BRAZIL

BUILDING

Local authorities and businesses, pioneers in a still weak national set-up

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Local authorities and businesses, pioneers in a still weak national set-up

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Photographs of slums in the shadows of skyscraper business centers are a common feature in geography textbooks to illustrate the inequalities generated by Brazil's economic development. The figures speak for themselves: after Japan, Brazil has the highest urbanization rate among the most populated countries, with 86% of its 209 million inhabitants living in cities. What impact does this level of urbanization have on the challenges of reducing greenhouse gas emissions? Given the country's recurrent economic crises, the escalation in household equipment for the middle classes, and the vulnerability of the national energy mix to climate variations, energy-saving policies for residential and commercial buildings are crucial. This analysis examines the success and failure factors of policies pursued by non-state actors to reduce the impact of buildings on GHG emissions in Brazil.

Key takeaways

GHG emissions from the Brazilian residential sector dropped by 20% from 2014 to 2018, down to 2010 levels. This decrease is mainly due to the significant share of hydropower in the electricity mix and an economic crisis starting from 2014 that greatly reduced energy demand.

The national energy-saving framework for buildings, which gains strength with every crisis, has since the 1980s corresponded to energy security considerations more than ecological concerns. The PROCEL label for equipment and the consumption thresholds established by the 2001 Act have led to savings of 21.2 TWh. The "PBE Edifica" labeling program in place since 2010 concerns all private and public buildings, but is only obligatory for federal buildings.

Electricity consumption in the residential sector due to air conditioning tripled from 2005 to 2017, impacted by architectural standards ill-adapted to the different regional climates in Brazil. Air conditioning is likely to represent 20% of electricity demand by 2050.

Brazilian local authorities have proved to be particularly enterprising and connected to international networks. The main lever is a property tax deduction for buildings certified as sustainable, ranging from 4% to 20% depending on the city and region, and on the criteria applicable. Cities like Recife apply a tool to regulate green roofs and self-supply.

Brazil is one of the biggest global markets for sustainable building certification with over 1,000 LEED or AQUA-HQE certified buildings; nevertheless, their standards are relatively ill-adapted to regional climates, materials, and traditional Brazilian construction techniques.

CONTENTS

1. Drop in emissions once the electricity mix back to normal

GHG emissions from the Brazilian residential sector dropped from 35 million tons of CO_2 equivalent ($MtCO_2e$) in 2014 to 28 in 2018, which is a 20% decrease in four years. During the same period, emissions from the sector linked to fossil fuel consumption nevertheless rose slightly (+1.2%) and residential electricity consumption increased by 3% (tab. 1).

In the tertiary sector, GHG emissions went from 20 to 12 $MtCO_2e$ over the same 2014-2018 period, a drop of 38%. At the same time, electricity consumption in this sector increased by 2%, and emissions linked to fossil fuel consumption went down by 12%. The evolutions of these energy consumption indicators do not alone explain the drop in total emissions in the residential and tertiary sectors. The main factor behind the emissions decrease is changes in the carbon content of electricity. Emissions levels are however higher than they were in 2010.

TABLE 1

EVOLUTION OF EMISSIONS IN THE BUILDING INDUSTRY IN BRAZIL - Source: Enerdata

	2010	2011	2012	2013	2014	2015	2016	2017	2018	Evolution 2010 - 2018
Total emissions from the residential sector ($MtCO_2e$)	23.44	22.14	25.81	31.32	35.34	34.38	29.03	29.80	28.14	**20%**
Emissions from the residential sector linked to fuel ($MtCO_2e$)	17.20	17.43	17.54	17.95	17.96	17.98	18.16	18.30	18.18	**6%**
Residential electricity consumption (TWh)	108.46	111.97	117.65	124.90	132.05	131.32	132.92	134.00	136.12	**26%**
Total emissions from the tertiary sector ($MtCO_2e$)	8.75	7.39	10.91	15.86	20.02	18.97	13.05	13.69	12.13	**39%**
Emissions from the tertiary sector linked to fuel ($MtCO_2e$)	2.61	2.68	2.50	2.40	2.47	2.21	2.22	2.15	2.16	**-17%**
Tertiary electricity consumption (TWh)	106.70	112.23	119.62	125.73	133.27	134.08	132.50	134.42	136.21	**28%**

Thus, in 2018, the building sector was responsible for 14.8% of Brazil's total energy consumption. Although this proportion is moderate, when taking electricity only the sector represents a much greater share, with 50% of electricity production consumed by buildings (EPE, 2019).

