, peer-reviewed journals across multiple disciplines. The SLR method helped determine relevant research areas, understand applied methodologies, review key findings from extant literature, and detect knowledge gaps, offering a comprehensive overview of the landscape. The results informed the decision on which sectors to examine in-depth for each country.

1.2.3 Desk review

The desk review examined the selected sectors in the country context, further searching for relevant studies and reports in the country context, including academic and grey literature to capture theoretical frameworks and practical implementation experiences related to the topic in the national context. Policy documents including Nationally Determined Contributions, national development plans, climate change policies and initiatives, education and TVET strategies, and sectoral implementation plans were analysed.

1.2.4 Stakeholder interviews

Key informant interviews (KIIs) were conducted with relevant stakeholders to gather in-depth, sector-specific insights on green skills requirements, current capacity, and development needs from practitioners and experts directly involved in the selected sectors. These interviews aimed to gather insights into current and needed public policies, training initiatives, technological and socioeconomic challenges in decarbonisation, and strategies to ensure a just transition. The stakeholder consultations encompassed a range of participants including skills providers, research institutes, civil society organisations and trade associations, private sector representatives (e.g. enterprises or employer organisations in the sector), government regulators, national and local government officials, and intermediary/ intergovernmental organisations as shown in Table 1.

Table 1. Different types of stakeholders covered in key informant interviews

Number of participants	Percentage	Stakeholder group
5	24%	Skills provider
2	10%	Research Institute
2	10%	CSO/ Trade association
3	14%	Private Sector
8	38%	National Government
1	5%	Intermediary/ Intergovernmental Organisation
21		**Persons interviewed**

Data gained from the KIIs was analysed using thematic analysis, employing a hybrid approach combining deductive codes derived from the literature review framework and inductive codes emerging from interview data.

1.2.5 Country validation workshops

The main findings and associated recommendations were corroborated through a validation workshop held in June 2025 with relevant stakeholders covered during the KIIs. The workshop aimed to present preliminary findings, gather feedback, and refine recommendations to ensure their relevance, feasibility, and acceptability to key implementation actors within the selected sectors.

1.3 Limitations of the study

This study acknowledges several methodological, data, and analytical limitations. The availability of up-to-date and sector-specific data on green jobs remains limited, as standardised definitions and classifications of green jobs and green skills vary across sources and contexts. Some findings are based on stakeholder perceptions and experiences from interviews, and some key stakeholders were unavailable during data collection timelines, thus the full range of stakeholder perspectives across the country may not be comprehensively reflected, which may limit the generalisation of findings. The dynamic context of green skills landscapes, which are evolving quickly, affects the temporal relevance of findings. Additionally, the sectoral focus may limit generalisability to other key sectors of the economy, and time constraints led to a rapid assessment approach which may have limited depth in some analytical areas. These limitations do not compromise the overall validity of the research but highlight the need to interpret conclusions in light of the qualitative nature of much of the evidence and current constraints in data availability.

Green terminology

Despite variations in terminology and emphasis across international frameworks, there is growing consensus on the need to align economic development with environmental sustainability and social justice. Green skills are a foundational element in this alignment, serving as a bridge between policy aspirations and practical implementation across labour markets and education systems (Figure 1).

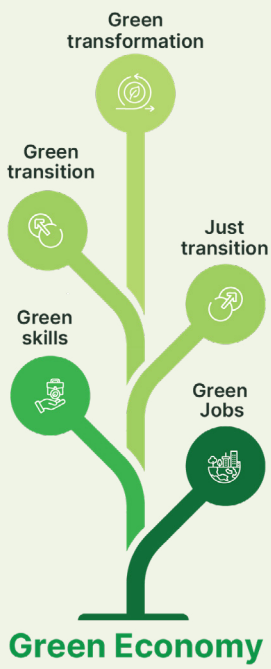


Figure 1. Green terminology
Source: Paeradigms, 2025

The global shift towards sustainability has placed increasing emphasis on the development of green skills – the knowledge, skills, values and attitudes needed to live in, develop, and support a sustainable and resource-efficient society (UNIDO, 2022). These competencies are essential for enabling individuals and institutions to navigate the green transition – the ongoing process of moving towards environmentally sustainable practices, technologies and policies across all sectors (GIZ, 2022).

The green transition drives a broader green transformation – a comprehensive systemic reconfiguration of economic, social, and political systems to achieve environmental sustainability while maintaining economic viability and social inclusion. This transformation is underpinned by the concept of a just transition, which refers to greening the economy in a way that is fair and inclusive, creating decent work opportunities, and ensuring that no one is left behind (ILO, 2024). It involves maximising the social and economic opportunities of climate action while minimising and carefully managing any challenges, engaging in social dialogue with those concerned, and respecting fundamental rights and labour principles. This approach recognises the need to balance environmental goals with social equity, ensuring that no group is disproportionately affected by the transition (Figure 2).

Figure 2. The just transition
Source• Paeradigms, 2024

Green jobs[1] – defined as decent jobs that contribute to preserving or restoring the environment – are central to this process. These jobs may be found in traditional sectors such as manufacturing and construction, or in emerging sectors such as renewable energy and energy efficiency (ILO, 2019). However, the emergence and transformation of such jobs require a workforce equipped with a broad spectrum of skills (ILO, 2021). Underpinned by personal values and attitudes – how a person responds to external situations – these skills encompass (Figure 3):

Technical skills: sector-specific skills

Skills for greening existing jobs: Technical skills for greening existing jobs to meet sustainability goals and changing labour-market needs.

Skills for new green jobs: Technical skills emerging from new occupational profiles in the green transformation.

Transversal skills

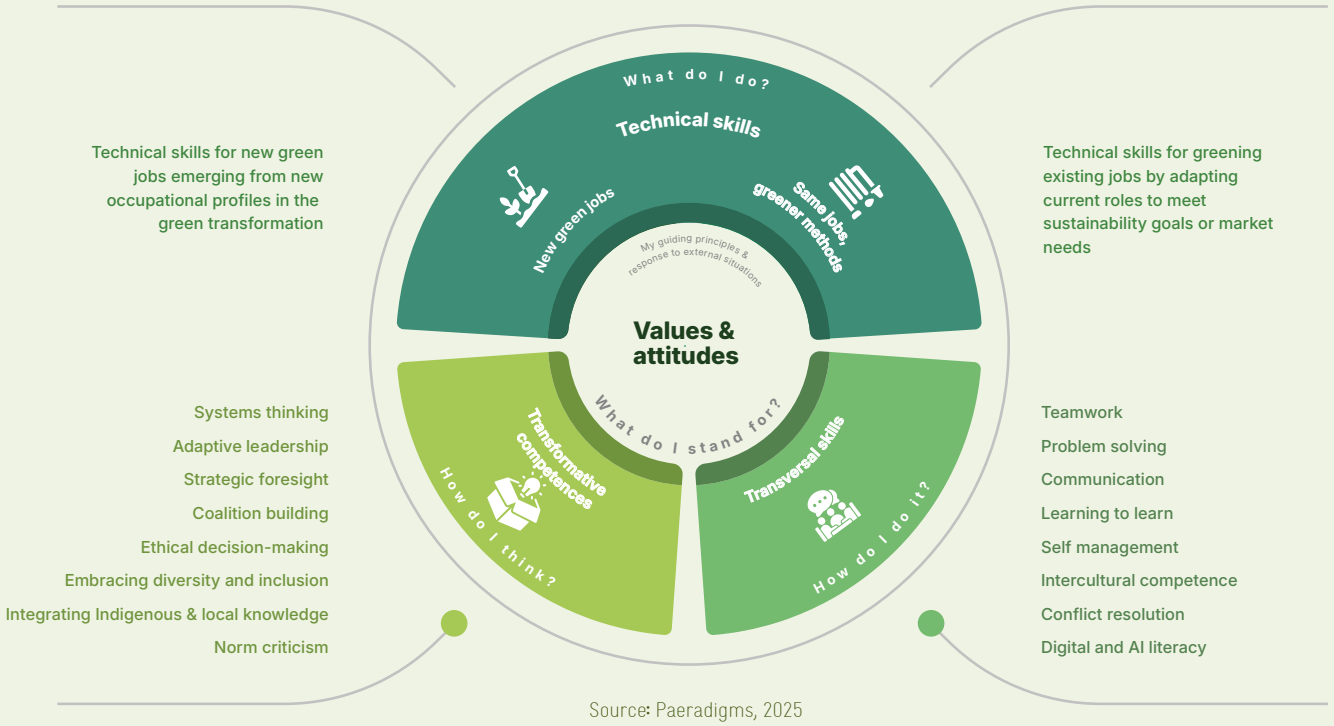
Generic green skills: transversal competencies ("core" skills) such as collaboration, critical thinking and resilience needed for green jobs

Transformative skill

competencies that enable systemic social and economic change, including disruptive thinking, political agency and valuing indigenous knowledge.

[1] For the full ILO definition of green jobs, see https://www.ilo.org/topics-and-sectors/just-transition-towards-environmentally-sustainable-economies-and-societies/what-green-job

Figure 3. Green skills typologies



Source: Paeradigms, 2025

Education and training systems play a pivotal role in embedding these skills. A holistic and interdisciplinary approach is required, integrating sustainability into curricula, pedagogy, research and institutional strategies. This includes fostering learner-centred, action-oriented education that prepares individuals to address complex environmental challenges and contribute to a sustainable and just society.

The effect on the labour market can be described as a combination of three elements as shown in Figure 4. Transforming existing jobs into "green" jobs would likely account for most of the transition, with workers in this category needing to "upskill" or acquire the technical skills necessary for adapting existing occupational profiles to match changing labour-market needs. Some new occupational profiles will emerge, and a few "unsustainable" jobs will cease to exist.
According to this model, workers holding these jobs would be reskilled into either new green jobs, or jobs that have become "greener".

Figure 4. Green transition impact on the labour market

Source: Paeradigms, 2025

Deutsche Gesellschaft für Internationale Zusammenarbeit. (2022). Green transformation. https://www.giz.de/en/downloads/giz2022-en-green-transformation.pdf
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02

Country context

- Climate, economic trends and socioeconomic status
- Key policy frameworks
- TVET system

2 Country context

2.1 Climate, economic trends and socio-economic status

Brazil presents a complex interplay of climate, economic, and social dimensions. From a climate perspective, the country is home to globally important biomes with exceptional biodiversity, notably the Amazon, which plays a crucial role in regulating the global climate (IEA, 2024). Yet, despite this natural capital, Brazil ranks among the world's top greenhouse gas emitters, primarily due to land-use change – especially deforestation in the Cerrado and Amazon, which together accounted for nearly 89% of the deforested area in 2024 (MapBiomas, 2024) – and agricultural practices such as livestock farming. Emissions are thus concentrated in harder-to-decarbonise sectors, such as land use and transport, underscoring the unique nature of Brazil's emissions profile.

This land-use dynamic is particularly relevant to sectors like construction and cement, which are indirectly affected by infrastructure expansion, though this connection is often not made explicit in broader climate discussions.The cement industry operates at a lower carbon intensity in comparison to the global average – 579 kg of CO_2 per tonne, compared to 634 kg worldwide – and, per capita, cement consumption is relatively modest (260 kg per person annually versus 553 kg globally). However, Brazil faces a substantial housing deficit, significant infrastructure demands, and population growth, which are likely to drive a substantial increase in cement production in the coming decades. Projections suggest potential growth of 60% to 120% in cement demand by 2050 depending on low- or high-growth scenarios relative to 2014 levels (ROADMAP, 2019). These developments point to the need for sustainable innovation in construction and materials, alongside inclusive workforce development strategies.

Brazil also faces a contradiction between its achievements in renewable energy generation and its continued reliance on fossil fuels. It is recognised as a global leader in renewable electricity, with approximately 87% of its power supply generated from renewable sources, primarily hydropower, solar, and wind. However, electricity represents only a portion of Brazil's total energy consumption. When considering the entire energy matrix, fossil fuels still account for a significant share, with oil and derivatives representing 37%, natural gas 9.3%, and coal 4.7% (MME/EPE, 2024). Despite this reliance, Brazil maintains one of the cleanest energy matrices worldwide, with around 48% of its total energy coming from renewables – far above the global average of just 14%.

The impacts of climate change are already being felt across the country. According to the Intergovernmental Panel on Climate Change (IPCC), Brazil is experiencing increasing weather variability, with severe droughts and floods becoming more frequent.

These events undermine water and food security and exacerbate existing social vulnerabilities, as poor and marginalised populations are disproportionately affected and have fewer adaptive capacities (Caretta et al., s.d.). As one interviewee notes:

The most concerning climate risks for Brazil are extreme heatwaves, droughts, and floods, which disproportionately impact populations such as low-income communities, Indigenous peoples, and agricultural workers.

