CENTRE FOR SUSTAINABILITY STUDIES (GVces)
AT THE GETULIO VARGAS FOUNDATION (FGV-EAESP)

Sustainable buildings and energy efficiency

First edition – February 2017

FEBRABAN
Brazilian Federation of Banks

CENTRE FOR SUSTAINABILITY STUDIES (GVces)
AT THE GETULIO VARGAS FOUNDATION (FGV-EAESP)

Sustainable buildings and energy efficiency

First edition – February 2017

FGV EAESP
CENTRO DE ESTUDOS EM SUSTENTABILIDADE

FEBRABAN
Brazilian Federation of Banks

CONDUCTED BY
FEBRABAN – Brazilian Federation of Banks

Murilo Portugal Filho – President
Mário Sérgio Fernandes de Vasconcelos – Institutional Relations Director
Alessandra Panza – Institutional Relations Advisor
Beatriz Stuart Secaf – Institutional Relations Advisor

PREPARED BY
Centre for Sustainability Studies at the Getulio Vargas Foundation (GVces)

COORDINATION
Mario Monzoni, Annelise Vendramini

TECHNICAL TEAM
Paula Peirão, Fernanda Rocha, Fabio Storino

ACKNOWLEDGEMENTS
FEBRABAN´s Social Responsibility and Sustainability Commission (CRSS)
FEBRABAN's Working Group: Banco do Brasil, Bradesco, Caixa Econômica Federal, Itaú Unibanco, Santander, Triângulo and Votorantim.

GRAPHIC DESIGN
Ideia Visual

ENGLISH EDITION
Philip Somervell
Peixoto Ramos Serviços Ltda.

Summary

Figures

Tables

Abbreviations

KWp – Kilowatt peak
KW – Kilowatt
MW – Megawatt
GW – Gigawatt
GWh – Gigawatt-hours
KWh/m – Kilowatt-hour/month

Preface

FEBRABAN and GVces have formed a partnership, now in its third cycle of activities, for the purpose of analysing the possible options for leveraging the transition to a Green Economy in Brazil, via resources intermediated by the National Financial Sector (SFN). As a result of the first year of this partnership a book was published in April of 2015 with the results of three complementary studies on the subject: the volume of resources allocated by the Financial Sector to the Green Economy, the institutional and regulatory framework for the National Financial Sector, and the relation between finance and sustainability in two sectors of the economy and two topics: agribusiness and renewable energy, and biodiversity and cities, respectively.

In the second cycle of this partnership, during 2015, a further three studies were developed: (i) a discussion on the opportunities and limitations for the development of a Green Bonds market in Brazil, following international experiences; (ii) the opportunities and limitations of configuring Environmental Reserve Quotas (CRAs) as securities; and (iii) improvement of the methodology and quantification of the volume of resources intermediated by the National Financial Sector for the Green Economy and in sectors whose activities potentially cause socio-environmental impact.

During the third period of cooperation between FEBRABAN and GVces, in 2016, another three studies were produced. The first seeks to make proposals for actions of the National Financial System in the agendas of sustainable buildings and energy efficiency, the second study is about the risks and opportunities of financial operations in sectors with intensive use of natural capital, and the third study is about the identification of viable financing models for forest recomposition as set forth in the New Forest Code (Law no. 12,651, May 25th, 2012).

This report corresponds to the first study, which aims to present a set of proposals for the SFN to be able to expand the amount of resources destined to the financing of projects that promote energy efficiency. Energy efficiency means conservation and rational use of energy by means of lighting, air conditioning (heating and cooling) and the construction's envelopment (natural ventilation and thermal insulation). This concept includes the generation of energy from renewable sources. The study also intends to promote improvements in existing financial mechanisms or the creation of new instruments aimed at financing the projects above.

The study covers (i) new sustainable buildings, (ii) retrofit projects in existing buildings, and (iii) solely acquisition and implementation of photovoltaic solar panel systems. These categories include the implementation of projects by individuals and/or companies, residential and/or commercial buildings, including real estate developments such as office buildings, shopping malls, hotels, schools, among others. Industrial plants were not taken into consideration for this study. This study was motivated by the growth of energy demand in Brazil and the Greenhouse Gas Emission (GHG) reduction targets of this sector, which Brazil has committed to internationally under the Paris Agreement. It is also rooted in the increased investment in projects for the generation of renewable energy worldwide, which totalled US$ 328.9 billion in 2015, a 156%

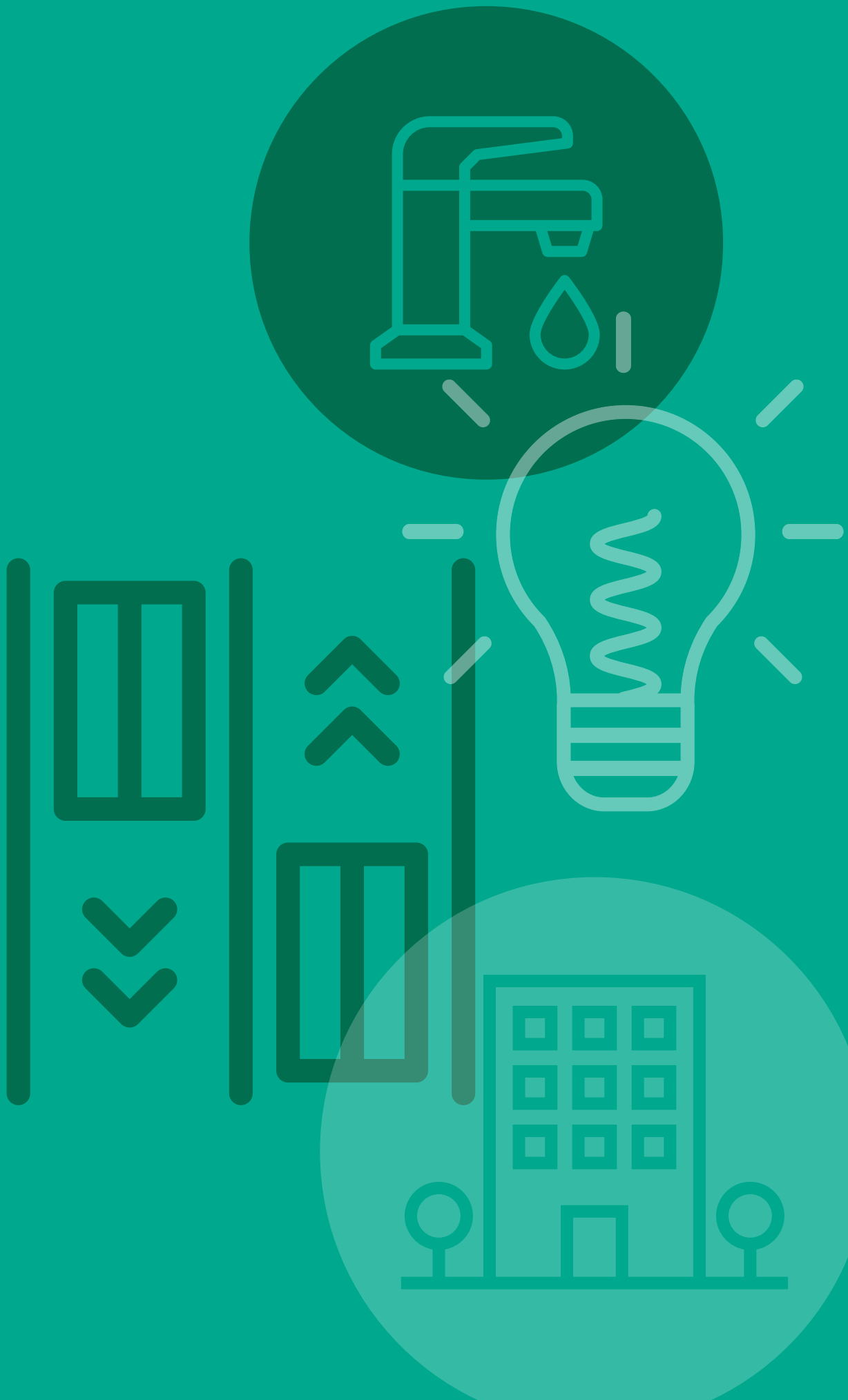
increase on investment in 2006 (US$ 128.3 billion).[1] In 2015, renewable energy financing in Brazil reached a total of R$ 51 billion, representing less than 2.3% of total financing for corporate clients (R$ 2.1 trillion).[2] Also, the publication of new national regulations for this sector is driving the market in this direction, and the financing of projects of this nature with private resources from the national financial system is necessary, as well as representing a market opportunity for the SFN.

The study was prepared by means of: i) a bibliographic review, in particular of reports on the economic, social, and environmental aspects of sustainable buildings, legal frameworks, and financial instruments; ii) 30 interviews carried out with national and international participants of the construction and energy efficiency market; iii) participation in specialized discussion forums; iv) reflections with representatives of FEBRABAN members participating in the Working Group (Energy Efficiency and Sustainable Buildings WG) organized for this project; and v) internal reflections of the GVces team.

All recommendations were made in conjunction with the WG established to follow up on this project and with the Social Responsibility and Sustainability Commission (CRSS), made up of representatives of 30 banks associated with FEBRABAN. They are additionally supported by interviews with industry experts and market players. The set of proposals is not exhaustive, but does suggest priority business models and markets taking into account factors such as demand, the potential impact for a transition to a green economy, as well as the challenges faced by these sectors in Brazil.

This report is divided as follows: the first chapter provides the context and a brief description of sustainable constructions. It highlights the main aspects of the market for sustainable buildings, retrofitting, and photovoltaic solar energy generation, presenting international and national experiences on these subjects. The second chapter identifies potential markets for energy efficiency projects. The third chapter specifies the challenges for current business models and details financial possibilities for key players in the market. In the fourth chapter, proposals and recommendations for new business models are presented, which aim to overcome the challenges described in the previous chapter. The fifth chapter contains recommendations for the development of new priority markets for operation of the National Financial System and the sixth chapter presents a set of general recommendations for advancing the agenda. The last chapter presents the final conclusions of the study.

[1] BLOOMBERG, 2016.
[2] FEBRABAN, 2016.



1. Context

Increasing emissions of greenhouse gases (GHGs) into the atmosphere are contributing to climate change. Increasingly evident on all continents, this phenomenon increases the likelihood of a serious, widespread, and irreversible impact to society and to the planet's ecosystems. However, there are ways to limit climate change while allowing for economic development, with new markets and business opportunities emerging.

The Paris Agreement, reached in 2015 as part of the United Nations Conference on Climate Change was an important step forward, and which should support national public policy which promotes sustainable development, with a focus on reduction of global GHG emissions. The Agreement aims to reinforce the global response to threats related to climate change, and to restrict the increase in temperature to up to 2°C based on pre-industrial levels, and to continue efforts to limit the increase of temperature to 1.5°C. Signatory countries to the agreement have established their own targets for reducing GHG emissions, called Nationally Determined Contributions (NDCs), which are to be updated every five years.

Brazil ratified the Paris Agreement on 21st September 2016, making a commitment to reduce its GHG emissions by 37% in relation to 2005 levels by 2025, and by 43% by 2030, through its NDC. Among other measures, the Brazilian NDC includes targets such as reaching a 45% share of renewable energy in its energy matrix, expanding the domestic use of renewable energy sources, particularly wind, biomass, and solar, as well as promoting clean technology standards throughout the industry. It sets out the objective of reaching a share of between 28% and 33% of other renewable sources in the energy matrix, excluding hydro sources, which in 2015 reached 11.5% and is set to reach efficiency gains of 10% in the electricity sector.