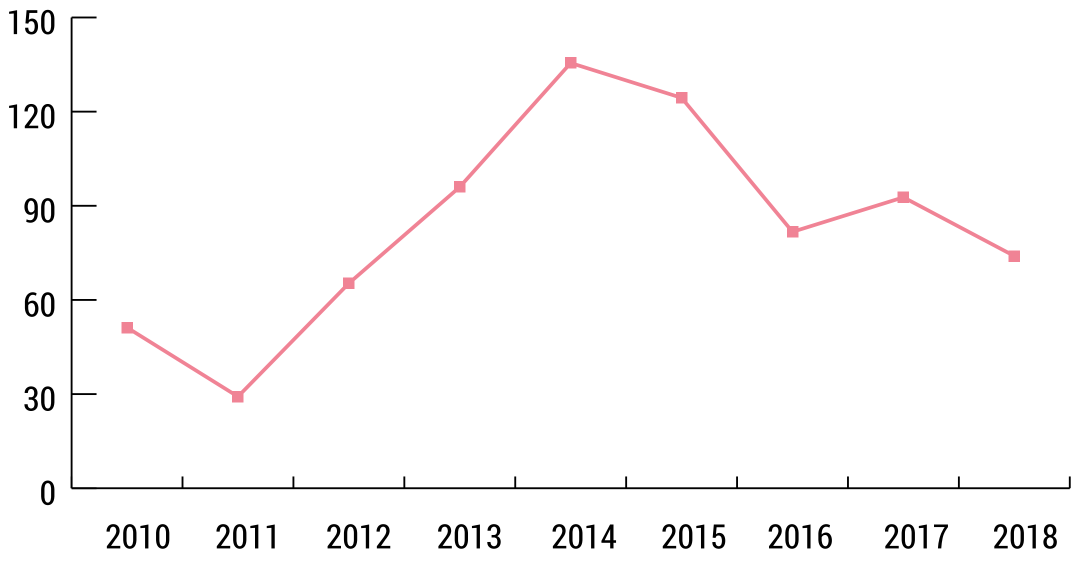
The share of renewable energy, mainly hydropower, in Brazilian electricity production is one of the highest in the world. Thus, in 2016, hydropower plants provided the country with 66% of its electricity (SEEG, 2018). However, this participation depends on climate and hydrological conditions: from 2011 to 2016, the country endured several droughts that reduced water volumes in reservoirs. To make up for the drop in hydropower generation and ensure energy supply, coal- and gas-fired power stations had to be activated, which increased the carbon content of the energy supply (SEEG, 2018).

From 2011 to 2014, the carbon intensity of electrical energy thus went from 29 to 135 gCO_2e/kWh, which is almost a fivefold increase (MCTIC, 2020). It then dropped back down to 74 gCO_2e/kWh in 2018 (fig. 1). As a comparison, the carbon intensity of the electricity produced in the European

Union was 296 gCO_2e/kWh in 2016, which is four times that of Brazilian electricity (EEA, 2018). This halving of the carbon intensity of electricity from 2014 to 2018 is the main cause of the reduction of emissions in the building industry.

FIGURE 1

EMISSION FACTOR OF BRAZIL'S ELECTRICAL ENERGY (gCO_2E/KWh) - *Source:* MCTIC



In addition, the economic recession that hit the country from 2015 to 2016 reversed the evolution of energy demand and related emissions: GDP shrank by 3.5% in 2015 and 3.3% in 2016, then climbed up to a relatively low growth rate in 2017 and 2018 (+1% and +1.1% respectively) (World Bank Data, 2020). Thus, from 2015-2016, total energy demand fell and energy sector emissions decreased by 7.3% (SEEG, 2018). The building sector was also impacted: residential electricity consumption, after rising sharply from 2010 to 2014 from 108 TWh to 132 TWh (+22%), has since almost stabilized (+3% from 2014 to 2018). In the tertiary sector, electricity consumption grew 25% before the recession from 2010 to 2014, and by only 2% from 2014 to 2018 (Enerdata). The current COVID-19 pandemic has had a significant impact, with a 10% drop in electricity consumption taking all sectors together since the start of lockdown measures adopted by some Brazilian states and cities (CCEE, 2020). More precise analyses of the building sector are still required to determine whether the pandemic is only accentuating a trend of a slower growth in electricity demand observed since 2014.