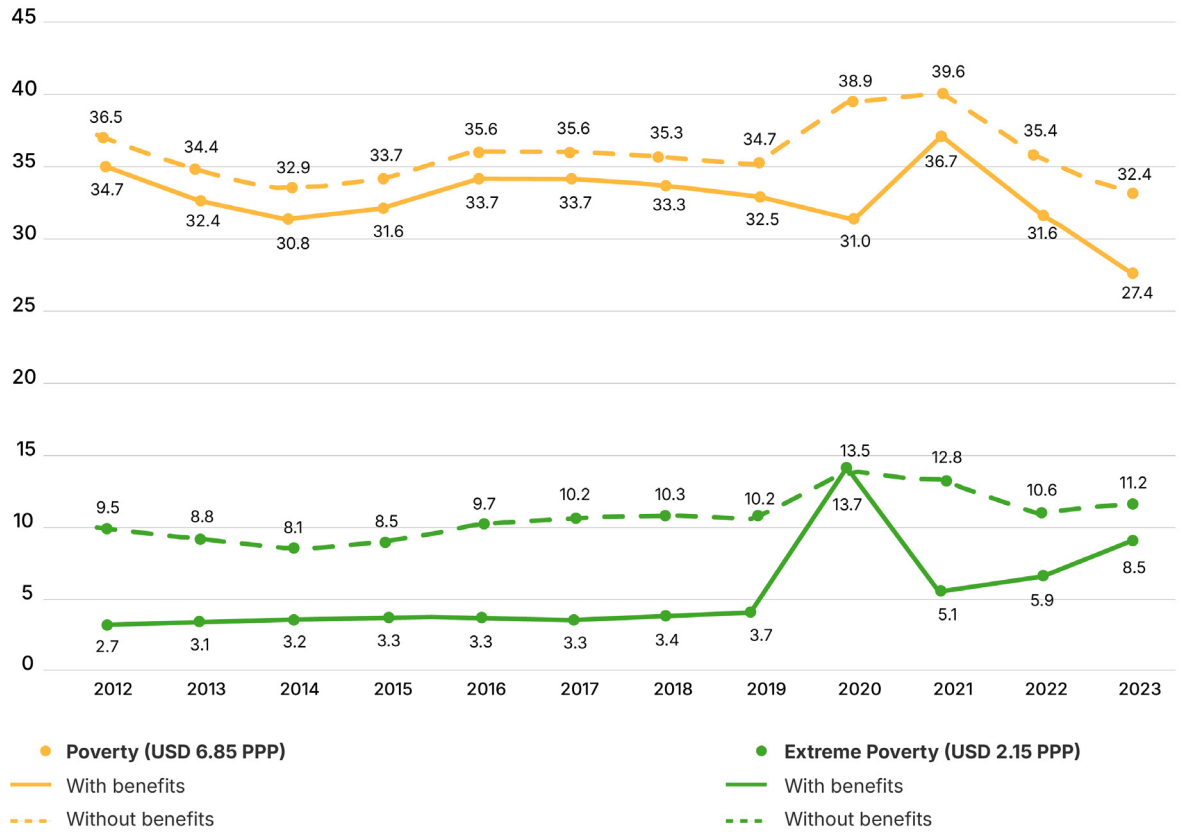
(KII – National Government, 2025)

This reinforces that adaptation policies must integrate social equity to avoid widening existing inequalities.

Economically, Brazil is Latin America's largest and most diversified economy, with significant contributions from agriculture, industry, and services. This diversity positions the country strategically to advance green industrialisation and regional climate resilience. Following a decade of inclusive growth in the 2000s, Brazil entered a period of economic stagnation in the 2010s, aggravated by the COVID-19 pandemic. While the country has shown signs of recovery, the pace has been moderate, revealing structural weaknesses such as low productivity, fiscal constraints, and a continued dependence on commodity exports.

On the social front, Brazil remains one of the world's most unequal countries. The Gini index has stayed static at around 0.52 in recent years (0 represents maximum equality, 1 maximum inequality), reflecting persistent income disparities (IBGE, 2024). Despite this inequality, poverty fell in 2023 to its lowest level since 2012, largely due to cash transfer policies (Figure 5). Programmes such as Cash Transfers for Families (Bolsa Família) and Emergency Aid played a decisive role in reducing poverty and extreme poverty, particularly in the wake of the COVID-19 crisis. The gap between poverty rates "with" and "without" benefits highlights how social protection measures can offset structural inequality by cushioning vulnerable populations from economic shocks.

Figure 5. Evolution of poverty and extreme poverty in Brazil (2012-2023)



Notes
PPP: Purchasing Power Parity – an international method of comparing income levels by adjusting for differences in cost of living and inflation across countries.
Benefits from social programmes include: **Cash transfers for families** *(Bolsa Família)*, **Continuous welfare benefit** *(Benefício de Prestação Continuada – BPC)*, **Emergency aid** *(Auxílio Emergencial)*, and other government social programmes.

Source: IBGE, Síntese de Indicadores Sociais, 2023.

Inequality in Brazil also has strong regional and demographic dimensions. The Northeast region alone accounts for nearly 50% of the country's poor, while wealthier regions such as the South and Centre-West have less than 10% (IBGE, 2020). Racial and gender-based inequalities persist, particularly in access to education, healthcare, and formal employment. These disparities complicate the implementation of an inclusive green transition, as not all segments of society are equally positioned to benefit from new economic opportunities. Therefore, aligning social protection with green development strategies will be essential to achieving a just transition.

2.2 Key policy frameworks

Between 2023 and 2025 under the third government of president Luíz Inácio Lula da Silva, Brazil launched a comprehensive set of policies and strategies that aim to promote a just and inclusive transition toward a green economy. These initiatives span climate change mitigation and adaptation, industrial and energy transformation, social inclusion, and skills development. Figure 6 outlines Brazil's policies related to the climate, followed by an overview of key frameworks, grouped by policy type.

Figure 6. Brazil's key policy frameworks for climate action

Source: Paeradigms, 2025

2.2.1 Overarching policies

- **New Growth Acceleration Programme (Novo Programa de Aceleração do Crescimento – Novo PAC):** The Novo PAC integrates various policy initiatives aimed at achieving interconnected goals on sustainability. It mobilises approximately BRL 1.7 trillion in investments across all Brazilian states, with a focus on infrastructure, job creation, and economic growth. Beyond physical projects, the programme includes five key institutional reform areas: (i) Regulatory Environment and Environmental Licensing; (ii) Credit Expansion and Economic Incentives; (iii) Concession Mechanisms and Public-Private Partnerships (PPPs); (iv) Alignment with the PTE; and (v) Public Planning, Management, and Procurement.
- **Ecological Transformation Plan (Plano de Transformação Ecológica – PTE):** A cross-cutting strategic policy initiative that articulates sustainable and technological development goals across key sectors-industry, agriculture, energy, finance, and society. The plan envisions a fairer, more inclusive economy through better jobs and income distribution, and aligns closely with industrial policy, green finance, and climate action.

2.2.2 Climate change policies and strategies

- **National Climate Change Plan 2025-2035** (Plano Nacional para Mudanças Climáticas – PNMC or Plano Clima): Established in September 2023, the Climate Plan guides Brazil's response to climate change based on two main pillars: (i) mitigation, aimed at reducing greenhouse gas emissions; and (ii) adaptation, focused on strengthening the resilience of natural and human systems. The plan comprises a National Adaptation Strategy, which includes 16 sectoral plans, and a National Mitigation Strategy, encompassing 7 sectoral plans. Additionally, it integrates a Cross-Cutting Strategy addressing (i) Just Transition, (ii) Socio-environmental Impacts, (iii) Means of Implementation, (iv) Education, Training, Research, Development and Innovation, and (v) Monitoring, Management, Evaluation and Transparency. The formulation of all strategies and sectoral plans is guided by participatory processes, reinforcing a commitment to inclusive governance.

- **Nationally Determined Contributions** (Contribuição Nacionalmente Determinada – NDCs): As part of its international commitments, Brazil updated its NDCs in November 2024, pledging to reduce greenhouse gas emissions to 59% from 67% by 2035 (compared to 2005 levels) and to achieve carbon neutrality by 2050. This target consolidates the country's institutional transition towards a low-carbon economy.

2.2.3 Economic and sectoral policies and strategies

- **National Energy Transition Policy** (Política Nacional de Transição Energética – PNTE): Launched to coordinate Brazil's transition to a clean energy economy and mobilise BRL 2 trillion in investment. The PNTE promotes alignment with the PNMC and the PTE. It focuses on: (i) Renewable energy expansion, (ii) Green hydrogen development, (iii) Transport electrification, (iv) Industrial decarbonisation, and (v) Job creation and social inclusion through a just transition.

- **PNTE Operational Roadmap** (Plante Política Nacional de Transição Energética – Plante): The long-term operational arm of the PNTE, designed to guide stakeholders – both public and private – toward a low-carbon energy matrix. The plan is still under development and doesn't yet have concrete pathways to achieve net-zero emissions and energy sustainability.

- **New Brazil Industry Plan** (Nova Indústria Brasil – NIB): A new industrial policy aimed at boosting national development up to 2033 as well as stimulating productive and technological development through financing long-term sustainability and innovation projects. The plan's six missions include energy transition, the bioeconomy, and decarbonisation.

- **National Circular Economy Strategy** (Estratégia Nacional de Economia Circular – ENEC): Endorsed in 2023, it establishes the National Strategy with the purpose of promoting the transition from a linear production model to a circular economy, aiming to encourage the efficient use of natural resources and sustainable practices throughout the production chain. Circularity breaks the logic of disposal and introduces a new productive model based on the development of more resilient products that are suitable for sharing, repair, reuse, redistribution, reconditioning, remanufacturing, and recycling.

2.2.4 Education policies and strategies

- **National Programme for Access to Technical Education and Employment** (Programa Nacional de Acesso ao Ensino Técnico e Emprego – Pronatec): Aims to expand technical and vocational training opportunities in strategic sectors. In recent years it prioritised courses linked to the green transition, particularly in bioeconomy and renewable energy. Coordinated by the Ministry of Education, it provides free courses through TVET Institutions, aiming to strengthen the workforce, promote regional development, and support Brazil's decarbonisation and sustainable growth goals. Since 2021, courses focusing on skills development for sustainable production, clean energy generation, and environmental management were offered by the Federal Network of Professional, Scientific and Technological Education Institutions through the program.

- **Brazil Energy and Innovation for Efficiency** (Programa para Desenvolvimento em Energias Renováveis e Eficiência Energética nas Instituições Federais de Educação – EnergIFE) programme: A collaborative effort between enterprises and technology institutes focused on promoting innovation and knowledge sharing in smart grids, renewable energy, and energy-efficient vehicles. It provides support through grants and soft loans, financed by institutions like the Brazilian Development Bank (BNDES), the Funding Authority for Studies and Projects (FINEP), and the Brazilian Electricity Regulatory Agency (ANEEL). The programme aims to induce the culture of the Renewable Energies and Energy Efficiency on the Federal Network of Professional, Scientific and Technological Education Institutions.

- **National Environmental Education Programme** (Programa Nacional de Educação Ambiental – ProNEA): A federal initiative coordinated by the Ministry of the Environment and the Ministry of Education to promote environmental awareness, education, and sustainable practices across Brazil. It integrates environmental topics into formal and non-formal education, supporting schools, communities, and public institutions in adopting environmentally responsible behaviours. The programme seeks to foster citizenship, strengthen social participation, and encourage collective action for environmental preservation and sustainable development.

- **Savings Incentive Programme for Secondary Students** (Pé-de-Meia): A federal educational savings programme that provides financial incentives to students aged 14-24 enrolled in public high schools to encourage school retention and completion. Students must maintain minimum 80% attendance to receive benefits, which can reach up to BRL 9'200 by graduation. The programme aims to reduce dropout rates and educational inequality.

- **Full-Time School Programme** (Escola em Tempo Integral – ETI): An educational initiative that extends school hours to provide comprehensive, full-day education in public schools. The initiative aims to improve educational quality and outcomes by offering extended learning time, extracurricular activities, and additional support services to students.

- **Thousand Women Programme** (Mulheres Mil): A federal program designed to provide professional training and educational opportunities specifically for women from vulnerable communities. It focuses on skills development, entrepreneurship training, and economic empowerment to promote social inclusion and gender equality.

- **100+ New Federal Institutes Programme** (Programa 100+ Novos Institutos Federais – 100+IF): A federal expansion initiative aimed at creating over 100 new Federal Institutes across Brazil to increase access to technical and vocational education. The program focuses on expanding professional education infrastructure, particularly in underserved regions, to meet workforce development needs.

