DDP BRAZIL

DEEP DECARBONIZATION OF CEMENT PRODUCTION IN BRAZIL

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SUMMARY

The Brazilian industry accounted for 26% of the national GDP in 2019. This participation has decreased over the last 30 years due to successive crises. Like the economy as a whole, industrial growth is assumed to resume after the pandemic. From 2020 until 2050, the value-added annual average growth rates of the cement, iron and steel, and chemical industries would be 2.6%, 1.9%, and 1.7%, respectively, following the national economic annual growth rate trend. The industry's 2019 sector GHG emissions corresponded to about 11% (162 Mt CO_2eq) of the country's total, with half of them coming from the three sectors above-mentioned and 39Mt CO_2eq from cement production.

The study simulates two economy-wide GHG emission scenarios for Brazil up to 2050: the current policies scenario (CPS) and the deep decarbonization scenario (DDS) (See the paper "Deep decarbonisation in Brazil").

In CPS, assuming the same performance of ongoing mitigation policies and measures, the industry's GHG emissions would reach 268 Mt CO_2eq in 2050, 75% from energy consumption and 25% from IPPU (Industrial

DDP

The DDP is an initiative of the Institute for Sustainable Development and International Relations (IDDRI). It aims to demonstrate how countries can transform their economies by 2050 to achieve global net zero emissions and national development priorities, consistently with the Paris Agreement. Analyses are carried out at the national scale, by national research teams. National research teams openly share their methods, modelling tools, data and the results of their analyses to share knowledge between partners in a collaborative manner and to facilitate engagement with sectoral experts and decision-makers.

About this project

The ACT-DDP research project is an international pilot project, which aims at accelerating the implementation of national and sectoral deep decarbonisation through a better dialogue between private companies and governments and for a mutual enrichment of their low-carbon strategies. Through the synergy between two pioneer initiatives, the Assessing low Carbon Transition (ACT) initiative and the Deep Decarbonization Pathways initiative (DDP), the project partners built and tested methodologies and tools for developing national and sectoral deep decarbonisation pathways compatible with the Paris Agreement and assessing company strategies with them.

This project is supported by the Fonds Français pour l'Environnement Mondial (FFEM) and by in-country French representatives such as the local French Development Agencies (AFD) and French embassies.

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Processes and Product Use). 66 Mt CO_2eq out of the total is due to cement production.

In DDS, implementing well-known mitigation measures in the industry sector leads to an absolute emissions increase of 13% in 2050, compared to 2019. In terms of emission intensity (tCO_2e/$GDP), the industry sector had a 26% reduction at the same time. No new industrial processes nor disruptive mitigation technologies are assumed. Mitigation actions include: substantial acceleration of energy efficiency improvement, allowing energy intensities to decrease between 21 to 25% in 2050, varying across industrial branches; fuel shifts to renewables, including an increased use of charcoal for pig iron production and wood and residues in cement kilns; and an increased use of ashes and slag to replace clinker in cement blending. The full replacement of HFCs by low GWP gases would be near completion (98% reduction of its GHG emissions) by 2050. As a result, in DDS, industry's emissions will reach 184 MtCO_2eq in 2050, 31% less than in the CPS, with energy-intensive industries accounting for 87% of these emissions.

CEMENT AND CLINKER CONSUMPTION

Cement and clinker consumption are expected to grow by 2050. The increase of population and GDP per capita drives its increase. Between 2019 and 2050, the population should increase 11%, from 210 to 233 million. In the same period, the GDP per capita has a 68% increase. These factors pushed the cement production from 54 Mt in 2019 to 111 Mt in CPS and 95 Mt in DDS, which represents an increase in demand per capita of 60% in CPS compared to 37% in DDS between 2020 and 2050.

This difference in the consumption represents the effect of a more rational consumption of cement due to a price increase. Indeed, the DDS scenario considers the implementation of technologies to reduce the emission intensity of cement having an impact on the production costs.

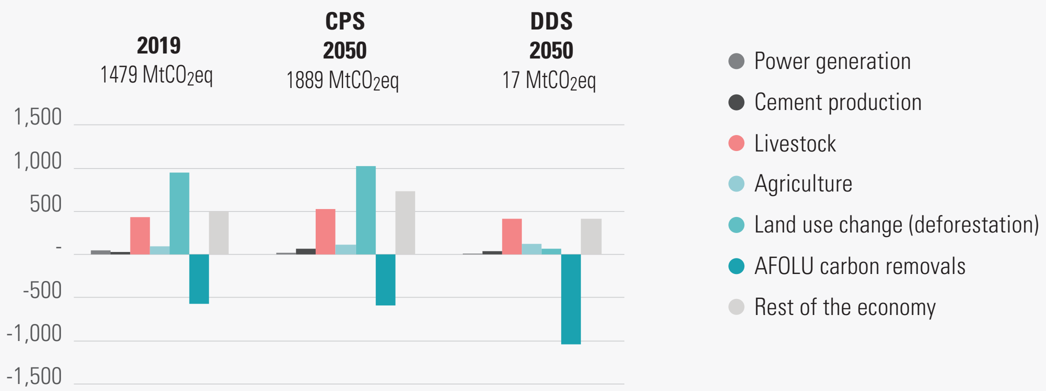
CEMENT AND CLINKER PRODUCTION

The decarbonisation of the production is based on technologies with a high level of technological readiness and high potential for reducing GHG emissions. **Table 1** summarizes the mitigation potential of the different options considered: change in process, energy efficiency measures, fuel replacement and clinker replacement. Innovative energy efficiency measures, demand-side measures or carbon capture and storage technologies are not considered.