The economic crisis has also had an impact on the choice of fuel used by Brazilian households, which are turning to traditional biomass: the hike in the price of liquified petroleum gas (LPG) (24% from July 2017 to May 2018) has spurred Brazilian households to replace this fuel with traditional biomass (wood, plant-based or green charcoal) particularly in cooking. In 2018, 14 million households used wood to cook their food, which is about 20% of households and 3 million more households than in 2016 (Gandra, A., 2019). In some of Brazil's poorest regions, more than one family in two currently uses traditional biomass for cooking. From 2013 to 2018, emissions generated by households burning biomass rose by 9% (SEEG, 2019).

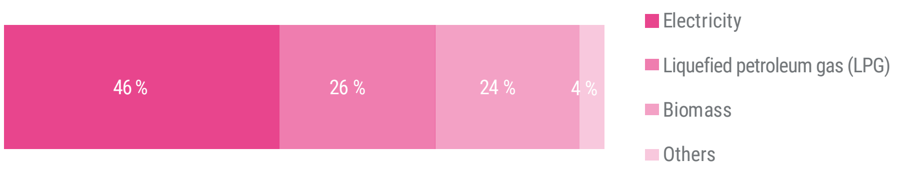
KEYS TO UNDERSTANDING

ELECTRICITY, BIGGEST SOURCE OF ENERGY FOR BUILDINGS IN BRAZIL

A few decades ago, biomass was the primary source of residential energy (40% in 1990), used by Brazilian families for heating water and cooking food. In 2016, it only represented 24% of energy usage, gradually replaced by LPG (26%) and electricity (46%) (EPE, 2017). Gas represents less than 3% of usage, since gas networks are not very developed in the country. Brazil is therefore one of the countries in which electricity represents the greatest share of consumption by buildings. By way of comparison, electricity accounts for 32% of consumption by buildings in Europe, behind natural gas (36%) (European Commission, 2018).
This difference can mainly be put down to the contrasting climate: the country is located in an intertropical zone and indoor heating requirements are almost nil. The technologies employed also vary, principally for heating water: while 57% of Brazilian households have no hot water facilities (for the most part in the north of the country where the climate is hottest), 41% of them use an instant electric water heater integrated into the showerhead (Eletrobras, 2020). This kind of water-heating system is cheap and easy to install but consumes a great deal of energy, representing 19% of residential electricity consumption in 2016 (EPE, 2017).

FIGURE 2

ENERGY SOURCE OF RESIDENTIAL BUILDINGS - *Source: EPE, 2017*



BOX 1

The recent drop in emissions in the residential sector can therefore be put down to two factors: firstly, the economic crisis since 2014 that has held back the rise in energy consumption; secondly, the end of a period marked by intense droughts, and thus a return to the share of hydropower in the Brazilian mix, which reduces the carbon intensity of electrical energy. In addition to these main causes, other factors are at play.

2. A national framework with few restrictions but with the potential for savings

• ACTION MOTIVATED BY ENERGY SUPPLY DIFFICULTIES • During the decades that preceded the current economic crisis, Brazil enjoyed substantial economic growth. The period saw a large share of the poorer population move up into the middle classes. With their increased spending power, households were able to purchase domestic appliances, and electricity consumption per capita progressed by 160% from 1980 to 2014 (World Bank Data). Demographic growth, urbanization, and a reduction in household size contributed to a 22% growth in electricity demand from the residential sector from 2010 to 2014 (Enerdata).

The first energy-saving measures were motivated more by a lack of production capacity than by ecological concerns. During recent years, national electricity consumption has only significantly dropped once, in 2001. Insufficient investment in energy-generating infrastructures, and a drought affecting hydropower plants provoked an energy supply crisis. To avoid electricity cuts, the Brazilian government set up an energy-rationing system: household monthly consumption was limited to 320 kWh subject to fines, and residential electricity consumption fell by 39% between the first and second halves of 2001 (Bardelin, 2004). Along with this drastic drop in consumption, the so-called "apagão" (power cut) crisis has had a long-term impact on consumer behavior. In particular, the crisis led to Act No. 10.295/01, known as the Energy Efficiency Act, which is the main national normative framework for energy efficiency.