2.2.5 Social policies and strategies

Brazil's transition policies have increasingly incorporated frameworks of social inclusion and just transition, acknowledging the country's deep-rooted structural inequalities.

- **PNMC (Plano Clima):** the cross-cutting strategy explicitly addresses issues such as just transition, socio-environmental impacts, and mechanisms to ensure that the benefits of the green transition reach marginalised populations. This approach represents a significant shift in climate policy, seeking to prevent mitigation and adaptation measures from exacerbating pre-existing inequalities, particularly those related to race, gender, and geography.
- **Conditional Cash Transfers for Families Programme** (Bolsa Família): Brazil also implements specific social programmes that contribute to a more inclusive transition. Cash Transfers for Families, for instance, provides conditional cash transfers and serves as a socioeconomic safety net for millions of low-income families, many of whom will be directly affected by labour market changes driven by the green transition.
- **Women in Construction** (Marias na Construção): the project stands out by offering technical training for women to enter traditionally male-dominated sectors, such as sustainable construction. This type of policy directly contributes to breaking structural gender barriers in access to green jobs and strengthens the role of women in the emerging green economy.

2.3 TVET System

The Technical and Vocational Education and Training (TVET) system in Brazil is decentralised and involves a variety of actors from the public, private, and non-governmental sectors. It is coordinated primarily by the Ministry of Education (MEC), which formulates national guidelines and policies, and by the National Council for Education (CNE), which regulates and monitors the delivery of TVET programmes. Other key government bodies include the Ministry of Labour and Employment *(Ministério do Trabalho e Emprego* – MTE), responsible for labour market integration policies, and the Ministry of Science, Technology, and Innovation (MCTI), which supports technology-oriented training initiatives.

In terms of institutional structure, the coordination and governance of TVET fall under the responsibility of the Secretariat for Professional and Technological Education (SETEC) of the Ministry of Education. SETEC oversees the Federal Network of Professional, Scientific, and Technological Education, composed of Federal Institutes (IFs), Federal Centres for Technological Education (CEFETs) and the Pedro II College. IFs are the newer and dominant model, offering a wide range of curricula, including specialised vocational and professional education in science, technology, and pedagogy integrated and not with general education, while CEFETs follow a traditional model more focused on technological education. Most CEFETs have been absorbed into the IFs following the 2008 reform (Brazil, 2008). Both offer undergraduate, graduate, and master's level education.

State and municipal professional schools complement the federal network and contribute significantly to access, reaching millions of students across Brazil. According to the INEP School Census (Censo Escolar) from 2023,

enrolment in TVET programmes increased from 2.1 million in 2022 to 2.4 million in 2023, representing a growth of 12.1%, making TVET the fastest-growing modality in Brazilian basic education (INEP, 2024). Most students are enrolled in subsequent secondary programmes (44.7%) and are concentrated in the fields of management and business (25.4%) and environment and health (26.5%), together accounting for over half of all enrolments (51.9%). In terms of provision networks, 44.4% of students attend private institutions, 38.2% state schools, and 13.7% federal schools, with the federal network maintaining the largest presence in rural areas (49'467 enrolments) (INEP, 2024).

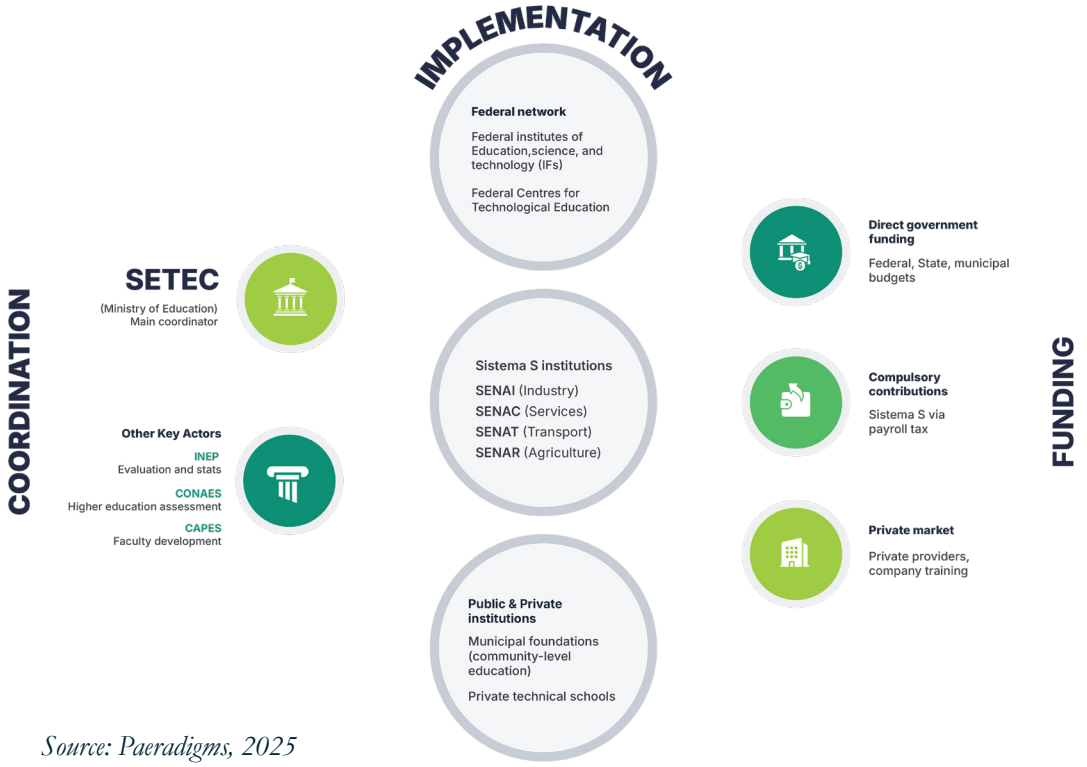
One of the defining features of Brazil's TVET system is "System S" (Sistema S). System S is a network of employer-led organisations funded mainly through compulsory contributions from industrial companies, dedicated to providing professional education, training, and social services (Agência Brasil, 2020). Although these entities serve the public interest, they operate independently and autonomously, in compliance with legal regulations and public governance frameworks. Among the nine main System S institutions, four focus primarily on education and training:

- **National Service for Industrial Training** (Serviço Nacional de Aprendizagem Industrial – SENAI): Focused on the industrial sector, SENAI offers technical and technological higher and continuing education programmes across areas such as mechanics, electronics, automation, environmental management, and renewable energy, playing a strategic role in developing skills for manufacturing and industry 4.0.
- **National Service for Commercial Training** (Serviço Nacional de Aprendizagem Comercial – SENAC): Dedicated to the commerce and service sectors, SENAC provides training in hospitality, tourism, administration, health, design, and information technology, often linking curricula to emerging market demands.
- **National Transport Learning Service SENAT** (Serviço Nacional de Aprendizagem do Transporte – SENAT): Specialised in the transport sector, SENAT delivers training for logistics, road safety, passenger and cargo transport, and vehicle maintenance, with a focus on professional certification and mobility sector modernisation.
- **National Rural Training Service** (Serviço Nacional de Aprendizagem Rural – SENAR): Oriented towards agriculture and rural development, SENAR offers training in crop and livestock production, agribusiness management, and sustainable rural practices, addressing the needs of Brazil's large agricultural workforce.

These institutions interact closely with industry federations, trade associations, and employers to align curricula with labour market needs. Collaboration also occurs with public schools, state technical institutes, and universities to integrate technical training into broader education pathways. In addition, non-governmental organisations, private training providers, and international agencies (such as UNESCO-UNEVOC) contribute through specialised programmes, pilot projects, and funding for innovation.

Beyond the national systems, TVET is also provided at the community level through municipal foundations and private technical schools. However, these alternatives are typically concentrated in more affluent municipalities and are implemented through localised initiatives (Figure 7). This multi-layered institutional landscape creates a complex network where government, System S, and other stakeholders share responsibilities for policy direction, financing, and training delivery, aiming to strengthen the link between education and employability while responding to Brazil's national development priorities, including the green transition.

Figure 7. Brazil's TVET system



Source: Paeradigms, 2025

Additional programmes expand access to technical and professional education, particularly for vulnerable populations. Pronatec is a key example, as it broadens access by offering courses through its Initial and Continuing Training (Formação Inicial e Continuada – FIC) Course Guide and by prioritising enrolment for beneficiaries of social assistance programmes such as Cash Transfers for Families and those registered in the national social assistance registry (Cadastro Único). Pronatec had cumulative enrolment of more than 7.3 million students from its launch in 2011 through 2014 (including short-term training). It set a target of 12 million enrolments by 2018, with approximately 40% of training slots in its FIC catalogue reserved for social assistance beneficiaries (World Bank, 2015a; World Bank, 2015b). More recent enrolment figures have not been published, however, current calls for FIC courses in 2023–2025 indicate ongoing delivery across states and federal institutes. Pronatec is one of Brazil's largest skills initiatives and directly links social protection with improved employability by equipping beneficiaries with recognised qualifications, technical skills, and better access to labour market opportunities. Alongside Pronatec, other programmes also align with employment policies that target disadvantaged groups and are key for skills development and labour market inclusion, including:

- **Thousand women** (Mulheres Mil), focused on women in vulnerable situations and those deprived of liberty.
- **Workers' school** (Escola do Trabalhador), which offers open-access courses to the general population.

The country's general educational indicators provide a solid foundation for technical and vocational training, with a youth literacy rate of 99.3% among those aged 15 to 24 ensuring that most young people entering TVET programmes have the basic literacy skills necessary for success (UNESCO, n.d.). Additionally, educational attainment shows relatively balanced gender participation, with women averaging 8.2 years of schooling compared to 7.8 years for men, suggesting that both genders have similar access to foundational education that can support their progression into vocational training pathways (UNESCO, n.d.).

TVET reach in numbers

- **10'199 TVET institutions**
  - 649 Federal
  - 6'259 State
  - 172 Municipal
  - 3'119 Private
- **~ 2.5 million students** enrolled in total
- **54.6% of participants are women** (censo escolar INEP 2024)

Brazil's TVET system has several key strengths:

Diverse institutional network – Brazil has around 41 federal institutions, more than 2'700 System S units offering TVET.

Comprehensive programme range – Courses span from initial and continuing training to higher technical and postgraduate programmes, providing pathways for different skill levels.

Multiple delivery formats – Face-to-face, distance, and mobile formats expand access even to remote regions.

Decentralised structure – Broad and decentralised provision allows for local adaptation and wider geographical coverage.

Established funding mechanisms – Programmes such as Pronatec, FINEP, and CNPq offer direct financial and structural support for professional and technical education, promoting training, skills development, and talent development in the country.

Although widely available, Brazil's TVET system faces several challenges (UNESCO, n.d.):

- **Low interest in TVET among youth –** only 6.2% of upper secondary students are participating in vocational programmes.
- **Access and retention are low –** access to TVET offers is limited for vulnerable groups and high dropout rates point to significant quality gaps and insufficient adaption to the needs of target groups.
- **Lack of alignment with labour market needs –** With an overall unemployment rate of 7.6% and 18% among youth across Brazil, persistent unemployment highlights the importance of aligning TVET more closely with labour market needs through stronger cooperation with employers. This cooperation can expand employment opportunities and reduce the skills gap, increasing employability for learners.

- **Lack of sustainability content –** Current training provisions fall short in reskilling, opportunities remain scarce and rigid, and upskilling suffers from weak coordination with industries, limiting contribution to the green transition.
- **Lack of public funding –** Direct support for vocational education is still limited, and programmes like Pronatec, FINEP, and CNPq are critical to expand access, improve quality, and better align training with labour market needs. The lack of targeted and sustained funding limits the system's ability to address low enrolment, retention issues, and the development of skills for emerging green sectors.

Addressing these gaps requires expanding investment in workforce development and ensuring stronger integration between education, industrial, and environmental policies to meet the growing demand for skilled workers for the ecological transition.

The challenges faced by Brazil's TVET system highlight the urgency of implementing clear and consistent policies capable of strengthening its role in supporting the green transition. Although Brazil has a formalised National Qualifications Framework, it currently lacks segmentation or standards specifically for green jobs, which limits the recognition and standardisation of skills in emerging sustainable sectors. At the same time, reductions in public funding underscore the need to diversify financial sources and improve governance mechanisms. TVET, as a strategic pillar for sustainable development, requires closer alignment with labour market needs and global trends, particularly the transition to a green economy, a priority also reiterated by interviewed stakeholders.

There is a lack of transversal training and a need for greater alignment of environmental and sustainability issues across the curricula of all careers. Furthermore, it is necessary to modernise technical programmes, encompassing all levels of qualification, so that workers can actively participate in the green economy transition by acquiring skills relevant to green jobs.