Energy consumption intensity in CPS has no significant reduction between 2015 and 2050, while in DDS, implementing energy efficiency measures and clinker replacement in cement cut the energy intensity of cement production by 30%, down to 2.1 GJ/Mt.

In addition, while the CPS does not consider any changes in fuel shift or clinker substitution, the DDS

Figure 1. GHG Emissions



assumes an increase of up to 10% of alternative fuels, such as charcoal and a reduction of the clinker to cement ration from 64% to 52% by 2050.
Together, all mitigation actions decrease the emission intensity of cement production in DDS from 0.59 to 0.44 $MtCO_2e$/Mt cement in 2050. With the increasing demand, total emissions continue to increase in both scenarios, but only by 8% over the period 2015-2050 in DDS against 70% in CPS.

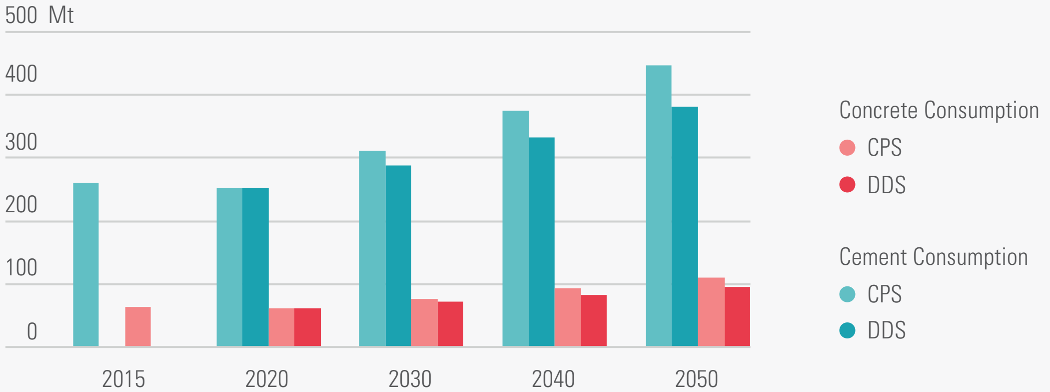
Table 1. Mitigation potential

Mitigation Action	Mitigation potential (2020-2050)
Dry process with multiple stages	BAT – 2,9 GJ/t clinker
Control and optimization	↗ 3.5% energy efficiency
Combustion improvements	↗ 8.0% energy efficiency
Additives	↗ 15% energy efficiency
Refractory in ovens	↗ 6.8% energy efficiency
Fuel shifts to renewables	↗ 3.8% to 10% of energy use
Reduction in clinker/cement ratio (i.e., clinker replacement)	↘ from 64% to 52% clinker/cement ratio

Table 2. Indicators

	2015	2020	2030		2040		2050	
			CPS	DDS	CPS	DDS	CPS	DDS
Cement production (Mt)	65	63	78	72	100	83	111	95
Demand intensity (kg cement/capita)	258	297	345	321	404	358	479	408
Energy intensity (GJ/Mt cement)	3.0	3.1	3.1	2.7	3.1	2.4	3.0	2.1
Energy consumption (ktoe)	4.75	4.63	5.72	4.62	6.85	4.71	8.08	4.73
Ratio Clinker/cement	64%	64%	64%	58%	64%	53%	64%	52%
GHG Emissions intensity ($MtCO_2e$/Mt cement)	0,59	0,59	0,59	0,53	0,59	0,48	0,59	0,44
% biomass	3.8%	3.8%	3.8%	6.1%	3.8%	8.3%	3.8%	10%
GHG emissions ($MtCO_2e$)	39	37	46	38	55	39	66	42

Figure 2. National final consumption of cement and concrete (Mt)



OPPORTUNITIES TO DECARBONIZE THE CEMENT SECTOR

Demand Side Opportunities

- Improvement in design and construction practices requiring less concrete in new buildings and infrastructure (may require revision to building codes).
- More efficient use and extended life of structures and recycling of cement from old buildings to further reduce demand

Production Side Opportunities

- Credit lines for energy efficiency actions
- Carbon pricing or emission performance standards
- Dissemination of low carbon technologies
- Training and awareness activities on the adoption of low carbon measures
- Regulations encouraging the use of waste as energy/raw material (e.g., landfill disposal taxation)
- Improvements in recycling regulations
- Labels certifying the origin of raw materials (energy forests)
- Certification and use of low clinker cements (e.g., shifting from prescriptive to performance-based design standards could stimulate uptake of lower-carbon blended cements and cements that include alternative binding materials)
- Creating demand for low carbon cements (e.g., public procurement or subsidies through contracts for difference)

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