In order to guide Brazil's actions in the area of energy efficiency, the Ministry of Energy and Mines (MME) published in 2011 the basic premises and guidelines for the composition of the National Energy Efficiency Plan (PNEf), via MME Ordinance No. 594. The plan is taking shape, having been through a public consultation phase until December 2016. According to this document, the energy consumption reduction target for the residential sector is 38,185 GWh. For commercial and industrial sectors, the stipulated target is of 16,706 GWh and 39,847 GWh, respectively. For the public sector, the target is 7,160 GWh and for the agricultural sector, the target is 551 GWh for 2030.[3] The PNEf also proposes the regulation of energy efficiency actions via permanent legislation, making the labelling of public buildings mandatory within 10 years, commercial and services buildings in 15 years, and residential buildings in 20 years.

[3] (PNEF, 2011)

Many of the mitigation and adaptation actions required to combat climate change and achieve the stipulated goals must be carried out at the level of the city, as approximately two thirds of global demand for primary energy and 70% of global GHG emissions related to energy originate from urban areas.[4] These factors are further constrained by the steady world population growth in urban areas, projected to grow from 4 billion people in 2016 to 6.3 billion in 2050. [5]

Brazil is ranked 22nd among the 23 countries with the highest energy consumption in the world, in a ranking which took into account national efforts made towards energy efficiency and energy intensity in buildings, industry, and transport.[6] With Brazil being the 9th largest economy in the world, in addition to the energy consumption classification mentioned above, the need and demand for energy generation is evident. However, electricity conservation and greater efficiency in the use of energy resources represent cost-effective investments. The average cost per MWh of energy efficiency projects in Brazil was calculated at R$ 79/MWh,[7] a figure lower than those recorded in national electricity matrix expansion auctions (R$ 125/MWh). [8] Assuming that the power sector operates at the limits of its capacity, this means that measures of energy efficiency (MWh avoided) are cheaper than the additional generation needed to supply an increase in demand (additional MWh generated).

The construction sector, which provides infrastructure and housing for the populations of cities, is a large consumer of natural resources and energy, and also a large generator of waste. Globally, it uses over half of the extracted natural resources of the planet in the production and maintenance of the constructed area.[9] Buildings account for between 30% and 40% of global energy consumption, GHG emissions, and waste generation.[10] In Brazil, buildings accounted for 18.7% of total electricity consumption in 2012,[11] making the construction sector a fundamental part of this agenda.

On the other hand, the construction sector has great potential for reduction of GHG emissions.[12] The International Energy Agency (IEA) estimates that the sector's CO_2 emissions will have to be reduced by 77% by 2050.[13]

[4] Christa Clapp; Alexia Leseur; Olivier Sartor; Gregory Briner; Jan Corfee-Morlot, "Cities and Carbon Market Finance: Taking Stock of Cities? Experience with CDM and JI". OECD Environmental Working Paper No. 29. Paris: OECD Publishing, 2010.
[5] (ONU, 2014)
[6] Chetana Kallakuri; Shruti Vaidyanathan; Meegan Kelly; Rachel Cluett, *The 2016 International Energy Efficiency Scorecard*. Washington, DC: American Council for an Energy-Efficient Economy [ACEEE], 2016.
[7] Confederação Nacional da Indústria [CNI]; Centrais Elétricas Brasileiras S.A. [Eletrobras], *Eficiência energética na indústria: o que foi feito no Brasil, oportunidades de redução de custos e experiência internacional. Brasília: CNI;* Eletrobras, 2009.
[8] "Leilão de hidrelétricas negocia R$ 17 bilhões em outorgas". *Portal Brasil*, 25th Nov 2015. Available at: <www.brasil.gov.br/economia-e-emprego/2015/11/leilao-de-hidreletricas-negocia-r-17-bilhoes-em-outorgas>.
[9] (Willmott Dixon, 2010)
[10] PNUMA, *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World*. Nairobi: PNUMA, 2008.
[11] EPE, 2016.
[12] Diana Ürge-Vorsatz; Aleksandra Novikova, "Potentials and Costs of Carbon Dioxide Mitigation in the World's Buildings". In: Intergovernmental Panel on Climate Change [IPCC], *Climate Change 2007 – Mitigation of Climate Change: Contribution of Working Group III to the Fourth Assessment Report of the IPCC*. Cambridge, United Kingdom; Nova York: Cambridge University Press, 2007. p. 389.
[13] International Energy Agency [IEA], *Capturing the multiple benefits of energy efficiency*. Paris: IEA/OECD, 2014.

The construction sector can be divided into four major phases or stages:

✓ **Pre-construction: involves the entire extractive and materials supply chain used in buildings, such as cement, wood, floors, tiles, porcelain and metals, paint and other chemical and petrochemical substances, and refrigeration equipment. It is also in this phase that the technical development of the building occurs, which specifies the materials to be used and their architectural characteristics.**

✓ **Construction: involving construction companies, property developers, and real estate agents.**

✓ **Operation: involves the occupants of the property and occurs during the lifetime of the building. Its useful life, in turn, will depend on the maintenance of the property in the phase of operation and its proper use.**

✓ **Post-use: involves the demolition of the building and the disposal of solid wastes generated. As an alternative to discarding, reuse (or "deconstruction") has increased, with the selection and reuse of inert materials for new construction.**

The concept of green buildings comprises real estate development or constructions that seek to minimize their environmental footprint in the pre-construction, construction and maintenance phases. The following are observed in the building operations: consumption of energy, water, soil and materials; GHG emissions and other gases, impacts on the area's ecology/biodiversity; generated solid wastes and liquid effluents; quality of the internal environment and performance maintenance (economy/efficiency in the use of resources).

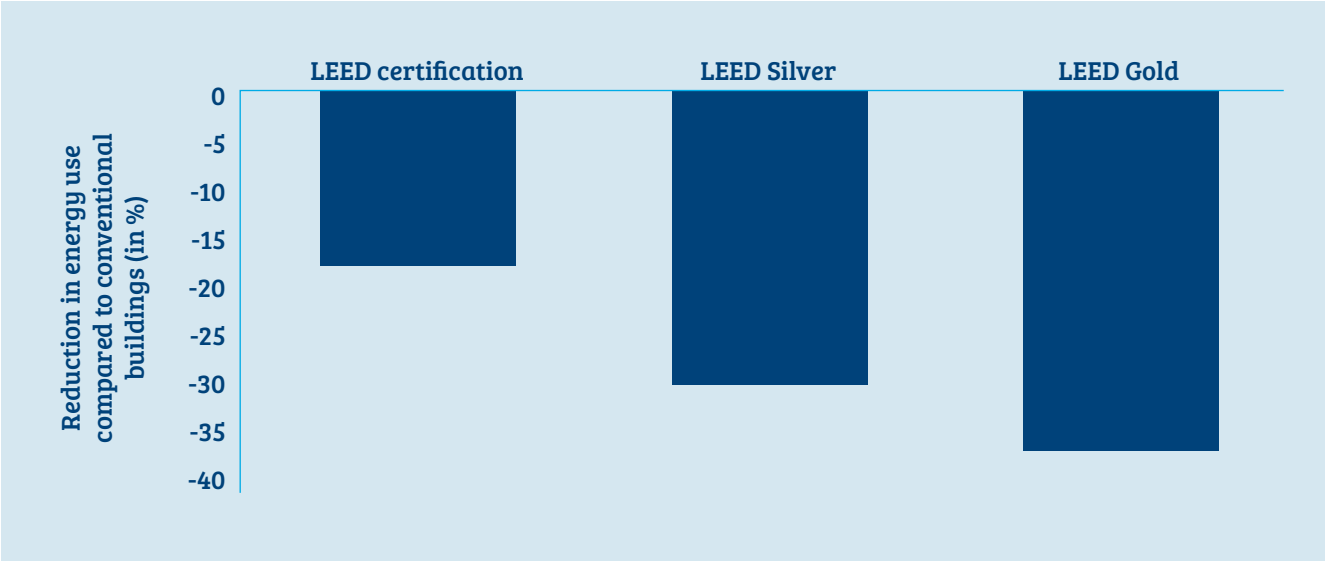
Sustainability, however, involves more than the environmental footprint of the building. Other important aspects include, for example, durability, adaptability, and flexibility of the building. A building with a useful life of 100 years has, over this timespan, a very different footprint than that of a building designed to last 50 years, which will have been demolished and replaced with a new construction in that period. Flexibility refers to new uses a building may acquire, different to the use for which it was originally designed.

Concern with the sustainability of a building also extends to aspects of health and safety, both of the workers involved in the construction supply chain and of the occupants of the building. Social and economic considerations, such as the impact of the building in its surroundings as a generator of traffic, in addition to other urban aspects as well as planning, are also part of the concerns with a buildings' sustainability. It is important to understand buildings not only as a consumer of natural resources and a waste generator, but also as generators of electric energy through solar photovoltaic panels.

As such, the various aspects of sustainability in buildings are determined and aggregated by different processes of sustainable buildings certification, which in recent years have increased in demand. Some current market certifications are LEED (Leadership for Energy and Environmental Design), issued by the U.S. Green Building Council, and Brazilian adaptations of certifications from other countries, such as the AQUA label (High Environmental Quality) from the French HQE certification (Haute Qualité Environnementale). Recent certifications in the Brazilian market are BREEAM (Building Research Establishment Environmental Assessment Method, from England), EDGE (Excellence in Design for Greater Efficiencies of the World Bank), and the label granted by the DGNB (German Council of Sustainable Construction).

The LEED label, the most recognized international certification in Brazil and one of the most popular in the world, takes into account aspects such as: energy efficiency, use of materials and resources, and quality of the building's internal environment. According to the building's score in these categories, a certain level of certification is granted. Levels are classified as LEED, LEED Silver, LEED Gold and LEED Platinum. As can be seen in Figure 1, the reduction in energy consumption of LEED certified buildings varies from 20% to 35%, depending on the score obtained in the process.

Figure 1 – Reduction in energy use in sustainable buildings



Source: KATS (2003), with data from the U.S. Green Building Council and Capital E consultancy.

The figure shows a positive correlation between efforts made in the design and execution of the project (translated into the level of certification achieved) and the final result in terms of energy consumption. However, often the performance of the building falls short of the original estimate. This gap can occur due to problems in various phases of construction and construction planning, such as modelling problems and design changes to save costs. However, this gap can mostly be explained by problems occurring in the operation phase of the building, either by "unregulated" consumption (inefficient equipment connected to the building's outlets) or by insufficient or inadequate maintenance of the building's infrastructure (Table 1).

Table 1 – Performance gap in relation to estimated energy consumption

Phase	Project	Construction	Inspection	Operation	
Source	Modelling Problems	Project Changes	Non-optimization of the project	Inadequate Maintenance	"Non-regulated" Consumption
Difference	From 10% to 20%	From 10% to 30%	From 10% to 20%	From 30% to 120%	From 80% to 120%

Source: Adapted from WorldGBC, op. cit.

The operational phase and mainly "non-regulated" consumption suggest a risk for energy efficiency projects in buildings. Therefore a sustainable construction, if mismanaged, may perform less well than a well-managed conventional construction. In order for the projected performance to be attained, professional building management is essential, so that the building is adequately maintained and operates within the specified parameters.