(KII, International Financial Institution, 2025)

While collaboration between TVET institutions and employers in the industrial sector is essential to ensure that curricula remain aligned with constantly evolving demands, complementary measures are equally important. These include public policies and fiscal incentives that support green skills training, targeted financing programmes and scholarships, integration with research and innovation initiatives, and the formal incorporation of sustainability competencies into national qualification frameworks. Collectively, such measures can accelerate the development of green jobs, promote regional development, reduce social inequalities, and foster technological diffusion.

03

Sector analysis

- Sector overview
- Skills gaps
- Social risks

3 Sector analysis

3.1 Sector overview

Several sectors of the Brazilian economy will experience more direct or immediate impacts, in terms of both opportunities and challenges from the green transition. The construction sector and cement industry are key examples due to their high green house gas (GHG) emissions intensity, potential for green job creation, and strategic relevance to the national economy.

3.1.1 Construction

Construction plays a foundational role in delivering critical infrastructure, including roads, ports, housing, sanitation, and energy projects (SNIC, 2024), making it a strategic component of the Brazilian economy. In 2024, it accounted for BRL 359.5 billion (~USD 66 billion) of Brazil's Gross Domestic Product (GDP) and a recorded growth of 4.3% per year, according to data from the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística – IBGE) and projections from the Brazilian Chamber of the Construction Industry (Câmara Brasileira da Indústria da Construção – CBIC) (CBIC, 2024).

Construction remains one of Brazil's largest job-generating sectors. In 2023, the industry employed approximately 2.5 million workers across 165,800 enterprises, which together paid BRL 89.6 billion in wages. Employment is broadly distributed across three segments: 37.6% in building construction, 32.8% in specialised construction services, and 29.6% in infrastructure works (IBGE, 2024).

Geographically, employment is widespread but tends to be concentrated in more developed urban regions, where demand for infrastructure and housing is highest and public and private investment in sustainable projects is greater. Over the past decade, there have been few changes in the rankings of federative units by construction value, with São Paulo consistently remaining the leading state in Brazil for incorporations, construction works, and related services. Programmes such as My House My Life (Minha Casa Minha Vida – MCMV) and green public procurement under the Novo PAC have reinforced this urban focus, supporting job growth in major metropolitan areas through the delivery of energy-efficient housing and sustainable public works.

The presence of cement plants across 88 municipalities in 24 states ensures some degree of regional dispersion in employment linked to construction supply chains. However, this distribution remains uneven: more industrialised and wealthier areas, particularly in the Southeast, lead the green transition and generate greater demand for skilled labour in sustainable construction, while less developed regions, particularly in the Amazon, face barriers such as limited training infrastructure, weak institutions, and lower access to green finance. This regional imbalance affects not only job availability but also the quality and sustainability of employment.

The demographic characteristics of the construction workforce reflect national labour market challenges, particularly high informality, which affects nearly 38% of Brazil's workforce (IBGE, 2025). The typical worker in the sector is a ~41-year-old male with incomplete primary education. Most workers are self-employed and work informally (Sinduscon-SP, 2024). Typically, this involves working under precarious conditions, with limited access to social protection or vocational training. Occupations within the sector range from low-skilled labourers to highly qualified professionals, highlighting a wide spectrum of skill requirements.

3.1.2 Construction and the green transition

As one of the country's largest employers and contributors to gross domestic product, construction has the potential to decarbonise multiple phases of the built environment – from materials to energy consumption – while simultaneously generating green jobs (Araújo et al., 2018; Júnior et al., 2023). Investment in green construction practices not only helps reduce GHG emissions but also promotes inclusive growth, particularly in social housing and basic infrastructure (SNIC, 2024).

However, achieving this transformation requires addressing the sector's current environmental impact and the technical challenges it presents. GHG emissions from the sector are linked not only to carbon-intensive materials such as cement and steel but also to inefficient energy use in buildings throughout their lifecycle (Huang et al., 2018). Transitioning to greener construction practices – including bioclimatic design, low-carbon materials, and circular economy techniques – is essential for reducing Brazil's greenhouse gas emissions and aligning infrastructure development with sustainability principles (Timm et al., 2023; Costa et al., 2022). Although the sector is gradually integrating low-carbon approaches, progress remains uneven, with traditional construction models still dominating and highlighting the need for broader structural change.

Supporting this transformation, several policy initiatives are beginning to create an enabling environment for green construction. Public and private initiatives, such as building certification schemes, the development of a national sustainable construction taxonomy, incentives for energy efficiency, and programmes like the Federal Savings Bank's (Caixa Econômica Federal) Sustainable Housing Seal and its Carbon Certification Programme (CECarbon) are supporting these efforts. In addition, public investments under the Novo PAC and local projects financed by BNDES are incorporating green procurement requirements. These policy commitments are backed by significant financial resources that demonstrate the sector's employment potential.

While detailed investment figures specific to green construction are limited, available data underscore the high employment multiplier associated with energy efficiency and sustainable infrastructure projects (ILO, 2024). For instance, a study supported by the German Agency for International Cooperation (GIZ) found that approximately USD 10.56 billion in annual investment in the energy efficiency sector could generate approximately 413'000 jobs across the economy, with 145'000 of these directly linked to energy-efficient construction (GIZ, 2019). Public initiatives such as Novo PAC and housing programmes incorporating environmental criteria are also directing substantial financial resources toward sustainable construction. In parallel, public banks and development institutions are exploring blended finance instruments to expand the scale of low-carbon construction investments and to ensure alignment with Brazil's broader ecological transformation agenda.

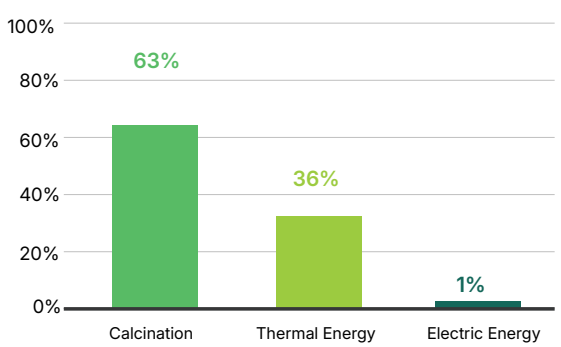
These investment flows are already beginning to reshape the occupational landscape (particularly those involved in high-carbon or traditional building methods) within construction, creating both transformation pressures and new opportunities. The interviewees claimed attention for occupations such as construction labourers, concrete finishers, and machine operators are increasingly influenced by sustainability requirements, demanding new skills in energy efficiency, material reuse, and emissions reduction. Simultaneously, mid- and high-skilled positions – including retrofit technicians, energy auditors, and green building engineers – are evolving to incorporate new responsibilities linked to sustainability standards. These changes signal a gradual redefinition of occupational profiles that will require widespread upskilling and requalification efforts, particularly for informal and low-skilled workers.

3.1.3 Cement production

The cement industry has a strategic position within Brazil's socioeconomic landscape. Although it accounts for less than 0.5% of the country's gross domestic product (SNIC, 2024), it is integral to infrastructure development, public works, and housing. Cement serves as a foundational input across nearly all construction and industrial projects, embedding the sector deeply into national development plans. Moreover, Brazil ranks among the top seven global cement producers, with an annual output of approximately 50 to 60 million tonnes, underscoring the sector's relevance to both domestic and international markets. Its industrial profile, involving large national and multinational firms operating across regional supply chains, positions the sector as a key pillar of Brazil's low-carbon transition, particularly as the country seeks to align economic development with climate goals.

Cement production is heavily concentrated in the Southeast region, which includes the states of São Paulo, Minas Gerais, Rio de Janeiro, and Espírito Santo. This area not only contributes significantly to the country's GDP but also accounts for roughly 46% of national cement output in 2023 (ZKG International, 2023). The Northeast follows with significant new investments and plant expansions, suggesting a growing role in future production capacity. The South, Central-West, and North regions contribute smaller shares. The concentration of production and employment in the Southeast and Northeast implies that workers in these areas are most likely to be exposed to technological innovation and to require targeted upskilling for the sector's decarbonisation.

Figure 8. GHG emissions from cement manufacturing in Brazil



Source: ROADMAP, 2019.

3.1.4 Cement production and the green transition

The cement sector plays a strategic role in Brazil's green transition due to its foundational importance for construction and infrastructure, and its substantial contribution to GHG emissions. Although the industry represents less than 0.5% of Brazil's gross domestic product (SNIC, 2022), it accounts for 23.5% of industrial GHG emissions and 1.5% of total national emissions (SNIC, 2019). Cement production is among the most carbon-intensive industrial processes globally, primarily due to the calcination of limestone and the thermal energy required in kilns, which together account for nearly all sectoral emissions (ROADMAP, 2019). As shown in Figure 8, calcination accounts for 63% of GHG emissions, thermal energy use in kilns contributes 36%, and electricity consumption represents only 1%.

Demand for cement is projected to rise sharply by 2050. According to BNDES (2024), annual cement consumption may exceed 100 million tonnes by 2050, driven by infrastructure development, urbanisation, and housing needs. The industry has begun integrating a range of approaches to advance decarbonisation. Current efforts include clinker reduction, co-processing of waste as alternative fuels, energy efficiency improvements, and research into carbon capture and storage (CCS). Additionally, initiatives promoting industrial symbiosis and circular economy practices, such as reusing waste from other sectors, are gaining traction. However, these efforts remain unevenly distributed across regions and enterprises, highlighting the need for coordinated policy frameworks and financial support to scale up (BNDES, 2024). Despite these relatively advanced practices compared to global peers, the sector's reliance on carbon-intensive processes and the growth trajectory highlights the critical need to accelerate decarbonisation (EPE,2020).

Other approaches have included closer alignment with national and international climate goals through policy instruments, industry roadmaps, and financial incentives. The Cement Industry Technology Roadmap, for instance, outlines a target of reducing CO_2 emissions by up to 33% by 2050 through a mix of cleaner fuels, material substitutions, and technological innovation.

Although investment in green transformation within the cement sector is gaining traction, it remains below the level required for large-scale decarbonisation. Initiatives like the Climate Fund have begun supporting projects focused on low-carbon industrial technologies, including cement, but regulatory incentives to stimulate market demand remain limited. This is particularly evident in the public procurement sector, where Type I cement (the most carbon-intensive) continues to dominate due to its low cost. The also industry still faces a significant financing gap. High-cost technologies such as CCS and advanced clinker substitutes attract limited investment, partly due to the absence of strong government signals such as green procurement mandates or fiscal incentives. Strengthening public-private cooperation and introducing targeted measures, like tax credits or procurement quotas, will be crucial to increase the scale and pace of investment in sustainable production practices.

The shift toward a greener cement industry will reshape numerous occupations, particularly those directly involved in energy-intensive stages of production. Occupations such as kiln operators and plant maintenance technicians will require upskilling to adopt new techniques for emissions tracking, waste co-processing, and the use of renewable energy sources. Additionally, traditional occupations will evolve as carbon footprint monitoring and sustainability standards become embedded in operational routines. The transition will also demand new professional profiles, including carbon accounting specialists, CCS system operators, and experts in low-carbon binder technologies, signalling a shift in the sector's workforce development requirements.

This shift will require investment in research, innovation, and training for professionals ranging from materials and chemical engineers to specialised operators and environmental managers, alongside technical and entry-level workers. To maximise returns on training investments, policymakers should prioritise skills that are transferable across multiple green occupations, creating spillover effects that strengthen the entire workforce and accelerate the sector's green transition.

The cement industry exemplifies spillover potential. By adopting low-carbon technologies and sustainable production practices, it not only reduces its own emissions but also generates transferable skills and knowledge that benefit other parts of the construction and industrial value chain. For instance, workers trained in energy-efficient cement production, carbon management, or sustainable materials can apply these skills in building construction, infrastructure projects, and related industrial activities, thus amplifying the green transition.

Spillover effect

The Brazilian Economic Complexity Platform (known as DataViva) uses economic complexity theory to map how occupations and economic activities in Brazil are interconnected. By exploring the national classification of occupations (CBO), users can identify roles with strong skill linkages – those most likely to generate spillover effects. For instance, chemical engineers are closely connected to occupations such as mining production managers, electrical engineers, and project engineers.

The illustration in Figure 9 demonstrates the spillover effect of the chemical engineer skills required to other occupations requiring the same skills in the cement industry. The high degree of interconnection seen in the figure suggests that investing in skills for chemical engineers can yield broad benefits across related fields, offering a data-driven rationale for prioritising training and funding in the cement sector's green transition.

