



Brasil Innovation Lab
for Climate Finance

DISTRIBUTED ENERGY FOR SOCIAL HOUSING (DESH)

INSTRUMENT ANALYSIS
SEPTEMBER 2018



Distributed Energy for Social Housing Fund (DESH)

LAB INSTRUMENT ANALYSIS

September 2018

DESCRIPTION & GOAL —

A fund to enable distributed solar energy for low-income tenants in Brazil, by providing a robust legal and financial structure to make it an attractive and low-risk investment option

SECTOR —

Energy

PRIVATE FINANCE TARGET —

Impact investors

GEOGRAPHY —

Brazil

The Lab identifies, develops, and launches sustainable finance instruments that can drive billions to a low-carbon economy. It is comprised of three programs: the Global Innovation Lab for Climate Finance, the Brasil Innovation Lab for Climate Finance, and the India Innovation Lab for Green Finance.

AUTHORS AND ACKNOWLEDGEMENTS

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ABOUT THE BRASIL LAB

Brazil aims to reduce greenhouse gas emissions by 43% by 2030, mostly through changes in its land use and energy sectors. Like in many emerging economies however, funding to meet these targets remains a challenge. In October 2016, a group of public and private investors – the Brasil Innovation Lab for Climate Finance – was established to tackle this challenge. The Brasil Lab identifies, develops, and supports implementation of transformative climate finance instruments that can drive funds for Brazil's national climate priorities. The Brasil Lab is one of the initiatives that was initially launched under the auspices of the Brazil-U.S. Climate Change Working Group, led by the Brazilian Ministry of Foreign Affairs and the U.S. Department of State. [Climate Policy Initiative](#) serves as Secretariat and analytical provider. The funders of the Lab are included below.



1. CONTEXT

Accelerating the deployment of residential distributed solar power will be key to achieving Brazil's NDC of mitigating carbon emissions by 43% by 2030.

Accelerating the deployment of residential distributed solar power will be crucial in meeting Brazil's nationally determined contribution (NDC) to the Paris Agreement, which includes mitigating carbon emissions by 43% by 2030. Concurrently, broader deployment of distributed solar can also increase clean energy access for low-income communities. However, low-income tenants typically lack the upfront capital required for purchasing solar generation systems, a key barrier to the scale-up of clean energy in these communities. An average household consuming 250 kWh per month would require approximately R\$ 15,000 in investments, approximately 15 times the minimum monthly wage in Brazil. Moreover, the current interest rates for retail solar investments in Brazil are 20-30%, with commercial credit markets perceiving low-income borrowers as higher risk, making solar financing prohibitive for this type of customer.

The Distributed Energy for Social Housing Fund (DESH) will foster the adoption of distributed solar by providing a robust legal and financial structure that enables access for people who are unable to invest upfront in solar systems, and also provides an attractive and low-risk investment option for investors. DESH is a third-party ownership and rental model for distributed solar systems in low-income condominiums, providing energy at a price that is lower than the utility rates. It offers a turn-key solution with no procurement or operations & maintenance responsibilities for the tenants.

The pilot for DESH will consist of 5 individual 1 MW plants, each in a selected Brazilian state capital. This will result in US\$ 6 million of investment and will bring affordable renewable energy to up to approximately 2,900 households. The pilot has the potential of mitigating ~105,000 tons of carbon emissions throughout its lifetime or 17 tons of carbon for each US\$ 1,000 invested. Moreover, the pilot will provide savings of approximately US\$ 20 million to 2,900 households. Considering that an average low-income household earns two minimum wages per month (R\$ 1900 or US\$ 477), this means 10% of the household budget.

DESH has the potential to reach 677,901 households in 12 years, enabling 1,125 MW of energy and mobilizing US\$ 1.1 billion. This is equivalent to the population of Fortaleza, the 5th largest city in Brazil.

CONCEPT

2. INSTRUMENT MECHANICS

The Distributed Energy for Social Housing Fund is a third-party ownership and rental model for distributed solar systems in low-income condominiums, that poses no upfront costs to the tenants and no procurement or operations & maintenance responsibilities.