International experience

Construction norms set performance standards, such as maximum energy consumption for buildings of a certain size, or minimum energy efficiency standards for equipment or the building as a whole. Large parts of Europe and Asia and some regions of North America and Australia set minimum standards of energy performance for commercial and residential buildings in both new and existing buildings.[14]

Countries such as France and Germany have made retrofitting compulsory for buildings when they reach a certain age, requiring an improvement in the energy consumption standards of the property when undergoing renovations or extensions, or not permitting buildings that do not meet a minimum standard of energy performance from being rented or sold. In 2004, 65% of existing commercial buildings in Switzerland were in the process of being retrofitted.[15]

[14] International Energy Agency [IEA]; United Nations Environment Program [UNEP], *Policy Pathways: Modernising Building Energy Codes to Secure our Global Energy Future*. Paris: IEA; PNUMA, 2013. Available at: <www.iea.org/publications/freepublications/publication/PolicyPathways ModernisingBuildingEnergyCodes.pdf>

[15] Emmanuel Rey, "Office building retrofitting strategies: multicriteria approach of an architectural and technical issue". *Energy and Buildings*, v. 36, n. 4, mar. 2004.

In addition, several US cities and states have made energy labelling of their buildings mandatory, making their energy consumption public, including New York, Washington, D.C., and Austin, and the states of California and Washington. The ENERGY STAR Portfolio Manager, a national labelling scheme, has been adopted by New York, Chicago, Boston, and Seattle. New York City requires the publication of energy (and water, in some cases) consumption of all buildings above 4,600 m^2 (50,000 ft^2), with mandatory energy auditing.

At the federal level, the Federal Housing Administration (FHA) has been running the Energy Efficient Mortgage (EEM) program since 1992, which supports the acquisition of energy-efficient real estate and retrofit projects focused on energy efficiency. EEM-type mortgage loans are based on a assumed additional payment capacity on behalf of owners of energy efficient properties due to lower monthly utility costs. If the financial institution approves credit to the borrower for the acquisition of a property, the FHA guarantees the total loan, including as additional income, the financial result generated through energy efficiency actions.

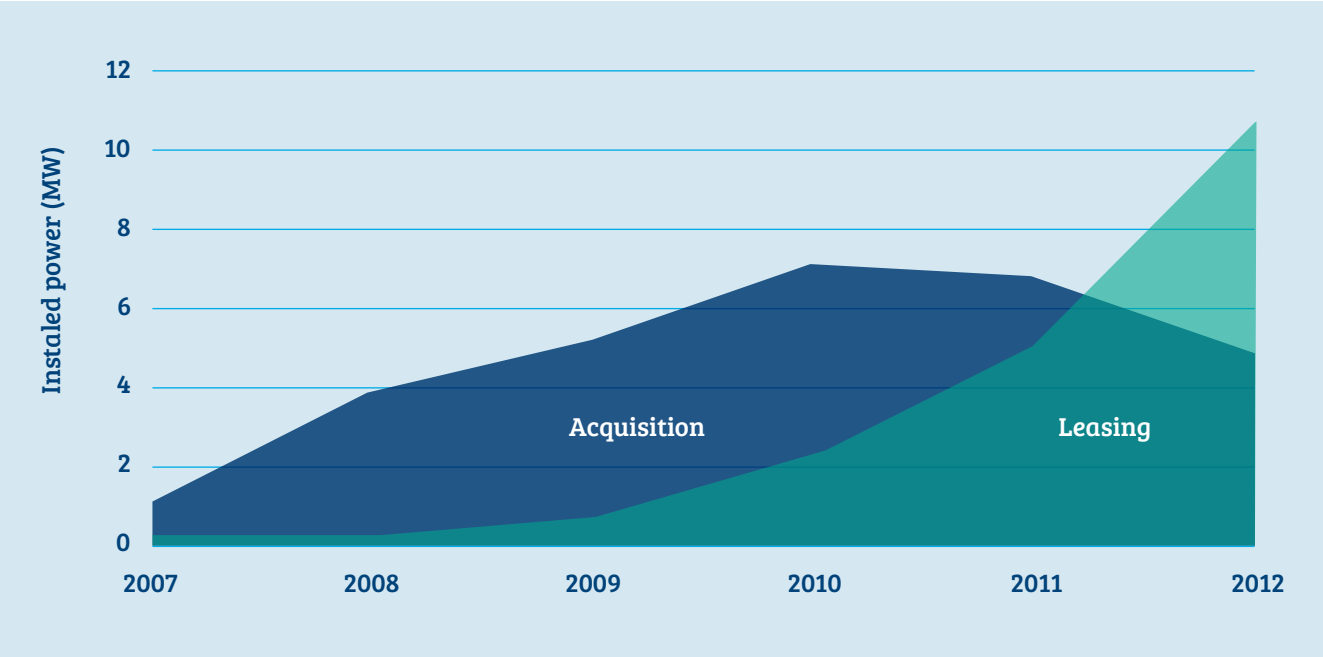
Countries of the European Union have a range of financial instruments focused on renewable energy and energy efficiency in buildings, such as the products of the German development bank KfW, which link financing conditions to the energy efficiency standards of a construction. Loans may have terms of up to 30 years, including a 5-year grace period and 10 years of simple interest.

In solar power distributed generation, defined as an electric power source which is directly connected to a distribution network or located at the site where it is used, the US private sector offered its residential customers innovative alternatives for financing with zero initial investment. In the PPA (Power Purchase Agreement) model, the customer pays a fixed price for the energy produced (below the dealer price) for the duration of the contract; in the leasing model, the customer pays a fixed monthly cost, which may be reduced depending on an initial contribution. If the customer's consumption is less than what is produced, the surplus can be added to the network and the corresponding credit is granted. In both cases the provider covers the installation costs and warranty of the equipment, and carries out all monitoring of power generation. At the end of the contract, the customer may opt for an upgrade of equipment, swapping it for more modern modules, extend the current contract, or have the system removed free of charge.

By eliminating the initial investment, lowering the risk to the homeowner, and generating a monthly expense lower than their current energy bill, PPA and leasing options have become the preferred option for US residences in recent years, accounting for 72% of new facilities in 2014.[16] Figure 2 shows the growth of this market in California.

[16] Nicole Litvak, *U.S. Residential Solar Financing 2015-2020*. [S.l.]: GTM Research, 2015.

Figure 2 – New installations of residential solar photovoltaic modules in California



Note: Residential scale understood as <10 kW.

Source: HOBBS et al., 2013.

However, a growing familiarity on behalf of US consumers with solar distributed generation, in addition to a continued price drop in solar modules has led analysts to project a recovery in the number of purchased systems, which may once again surpass the number of systems under PPA or leasing models in 2020.[17]

It should be noted that international experience highlights the advantages of sustainable buildings in relation to traditional buildings for various stakeholders. For property developers, potential benefits include price premiums, lower construction costs, and shorter times for sale of real estate. For owners, a faster return on investment through a lower credit rate, lower real estate depreciation, and lower maintenance costs. For occupants, lower operating costs, better health and well-being.

The next section will present the Brazilian situation in relation to the sustainable construction agenda, from the different perspectives necessary for the establishment and growth of the sustainable construction market and solar energy generation through photovoltaic panels in the urban environment, in Brazil.

[17] Nicole Litvak, op. cit.

National overview

Within Brazilian regulation on sustainable buildings and energy efficiency, at the federal level, norm NBR 15,575 (2013), known as the "performance standard" of residential buildings, represents a milestone for technological modernization in Brazilian construction, and establishes minimum performance standards in various aspects, such as acoustic performance, thermal performance, durability of materials, and the useful life of the property. However, in addition to problems of unfamiliarity with regulation, there are also challenges regarding its supervision. There is no established penalty in case of non-compliance with the standard, although the Consumer Protection Code vetoes the provision of products or services that do not comply with existing technical standards.

In terms of waste generation, CONAMA resolution No. 307/2002 establishes guidelines for the management of construction waste (RCD). In Brazil, 73% of municipalities have construction waste management services, obliging construction firms to correctly dispose of their waste.

At the subnational level, the City Statute (2001) instituted a master plan as a basic tool for urban development and expansion. In terms of sustainable construction, this instrument deals with questions such as the mixed use of buildings (commercial on the ground floor and residential above), population density in neighbourhoods (avoiding extensive travel through the city), solidarity quotas (reserve of housing units for low income occupants), and limiting spaces for vehicles. Some municipalities have established a mandatory requirement for the installation of solar panels for hot water in new buildings - e.g., São Paulo (2007), Porto Alegre (2007), Campinas (2008); with bills in progress in Rio and Belo Horizonte.

Regarding water use, there is an increase in the number of state and municipal laws determining the individualization of a hydrometer in buildings of a certain size – e.g. Recife (2002), Distrito Federal (2005), Diadema (2005), Campinas (2006), Natal (2007), Campo Grande (2007) and Salvador (2009). The recent water crisis in some regions of the country has also increased pressure for measures to capture rainwater and reuse water.

There are yet gaps in the regulatory framework for civil construction in Brazil, such as:[18]

- ✓ **Energy: lack of minimum performance requirements in new constructions, compulsory labelling (energy efficiency) and mandatory generation from renewable sources in new constructions.**
- ✓ **Water: no minimum performance requirements in new constructions; compulsory labelling (water efficiency), legislation and tools for implementation of undrinkable water sources, flow and pressure limits in design and equipment.**
- ✓ **Waste: lack of incentives to guarantee the long-term performance of buildings (water and power consumption and generation of waste), carry out and publish analyses of embedded energy and GHG emissions from buildings (resulting from the manufacturing process of materials and equipment used), controlled demolition with construction and demolition waste management plan (RCD).**

Some Brazilian municipalities have encouraged the adoption of measures for environmental preservation in residential properties, with an instrument called IPTU Verde. In recent operation in some municipalities and under discussion in others, this instrument may constitute a significant tax incentive, creating a discount on the Urban Land and Building Tax (IPTU) for certified sustainable buildings (new and retrofitted). The aim of this mechanism is to establish measures for the recovery and preservation of the environment, through the granting of tax benefits to the taxpayer, according to the degree of certification of the enterprise. In São Paulo, the bill provides for a 4%, 8% and 12% discount on the IPTU, depending on the degree of certification that the building obtains from recognized labels, such as LEED or AQUA.[19]

In Guarulhos (SP), the 2011 law offers a discount of up to 20% off the annual cost of the IPTU for buildings that adopt measures provided for in Law 6,793/2010 (Art. 61), such as accessibility, rainfall capture systems, green roofing, solid waste separation, use of solar and wind energy, and urban afforestation.

ICMS agreement 16/2015, of the National Council of Finance Policy (Confaz), establishes the exemption of ICMS on the internal operations of distributed micro- and mini-generation of energy, that is, in relation to the electrical energy injected into the distribution network by the consumer unit and for the energy credits originating from that unit and subsequently used. Twenty states have adhered to the agreement, representing over 80% of the population, of which 11 have published a state decree making the benefit effective.

[18] CBCS (Brazilian Council for Sustainable Construction; PNUMA (United Nations Environment Program); MMA – Ministry of the Environment, *op. cit.*
[19] City Hall of SP, 2016

Regarding the generation of energy from renewable sources, Aneel normative resolution No. 482/2012 stipulated the legal basis for distributed micro- and mini-generation of energy via the creation of an Electric Energy Compensation System, which allows the surplus generated by individuals and companies to be converted into credit with the distributor, which can be deducted from the energy bill. Aneel normative resolution 687/2015 broadened incentives for distributed micro- and mini- generation, permitting remote self-consumption (credits generated by one unit and discounted by another unit owned by the same company, including parent company and subsidiaries) and shared generation (consumers and individuals within the same concession area, through a consortium or cooperative) and extending the term of use of credits from 36 to 60 months.