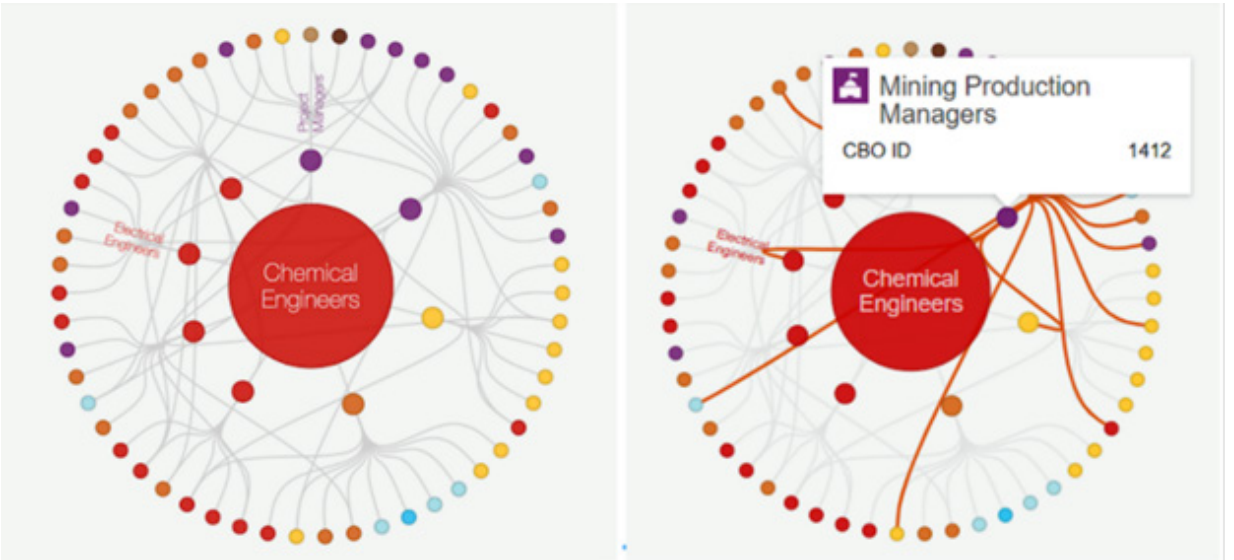
This highlights the importance of Brazil's cement sector for the green transition:

(a) Decarbonisation potential – emissions intensity, especially in cement, urgently needs climate mitigation efforts.

(b) Green jobs potential – construction can absorb a large share of the emerging green workforce, while cement offers qualified occupations in environmental technologies (potential for GDP growth).

(c) Economic and social relevance – both the construction and cement sectors are essential for development. Promoting sustainability here means aligning climate goals with income generation, dignified housing, and modern infrastructure (potential for just transition).

Figure 9. Spillover of chemical engineer skills to other occupations in the cement industry



Source: Paeradigms 2025, based on DataViva

3.2 Skill gaps

3.2.1 Construction sector

In the construction sector, there are significant skills gaps, beyond mere technical knowledge, that need to be filled for the green transition. According to the ILO (ILO, 2020), the construction sector is particularly vulnerable to these gaps due to its traditional reliance on a workforce with limited practical training and low formal qualifications. In informal economies, where working conditions tend to be less regulated, it is necessary to develop competencies that enable people to respond flexibly to contextual challenges – for example, critical thinking, problem-solving, and adaptability to new technologies and sustainable practices (UNICEF, 2025).

Interviewees highlighted that workers' lack of familiarity with concepts such as sustainability, energy efficiency, and the impacts of climate change is a structural problem, rooted in outdated curricula of technical (TVET) and university courses. As one interviewee noted:

More than mastering technical skills, it is essential for workers to understand the logic of the green transition and the sustainability of processes across all levels of the organisation.

(KII, CSO/Trade association, 2025)

In addition to transforming existing occupations, entirely new job opportunities are expected to emerge in areas closely connected to green infrastructure and sustainable construction practices. Interviews with sector representatives highlighted occupations in solar energy installation, water reuse systems, energy-efficient retrofitting, and climate-resilient public works. These developments are also expected to increase demand for architects and engineers with environmental expertise, as well as skilled technical labour capable of operating within circular construction models. Urban regeneration and smart city projects are expected to further broaden the scope of employment in digitalised, low-carbon construction systems. These shifts signal a gradual redefinition of occupational profiles, requiring widespread upskilling and requalification efforts – particularly for informal and low-skilled workers.

Interviewees however, noted that many essential skills for the green economy, such as energy retrofitting techniques, rainwater harvesting, and bioclimatic design, remain underdeveloped in technical and higher education programmes. Given this context, it is essential to expand and modernise TVET programmes, incorporating both up-to-date technical skills and behavioural and environmental competencies. Short courses focused on sustainable construction technologies, solar energy, and efficient design should be encouraged, alongside more comprehensive training that addresses climate resilience, rational resource use, and adaptive solutions to extreme weather events. Partnerships between the private sector, institutions such as SENAI, trade unions, and federal institutes could enable training that is better aligned with local and regional needs. It is also important to provide continuous and decentralised education, ensuring access to training across the different regions of the country.

Several obstacles hinder the progress of these initiatives. A key challenge, widely discussed in the interviews, is the concentration of training infrastructure in the South and Southeast regions, which restricts access for workers in the North and Northeast, areas that often face greater socio-economic vulnerabilities. This regional imbalance exacerbates inequalities, limits sustainable development, and undermines efforts to universalise the benefits of the green transition.
Additionally, many TVET courses are misaligned with the evolving demands of a low-carbon economy. Interviewees highlighted a significant disconnect between course offerings and actual labour market needs, which contributes to shortages of qualified professionals and hinders productivity, innovation, and the adoption of new technologies. This structural barrier prevents investments in training from translating into real green job opportunities. Moreover, small and medium-sized enterprises, which are essential to the construction sector, face financial difficulties investing in training and innovation, perpetuating a cycle of low qualification and limited technological uptake.

Another issue, often overlooked yet raised in the interviews, is the lack of awareness and systemic understanding of the urgency of the green transition among both employers and workers. This can lead to resistance, insecurity, and fear of job displacement or economic loss, despite a shared view among interviewees that the long-term benefits outweigh these challenges.

3.2.2 Cement sector

The cement sector also faces significant skills gaps. While it does have technically qualified professionals, there is still a lack of specific competencies to work with emerging technologies aimed at reducing emissions. To address these challenges, the sector requires highly specialised training (TVET) and higher education programmes that encompass both technological advancements and the integration of environmental criteria into production.

Our universities and technical schools are not keeping pace with the rapid emergence of low-carbon technologies. Curricula must be redesigned to include hands-on experience with energy-efficient materials, process automation, and carbon capture methods, otherwise the workforce will remain unprepared for the green economy.

(KII – National Government, 2025)

According to the International Energy Agency (IEA, 2020), decarbonising the cement industry requires advanced knowledge of processes such as the use of alternative fuels, waste co-processing, clinker substitution, and carbon capture and storage (CCS). Interviewees emphasised that the shortage of operators and engineers with these skills not only hinders the adoption of these technologies but also threatens the sector's competitiveness and compliance with national and international emission reduction targets. This skills gap is further compounded by insufficient training on transversal skills in areas such as automated industrial process control, materials chemistry, and life cycle assessment, limiting the development and implementation of innovative solutions and slowing the widespread dissemination of sustainable practices (Nilimaa, 2023).

Interviewees identified regional disparities in access to training as a major barrier to advancing the green transition, citing that current training efforts are often limited and concentrated to economically developed regions, restricting opportunities for workers in peripheral and disadvantaged areas and reinforcing existing inequalities. Other critical barriers mentioned include inadequate technological infrastructure, cultural resistance to change, and financial constraints. These factors emphasise the need for robust investments in infrastructure, effective communication, and financial support to enable the transition (Santos Júnior et al., 2025).
To address these disparities, effective reskilling and upskilling programmes are essential. They help close skills gaps, improve talent retention, and enable workers to seize emerging opportunities in a rapidly evolving labour market (World Economic Forum, 2025). However, this requires adapting and harmonising vocational training systems to support lifelong learning. Increased investment and stronger links between education and TVET systems are needed, particularly in competencies relevant to the building materials industry and the broader construction sector (ILO, 2019).
Another critical challenge is the fragmentation between industrial, environmental, and educational policies, which creates systemic disarticulation. This lack of integrated coordination undermines the development of a qualified workforce for the green economy and may delay the sector's adaptation to climate challenges and shifting global market dynamics (Camargo-Bertel et al., 2025).
To synthesise the findings from the interviews regarding skills gaps in the construction and cement sectors, Table 2 provides a summary of the main professional profiles and competencies required for the green transition in Brazil. The table brings together the diverse perspectives of the interviewees, highlighting both technical and transversal skills essential for adapting existing occupations and creating new opportunities within these sectors. It reflects the specific demands of sustainable construction, low-carbon cement production, and broader environmental and energy-related activities, emphasising the importance of modernising TVET programmes to address these needs.

Table 2. Skills and competencies required for the green transition in construction and cement

Sector	Green Jobs Profiles	Green Skills
Construction	Civil, Mechanical, and Electrical Engineers; Construction and Building technicians; Sustainability Managers	Sustainable construction techniques, climate-resilient infrastructure, adaptive and innovative processes, energy efficiency, low-carbon technologies, life cycle assessment, climate risk analysis, Environmental, Social and Governance (ESG) practices
Cement	Chemical, Industrial, Mechanical, and Electrical Engineers; Industrial Operators; Industrial Technicians; Decarbonisation and Clean Technology Specialists	CO_2 emissions reduction, carbon capture and storage, alternative fuels and waste co-processing, process optimisation, technological innovation, life cycle assessment, automation, materials chemistry, low-carbon solutions

Overall, most of the professional profiles identified in both the construction and cement sectors require advanced technical knowledge and specialised training. This highlights the importance of expanding and modernising TVET programmes, as well as promoting continuous professional development opportunities. By aligning education and training with the evolving demands of the green economy, Brazil can ensure that its workforce is equipped with the necessary technical, transversal, and environmental competencies.

3.3 Social risks

3.3.1 Construction sector

The construction sector has historically been marked by high levels of informality, reaching 67% of the workforce in Brazil in 2023, (Sindicato da Indústria da Construção Civil do Estado de São Paulo, 2024), which heightens social vulnerabilities. Interviewees equally noted the significant social challenges caused by persistent informality and precarious working conditions in the sector.

The green transition in construction poses significant social risks, particularly for informal and low-skilled workers, who may face job loss, increased precariousness, and limited access to training opportunities unless targeted inclusion policies are implemented.

(KII – National Government, 2025)

Skills development policies must be equitable and inclusive of all workers, especially those in the informal economy, who face significant barriers in accessing training and lifelong learning opportunities. These difficulties arise from, among other factors, the requirements of formal education, low levels of foundational skills, and the costs associated with training (ILO, 2018). Interviewed stakeholders also noted the green transition carries the risk of intensifying existing inequalities. Women employed as informal workers often perform unskilled tasks, receive lower wages, face precarious working and living conditions, and are more exposed to exploitation, long working hours, and health risks. Additionally, they are disproportionately affected by displacement caused by mechanisation in the sector (ILO, 2022). Interviewees also highlighted that beyond gender inequalities, aspects related to race, age, regional location, and social vulnerability are crucial factors that exacerbate the challenges of the green transition in the labour market, accentuating the need for inclusive and targeted policies for these groups. These structural inequalities linked to racial factors also influence access to green jobs, hindering the inclusion of marginalised communities in a just transition towards a sustainable economy (Kuersteiner and Ordal, 2023).

3.3.2 Cement Sector

According to the study "Encadeamento da Indústria do Cimento no Brasil" (Cement Industry Chain in Brazil, 2021), by the National Union of the Cement Industry (SNIC), for every million tonnes of cement produced in Brazil, approximately 1'200 jobs are generated, including direct, indirect, and induced employment. These figures highlight the significant impact of the sector on employment generation, particularly in regions more vulnerable to structural economic transformations.

However, according to the interviewees, the green transition in the cement sector entails significant social challenges, mainly related to automation and the adoption of new technologies such as CCS, the use of alternative fuels, and the digitalisation of processes. These technologies tend to reduce the demand for low-skilled labour and increase barriers to entry for workers without access to adequate technical education.

The interviews conducted reveal a recurring concern about the reduction in demand for low-skilled labour, a trend exacerbated by automation and the digitalisation of production processes. Older workers, those with lower educational attainment, and residents of regions with limited educational infrastructure are the most vulnerable to this technological displacement (Chang and Huynh, 2016). As one interviewee notes, "Automation and low-carbon technologies in the cement industry can exacerbate regional and social inequalities, as older, low-skilled, and less-educated workers are at higher risk of exclusion without effective retraining and support programs" (KII – National Government, 2025). The lack of access to effective technical training and retraining programmes further entrenches the exclusion of these groups, deepening existing regional and socioeconomic inequalities.