2.1 OVERVIEW & OBJECTIVES

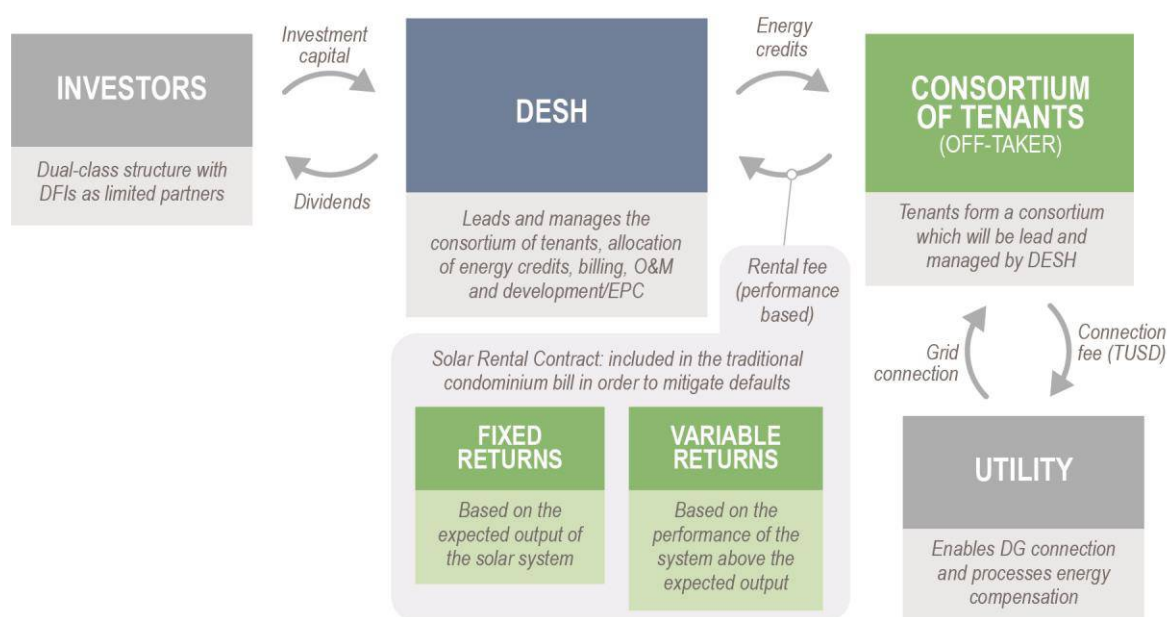
The Distributed Energy for Social Housing Fund (DESH) is a third-party ownership and rental model for distributed solar systems in low-income condominiums, that will pose no upfront costs to the tenants. Tenants will only pay a monthly rental fee that is 10-20% lower than their standard utility rate and will bear no risk related to procurement, operations & maintenance costs. It provides potentially attractive investment opportunities for the implementation of these systems and through that is able to fund 100% of the distributed generation projects with no Brazilian local content requirements for the equipment,¹ no guarantee requirements, and terms that match the lifetime of the projects.

The mechanics of the instrument are as follows:

1. Investors advance capital to the newly created DESH Fund, a dual-class fund structure. This structure includes a first-loss tranche, aimed at concessional capital providers and a senior tranche, aimed at commercial capital providers. The SPV is the actual owner of the generation systems.
2. DESH manages all operational activities related to the instrument, including development/EPC, O&M, billing, and the allocation of energy credits.
3. A consortium of tenants is created. It encompasses all tenants within a given distribution area, regardless of their location. For example, tenants from different condominiums in the same distribution area sit inside the same consortium.
4. Energy credits produced by the distributed generation system are allocated to the consortium of tenants in the form of generation capacity rental (according to Brazilian legislation).
5. The consortium of tenants pays a monthly rental fee to DESH. This fee has two main components: a 'fixed return' component, that is based on the expected output of the generation system, and a 'variable return' component, that is based on the performance of the system above that expected output. This is done to provide a link between the rental fee and the system's performance without resulting in actual energy sales, which are forbidden by Brazilian legislation. The variable share will eventually make up a source of extra earnings for less risk-averse investors.
6. The tenants also pay a monthly connection fee in the form of minimum consumption to their regional utility.
7. DESH passes through the rental fee to the investors in the form of pay-outs.

¹ Brazilian regulation requires that generation systems must include 65% or more of materials that have been produced locally. This is imposed by the majority of subsidized credit lines in Brazil.