In addition to regulation and tax incentives, the market for certification of sustainable buildings has also been growing in Brazil. According to the US Green Building Council (USGBC), Brazil is ranked fifth in the world per number of LEED (Leadership in Energy and Environmental Design) certifications, with 991 projects certified in 2015, behind the United States (53,908), Canada (4,814), China (2,022) and India (1,883). The AQUA label has 167 certified real estate projects. There are still few constructions in Brazil which seek the BREEAM certification (Building Research Establishment Environmental Assessment Method, from England) and the label issued by the DGNB (German Council on Sustainable Building), which have both been more recently introduced. The Casa Azul label is also worthy of note, a socio-environmental classification methodology for housing projects financed by the Caixa Econômica Federal. Six categories are assessed: urban quality, design and comfort, energy efficiency, water management, conservation of material resources, and social practices.

Lastly, there is the EDGE (Excellence in Design for Greater Efficiency) label, a World Bank certification that provides a free tool and has already certified a building in the city of Belo Horizonte.

INMETRO has developed a quality label specifically for the acquisition of photovoltaic solar panels, IEC 61215, which certifies that the equipment meets the worldwide requirements for a panel to have the durability, performance, and safety necessary to be marketed in Europe, Japan, China, the USA, and others. Solar panels with the IEC 61215 label are more likely to perform well and do not present early problems, and is thus a minimum requirement for their commercialization in Brazil.

With regards to norms and certifications developed specifically for Brazil, the Procel Edificações label, a government program coordinated by the Ministry of Energy and Mines and executed by Eletrobrás, is focused on energy efficiency in buildings. Created at the end of 2014 and of voluntary adhesion, it is now a requirement for new federal public buildings and retrofit projects. The label is also an alternative for those seeking LEED or AQUA certification, serving as proof of compliance with the minimum requirements for energy efficiency, thermal comfort, and air quality of these labels.

The Procel Edificações label has additional advantages: as it works with fewer indicators, it is cheaper to pursue and is easily measurable and comparable (like energy efficiency labels on domestic appliances). Although it focuses on energy efficiency, it has a positive snowball effect on other good building practices: increasing the efficiency of heating, ventilation, and air-conditioning equipment may depend on good envelope design,[20] the reduction of water consumption, which in turn reduces energy consumption by decreasing the need for pumping to higher floors.

For the financial sector, certifications can be an important tool for banks to focus on the financial aspect of property investment, leaving the responsibility of technical monitoring of the building to specialized companies for ensuring good operational development in relation to the sustainability of the building.

Brazilian financial institutions already provide some specific credit lines for retrofitting and for sustainable buildings, as well as specific mechanisms for the acquisition of photovoltaic solar panels not necessarily linked to sustainable building projects. These mechanisms are detailed in Appendix 2.

[20] An envelope project involves decisions on materials and architectural design regarding the facade of the building, with the purpose of providing thermal insulation, making use of natural lighting and ventilation etc.

2. Potential markets for the financing of sustainable buildings, retrofit projects, and photovoltaic solar energy

The next chapter presents an analysis of the potential markets for expanding credit of new sustainable buildings, retrofit activities, and the acquisition of photovoltaic solar panels.

New sustainable buildings

The construction sector and property services together account for over 16% of Brazil's GDP[21] and, following the low growth of the Brazilian economy, has been through a slowdown period. However, there is enormous potential in Brazil for construction. The change in the age profile of the population, whose average age was 28.5 years in 2000 and is expected to reach 38.4 years in 2030[22], together with efforts to end precarious housing and family cohabitation, point to an increase in demand for housing in the coming decades. It is estimated that in 2050 there will be 98 million households in the country, a rise of almost 50% in relation to the 67 million households registered in 2014, according to the PNAD (National Survey by Domicile Samples) of the IBGE.

LEED-certified projects have higher average rent prices - 24% in Rio de Janeiro and 10% in São Paulo- in relation to non-certified projects[23]. There is also a difference between certified and non-certified real estate developments in relation to the vacancy rate. In Rio de Janeiro, certified buildings have, on average, a 7% lower vacancy rate. In São Paulo, this difference rises to 9.5% in favour of LEED-certified real estate developments.

The case is the same with condominium (administration) fees. In the comparison between LEED certified and non-certified real estate developments, on average, non-certified real estate developments in São Paulo have condominium fees up to 12% higher per square meter, and in Rio de Janeiro up to 25% higher. This is a result of savings obtained from energy efficiency projects, among others, required for obtaining sustainable building certifications.

Regarding water resources, it is estimated that average water consumption resulting from strategies such as reuse and saving equipment is 39% lower in sustainable buildings compared to a conventional building of similar size.[24]

[21] Databank of the Brazilian Construction Industry Chamber [CBIC]. Available at: <www.cbicdados.com.br/menu/pib-e-investimento/pib-brasil-e-construcao-civil>.
[22] IBGE forecast
[23] Green Building Council Brasil [GBC BRASIL], Anuário de Certificações GBC Brasil 2016. Revista GBC Brasil, v. 3, n. 9, jul. 2016.
[24] Greg Kats; Jon Braman; Michael James, Tornando nosso ambiente construído mais sustentável: custos, benefícios e estratégias. São Paulo: Secovi-SP, 2014.

These savings, reflected in the condominium fees, are pertinent to the operation phase of the building, that is, occupation during its useful life.

In Brazil, however, these benefits are still unclear for the real estate sector and potential owners or occupiers. Although the decrease in condominium costs may be relevant, the average Brazilian consumer is still more sensitive to the purchase cost of a property than to its operational costs.

There is evidence, however, that the estimated cost of a sustainable building, in the case of Brazil, represents an increase of up to 6% in the total costs of construction (the certification process itself represents up to 1%),[25] with the bulk of the cost being in the pre-construction phase, during the development of the project, where it is necessary to bring together the different teams involved (owner, designer, developer, etc.). On the other hand, this additional cost turns into a reduction of errors in the construction phase, and increases the final quality of the property. The developer, after a learning curve, has the potential to minimize this cost increase and match it to the cost of a traditional construction.[26]

Regarding SFN participation, Table 2 summarizes the traditional markets in the agenda of new sustainable buildings, which concentrated credit for real estate corporations, mostly large property developers, for projects destined for sale or rent to buyers or renters with a high income profile. Generally, real estate developments are also large-scale: corporate headquarters, high-value residential buildings, or rental buildings. In these cases, buyers tend to be more willing to pay the additional construction costs either because they understand that they will recover them over time or to comply with their social and environmental responsibility policy. The complexity of the operation is relatively low, as it consists of traditional operations, but financial mechanisms or technological advances that reduce construction and financing costs will help to expand this market. As previously mentioned in this report, Brazil is the fifth country in the world in terms of number of projects registered and LEED certified.

[25] Interview with representatives of the Brazilian office of the U.S. Green Building Council on 14/6/2016.
[26] Interviews with Sinduscon representatives (Construction Syndicate).

Table 2 – Traditional markets of SFN operation in the financing of new sustainable buildings

Customer Profile	Average volume of operation	Operation characteristics	Complexity of structuring the operation
1. REAL ESTATE COMPANIES Large Property Developers. Developments for sale.	Traditional financing for large construction companies.	Financing of *Green Building*.	Small
2. REAL ESTATE COMPANIES Large Property Developers. Developments for rent.	Traditional financing for large construction companies.	Financing of *Green Building*.	Small

Source: GVces and FEBRABAN

Retrofitting

Retrofit projects involve improvements and solutions for customizing, adapting, and improving the use of an older property. The main purpose is to revitalize old buildings by increasing their useful life using advanced technologies in building systems and modern materials, making them compatible with current urban and occupational restrictions, as well as caring for the environment.

Although there is a huge potential for retrofit projects in Brazilian buildings, residential buildings suffer from the difficulty of reaching a consensus among residents to approve the related expenses, which would increase the cost of condominium fees in the short term. This is due to the lack of information regarding cost reductions (also in the short term) of retrofit projects' consumption and maintenance to counteract the certainty of implementation costs and doubts about the technical quality of the project. An additional factor is that in Brazil, occupants themselves are largely responsible for the overall performance of the property, and common areas represent a smaller share of the total consumption of the building – compared to Europe, for example, where residents usually receive much better-equipped units, with lighting design, fixtures, and sometimes even domestic appliances.

According to Table 3, depending on the type of project to be retrofitted, energy consumption savings can reach between 18% and 39% of the total consumed. This can translate into monetary gains of between R$ 500,000 to R$ 2 million per year.[27]

[27] Sustentech.

Table 3 – Benefits of *retrofit* implementation

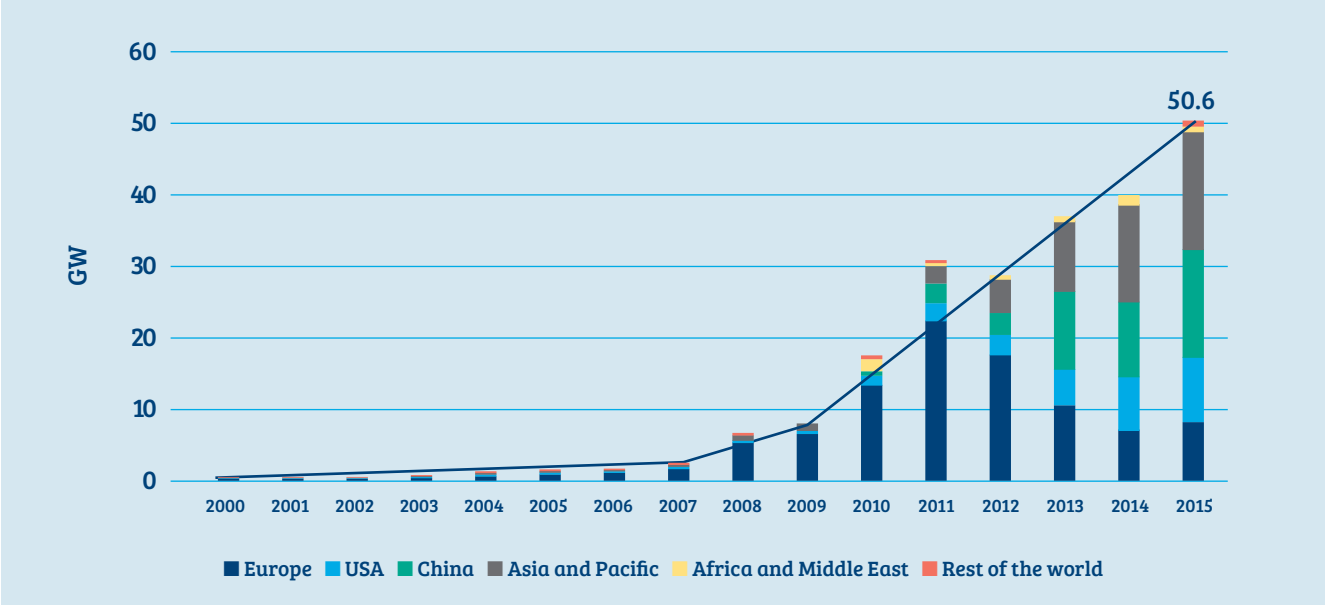
Type of Development	Energy Savings (%)	Energy Savings (R$ mm/year)
Old Buildings	21%	0.499
Hotels	30%	1.71
Hospitals	31%	1.41
Shopping Malls	18%	1.11
Distribution Centres	39%	Not available

Source: Sustentech.