The interviewees also expressed concern about the rising costs of cement production, noting that these increases may contribute to construction expenses and ultimately be passed on to the final price of housing. This risk is particularly significant for social housing initiatives such as the My House My Life programme, unless accompanied by subsidies or adapted procurement policies to mitigate its impact. In the absence of effective compensatory policies – such as targeted subsidies, tax incentives, or stringent criteria for sustainable public procurement – there is a real risk that access to social housing will become more restricted, thereby widening regional and social inequalities. The Organisation for Economic Co-operation and Development (OECD) further emphasises that the limited capacity of local governments for revenue collection and sustainable infrastructure planning hampers efforts to mitigate these inequalities and to build more inclusive and resilient cities (OECD, 2018).

04

Solutions assessment

- Ecological Transformation Plan (PTE)
- New Brazil Industry Plan (NIB)
- Brazil Building Information Modelling Strategy (BIM)
- Women in Construction (Marias na Construção)

4 Solutions assessment

Brazil is making significant strides in its green transition through strategic national policies that integrate environmental objectives with inclusive economic and social development. This transformation is motivated by the limitations of the current growth model, which relies heavily on the intensive use of natural resources, high greenhouse gas emissions, and environmental degradation – all of which heighten the country's vulnerability to extreme weather events, resource scarcity, biodiversity loss, and social inequalities (Ministério da Fazenda, 2024).

In this context, two major structural initiatives stand out: the PTE and the NIB. These initiatives align climate action with industrial and fiscal reform. The PTE was designed to guide Brazil's agenda on NDCs, by integrating environmental objectives into fiscal policy and promoting the creation of green jobs, especially in sectors with low innovation capacity and in historically vulnerable regions such as the North and Northeast of the country (Ministério da Fazenda, 2024). The NIB complements the PTE by targeting low-carbon industrial transformation, regional development, and workforce upskilling.

Both strategies align with Brazil's broader goals for a just and inclusive green transition, promoting green skills provision, sustainable employment, and integrated economic and environmental policymaking. However, the following challenges still persist: green skills are not yet sufficiently integrated into national education and labour policies, data on green jobs remains inconsistent, and sustainability training for educators is lacking. Addressing these gaps requires stronger governance, adequate financing, decentralised and inclusive training, and robust public-private collaboration. Clear and targeted strategies are also needed to create an enabling environment for the green transition in priority sectors such as construction and cement.
In addition to these national frameworks, Brazil has developed sector-specific policies for its most resource- and emission-intensive industries. The four solutions discussed in the following sections demonstrate Brazil's evolving policy environment for green skills and jobs.

4.1 Ecological Transformation Plan (PTE)

4.1.1 Challenge

Brazil's PTE faces the challenge of aligning the national climate agenda with the creation of green jobs and the development of a skilled workforce for the transition to a low-carbon economy. The plan specifically addresses the need to train workers in sectors such as sustainable construction, low-impact cement production, and renewable energy, responding to the growing demand for green skills in strategic areas of the economy (Ministry of Economy, 2023; OECD, 2024). The PTE also considers vulnerable demographic groups to ensure a just and inclusive transition, promoting training that broadens social and economic opportunities (Ministry of Economy, 2023; OECD, 2024).

4.1.2 Solution

The PTE focuses on equipping skilled workers in key sectors for the green transition, such as construction, cement, bioeconomy, technology, and the circular economy. Its goal is to expand technical capacity while promoting workforce inclusion. The PTE's main innovation is its integrated financing model, which blends public and private resources through four tools: sustainable sovereign bonds, climate-focused credit lines, a restructured Climate Fund prioritising innovative projects, and a sustainable finance taxonomy. These mechanisms link funding directly to workforce training and climate impact assessment, meaning that access to credit depends on both the environmental benefits of a project and its ability to provide skills development. This approach ensures that investments not only reduce emissions and support green industries but also create a better-trained workforce prepared for new opportunities, making it a powerful driver for sustainable economic growth.

Studies conducted by Green New Deal Brazil (GND-BR) and the Federal University of Rio de Janeiro (UFRJ) estimate that implementing the plan's proposed actions could boost GDP by BRL 1.3 trillion, generate 9.5 million jobs by 2030 – primarily in green economy sectors – reduce annual CO□ emissions by one gigatonne, increase tax revenue by BRL 121 billion, achieve net-zero emissions by 2050, and raise the income of the poorest population by more than 130% compared to 2020 levels (Ministry of Finance, 2024).

The plan is estimated to generate up to BRL 772 billion in economic impact by 2050, with workforce upskilling embedded throughout technology hubs, bioeconomy clusters, and sectors affected by the green transition. This integrated financial model is replicable in other economies seeking to align green finance with labour market transformation while managing transition risks in a coordinated, inclusive manner (Ministry of Finance, 2024; Ministry of Economy, 2023).

4.1.3 Implementation

Various public actors participate in the implementation of the PTE, including the Ministry of Economy, the Ministry of the Environment, the Ministry of Science and Technology, BNDES, and international financial institutions such as the International Monetary Fund (IMF). Sectoral organisation into six strategic pillars facilitates coordinated action by these actors, distributed across specialised subgroups to mitigate risks and promote technical and social adaptation (BNDES, 2024; IMF, 2023). Furthermore, interministerial coordination of the PTE is ensured through working groups and committees that articulate the various ministries and agencies involved. These groups also incorporate participatory inputs from technical experts and societal stakeholders, enabling policy alignment, sharing of technical information, and efficient project implementation, as well as continuous monitoring and strategy adaptation according to the progress of the transition (BNDES, 2024).

Funding for the PTE combines public and private resources, highlighted by the issuance of Brazil's first sustainable sovereign bonds in 2023, credit lines granted by public and development banks, and the reallocation of the Climate Fund to prioritise sustainable and innovative projects (Ministry of Finance, 2024; Ministry of Economy, 2023).

4.2 New Brazil Industry Plan (NIB)

4.2.1 Challenge

Within the framework of Brazil's ecological transition, industrial policy plays a pivotal role in driving low-carbon development and advancing inclusive economic growth. The NIB is a strategic response to the urgent need to modernise the country's industrial base, addressing long-standing challenges related to high greenhouse gas emissions, low technological innovation, and regional inequalities. Brazilian industry, especially traditional sectors such as cement and metallurgy, faces pressure to adapt to the green transition, which demands new green skills and competencies and the creation of sustainable jobs to ensure competitiveness and sustainability (MDIC, 2025). These efforts are structured around coordinated action plans covering the period 2024-2026, aligning ministry goals with national missions and sectoral targets.

4.2.2 Solution

The innovation of the NIB lies in its integrated and participatory approach to developing green skills and driving industrial transition. The initiative has adopted a governance model that coordinates ministries, federal agencies, industry, and industrial associations through the National Industrial Development Council (CNDI). This enables the joint identification of challenges and the co-design of actions, with public consultations feeding directly into project design and priority setting. It also enhances alignment of TVET with the demands of clean technologies, digitalisation, and sustainability. The NIB prioritises various categories of workers and regions, with a special focus on carbon-intensive industrial sectors as well as emerging sectors such as the bioeconomy, healthcare, and urban infrastructure. Regions with the greatest potential for industrial development and socio-economic impact are targeted by projects that seek to transform their regional potential into engines of sustainable development, generating local employment and income (MDIC, 2025).

The NIB incorporates innovative financial instruments aimed at attracting private capital to green sectors and mitigating transition risks (MDIC, 2025). These include specific credit lines for innovation and sustainability, sectoral funds, and regulatory mechanisms for the carbon market. These tools function both as direct incentives for investments in clean technologies and as risk mitigation mechanisms for private investors, fostering public-private partnerships and generating resources for green projects. Regarding expansion and scalability, the NIB faces several challenges. These include the complexity of coordinating multiple stakeholders, adapting credit lines to reflect regional contexts, and developing local competencies. At the same time, there are opportunities to consolidate robust financial mechanisms, consequently strengthening collaborative governance and aligning with national and international climate policies that promote sustainable investment.

4.2.3 Implementation

The implementation of the NIB involves various actors. Strategic ministries lead the formulation of guidelines and regulations. The CNDI coordinates the cross-sector integration of priorities. Interministerial commissions oversee technical and operational execution. Industry associations and companies actively participate in the co-design and implementation of actions. This structure incorporates multiple perspectives, promoting collaborative and transparent governance (MDIC, 2025).

The implementation framework operates through five coordinated layers: strategic leadership by government ministries; policy coordination by CNDI; operational execution by interministerial commissions; sector engagement through consultation and co-design with industry; and innovation support by federal agencies that promote technological upgrading and research funding.

Funding for the NIB primarily comes from federal public resources, including the Ministry of Economy's budget, sectoral funds, and credit lines from public banks such as BNDES.

This is complemented by private resources mobilised through innovative financial instruments and multilateral partnerships. To date, approximately BRL 472.7 billion has been invested in over 168'000 industrial projects, reflecting a strong financial commitment to the green transition and the sustainable modernisation of Brazilian industry (MDIC, 2025).

This mission-oriented, multi-stakeholder framework provides a replicable model for other countries seeking to design green industrial policies that balance opportunity with transition risk.

4.3 Brazil Building Information Modelling Strategy (BIM)

4.3.1 Challenge

BIM represents a crucial innovation in the construction sector, particularly in a context where efficiency, sustainability, and the reduction of environmental impacts have become strategic priorities. In Brazil, BIM is increasingly recognised as a fundamental tool for promoting digital transformation in one of the most resource-intensive industries, responsible for a significant share of greenhouse gas emissions. This technology enables the integration and management of information throughout the entire life cycle of a building – from planning to operation and maintenance – resulting in more efficient processes, reduced waste, and a significant decrease in the environmental footprint of construction projects (MDIC, 2024).

From the perspective of the green transition, BIM is directly aligned with sustainability goals, as it supports the development of buildings with lower environmental impact and greater energy efficiency. However, full implementation requires the development of new technical and digital competencies among professionals in the sector. This is a challenge tied to the green skills gap in Brazil. The construction sector lacks sufficient qualified professionals to manage the transition to cleaner technologies, making professional training a central pillar for ensuring a structured and inclusive transition.

4.3.2 Solution

In this regard, the National Strategy for the Dissemination of BIM constitutes a comprehensive public policy aimed at overcoming long-standing structural issues in the sector, such as material waste, low productivity, and a lack of technological innovation. The strategy's objectives include the technical training of professionals, the development of specific standards and digital platforms, and the adoption of BIM in public procurement processes, as stipulated by a new public procurement law that encourages the preferential use of BIM methodology in public works (MDIC, 2024). Brazil's innovative approach lies in the integration of digitalisation and sustainability, promoting professional qualification aligned with both technical requirements and the principles of the green economy.

The strategy targets engineers, architects, technicians, public managers, and professionals involved in urban planning and infrastructure, broadening its impact beyond traditional technical profiles. The Brazilian Agency for Industrial Development (ABDI) plays a key role, having launched the "Democratise BIM" programme in 2020 in partnership with the National School of Public Administration (ENAP). The course, free of charge and offered through the Government's Virtual School, has already reached more than 14'000 participants (ABDI, n.d.). Although the decree does not set specific numerical targets, the number of professionals already trained demonstrates the strategy's reach. Nevertheless, it would be beneficial for the policy to establish quantifiable goals to guide the expansion and monitoring and evaluation of training activities, such as annual targets for trained professionals or indicators on the adoption of BIM in public works.

In terms of scalability, the gradual mandatory use of BIM in public procurement represents one of the main drivers for widespread adoption of the methodology across the country. Furthermore, the use of distance learning platforms, such as the ENAP course, allows for significant geographical expansion of training, benefiting professionals in rural and underserved regions. This model could be replicated in other sectors requiring digital upskilling for the green transition, provided there is continued investment in digital infrastructure and professional education that strengthens collaboration networks among public and private stakeholders.

4.3.3 Implementation

Regarding institutional coordination, the National Strategy is managed through joint actions involving the Ministry of Development, Industry, Trade and Services (MDIC), ABDI, ENAP, and other federal entities such as the Ministry of Management and Innovation in Public Services. Programme governance involves the creation of technical committees, working groups, and integrated digital platforms that enable coordination across training, funding, and regulatory actions. This collaboration is essential to ensure coherence between public policies on technological innovation, professional training, and sustainability in the construction sector.

The strategy is financed through public funds allocated to technological development, professional training, and support for innovation. These resources are drawn from federal funds linked to industrial and innovation policies, forming part of a broader effort by the Brazilian government to digitalise strategic industries and accelerate the ecological transition. Although the decree does not disclose specific figures, financial support is directed towards research and development (R&D), technical training, and the structuring of digital platforms (MDIC, 2024). Additional funding mechanisms, including sectoral funds and public procurement incentives, further support adoption.