Figure 1: Instrument mechanics for DESH



3. INNOVATION

DESH is the only financing option in Brazil that enables distributed energy at feasible rates and terms that match the lifetime of solar projects, especially for low-income households, who generally lack the credit worthiness of other debtors.

3.1 BARRIERS ADDRESSED: NO UPFRONT COSTS, NO INTEREST RATES, LOW DEFAULT RISK,

The main barriers that hinder the advancement of low-income solar in Brazil, as well as the DESH's strategy to address them, are as follows:

Barrier: All financing options for distributed solar currently in place in Brazil do not fund 100% of the projects, requiring the advancement of upfront capital from producers to consumers. However, low-income households generally have little or no savings, lacking the capital to make these upfront investments.

Response: DESH sets up a third-party ownership and rental structure with no upfront costs for low-income households. The financial effect of adhering to the DESH structure are positive from the first month, as clients will receive a 10-20% discount on their energy fees.

Barrier: Current financing options for distributed solar require high interest rates that make most projects unfeasible. The few credit lines that provide subsidized rates, such as *Cartão BNDES*, require that the generation systems have 65% or more of 'local content' (manufactured in Brazil), which makes these systems more expensive than imported ones, even when factoring in subsidized interest rates.

Response: Because DESH is structured as a rental model, rather than a financing line, low-income households aren't charged any interest rates. Instead, they only pay a monthly rental fee, bearing no financial costs.

Barrier: The market for commercial debt perceives a high risk in low-income borrowers. One piece of evidence of this is that, currently, interest rates for non-recourse loans are 6-7x the baseline country rate in Brazil.

Response: DESH has the ability to re-allocate energy credits within 90-120 days among its clients. This means that any defaulting party will stop receiving energy credits within this period, which limits the impact of defaults in the overall structure. Moreover, proponents are studying the use of a layer of guarantees provided by a third-party insurance company that will ensure the payment of future receivables against a 2-3% fee on the total assets deployed.

Barrier: Brazilian regulation for distributed energy generation includes a limited net-metering solution in which the energy generated can be compensated in the consumer-producer's energy bills, but cannot be sold back to the grid, as it is in the US, for example. This means consumer-producers can generate energy only up to the point of their consumption (excluding minimum consumption charges). Energy generated above the consumption levels is credited in an individual account and expires within five years.

Response: The third-party rental model proposed by DESH addresses this issue by avoiding direct energy sales to end-customers.

3.2 INNOVATION: THE FIRST FEASIBLE PATHWAY TO DISTRIBUTED SOLAR FOR LOW-INCOME HOUSEHOLDS IN BRAZIL

DESH will be the first instrument in Brazil to provide a feasible pathway to distributed solar generation to low-income households, funding 100% of projects without any additional requirements and no efforts for end-customers.

Current financing alternatives for distributed solar in Brazil fall within 3 main categories:

(i) The main pathway for retail customers to access subsidized loans is through the Cartão BNDES, a credit program aimed at individuals and small companies, which offers a 7.5% p.a. interest rate. However, the Cartão BNDES program funds only up to 80% of each project and while this may already be of great aid to end-customers, the remaining 20% can still be quite onerous for low-income clients.

(ii) Commercial credit lines from both public and private banks generally charge 20-30% p.a. interest rates for this type of investment and are not extended for more than five years. However, most solar project would require much lower rates to reach feasibility and have an average 20-year lifespan. This means that these credit lines overcharge customers while also undermining the potential for cash flow generation of solar investments.

(iii) The Distributed Energy Generation for Cooperatives (DGC) instrument, developed in the 1st cycle of the Brasil Lab, has several similarities to the DESH (third-party ownership, for example), but focuses only on cooperatives, leaving retail customers unattended.

Table 1: Alternative instruments for distributed solar financing in Brazil

Alternative Instruments	Description	Differentiation of DESH
Cartã BNDES	Subsidized line at 7.5% p.a. that finances up to 80% of project and requires local content	DESH offers financing of 100% of projects' needs and no local content requirements
Commercial lines (BB, Bradesco, Caixa, Votorantim, Santander)	Credit lines at 20-30% p.a. for a maximum period of 5 years	DESH offers lower interest rates and a contract period that matches solar generation investments
Distributed Energy Generation for Cooperatives	Provides cooperatives with discounted, clean energy, under the "shared generation" regulatory framework	Different end-customer (off-taker) imposes other challenges/benefits

3.3 CHALLENGES TO INSTRUMENT SUCCESS

There are several challenges DESH may face, with strategies in place to address them.