Photovoltaic solar panels

Micro- and mini- generation of energy from renewable sources has been growing exponentially in the world in recent years (Figure 3), and has been boosted in Brazil thanks to Aneel's normative resolutions No. 482/2012 and 687/2015. These resolutions establish a legal basis for the creation of an Electric Energy Compensation System, which allows the surplus generated by individuals and companies to be converted into credit with the distributor, and can be deducted from the energy bill up to 60 months from the date of creation of the credit, including for other properties belonging to the same person or company (remote self-consumption) or from the invoice of other consortium members.

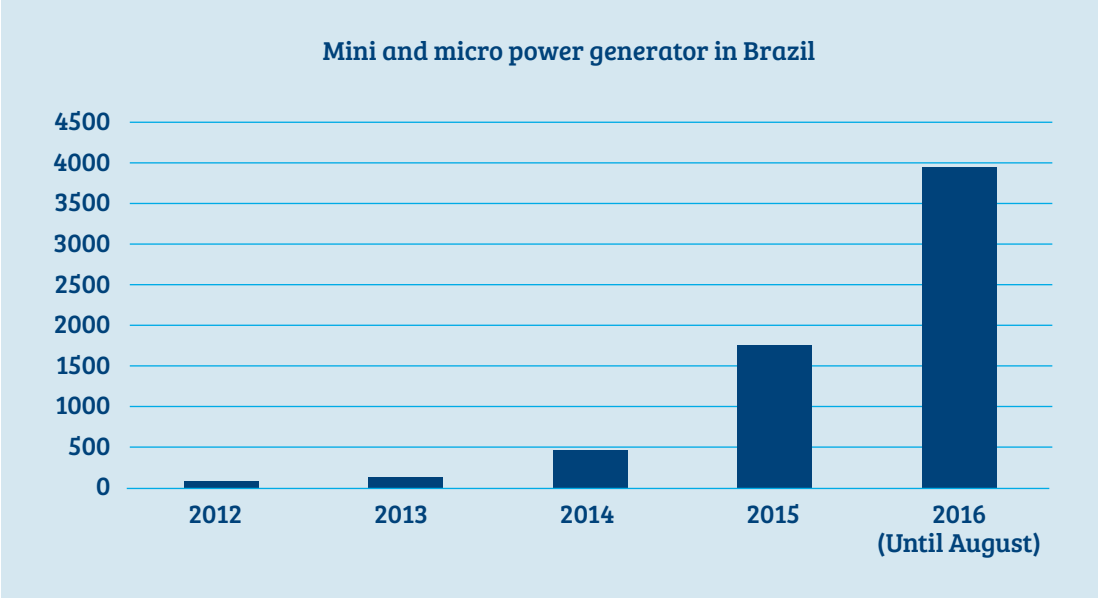
Figure 3 – Evolution of the installed capacity of photovoltaic solar panels (2000-2015)



Source: SolarPower Europe.

Photovoltaic solar technology is especially relevant to this context, as Brazil has great potential for growth in this sector (Figure 4). However, it is a technology which is still little exploited in the country, which has 3,931 micro- and mini-generators, of a total of 77 million possible consumer units.

Figure 4 – Cumulative number of photovoltaic systems in Brazil



Source: 2012-2015: Aneel; 2016: ABSOLAR.

According to the National Energy Balance 2016,[28] distributed generation by solar photovoltaic sources reached 20 GWh in 2015. The EPE estimates generation will reach 1,593 GWh by 2024,[29] an annual average growth of 63% in relation to the 20GWh generated in 2015.

Brazil has high levels of irradiation in almost all of its territory, with a more vertical incidence of solar rays. It receives between 1,500 and 2,200 kWh/m² of solar irradiation per year, and even the areas with the lowest levels of irradiation are still superior to the best regions of Germany, which receive between 900 and 1,250 kWh/m².[30] Brazil has, in international climate negotiations, set itself a target of 23% of its power to be generated from renewable non-hydro sources by 2030.

Regulation of the distributed generation system establishes that the maximum quantity of power generated is 5 MW. Distributed micro- and mini-generation from photovoltaic solar energy could therefore be prioritised for smaller scale consumers.

[28] Energy Research Company [EPE]. *Balanço Energético Nacional 2016. Brasília: MME/EPE, 2016.*
[29] Energy Research Company [EPE]. *Plano Decenal de Expansão de Energia 2024*. Brasília: MME/EPE, 2015.
[30] Maurício T. Tolmasquim, op. cit.

3. Challenges of the current business and financing models of sustainable buildings, retrofit projects and photovoltaic solar energy

The data presented shows that there is considerable potential for the development of markets for new sustainable buildings, retrofitting, and photovoltaic solar panels for small and medium sized companies and individuals in Brazil. Projects for distributed generation of power from renewable sources, sustainable buildings, and retrofitting are fundamental for the development of a low carbon economy and for reaching Brazilian targets for reducing GHG emissions agreed to in Paris.

However, despite the potential, turnover is small, as is the volume of financing from the banking sector. Surveys carried out in 2015 found that financing for renewable energy and energy efficiency, both components of sustainable construction projects, reached R$ 51 billion, representing less than 2.3% of the total of corporate client financing, of R$ 2.1 trillion.

As such, it is necessary to examine currently practiced business models as well as available financial products, the creation of new products, and financial mechanisms and guarantees, so that projects may gain greater viability for all involved in the process.

This chapter will present the main challenges facing current business models for financing these activities in Brazil, which, when overcome, will contribute to broadening the SFN's performance in the area. It is worth mentioning that some of the challenges are of a general and market nature, and have a large impact on the viability of business models for financing projects in the field of sustainable buildings and their components (such as retrofitting and distributed energy).

The challenges presented in this chapter are the result of a series of interviews with experts in the area, as well as a compilation of information presented in specific thematic events. Challenges were categorized according to the participant of the impacted market, these participants being the financial institutions, the implementing and developing companies, and the beneficiaries of the financial operation (the end clients).

Financial institutions

Inadequacy of projects to financing requirements

In most cases, credit is requested by companies which are developing/implementing projects. The credit risk is therefore concentrated in these companies, which often have limited balance sheets as well as difficulties in presenting guarantees and mitigating the risk of project performance. In the case of photovoltaic solar energy generation projects, for example, modules (panels) would be the guarantee for the financial institution. However, the absence of a secondary market makes execution difficult in cases of defaulting.

Projects related to new sustainable buildings, retrofitting, and photovoltaic solar panels demand specific technical aspects, with the purpose of reaching certain goals (established, in some cases, by environmental certification systems). Not all projects submitted for credit approval to financial institutions are subject to technical standardization. This makes it difficult to analyse the project, as financial institutions do not have specialists in this field and, should external assessment be hired, a significant additional cost to the transaction is generated, which contributes to unfeasible financing conditions for the borrower.

Unfamiliarity with the economic advantages of a sustainable project and its potential return, coupled with the lack of a database on sustainable constructions, adds up to a greater risk perception by the financial sector. The higher the perception, the greater the additional risk to be factored into the financing conditions – translated into higher rates and shorter terms.

Good sustainability practices, even those that generate clear financial gains in terms of reduction in utility bills when the building is in operation, or a decrease in the vacancy rate for a sustainable building operator, still don't count for much in the risk analysis of a potential client, and end up not being reflected in the financing conditions offered by the financial institution.

Developers/implementers

The challenges below refer to retrofit projects and the generation of solar photovoltaic energy, as new building projects do not have developers/implementers involved in the process.

Technical security of projects

It is necessary that companies developing/implementing projects within the scope of sustainable construction, including retrofitting and the generation of photovoltaic solar energy via the distributed generation system, present clear reports as to the economic gains of the implementation of their projects, in order to help secure the confidence of banks and customers. This aspect is essential as energy gains come from the design and execution of the technical projects. Likewise, there are few institutionalized processes that guarantee the technical quality of the project, its costs and benefits, which increases its performance risks. This contributes to doubts the final consumer (small or medium sized, individual or corporate) may have about the safety, return, and credibility of the initiative.

The lack of a public databases contributes to the absence of information on the technical performance of retrofit and photovoltaic solar energy projects. In addition, given that it is still a developing market in Brazil, there is a shortage of specialized technicians in the sustainable construction, which has an impact on demand and development. Associated with this factor is the risk some projects are exposed to of not delivering on their planned energy savings - often the result of the building being poorly operated. For projects to be executed with quality and guarantee of compliance with these goals, skilled and specialized labour is necessary, as these goals are dependent on products with certification of origin and/or labels of efficiency.

One of the remaining challenges is in relation to securing credit. Generally speaking, the guarantee is the energy-generating system itself, consisting, for example, of photovoltaic modules (panels) and inverters, in the case of photovoltaic solar energy generation. In the event of default, the system would have to be auctioned, although there is currently low liquidity in this type of market - in addition to the difficulty in executing the guarantee itself. The participation of a developer/implementer that assumes responsibility for the system itself, together with the creation of a consortium of final customers that can rent the equipment and get financing, lessens this challenge. The developer/implementer is responsible for the operational risk of the project, with the final consumer and the consortium being responsible for the financial risk. Shared generation, provided for by Aneel's resolution, also allows the bank to enter as part of the consortium and, in the event of a default, to retain the credits resulting from the generation of the customer's plant. Another option is for the developer/implementer itself to be responsible for both the operational risk of the project and the financial risk, although generally developer companies also have limited balances.

End client/Individual or company

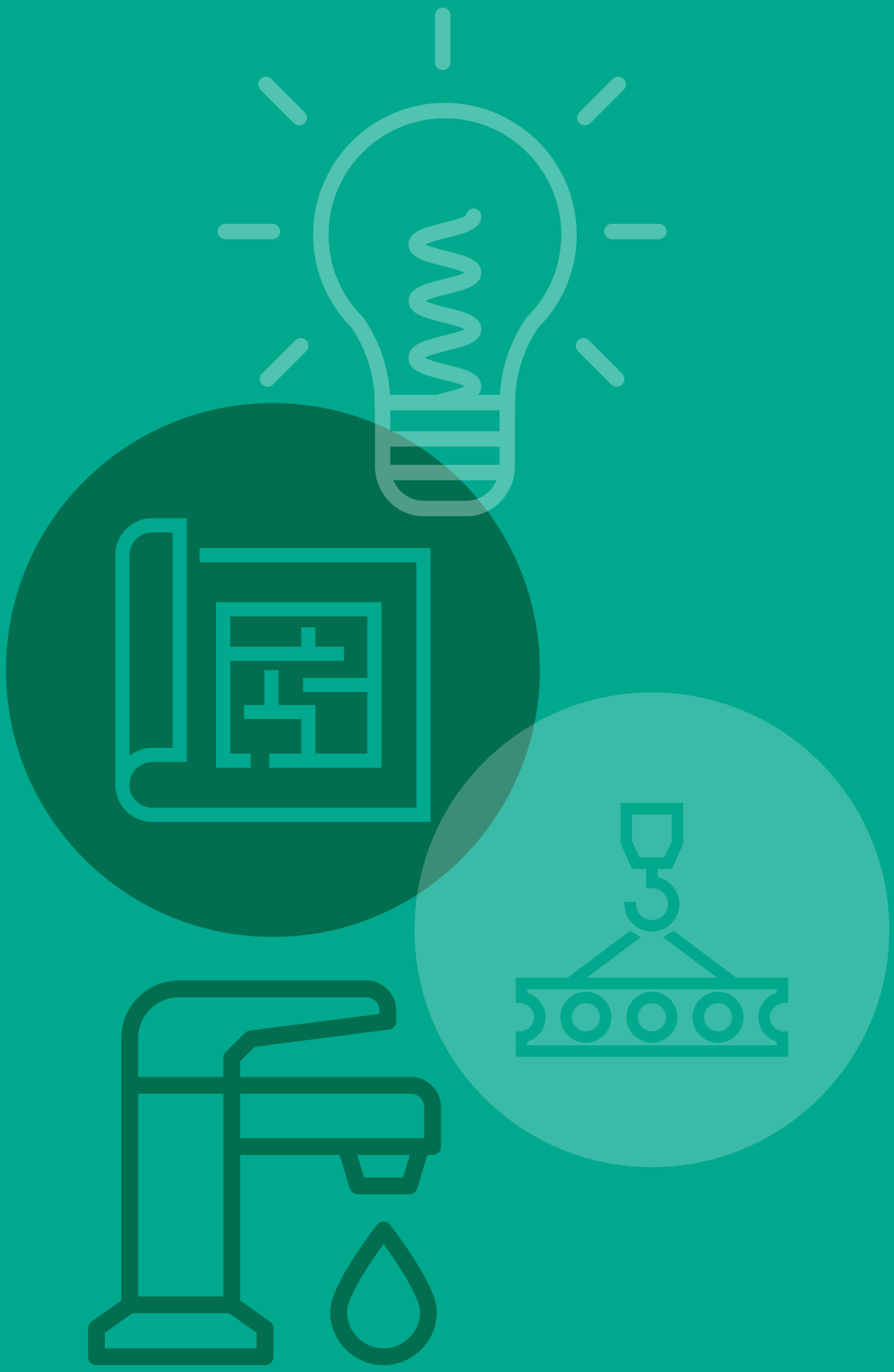
The results of energy savings, optimization of procedures, reduction of waste disposal costs, among others, are still largely unknown by the population and potential clients for financing sustainable building projects, including retrofitting processes and acquisition of photovoltaic solar panels. There is a lack of information on the reduction of operation and construction costs on a large scale. These potential clients end up opting for traditional construction models. Therefore, the difficulty in systematizing this data may explain the difference in perception in relation to the increased risk and cost of the project.