The first energy-saving programs emerged in Brazil following the oil shock and the Latin American debt crisis in the 1980s. The PBE energy labeling program was created in 1984 with the aim of informing consumers about the energy consumption of domestic appliances using a ranking from A to E. The PROCEL (National Electricity Conservation Program) established by the Ministry of Mines and Energy dates from 1985, with an objective to promote energy-saving action, including supporting municipalities to adopt energy-saving measures, offering training, and pursuing public awareness campaigns. In addition, low-energy appliances labeled by the PBE program receive a PROCEL label for information purposes only.

These programs, initially voluntary, were reinforced by the 2001 Energy Efficiency Act. Through this law, the federal government imposes maximum consumption or minimum energy-saving levels on domestic appliances. The law also applies energy saving to the construction sector: in 2009, the PBE energy label was extended to cover commercial and public buildings, and in 2010 to residential buildings, with the name "PBE Edifica". The energy class of buildings is determined on the basis of a performance diagnosis that evaluates three criteria: building envelope, air conditioning systems, and lighting.

EXPERIENCE FEEDBACK

SOLAR THERMAL PANELS IN SOCIAL HOUSING

Dating from 2009, the program "Minha Casa Minha Vida" (my house my life) reduced the housing deficit with the construction of over 4 million dwellings (Lis L., 2019). This large-scale social housing program provides financial aid to households whose monthly income is lower than 1,800 reals (~ €400) and makes it easier to access property for families with incomes below 9,000 reals (€2,000). Social housing resulting from this program was constructed with the main aim of reducing costs, and the architectural projects are almost identical throughout the country, with no concern for climatic variations between regions. Consequently, the energy efficiency level of the housing is often low (Cabral K, 2014).

For families with the lowest incomes, the federal government has made it obligatory to install solar water heaters in new "Minha Casa Minha Vida" buildings. Financial aid has been increased to incorporate this technology in buildings, thus avoiding later purchases of instant electric water heaters. The measure has led to energy savings in the southern regions of the country, where inhabitants are used to washing with hot water. However, in the north and northeast regions, where the climate is hotter and the use of hot water for personal washing is rare, it has increased people's comfort but has not generated savings (WRI BRASIL, 2017).

BOX 2

The PBE Edifica program is voluntary and was made obligatory for federal government buildings in 2014. Due to its voluntary nature, few buildings are currently labeled. Moreover, the process is complex, relatively expensive (from 11,000 to 22,000 reals) and has to be validated by an accredited inspection body, of which only three exist in Brazil at present. The Brazilian Council for Sustainable Construction, a civil society organization, has been working with the Ministry of the Environment on public policies to support sustainable building. Its recommendations include simplifying the energy audits in the PBE Edifica program, such as by developing energy diagnosis tools which would make the audits cheaper to carry out, and making them obligatory for all real estate transactions (CBCS, 2015).

This national framework on energy efficiency has led to significant savings. The PROCEL program thus reports energy savings of 128.6 TWh from 1986-2017 and 21.2 TWh for the year 2017 alone (Procelinfo, 2019). Despite these encouraging results, the public energy research enterprise EPE anticipates an annual rise in energy consumption in the residential sector of between 1.2% and 1.7% up to 2050. This increase will be led by electricity consumption, which is set to more than double in the sector due to higher living standards and greater market penetration of domestic appliances, in particular air conditioning units (EPE, 2018a).

• SURGE IN ELECTRICITY CONSUMPTION FROM AIR CONDITIONING • Electricity consumption due to the use of air conditioning (AC) tripled from 2005 to 2017 in the Brazilian residential sector. During this period, AC consumption rose at a pace of 9% per year, reaching 18.7 TWh in 2017 (EPE, 2018b). This high growth results from increased household income coupled with several recent heatwaves: record temperatures were reached in numerous towns in 2015 (39°C in Manaus, 42.5°C in Goias). These phenomena have an immediate impact on sales of AC units with long-term consequences, since the apparatus go on to be used regularly in cooler temperatures (Angelo C, 2015). The boom in sales of this type of energy-consuming equipment feeds into a positive feedback loop, accelerating climate change and increasing the demand for cooling.