4.4 Women in Construction (Marias na Construção)

4.4.1 Challenge

Local policies play a crucial role in translating national strategies into concrete actions that directly address community needs, reduce inequalities, and generate tangible impacts on people's lives. In Brazil, women are underrepresented in certain economic sectors, such as construction – a field historically dominated by men. At the same time, the green transition is reshaping the sector, generating demand for new technical skills related to energy efficiency, sustainability, and low-carbon infrastructure. The challenge, therefore, is to advance gender equity in employment within the construction sector while equipping the workforce with the technical green skills needed for the green transition.

4.4.2 Solution

The Women in Construction programme was launched in 2019 by the Municipal Secretariat for Policies for Women, Children and Youth (SPMJ) of Salvador City Hall, in partnership with the National Service for Industrial Training of Bahia (SENAI-BA). The programme promotes the inclusion of women in situations of social vulnerability and survivors of violence through free vocational training and support for integration into formal employment (SPMJ, 2023). Its central aim is to strengthen the autonomy and financial independence of these women.

As an innovative example of gender-sensitive policy, the programme demonstrates how local initiatives can combine social inclusion with workforce development in strategic sectors of the green economy. The training courses include

qualifications such as industrial electrician, construction painter, tiler, multipurpose builder, photovoltaic system installer, and building plumber. The photovoltaic system installation course is particularly relevant in the context of the energy transition, as it qualifies women to work with clean energy systems and contribute to the reduction of carbon emissions.

The courses are delivered in training units operated by SENAI, which expands access to education in peripheral and underserved areas (Prefeitura de Salvador, 2023). In collaboration with the Civil Defence Authority (CODESAL) and the Brazilian Micro and Small Business Support Service (SEBRAE) in Bahia, the Women in Construction programme also offers training on safe construction practices, entrepreneurship, access to credit, and guidance for self-employment in the construction sector.
The initiative also incorporates elements of social innovation by linking public policies on gender, labour, and local development with industry. This coordination is further reflected in actions such as the reservation of 5% of vacancies in public works for women in municipal procurement processes, reinforcing women's presence in the sector and contributing to gender-equitable employment in the green economy (CREA-BA, 2023).

The effectiveness of this programme has gained international recognition. In 2023, Women in Construction received the UNESCO International Award at the 3rd World Forum on Human Rights in Buenos Aires (SPMJ, 2023). Its success led to an expansion in 2024, reflecting both growing demand and the programme's relevance in the city's social and economic context.

While Women in Construction is implemented at the local level, this model – based on the integration of social inclusion, technical training, and public-private partnerships – holds strong potential for replication in other urban centres undergoing energy transitions. Key success factors for adaptation in different contexts include partnerships with local skills providers (e.g. SENAI or equivalents), institutional support from municipal or state governments for funding, coordination with enterprises in the construction sector for labour absorption, and the involvement of organisations that support women in situations of vulnerability. Mobile training units further facilitate replication in both dense urban areas and rural or climate-vulnerable regions with limited infrastructure.

4.4.3 Implementation

The programme's governance is based on strong institutional coordination among several key actors. The SPMJ leads coordination efforts, while SENAI in Bahia provides vocational training courses tailored to the needs of the sustainable construction sector. CODESAL, which is responsible for Municipal Civil Defence Coordination in Salvador, ensures that safety and civil defence regulations are integrated into the programme. The Bahia regional branch of SEBRAE supports local entrepreneurship by offering guidance and resources to participants interested in starting their own businesses. The Municipal Labour Mediation Service (SIMM) plays a critical role in facilitating access to employment opportunities for programme participants. This cooperation strengthens coherence between training, gender equity, and labour market integration, positioning Women in Construction as a replicable model for gender-responsive green workforce development.

The programme is primarily funded by the Salvador City Hall through SPMJ, which covers the costs of teaching materials, classroom infrastructure, the operation of mobile units, transportation subsidies for participants, and administrative support. SENAI in Bahia, as a technical and educational partner, receives municipal funding to deliver the courses, ensuring both the quality and geographical scope of the training. In addition, partnerships with CODESAL and SEBRAE in Bahia – both publicly funded – provide technical support and complementary guidance to participants. Although no detailed breakdown of investment is publicly available, municipal resources are known to cover the programme's essential operations (SPMJ, 2023; SENAI Bahia, 2023).

05

Conclusion

5 Conclusion

Brazil holds significant potential for green job creation, with projections estimating up to 7 million green jobs by 2030, particularly in sectors like renewable energy, sustainable agriculture, waste management, and energy efficiency. The construction and cement sectors are especially critical due to their economic importance and high carbon intensity. However, realising this potential and overcoming the persistent structural challenges requires a coordinated and inclusive approach.

Despite promising national initiatives, such as the PTE, the NIB, and the National BIM Strategy, several barriers continue to hinder a just and effective green transition. These include high levels of informality, outdated vocational training, regional disparities in infrastructure and education, and the absence of a national green skills strategy. In 2023, informality in construction reached 67%, limiting workers' access to training, social protection, and proper work conditions. The cement sector faces similar constraints, including the dominance of low-cost, high-carbon materials; limited regulatory incentives for greener alternative; and uneven policy enforcement across regions.

Interviewees highlighted that the available training opportunities remain concentrated in the South and Southeast, leaving other regions underserved. Addressing this imbalance requires decentralised and context-specific training programmes developed in partnership with employers, unions, and institutions like the S S and Federal Institutes. Existing initiatives such as Women in Construction, demonstrate the potential of inclusive vocational education to empower underrepresented groups and strengthen local labour markets. In both sectors, the adoption of sustainable technologies has proven to increase job qualifications, creating more specialised, stable occupations with improved working conditions, and offering a pathway to reduced informality and enhanced job quality.

To ensure that green jobs are accessible and equitable, Brazil must align TVET with labour market needs by embedding sustainability into curricula and expanding access for informal workers and vulnerable populations. Introducing green job classifications into the national occupation system (CBO) and establishing robust monitoring frameworks will also be essential for evidence-based policymaking.

Ensuring the success of Brazil's green transition also depends on the strategic alignment of sectoral and social programmes. Initiatives such as My House My Life, when integrated with digital tools like BIM and supported by green finance from public banks such as BNDES, can amplify the social and environmental impact of housing and infrastructure investments. Similarly, Novo PAC provides a critical platform for scaling sustainable infrastructure and reducing regional inequalities. Aligning these programmes under a coherent national strategy will be essential for maximising public investment and delivering inclusive, low-carbon development outcomes.

Importantly, green skills are not only a tool for environmental and social transformation but also a powerful economic lever. By equipping workers with the competencies needed for emerging green technologies and sustainable practices, Brazil can boost productivity, foster innovation, and enhance the global competitiveness of its industries. Investing in green skills development strengthens the country's capacity to attract sustainable investments, modernise infrastructure, and create high-quality jobs that drive long-term economic growth.

Ultimately, a just green transition in Brazil's construction and cement sectors depends on integrated action across government levels and sectors. This includes aligning industrial, environmental, and educational policies; mobilising targeted investments; and embedding social equity into all aspects of the transition.

06

Recommendations

The recommendations presented in this case study are derived from research findings and are intended to stimulate dialogue. Any suggested implementation steps are illustrative examples only, provided to clarify the recommendations. They are not prescriptive and should not be interpreted as definitive guidance. Final design and execution of policies or programmes rests with the respective country stakeholders, who are best positioned to adapt and contextualise approaches in line with national priorities and capacities.

6.1 General recommendations

1 Policy & governance

Develop a National Green Skills Strategy

Recommendation and rationale

Brazil lacks consistent integration of green skills across existing policies. The absence of an overarching national strategy on green skills has resulted in fragmented and siloed approaches. The case study has identified skills gaps across multiple sectors of Brazil's economy. Interviews with stakeholders have also shown how the lack of a green skills strategy significantly impacts green jobs training; particularly through the evident misalignment between green skills development and existing climate policies, strategies, and programmes. A national strategy would ensure the coordinated development of green competencies, inclusive employment, and regional equity.

Responsible stakeholder

- Federal Government
- Ministry of Education
- Ministry of Labour and Employment (MTE)
- Ministry of Science, Technology and Innovation
- Ministry of Development, Industry, Trade and Services (MDIC)
- National Institute for Educational Studies and Research (INEP)
- Skills providers (especially the National Service for Industrial
- Training (SENAI) and the National Service for Commercial Training (SENAC)
- Private enterprises, businesses, and trade associations
- International cooperation partners (e.g. International Labour Organisation (ILO)

Implementation

- Mobilise strategic stakeholders, focusing particularly on engaging the private sector to align skills development with job creation and innovation within various sectors and skills providers.
- Establish a representative working group mandated to identify opportunities within existing policies (both federal and regional) with the goal of integrating green skills and ensuring coherence across policies; reviewing regulatory implications; developing training roadmaps on collaboration with TVET providers; establishing funding mechanisms such as green credit lines and public-private partnerships to scale up training programmes and ensuring their long-term viability; and to explore other cooperation models with employers and the private sector to increase demand for green skills.

2

Data, research, & foresight

Introduce a green jobs indicator within the Brazilian Occupation Classification (CBO) system

Recommendation and rationale

Brazil's current CBO classification framework does not distinguish green jobs from conventional jobs, creating a data gap that prevents accurate measurement of workforce transitions towards sustainability objectives. This gap also limits the government's ability to design targeted interventions or allocate resources efficiently. Establishing green job indicators within the existing CBO data infrastructure would enable systematic tracking of employment patterns aligned with environmental goals and provide the analytical foundation necessary for evidence-based policymaking in the green economic transition.

Responsible stakeholder

- Federal Government
- Ministry of Labour and Employment (MET)
- Ministry of Development, Industry, Trade and Services (MDIC)
- Brazilian Institute of Geography and Statistics (IBGE)
- Institute for Applied Economic Research (IPEA)
- Skills providers (TVET institutions, especially SENAI, SENAC)
- Private enterprises
- Trade unions
- International cooperation partners (e.g. ILO)

Implementation

- Set up a task force mandated to develop and oversee the implementation of a new green jobs indicator within the CBO system.
- Develop green jobs classification tags using the ILO and Occupational Information Network (O*NET) frameworks, covering direct benefits (e.g. green building construction, energy-efficient retrofitting), indirect contributions (e.g. sustainable materials production), and enabling activities (e.g. environmental compliance, waste management).
- Implement this new job classification through stakeholder consultations with industry partners, trade unions, and government ministries; pilot testing with major employers; and validation against international databases.
- Enable disaggregated data reporting by green job categories across regions, company sizes, and skill levels, with monitoring capabilities for job creation, skills demand, and standardised international comparisons.

3 Policy & governance

Mainstream green jobs into the Novo PAC and My House My Life programmes

Recommendation and rationale

Brazil is investing considerably in the Novo PAC and My House My Life *(Minha Casa Minha Vida)* programmes to stimulate economic growth. This includes investment in the construction and cement sectors. Existing programmes do not yet fully capitalise on the opportunities related to green skills and green jobs. To effectively leverage these opportunities, there needs to be alignment between infrastructure investment and Brazil's NDC climate commitments through the Multi-Year Plan for Public Administration (PPA).

Responsible stakeholder

- Federal Government
- Ministry of Planning
- Ministry of Cities
- Ministry of Labour and Employment (MTE)
- National Congress
- Municipal governments
- Construction and cement contractors

Implementation

Encouraging and mobilising Brazil's industry to add green jobs and use sustainable building materials, requires the introduction of quotas and minimum requirements for programme contractors. Implementing this policy would involve three key steps:

- Establishing a clear, nationally recognised definition of what constitutes a "green job" (see previous recommendation).
- Creating a standardised list of recognised "green" (sustainable) building materials.
- Specifying which categories of the Novo PAC and My House My Life projects will be subject to these quotas for green jobs and sustainable materials.

These measures will require supplementation with percentage targets aligned to Brazil's NDC climate commitments and integrated into the PPA.

6.2 Sector-specific recommendations

6.2.1 Construction

4 Policy & governance

Establish green procurement mandates with regional oversight

Recommendation and rationale

Interviews with stakeholders have indicated that employers in the construction sector struggle to find qualified workers for low-carbon projects. This skills gap limits the sector's contribution to NDC commitments. Without a workforce possessing recognised green construction qualifications, enterprises cannot ensure compliance with environmental targets or project quality standards.

It is paramount to establish green skills public procurement mandates that encourage enterprises to support worker certifications, while also creating incentives for all workers, formal and informal alike, to obtain recognised qualifications.