In turn, the payback for the implementation of photovoltaic solar energy projects in Brazil is about six years, [31] considering only gains obtained from the reduction of the consumer energy bill. This period is still considered to be high for some potential clients. At the same time, as the sector develops, the payback period tends to decrease, especially when taking into account lower technology costs, now an average of R$ 6,500 per kWp installed, and an increase in electricity tariffs.

Insecurity regarding the achievement of the project's economic goals, the fragility of technical assistance, and the inexistence of mechanisms which reduce the project's performance risk – essential to the end-client's ability to pay – can reduce the attractiveness of a retrofit project or photovoltaic solar panels for small and medium clients.

Finally, the misperception of low returns and competition with end-focused projects in small and medium-sized real estate developments makes energy efficiency projects less important.

[31] Payback depends essentially on the prices of the photovoltaic modules and system installation, which have been falling year on year. See, for example, David Feldman et al., *Photovoltaic System Pricing Trends*. Washington, D.C.: U.S. Department of Energy, 2015.



4. Recommendations

New business models

Based on the challenges presented in the previous chapter, the development of new business models associated with adequate financing structuring will contribute to the broadening of SFN performance in this area. It is necessary to create conditions to leverage the energy efficiency market in general, based on the following aspects:

- ✓ **Reducing the existing information asymmetry in the markets**
- ✓ **Institutionalizing project standardization**
- ✓ **Increasing the degree of project security**
- ✓ **Developing processes and mechanisms for the accreditation of developers and implementers***
- ✓ **Reducing performance and credit risks**
- ✓ **Ensuring reliability for the end customer (individuals and companies)**

* Accreditation is the formal recognition by an independent body that a particular process and / or company meets predefined requirements and demonstrates that it is competent to carry out its activities. (Inmetro)

For the sustainable construction, retrofitting, and energy efficiency markets to grow and scale, and for banks to increase the financing flow to feed this market, progress needs to be made in areas of different natures. The recommendations detailed in this section was carried out through interviews with experts, discussions with the FEBRABAN Working Group formed especially for this study, and also takes into account studies and proposals from the Inter-American Development Bank (IDB) which have the same purpose as this study.

In a general sense, it is important to note that for all recommendations, developers/implementers, financial institutions, trade associations, and government agencies should work together to align business models that make sense to all involved stakeholders, it being up to each party what decisions to make and under what conditions.

Reducing information asymmetry

Firstly, initiatives should be taken to reduce the information asymmetry on sustainable building projects, retrofitting, and photovoltaic solar energy generation. The creation of a public database with information on implemented projects and their respective results, practical cases of energy consumption savings, lists of efficient equipment and component costs, would contribute to improve the credibility of projects for all involved.

Structuring and publishing information relative to the costs of implementation, maintenance, and financial return of sustainable building vis-à-vis traditional projects are also actions which will help to reduce risk perception from financial institutions when analysing potential financing. Also in this regard, it is recommended that diagnostic reports and audits form part of this database, in addition to detailing success stories. All of these components can improve the transparency of the sector and also contribute to increasing demand for projects.

Standardization and security of projects

Another challenge to be overcome in order for the SFN to expand activity in the sustainable construction market is the lack of project standardization. To reduce transaction costs and increase efficiency in analysis on behalf of banks, the development of models for energy efficiency projects and sustainable construction according to investment size and market is necessary. Standardization will lead to the development of previously outlined financial products. This system could contain a typology of possible contracts and forms of remuneration as well as third-party measurements and certifications regarding the economic objectives outlined in the project. This component is of particular relevance to banks in that it reduces the need for a thorough technical analysis of the project by considering as valid, performance reports signed by specialized companies that have proven credibility. Depending on the size and complexity of the project, it is recommended that it be validated by an independent third party, which would enhance credibility in the quality and effectiveness of delivery of expected results.

Governing bodies could create methodologies for labelling equipment and classifying energy efficiency according to economy, as is the case, for example, with domestic appliances.

Implementing processes of accreditation in development/Implementation companies

Companies working with the development/implementation of sustainable construction and energy efficiency projects could make progress in performance contract solutions which could consider an initial reserve of performance guarantee and, eventually, performance insurance. The mitigation of performance risks and the technical quality of projects would encourage the client to buy them either with their own resources or through bank financing.

These companies could guarantee technical assistance and the measurement and validation of the results obtained with the project in operation vis-à-vis the initial estimates of their performance. A third party could be considered to settle disputes between businesses and customers.

This change would broaden the possibility of increasing the volume of loans as the balance of developers and implementers would not be used in the process of credit analysis. The credit risk to be considered by the banks could be that of the final customer, the buyer of the project.

Reducing Credit and Performance Risks

As mentioned in the previous item, performance risks can be reduced through performance contracts which would have an initial performance guarantee reserve and a percentage payment retention in the client's project hiring. There are possibilities for the development of insurance guarantees for the purpose of covering and complementing the initial performance guarantee reserve. Evidently these mechanisms will vary according to the size and financial project viability, and the client's payment capacity.

It would be the bank's role to examine the payment capacity and credit limits to be granted to its customers for the purchase of energy efficiency projects, which would broaden the scale of operations and the market itself.

Furthermore, the participation of multilateral development agencies and institutional funds may constitute less risky financial models for financial institutions through guarantee and insurance mechanisms for potential projects.

Increasing the sources of funds for insurance and insurance mechanisms in Brazil is also necessary. The Energy Efficiency Guarantee Mechanism (EEGM), designed to encourage increased energy efficiency and the use of renewable energy for self-consumption, with a focus on commercial and public buildings, is an example from which the SFN can draw inspiration. Frame 1 explains this instrument, which can assist projects in the field of sustainable buildings. This is, however, only an example of a mechanism. Seeking greater use of national and international environmental funds to ensure guarantees in financing is necessary.

Frame 1 – Energy Efficiency Guarantee Mechanism (EEGM)

- ✓ **The EEGM is an initiative of the IDB, the UNDP (United Nations Development Program) and the GEF (Global Environment Facility) for Brazil, which provides guarantees to access credit lines from state owned and private banks. It also offers a guarantee in performance contracts that assure the end customer of the project performance, contributing to the reduction of asymmetry of information in the market.**
- ✓ **It was created to encourage the increase of energy efficiency and the use of renewable energies, focusing on the commercial and public buildings sector.**
- ✓ **The EEGM extends the credit limit of companies with financial institutions and reduces the final cost of the lines of credit already available; by guaranteeing the performance of the project, ensuring projected savings, decreasing the client's resistance to implement the project; it also provides a credit guarantee to the manufacturer and/or engineering firm that executed the project to ensure that payments will be made by the end client.**
- ✓ **It can cover up to 100% of the financing or loan made by the financial institution, with a minimum value of US$ 100,000 and a maximum of US$ 1.6 million (equivalent in reais), within a maximum period of 7 years.**
- ✓ **The World Bank, through the International Finance Corporation (IFC), offers guarantees on credit risk in financing operations over US$ 20 million through the issuance of green bonds. The financial structuring of this guarantee can be negotiated with each company.**
- ✓ **It should be noted that both guarantee mechanisms serve only corporate clients.**

The IDB Energy Efficiency Insurance Program is another example from which the SFN can draw inspiration. Frame 2 describes this instrument, which can assist projects in the field of sustainable buildings.

Frame 2 – IDB Energy Efficiency Insurance Program

The IDB energy efficiency insurance is a performance insurance for the final customer offered by the developer/implementer companies. This insurance helps to reduce performance risks and increase project security, to reduce information asymmetry in the market, and to legitimize developer/implementer companies and to secure the confidence of the final customer, people or companies.

Its functioning takes into account the following factors:

- ✓ **Independent third party validation of the project.**
- ✓ **Validation/certification mechanisms of the intermediary by an official body (Inmetro/ABNT) regarding legal and fiscal regularity, experience and technical capacity.**
- ✓ **Insurance guarantee given to the client to supplement coverage of the initial guarantee reserve.**
- ✓ **Improves risk perception by the bank indirectly by verifying the project.**
- ✓ **Bank assesses the end customer's credit risk and defines financing conditions.**
- ✓ **Bank registers and validates intermediary according to its interests, and receives a validated project, contracts for the initial reserve of guarantees and insurance.**

Reliability for the end client (individuals and companies)

According to what is proposed in Frame 2, an accreditation process, carried out by a government body (Inmetro or ABNT, for example) for developers and implementers of projects relating to sustainable construction may contribute to increasing the credibility of submitted technical projects. Banks could also develop and register suppliers - developer and implementer companies - and inform interested customers by facilitating and/or intermediating contacts.

In addition, the mechanisms developed for the standardization and technical qualification of the projects, along with a greater availability of information, all previously mentioned, will contribute to ensuring the end client's greater confidence in adopting sustainable construction and energy efficiency projects.

New markets for the National Financial Sector

National consumption of electricity from the grid, today at 470,918 GWh, will reach 692,137 GWh by the end of 2024,[32] an average growth rate of 3.9% per year. Of this consumption, the commercial segment shows greatest expansion, followed by the residential segment – as presented in Table 4.

Table 4 – Electricity consumption from the grid by consumer type

	Residential	Industrial	Commercial	Other	Total
Year			**GWh**		
2015	135,346	170,173	92,275	73,125	470,918
2019	156,267	187,571	109,183	84,372	537,393
2024	197,193	239,587	147,806	107,551	692,137
Period			**Variation % p.a**		
2014 - 2019	3.4	1.0	4.0	2.8	2.6
2019 - 2024	4.8	5.0	6.2	5.0	5.2
2014 - 2024	4.1	3.0	5.1	3.9	3.9

Source: EPE, 2015.