Air conditioning changes household energy usage, spurring an increase in the share of electricity employed in air conditioning from 7% in 2005 to 14% in 2017. This trend continues today, while only 16% of households are equipped with AC (IEA, 2018). The hottest regions of Brazil (North and Northeast) are also the poorest and the next few years will see a high demand for AC. Thus, only 5% of households in the Northeast possess AC, compared to 23% in the South, a region which is nevertheless not as hot. The differences are even more striking in terms of income: while 45% of the richest households are equipped (monthly income above 8,159 reals and 14% of the population), only 5% of the poorest households possess AC units (income below 2,004 reals and 30% of the population) (Eletrobras, 2020). According to IEA, Brazil is one of the countries in which electricity consumption from AC is likely to surge in the next few decades, by 5.4% a year between 2017 and 2035 according to the Ministry of Mines and Energy (EPE, 2018b). Air conditioning is set to represent 20% of national electricity demand in 2050 and 30% of demand at peak times (compared to under 10% in 2017) (IEA, 2018).

In the absence of suitable capacity, energy rationing or power cuts could occur. This is because the use of air conditioning often coincides with peak consumption periods, meaning that the increased demand will have a direct impact on the electricity production capacity. It could also provoke the use of thermoelectric plants and a rise in greenhouse gas emissions (Forrester, S. P., 2019).

To reduce the impact of increased use of air conditioning on electricity consumption, the public energy research enterprise (EPE) recommends adopting stricter energy-saving criteria, while the current criteria are lower than those adopted in e.g. China. This could lead to a 14.5 TWh reduction in energy consumption from AC by 2035 (EPE, 2018b). The adoption of passive technologies in the building industry would also reduce the need for AC. A study by Invidiata and Ghisi has thus shown that widespread take-up of low-energy buildings would lead to a 50% reduction in electricity consumption from AC (Invidiata, A. & Ghisi, E, 2016).

3. Local authorities focus on tax incentives for sustainable buildings

One of the measures adopted today by numerous local authorities is the IPTU Verde, an incentive tax in the form of a property tax deduction for certified sustainable buildings. For example, in São Paulo, the property tax is reduced by 4%, 8% or 12% depending on the level of LEED or AQUA certification obtained (Gbcbrasil, 2017). In the city of Guarulhos, the tax deduction can reach 20% of the property tax if the building adopts measures like solar power generation or green roofs (O Jornal de Todos os Brasil, 2011). In the city of Salvador, the reduction ranges from 5% to 10% and applies to new constructions applying a list of criteria, one of which is to produce an inventory of the building's GHG emissions (IPTUVerde, 2020).

EXPERIENCE FEEDBACK

BELO HORIZONTE ADOPTS ITS OWN SUSTAINABLE BUILDING CERTIFICATION SYSTEM

The city of Belo Horizonte has committed to reducing its GHG emissions by 20% before 2030 compared to 2007 levels. In 2012, energy consumed by buildings represented 14% of the city's emissions. To help achieve its targets, in 2012 the city launched its own building certification program, called BH Sustentavel. This certification assesses different characteristics of building projects, with a focus on water management and energy efficiency. To obtain certification, buildings must be able to show a 25% reduction in their energy consumption and carry out a GHG emissions inventory. The program is voluntary and, from 2012 to 2015, 50 buildings were certified, including residential and commercial buildings, municipal schools, and the stadium used in the 2014 football world cup (ICLEI, 2016). The program has served as a model for other towns; for example, Fortaleza launched a municipal sustainable construction standard in 2017 le called Fator Verde.

BOX 3

Along with tax measures, many Brazilian cities apply local regulations for green roofs or self-supply of renewable energy. The city of Recife was one of the first Brazilian towns to define a low-carbon urban development strategy. In its climate plan, improving the energy efficiency of buildings is identified as one of the target mitigation measures, capable of reducing the city's GHG emissions by 88,000 tCO_2e over the period 2017-2040. In 2015, a municipal law made it obligatory to install green roofs on buildings higher than four stories. The objective of this law is to improve the thermal comfort of buildings and to reduce the need for air conditioning and the associated energy costs. The creation of green roofs also helps to attenuate urban heat island effects (Recife, 2016).