Responsible stakeholder

- Ministry of Labour and Employment (MTE)
- Municipal governments
- Brazilian Chamber of the Construction Industry (CBIC)
- Skills providers (especially SENAI, SENAC)
- Private construction enterprises
- Trade unions

Implementation

Establish a working group to develop operationalisation plans and monitoring mechanisms. Within these mandates:

- Include regulations requiring designated certifications for specific construction occupations and tasks, such as those directly related to energy efficiency and sustainable building practices.
- Require certified workers for public infrastructure and climate-related construction projects, with defined minimum thresholds (e.g. 30% of workers on site must be certified; certain occupations must have certification).
- Link certification compliance to eligibility for public contracts, subsidies, and green financing schemes.

Make green skills certification a prerequisite for professional licensing and accreditation of skills providers in the sector.

5

Education & training systems

Develop green construction certification programmes to support procurement mandates

Recommendation and rationale

To operationalise procurement mandates requiring certified workers, Brazil must establish comprehensive green construction certification programmes. The construction sector currently lacks standardised curricula addressing the green skills and technologies necessary to meet low-carbon and environmentally responsible construction standards. Without these certification programmes, procurement mandates cannot be effectively implemented, which limits the sector's capacity to deliver sustainable public infrastructure projects.

Certification programmes should be developed by integrating green skills into existing curricula and designing new programmes for emerging green technologies. These programmes must align with procurement requirements and ensure that workers possess the competencies needed for sustainable construction practices across diverse regional contexts.

Responsible stakeholder

- Ministry of Education
- Ministry of Labour and Employment (MTE)
- Municipal governments
- National Institute for Educational Studies and Research
- (INEP)
- Skills providers (especially SENAI, SENAC)
- Private enterprises
- Trade Unions

Implementation

- Establish or embed regional skills councils within existing systems to oversee curriculum development, incorporating input from public- and private-sector employers to ensure training content aligns with sector demands.
- Design certification programmes for green construction skills with three-year renewal cycles linked to public procurement requirements, by integrating green skills into existing curricula and developing new programmes for emerging technologies.
- Partner with TVET institutions to deliver tailored training programmes for construction professionals, ensuring alignment with both technical standards and regional needs.
- Address socio-economic inequalities by establishing flexible pathways for informal workers through modular training options, recognition of prior learning, and skills-based assessments that can translated into formal education credentials.

6

Social protection & inclusion

Expand access to green upskilling for informal workers in Brazil's cement sector

Recommendation and rationale

The cement sector in Brazil is characterised by high levels of informality. In economically deprived areas, workers also experience structural exclusion due to inadequate transport infrastructure and limited digital connectivity. These barriers prevent access to formal education and training, perpetuating marginalisation and restricting opportunities for workforce development in green construction practices.

To address these challenges, mobile training units operated by SENAI should be deployed to economically deprived regions where informal construction work is already prevalent. These units can deliver targeted green skills training directly to communities, reducing the need for travel and accommodating workers' time constraints.

Responsible stakeholder

- Ministry of Labour and Employment (MTE)
- Municipal Governments
- SENAI
- Private enterprises
- Trade unions

Implementation

- Conduct a scoping mission to develop the project.
- Identify target regions with high levels of informal construction work and limited access to formal training (MTE).
- Carry out an assessment to match existing training and existing systems that can support to local needs (i.e. partnerships with skills providers, employers, and communities).
- Identify stakeholders in selected regions for planning purposes (financing).
- Mobilise finance through grant or development funding.
- Engage local stakeholders to raise awareness and encourage participation among informal workers.
- Coordinate with SENAI to plan the deployment of mobile training units to selected areas.
- Schedule training sessions that align with workers' availability and community routines.
- Deliver green construction skills trainings on-site using mobile units, minimising travel and digital access barriers.
- Monitor participation and outcomes to assess effectiveness and inform future deployments.
- Scale and adapt the model based on feedback and evolving needs in other regions.

7

Finance & investment

Establish a Green Regional Development Investment Fund

Recommendation and rationale

Brazil's regional development policies underutilise investment in green jobs and green skills as tools for addressing socio-economic disparities, despite their potential to deliver economic returns. Integrating green skills and green jobs into policy development could improve the impact of public funding and reduce regional disparities.

To incentivise regional participation, a dedicated financing mechanism should be developed to reposition green jobs and green skills as investment opportunities. Priority should go to regions with high carbon intensity, uneven innovation, and socio-economic challenges. Such a fund would demonstrate that green investments can provide a viable alternative to traditional regional development approaches by creating jobs and improving income opportunities in underserved areas.

Responsible stakeholder

- Ministry of Finance
- Ministry of Development, Industry, Trade and Services (MDIC)
- Ministry of Environment and Climate Change
- Municipal governments in participating regions
- BNDES (Brazilian Development Bank)
- Banco do Nordeste
- FINEP (Funding Authority for Studies and Projects)
- Skills providers (especially SENAI)
- Academic and research institutions
- Brazilian Chamber of the Construction Industry (CBIC)
- Cement and construction firms

Implementation

- Establish the fund as a new window within the Brazil Climate and Ecological Transformation Platform (BIP), with BNDES as the fund manager targeting regions with cement production, industrial decarbonisation, and green innovation potential.
- Design the fund on proven models: integrate lessons from Minas Gerais's Decarbonisation Route alliance (multi-stakeholder coordination) and São Paulo's government-led industrial strategy (policy alignment and innovation incentives).
- Capitalise the fund through a blended finance model (e.g. 40% from the federal budget (Ministry of Finance), 35% from international climate finance mobilised via BIP, 25% from private sector co-investment, incentivised through tax relief).
- Implement a monitoring framework using BNDES's existing "green seal" processes to track green job creation, regional development outcomes, and innovation deployment effectiveness.
- Support peer learning and visibility by facilitating peer-to-peer exchange to encourage uptake by other regions through demonstrated impact.

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8 Annexes

8.1 Overview of existing initiatives

Brazil has seen the emergence of numerous practical initiatives supporting its transition to a green economy, spanning public policies, private sector programmes, training strategies, and financial instruments. These actions reflect a growing yet still fragmented ecosystem aimed at preparing the country's workforce, industries, and institutions for a more sustainable future.

Public training Initiatives on green skills:

- **SENAI upskilling programmes:** Expanded non-formal training opportunities with short-term modules focused on energy efficiency, sustainable construction, and use of alternative materials, particularly for high-emission sectors like construction and cement. However, regional disparities remain, with limited training infrastructure in the North and Northeast.
- **Federal Institutes (IFs):** Offering technical and qualification courses in renewable energy, such as photovoltaic panel installation and maintenance, supporting skills growth relevant to solar energy expansion and carbon footprint reduction.
- **EnergIFE programme:** A collaborative effort between enterprises and technology institutes focused on promoting innovation and knowledge sharing in smart grids, renewable energy, and energy-efficient vehicles. It provides support through grants and soft loans, financed by institutions like the Brazilian Development Bank (BNDES), the Funding Authority for Studies and Projects (FINEP), and the Brazilian Electricity Regulatory Agency (ANEEL). The programme aims to induce the culture of Renewable Energies and Energy Efficiency on the Federal Network of Professional, Scientific and Technological Education Institutions.
- **Pronatec Bioeconomy** aims to expand technical and vocational training opportunities in strategic sectors. In the last years, courses linked to the green transition were prioritised, particularly the bioeconomy and renewable energy. Coordinated by the Ministry of Education, it provides free courses through TVET Institutions, aiming to strengthen the workforce, promote regional development, and support Brazil's decarbonisation and sustainable growth goals. Since 2021, courses focusing on skills development for sustainable production, clean energy generation, and environmental management were offered by the Federal Network of Professional, Scientific and Technological Education Institutions through the program.

Private sector training Initiatives on green skills

- **Renewable energy training:** Enterprises have created programmes for solar panel installation and maintenance. For example, SENAI offers a course for Photovoltaic Solar System Installers, training professionals to plan, execute, and assess solar installations while covering key topics such as system components, protection devices, technical standards, and safety procedures (SENAI, 2025).

- **Construction sector certifications:** LEED and AQUA sustainability certifications incentivise enterprises to train teams in green practices. For example, large construction companies like MRV Engenharia, which specialize in affordable and residential developments with a focus on the Minha Casa Minha Vida programme, have adopted these certifications and, as a result, invest in training their teams on green building practices, energy efficiency, waste management, and sustainable material use (MRV, 2017).

- **National Construction Workforce Training Plan 2025 *(Plano Nacional de Capacitação para a Construção Civil 2025):*** Launched by SENAI and CBIC, this programme provides free, on-site training in trades such as masonry, carpentry, and reinforcement, offering CBO-based certification and addressing the sector's shortage of skilled labour (CBIC, 2025). The plan also includes the Women Build (Elas Constroem) initiative, which targets female workers, providing training and linking them with employment opportunities.

Inclusion programmes

- **Diogo de Sant'Ana Programme** for Waste Pickers and Recycling for the People (2023, formerly Pró-Catador): Federal initiative promoting the inclusion of low-income waste pickers into formal recycling chains through cooperative support, technical training, improved access to finance, and public procurement. The programme emphasises participatory governance, regional coordination, gender and racial equity, digital inclusion, and environmental education (Brazil, 2025).

Collaborative frameworks and partnerships

- **BNDES industry dialogues:** Led discussions with heavy industry representatives (cement, steel, fertilisers) on decarbonisation strategies aligned with the Paris Agreement, laying groundwork for sectoral transitions and reaffirming financing commitments (BNDES, 2023).

- **Cement 2050 Technology Roadmap:** Developed collaboratively by government, industry, academia, and international organisations to outline emissions mitigation, R&D, and workforce training actions specific to the cement sector.

- **International partnerships:** Brazil participates in networks like Alliances for Climate Action and Green Jobs Pact for Youth, signalling openness to external collaboration, resource mobilisation, and knowledge-sharing (Young, da Costa, & Mendes, 2019).

Public financing instruments

- **National Climate Change Fund (Fundo Clima):** Managed by BNDES, supports renewable energy and sustainable infrastructure.

- **Amazon Fund:** Provides resources for forest conservation with social co-benefits.

- **Public bank programmes:** BNDES, Banco do Brasil, and the Federal Savings Bank offer sustainable credit programmes targeting solar energy and low-carbon agriculture.

- **External Financing Commission (Cofiex**): Under the Ministry of Planning and Budget, Cofiex aims to mobilise external investments to support clean energy, green industry, and sustainability-related public policies (Cofiex, 2024).

- **Eco Invest Brazil:** Part of the New Brazil initiative (Novo Brasil), Eco Invest Brazil mobilises private and international capital for sustainable, long-term projects, offering financial instruments to mitigate currency volatility. The programme supports strategic sectors including renewable energy, bioeconomy, circular economy, and green infrastructure, enabling climate adaptation, ecosystem restoration, and technological innovation for ecological transformation (Brazilian National Treasury, 2025).

- **Brazilian Platform for Investments in Climate and Ecological Transformation (BIP):** a government initiative aimed at boosting investments in decarbonisation, sustainable resource use, and improving quality of life. It is led by the Ministry of Finance, in collaboration with the Ministries of Environment and Climate Change, Development, Industry, Commerce and Services, and Mines and Energy. The National Bank for Economic and Social Development (BNDES) serves as the Secretariat, overseeing daily operations. The Platform supports the Ecological Transformation Plan and other climate transition and adaptation strategies across key sectors.

Private financing instruments

- **IFC investment (2023):** USD 150 million invested in Votorantim Cimentos to improve co-processing capabilities and reduce greenhouse gas (GHG) emissions through increased use of alternative fuels (IFC, 2023).

In general, it can be stated that the provision of green skills in the country remains very limited, with a significant shortage of qualified labour, for instance in the renewable energy sector. Despite the substantial progress achieved, several challenges continue to constrain the full potential of these initiatives. Regional disparities persist, particularly in the North and Northeast, where access to adequate training and infrastructure remains insufficient. As an interviewer highlighted, "regions such as the Southeast concentrate the majority of investments, which limits the development of a specialized technical workforce in other areas and makes it difficult to redistribute resources and professionals across the country. Furthermore, even in regions that do receive investments, these remain insufficient given the high cost of acquiring green technologies, which are often imported due to limited domestic production" (KII, Skills Provider, 2025).

The absence of a comprehensive national framework for reskilling workers transitioning from traditional or carbon-intensive sectors further hinders a just and inclusive green economy transition, with existing efforts, such as those in the cement industry, still limited in scope. Moreover, coordination across programmes is weak, as Brazil lacks a permanent national forum to oversee and align green jobs initiatives, undermining long-term strategic planning and institutional continuity. While large companies have demonstrated commitment by investing in green technologies and developing training programmes, many micro, small, and medium-sized enterprises face significant financial and logistical challenges that restrict their participation. Finally, obstacles in accessing green finance and limited technical capacity at the municipal level highlight the urgent need to strengthen support mechanisms and foster stronger collaboration among public, private, and civil society actors to ensure that the benefits of the ecological transition are widespread and sustainable.

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