There is a greater potential for retrofit projects in the commercial sector. Hospitals, such as the Sírio-Libanês, Albert Einstein, and Oswaldo Cruz in São Paulo have expressed interest. In addition to a lower operating cost, they were also interested in the improvements in air quality and wellbeing of occupants, which contributes positively to patient recovery. Hotels see a benefit to their image, with simple actions such as the substitution of bathroom taps (anti-vandalism and activated by a timer).

The most favourable potential market is the commercial segment, with projects ranging from R$ 200,000 to R$ 10 million. This category would encompass financing for corporate clients of small and medium scale of the commercial segment, covering retail chains, bakeries, dealerships, supermarkets, car parks, among others – with projects estimated at between R$ 200,000 and R$ 5 million. In addition, another possible focus would be corporate clients in the medium to large scale commercial segment, such as for example, corporate buildings, hospitals, shopping centres, and hotels – with retrofit project sizes of between R$ 5-10 million.

[32] (EPE, 2014)

Table 5 outlines new market suggestions for the SFN's role in financing retrofit processes in existing buildings. The Table also shows projects for the acquisition of photovoltaic solar panels, as the potential market is closely associated to retrofitting. It should be mentioned that the acquisition of photovoltaic solar panels often represents one of the components of the retrofit of a building, as it contributes to energy efficiency and the reduction of GHG emissions. The proposals mention guarantee instruments in the operation structuring, as an example of an IDB mechanism.

Table 5 – Proposals of new markets for retrofitting and photovoltaic solar panels

Customer profile	Average volume of operation	Operation characteristics	Complexity of structuring the operation
1. INDIVIDUAL Special client	R$ 50,000 average	Financing of photovoltaic equipment only.	Small
2. COMPANY Commercial Branch – Pharmacies, supermarkets (medium-scale) chains	Up to R$ 10 million	CAPEX* financing of client for distributed generation and/or retrofit. Possibility of hiring IDB guarantee for 7 years, limited to 80% of the value of the operation. The IDB evaluates the technical project, reducing the technical risk to the financial institution. In that case, the bank could consider the operation as extra-limit.	Medium
3. COMPANY Energy distributors (large-scale)	CAPEX financing (solar photovoltaic generation)	CAPEX Financing; focused on the intermediation of distributed solar energy to commercial clients with B3 tariffs, with PPA (power purchase agreement) contracts as guarantee. It is also possible to hire the IDB guarantee, which assesses the technical project and guarantees the PPA portfolio (7 years, limited to 80% of the amount).	Large

Source: GVces and FEBRABAN.

* CAPEX – Capital Expenditure, designates the amount of money spent on the acquisition (or introduction of improvements) of capital goods of a particular company.

Lastly, in order to broaden the operations of financial institutions on new sustainable building, in addition to the traditional markets cited in Table 2, corporate clients in the medium-scale commercial segment stand out as the target market and priority, these being developers and/or construction companies, given that new sustainable building projects have become increasingly recognized and in demand.

Credit line expansion

Other recommendations of this study concern the expansion of the use of credit lines that serve the sustainable building sector already offered by public and private institutions in Brazil.

New financing models of the banking sector can be developed as the previously mentioned obstacles are overcome. Potential business models to be used specifically by the photovoltaic solar energy market are:

For residential consumers:

✓ ***Leasing:*** **the proprietor pays a monthly fixed amount for the rental of solar photovoltaic panels. Installation, warranty, and monitoring are the responsibility of the developer/implementer. At the end of the contract, the proprietor may choose to extend it, buy the technology, upgrade the equipment, or have the solar panels removed at no cost. However, this mechanism would have a greater potential for success if there were a better alignment of the depreciation and taxation of the equipment. It is therefore important to substitute the traditional depreciation model for an accelerated depreciation model, as well as evaluate the possibility of changing the taxation of existing equipment - so that the leasing option can become more attractive to clients and financial institutions.**

For the commercial sector (small and medium-scale):

- ✓ **Financing:** direct financing to the end user for small or medium-scale real estate developments with a capacity of 1 to 5 MW; high potential, given the possibility of shared generation – different stakeholders can join a consortium or cooperative and use the energy generated to reduce the bills of the consortium or cooperative.

- ✓ **Consortia:** Modality in which a consortium formed by end-clients leases the equipment of the installation company and takes the financing, both for projects in commercial and residential properties. The installation company assumes the operational risk of the project with the end-consumer, and the consortium assumes the financial risk with the financial institution.

- ✓ **Direct lease contract:** developer/implementer is hired to build and maintain a solar photovoltaic power plant for energy delivery at a lower price than the captive market. The financial institution may offer credit for the construction of the plant which will make a contract with the client(s). In this case, a financial institution can be the end-client and make a lease for the supply of energy to its agencies.

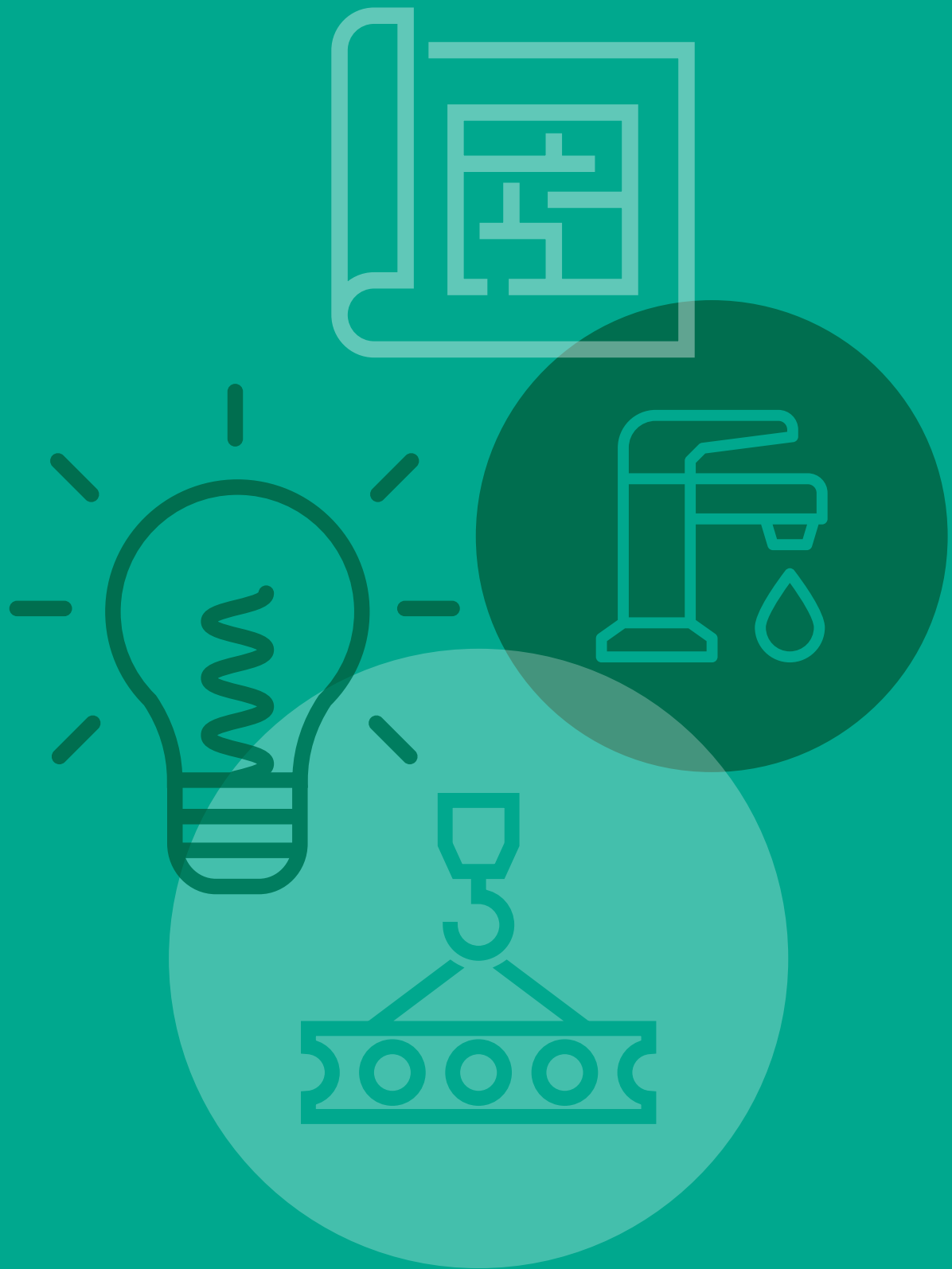
5. Conclusions

Cities have become one of the most important actors for the building of an economy aligned with the principles of sustainability. They concentrate demand for energy, and it is therefore important to promote its rational use, through the development of sustainable construction projects, retrofitting, and the distributed generation of solar photovoltaic energy.

However, these are emerging markets that depend on actions taken in a coordinated way by market agents, multilateral development agencies, and government agencies. This joint action will enable the development of solutions that stimulate sustainable construction activity and projects, with benefits for the whole of society. Added to this is the context of the current macroeconomic scenario, in which consumers are unlikely to be able to pay more for sustainable projects, even if they recover their initial investment over time.

The SFN has an important role in the development of these sectors, providing resources for activity linked to sustainable buildings and energy efficiency projects. As such, financial institutions must evaluate new mechanisms or seek a greater use of existing mechanisms, adapting to the various markets, provided business models are adjusted to ensure returns are aligned with perceived risk.

In summary, to improve risk perception and contribute to the alignment of financially viable business models, work will need to be done to diminish information asymmetry, increase the credibility of the technical projects presented, develop the standardization of technical projects, develop processes for the accreditation of developer and implementer companies, improve guarantees, and align incentives among the involved agents. With all of this, it will be possible to create the conditions to leverage the sustainable construction market, retrofit projects, and the acquisition of photovoltaic solar panels.



6. Bibliographic references

BRASIL. Instituto Brasileiro de Geografia e Estatística [IBGE]. *Censo Demográfico, 2010*. Rio de Janeiro: IBGE, 2010.

BUNDESMINISTERIUMS FÜR WIRTSCHAFT UND ENERGIE [BMWi]. *Making More Out of Energy: National Action Plan on Energy Efficiency (NAPE)*. Berlin: BMWi, 2014.

CÂMARA BRASILEIRA DA INDÚSTRIA DA CONSTRUÇÃO [CBIC]. Programa Construção Sustentável. [S.l.]: CBIC, [2011?].

Banco de Dados da CBIC. Available at <www.cbicdados.com.br/menu/pib-e-investimento/pib-brasil-e-construcao-civil>.

CLAPP, C. et al. "Cities and Carbon Market Finance: Taking Stock of Cities? Experience with CDM and JI". OECD Environmental Working Paper No. 29. Paris: OECD Publishing, 2010.

CONFEDERAÇÃO NACIONAL DA INDÚSTRIA [CNI]; CENTRAIS ELÉTRICAS BRASILEIRAS S.A. [ELETROBRAS]. *Eficiência energética na indústria: o que foi feito no Brasil, oportunidades de redução de custos e experiência internacional*. Brasília: CNI; Eletrobras, 2009.

CÂMARA BRASILEIRA DA INDÚSTRIA DA CONSTRUÇÃO [CBIC]. *Construção verde: desenvolvimento com sustentabilidade*. Brasília: CNI, 2012.