With one of the highest solar irradiance levels in the world, Brazil has huge solar energy potential. Nevertheless, decentralized electric solar energy only represented 0.1% of domestic energy production in 2017 (Assunção et Shutze, 2017). To encourage self-supply of renewable energy, local governments are adopting incentive tax measures. For example, the Minas Gerais state government was the first to abolish ICMS (similar to VAT and the main source of income for federal states) on all photovoltaic installations. Today, this state features 22% of Brazil's photovoltaic energy production, with power of 103 MW (Pizarro L, 2019). As well as the environmental aspect and a reduction in GHG, photovoltaics make it easier to access energy and reach isolated rural communities. Following the launch in 2003 of the national energy access program, Luz para Todos, the electrification rate in Brazil went from 93% in 2000 to 98.6% in 2010 (Forrester, S. P., 2019). Today, despite the unequal distribution of hydropower stations, the country is almost totally covered by an interconnected grid, the SIN – National Interconnected System. Access to energy however remains a significant challenge in the Amazon, where almost one million Brazilians are without electricity (IEMA, 2019).

KEYS TO UNDERSTANDING

THE CITY OF PALMAS GAMBLES ON SOLAR POWER

When the city of Palmas initiated its Palmas Solar program in 2016, it established regulations to encourage self-supply. The program means that property owners who install a photovoltaic system can benefit from an 80% rebate on their property tax. Palmas Solar also aims to stimulate the entire solar chain in the area, with a prerequisite to call on local companies to carry out projects and install equipment. These companies also benefit from a reduction in the municipal business tax. In 2018, 90 residential and commercial properties took advantage of the Palmas Solar program, amounting to 900 kWc of total solar power (Maia, 2019).
In addition, Palmas is targeting energy self-sufficiency for all municipal buildings and is currently developing photovoltaic projects to achieve it.

BOX 4

Some Brazilian municipalities receive support from international programs dedicated to cities or city networks. For example, Building Efficiency Accelerator (BEA) aims to make it easier for municipalities to access the expertise required to accelerate implementation of local policies on saving energy in buildings, with a focus on partnerships with the private sector. In Brazil, the initiative is coordinated by ICLEI South America, with the support of the World Resource Institute. The cities of Betim, Fortaleza and Recife joined the initiative in July 2019 and are currently defining their objectives. Porto Alegre, a member since 2016, is the only one of the four Brazilian cities, and one of only three in the world that are members of the initiative, to have produced market feedback. Sixty-one stakeholders from the sector at city scale (NGOs, investors, property owners, regional civil servants, building professionals, etc.) ranked the importance and difficulty of eight energy-saving building measures applied to the city. Porto Alegre has also made two engagements to the BEA: to create a municipal investment fund for energy efficiency and the deployment of renewable energy, and to produce benchmarking of school and municipal buildings to prioritize investments in the sector (BEA, n.d.).

4. Brazil, one of the biggest markets for sustainable building certification

Beyond the regulations and incentive taxes set up by local authorities, sustainable building certification is particularly developed in Brazil. According to the Green Building Council, Brazil is thus the fifth country in the world for the number of LEED[1]-certified constructions, with 531 projects certified in 2018, behind the United States (33,632), Canada (3,254), China (1,494) and India (899) (USGBC, 2019). The AQUA-HQE standard, which is adapted from the French HQE program to fit the Brazilian context, is the second most widespread certification program in Brazil. Over 500 buildings have been certified since the program was initiated in 2008 (Nunes, 2018). Other labels present in Brazil but with a lower level of penetration include BREEAM and DGNB.

The state-owned Brazilian bank CAIXA, which manages the finances of the social housing program Minha Casa Minha Vida, has created its own label, Casa Azul. Projects certified as Casa Azul benefit from a lower interest rate, applying either to the building company when the CAIXA finances the worksite, or to the purchaser of the property.

LEED-certified buildings are thus considered to consume between 5% and 20% less energy than standard buildings (Kats, 2017). **However, these certification programs have brought Western architectural trends to Brazil that do not always correspond to the local climate.** For example, they often require the use of air conditioning that leads to higher energy consumption. Air conditioning is in fact obligatory to obtain LEED certification, and alternatives like natural ventilation are not currently taken into account. In general, the programs were devised before the Paris Agreement and the Sustainable Development Goals, and the question of GHG emissions is treated as secondary if at all (Reina K. 2019). The impact on the climate of these green certification programs is therefore currently difficult to quantify.

EXPERIENCE FEEDBACK

COMPANY SYNDICATE LAUNCHES A METHOD TO QUANTIFY INDIRECT EMISSIONS

The Sinduscon-SP syndicate of construction companies in the state of São Paulo launched a methodological guide in 2013 to produce inventories of GHG emissions generated when constructing buildings (Sinduscon-SP, 2013). This approach is used to quantify the indirect emissions of a building: principally the fossil fuels and electricity consumed on the worksite and the carbon contained in the materials used. This method was put together based on the GHG Protocol method and with the contribution of construction companies in the state of São Paulo. This kind of inventory can be used to identify the construction methods and materials

1 - LEED (Leadership in Energy and Environmental Design) is a North American green building certification program created in 1998

that emit the most gases. The construction company Even has produced an inventory of all of its worksites since 2010 and worked out their emission factor per square meter. From 2010 to 2016, the company succeeded in reducing this figure from 0.276 tCO_2/m^2 to 0.172 tCO_2/m^2 by adopting more low-carbon practices (Even, 2017).

ENCADRÉ 5

With the engagement of Net Zero Carbon Buildings, the World Green Building Council is calling for all buildings to reach zero energy by 2050, and challenging companies, cities and regions to reach zero emissions in their portfolios by 2030. Its Brazilian branch, the Green Building Council Brasil, launched a label for these zero-energy buildings in 2017. The program rewards highly energy-efficient buildings that compensate their remaining energy requirements by producing renewable energy, preferably on-site. When energy consumption cannot be totally supplied by renewable energy, the related GHG emissions can be compensated. Two projects have already received certification and eleven are under study (WorldGBC, 2017). In Cuiaba, a city with a hot, humid, tropical climate, the architecture of the headquarters of SEBRAE (Brazilian service to support small and very small businesses) is inspired from the traditional indigenous habitat to reduce its energy consumption (BREEAM Awards). The engineering firm Petinelli has converted an old warehouse into offices with an energy consumption of just 25 KWh/m^2 and solar panels that produce all of the energy consumed by the building (USGBC, 2019).

On a final note, few Brazilians living in favelas, informal settlements or slums benefit from green constructions or energy and thermal renovation projects. Some organizations do however arrange access to solar power by financing the installation and maintenance of solar panels, like the small company Insolar funded by Shell, which has brought solar energy to 5,000 people in the favela of Santa Marta (Wired).

EXPERIENCE FEEDBACK

THE CEMENT INDUSTRY AIMS AT A 33% REDUCTION IN THE EMISSION FACTOR OF CEMENT BY 2050

Brazil is one of the biggest producers of cement in the world: in 2014, before the recession, the country was the 6th global producer with a cement production of 72 million tons (US Geological Survey, 2015). The pollution generated by this industry is considerable. Its carbon footprint is largely related to its principle component, clinker, which is obtained by heating a mix of limestone and clay to 1,450 °C. The emissions factor of Brazilian cement is already one of the lowest in the world (564 $kgCO_2e/t$ in 2014) thanks to the low level of clinker employed, and the national industry is keen to pursue its efforts. In 2019, the National Cement Industry Syndicate and the Brazilian Association of Portland Cement launched a "cement technology roadmap" with the target of a 33% reduction in the carbon intensity of cement by 2050. The main measures put forward are: a reduction in the proportion of clinker; the use of alternative fuels like biomass; an improvement in the energy efficiency of factories; and research and development into carbon capture and storage (SNIC, 2019).

BOX 6

CONCLUSION

The recent drop in emissions in the building sector is mainly due to the economic crisis affecting Brazil and the country's relatively low-carbon electric power. National regulations, still largely voluntary, have significant potential to limit increases in predicted consumption, in particular from air conditioning systems, for which efficiency requirements are currently low. Financial incentives have mainly been put in place by cities. Although they currently cover only a small share of Brazilian households and businesses, they can be an interesting source of inspiration for putting together a more ambitious national framework. Lastly, the commercial building sector relies on international certifications like LEED, which are ill-adapted to the Brazilian context, along with self-supply of solar power in buildings, and on emissions generated upstream in the building sector (cement). Non-state actors in Brazil are clearly prepared to come up with low-carbon solutions both upstream and downstream from housing.

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