CONSELHO BRASILEIRO DE CONSTRUÇÃO SUSTENTÁVEL [CBCS]; PROGRAMA DAS NAÇÕES UNIDAS PARA O MEIO AMBIENTE [PNUMA]; MINISTÉRIO DO MEIO AMBIENTE [MMA]. *Aspectos da construção sustentável no Brasil e promoção de políticas públicas*. São Paulo: CBCS; PNUMA; MMA, 2014.

Empresa de Pesquisa Energética [EPE]. *Inserção da geração fotovoltaica distribuída no Brasil – Condicionantes e Impactos*. Technical Note DEA n. 19/2014. Brasília: MME/EPE, 2014.

Plano Decenal de Expansão de Energia 2024. Brasília: MME/EPE, 2015.

Balanço Energético Nacional 2016. Brasília: MME/EPE, 2016.

ERNST & YOUNG [EY]. *Sustainable buildings in Brazil.* [S.l.]: GBC Brazil, 2013.

"GERAÇÃO doméstica de energia é caminho sem volta; distribuidoras prometem brigar". *Gazeta do Povo*, 1st July 2016. Available at <www.gazetadopovo.com.br/economia/energia-e-sustentabilidade/geracao-domestica-de-energia-e-caminho-sem-volta-distribuidoras-prometem-brigar-98b2krdh4x6my1yfzzw10toot>.

Green Building Council Brazil [GBC BRASIL]. Anuário de Certificações GBC Brasil 2016. *Revista GBC Brasil*, v. 3, n. 9, July 2016.

INTERNATIONAL ENERGY AGENCY [IEA]. *Capturing the Multiple Benefits of Energy Efficiency*. Paris: IEA/OECD, 2014.

IEA Energy Technology RD&D Statistics. Paris: IEA/OECD, 2016. Available at: <www.oecd-ilibrary.org/energy/data/iea-energy-technology-r-d-statistics_enetech-data-en>.

KALLAKURI, C.; VAIDYANATHAN, S.; KELLY, M.; CLUETT, Rachel. The 2016 *International Energy Efficiency Scorecard*. Washington D.C.: American Council for an Energy-Efficient Economy [ACEEE], 2016.

KATS, G.; BRAMAN, J.; JAMES, M. Tornando nosso ambiente construído mais sustentável: custos, benefícios e estratégias. São Paulo: Secovi-SP, 2014.

KATS, G. et al. *The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force*. [S.l.]: Sustainable Building Task Force, 2003. Available at: <www.usgbc.org/Docs/News/News477.pdf>.

"LEILÃO de hidrelétricas negocia R$ 17 bilhões em outorgas". *Portal Brasil*, 25th Nov 2015. Available at: <www.brasil.gov.br/economia-e-emprego/2015/11/leilao-de-hidreletricas-negocia-r-17-bilhoes-em-outorgas>.

MCEWEN, B.; MILLER, J. Local Governments' Role in Energy Project Financing: A Guide to Financing Tools for the Commercial Real Estate Sector. Washington D.C.: Institute for Market Transformation [IMT], 2013.

MCKINSEY & COMPANY. Pathways to a Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve. Nova York: McKinsey & Company, 2009.

MITSIDI PROJETOS. *Diagnóstico energético em edificações*. São Paulo: Mitsidi Projetos, 2016.

OLIVEIRA, W. *LEED previsto x LEED realizado: o desafio da performance*. GreenBuilding Brasil Conference, São Paulo, 2014.

ONU: Desastres naturais foram responsáveis por 22 milhões de deslocados em 2013". Available at: <nacoesunidas.org/onu-desastres-naturais-foram-responsaveis-por-22-milhoes-de-descolados-em-2013>.

ONU: The 2014 Revision. CD-ROM. New York: ONU, 2014.

PERDUE, W. C.; STONE, L. A.; GOSTIN, L. O. "The Built Environment and Its Relationship to the Public's Health: The Legal Framework". *American Journal of Public Health*, v. 93, n. 9, Sep 2003. pp. 1390–1394. Available at<www.ncbi.nlm.nih.gov/pmc/articles/PMC1447979>.

PROGRAMA DAS NAÇÕES UNIDAS PARA O MEIO AMBIENTE [PNUMA]. *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World.* Nairobi: PNUMA, 2008.

The Financial System We Need: Aligning the Financial System with Sustainable Development. Geneva: International Environment House, 2015.

SOLARPOWER EUROPE. *Global Market Outlook for Solar Power (2016-2020)*. Brussels: SolarPower Europe, 2016.

TOLMASQUIM, M. T. (Coord.). Energia renovável: hidráulica, biomassa, eólica, solar, oceânica. Brasília: MME/EPE, 2016.

ÜRGE-VORSATZ, Diana; NOVIKOVA, Aleksandra. "Potentials and Costs of Carbon Dioxide Mitigation in the World's Buildings". In: Intergovernmental Panel on Climate Change [IPCC]. *Climate Change 2007 – Mitigation of Climate Change: Contribution of Working Group III to the Fourth Assessment Report of the IPCC*. Cambridge, UK; New York: Cambridge University Press, 2007. p. 389.

WILLMOTT DIXON. *The Impacts of Construction and the Built Environment*. Briefing Note. [S.l.]: Willmott Dixon, 2010. Available at: <www.willmottdixon.co.uk/asset/download/9462>.

WORLD GREEN BUILDING COUNCIL [WORLDGBC]. The Business Case for Green Building: A Review of the Costs and Benefits for Developers, Investors and Occupants. [S.l.]: WorldGBC, 2013.

7. Appendixes

Appendix 1 – Interviews and discussion forums

Associations
- ABESCO – Brazilian Association of Energy Conservation Service Companies
- ABSOLAR – Brazilian Association of Photovoltaic Solar Energy
- CAU – Architecture and Urbanism Council of Brazil
- CREA – Regional Council of Engineering and Agronomy
- Green Building Council Brasil
- Secovi-SP – Housing Union of São Paulo
- Sinduscon-SP – Construction Union of São Paulo

Financial Institutions
- BID/EEGM
- BNDES
- CAIXA
- IFC
- Itaú Unibanco
- Santander
- Votorantim
- Bradesco
- Banco do Brasil
- Tribanco

Builders and developers
- Cushman & Wakefield
- Cyrela
- ECOGEN
- Gafisa
- Tecnisa

Consultants
- EkobeSolar
- Inovatech
- Mitsidi
- Solatio
- Sustentech

Government
- EPE – Energy Research Company
- Ministry of the Environment (MMA) / Project 3E – Energy Efficiency in Construction
- Procel Edifica

Specialists
- C40 – Cities Climate Leadership Group
- CEBDS and SITAWI
- City of London: Urban Development Funds
- One NYC: Green Buildings and Energy Efficiency
- WRI – World Resources Institute

Appendix 2 – Financial products

Table 6 – Products which finance energy efficiency and sustainable construction

Bank	Name	Product description	Financial structuring
BNDES	FINEM line Energy Efficiency	Any corporate client that needs financing for buildings, focusing on air conditioning, lighting, the building envelopment, and distributed generation; including co-generation, for new or existing units (retrofit), production processes, focused on co-generation, use of gas as an energy source and other interventions prioritized by BNDES; and smart grids	Amount: R$ 5 million minimum Rate: Long term interest rate + 1.5% p.a. + credit risk (Direct operation) Rate: Long term interest rate + 1.5% p.a. + Financial intermediation + credit risk (Direct operation)
BNDES	PSI – Innovation and Efficient Equipment and Machinery	Manufacturing investments to introduce market innovation, provided they are inserted in a development project in the context of a innovation business plan. Buildings, provided that the investments are directly related to R&D activities and are not carried out in isolation Current R&D expenses of the company related to the business plan in innovation Technology parks	Term: 6.5% per annum (p.a.) for micro, small, and medium companies (MPME); and 7% p.a. for larger companies. Limit: Minimum R$ 1 million

Bank	Name	Product description	Financial structuring
Caixa	BCD Eco-efficiency PJ	Credit line with eco-efficient attributes for the following features: • Solar water heating system • Control or filtering of gases or particles • Solid waste treatment • Liquid effluents treatment • Recycling of waste • Wastewater treatment and reuse • Reduction of waste of inputs and/or natural resources • Energy efficiency • Water pollution control • Remediation of contaminated areas	Minimum term: 3 months Maximum term: 60 months Grace period: up to 6 months Maximum amount of financing: up to 100% of invoice value Minimum gross annual tax revenue: R$ 3.6 million Minimum amount: R$ 100,000 Rates: long term interest rate +: • Revenue up to R$ 60 thousand: 2.15% p.a. • R$ 60 to R$ 360 thousand: 2.05% p.a. • R$ 360 thousand to R$ 3,6 million: 1.95% p.a. • R$ 3.6 million to R$ 15 million: 1.90% p.a.
Santander	CDC Sustainable	Any corporate client that needs financing for machinery and equipment that promotes energy efficiency, rational use of water, sustainable construction and accessibility, waste treatment and corporate governance.	Term: up to 60 months Limit: varies from client to client Rate: varies from client to client Guarantee: Real or third party.
Desenvolve SP	Green Economy Line	Finances buildings with sustainable construction parameters - water reuse, energy efficiency, retrofitting of existing buildings.	Rate: 0.53% per month Term: up to 120 months Grace period: up to 24 months

Source: GVces and FEBRABAN.

Table 7 – Products that finance solar energy

Bank	Name	Product description	Financial structuring
Banco do Nordeste	FNE Sol	Any customer who needs financing for all components of micro- and mini-generation systems for photovoltaic, wind or biomass, as well as their installation	Term: Up to 12 years Grace period: from 6 months to 1 year Rate: Interest rate below the market average
BNDES	Energy efficiency	Any corporate client that needs financing for buildings, focusing on air conditioning, lighting, the building envelopment, and distributed generation; including co-generation, for new or existing units (retrofit), production processes, focused on co-generation, use of gases as an energy source and other interventions prioritized by BNDES; and smart grids	Amount: R$ 5 million minimum Rate: Long term interest rate + 1.5% p.a. + credit risk (direct operation) Rate: Long term interest rate + 1.5% p.a. + financial intermediation + credit risk (direct operation)
Caixa	Construcard	Any individual client that needs financing of solar water heating systems and micro power generation systems - solar and wind	Term: The current hiring terms consider the sum of the purchase and payment phases and are up to 240 months Limit: minimum of R$ 1,000 and maximum depending on term, relationship and payment capacity of the borrower approved in the credit risk assessment.

Bank	Name	Product description	Financial structuring
Caixa	Producard	Any corporate client that needs financing of micro power generation systems - solar and wind	Term: is the sum of the terms of use and amortization. Up to 36 months. Limit: The same client may be granted more than one loan, provided that the previous ones are not in use and the sum of the debit balances does not exceed the credit limit defined after a credit assessment
Santander	CDC sustainable	Any corporate client that needs financing for machinery and equipment that promotes energy efficiency, rational use of water, sustainable construction and accessibility, waste treatment and corporate governance.	Term: up to 60 months Limit: varies from client to client Rate: varies from client to client Guarantee: Real or third party
Sicredi	Solar energy	Any corporate client associated with Sicredi who needs financing for generation of electricity through solar energy	Rates and terms to be discussed in the branch
Desenvolve SP	Green Economy Line	Finances projects that promote the reduction of energy consumption, exchange of fossil fuels for renewables, among others.	Rate: 0.53% per month Term: up to 120 months Grace period: up to 24 months

Source: GVces and FEBRABAN.

FEBRABAN

Brazilian Federation of Banks