Firstly, low-income tenants may be perceived as having a higher probability of payment default, so potential funders may be hesitant to provide resources for low-income financing. To overcome this barrier, DESH is able to re-allocate its energy credits, shifting them away from defaulting clients within 90-120 days. There is also the possibility of the instrument purchasing a layer of guarantees for the receivables or having a national, regional or multilateral development finance institution (DFI) provide these guarantees.

A second challenge is that DESH will deal with a very large number of individual customers, which will pose challenges in the management of customer relationships and acquisition. To address this issue, DESH will use the heads of homeowner associations as interfaces with the clients, providing aggregated information exchange and customer relationships. A potential association with MRV (the largest low-income housing developer in Brazil), an agreement with SECOVI (national housing association) for distribution, and cooperation with the Belo Horizonte municipality will also contribute to this solution. The current models account for a reasonable marketing budget (2% of assets), implying an important in-house distribution effort.

A last challenge is that a large number of low-income households benefit from low-income tariffs in Brazil. This means a discount of 10-50% in their energy bills, which would undermine the value proposal of the instrument. To counter this, the proponents are targeting only the households that fall within the "low-income" category (up to 2 minimum wages of income) but that still do not benefit from these discounts.

MARKET TEST AND BEYOND

4. IMPLEMENTATION PATHWAY AND REPLICATION

The pilot for DESH will consist of 5 individual 1 MW plants, each in a selected Brazilian state capital. This will result in an ~US\$ 6 million investment and will bring affordable renewable energy to up to approximately 2,900 households.

4.1 INITIAL PILOT AND BEYOND

The pilot for the DESH will consist of 5 individual 1 MW plants, each in a selected Brazilian state capital. This will result in an ~US\$ 6 million investment and will bring affordable renewable energy to up to approximately 2,900 households. The instrument will focus on states in Brazil that provide ICMS (VAT-like tax) exemption for energy generated by distributed generation and have high solar irradiance levels. Estimates for the cost of renting the land required for the solar plants are based on premium land, located near transmission lines.

The first step towards securing a pipeline for the pilot have already been taken – the DESH team has initiated a cooperation with the municipal Housing Department of Belo Horizonte, one of the largest metropolitan areas in Brazil. This cooperation should allow a much faster insertion in this region, that offers some of the best natural, political, and fiscal conditions for the development of distributed solar.

The proponent Endless AB is a newly formed company whose partners have extensive experience in the energy generation for condominiums and solar/renewable energy projects. The main partners selected so far for the pilot are SOCOPA, one of the leading providers of structured finance products in Brazil, Scaramucci Advogados, a boutique law-firm specializing in the energy market, Caixa Econômica Federal, a public bank that is the largest funder of low-income housing in Brazil and MRV, the largest low-income housing developer in Brazil. Partners related to the physical development of the projects, such as solar EPC and O&M contractors, are still being evaluated.

The central administrative structure required to run the pilot, which will be managed by Endless AB, is estimated to be composed of around five employees, with total costs amounting to US\$ 7,500 per month. The size of the structure will be scaled up along with the instrument and the pilot will invest about US\$ 200,000 in the development of a customized IT system that will help central management deal with the growing amount of customers and transactions.

The Brazilian distributed generation arena was first regulated by the Normative Resolution 482 / 2012 and later by the Normative Resolution 687 / 2015, which broaden its scope with the intention to further foster distributed generation in the country. It is based on a net metering system that allows small scale producers to benefit from credits.

Regarding potential regulatory changes, we have recently identified negative cases of diminishing feed-in-tariffs in Europe, the end of some subsidies in China (legislation China 531) and a pro-fossil fuel policy in the USA. In the Brazilian case, regardless of the needs for investments in energy generation, the distributed energy sector has become more relevant and organized. Currently ANEEL (regulatory agency) has published the Public Consultation

10/2018, aiming at improving the legislation. The expectation is that future regulation will allow more flexibility in contracts and a direct sale of DG energy to the free energy market. This should only help DESH achieve an even more robust, direct structure.

Table 2: Basic quantitative assumptions and results for the pilot model

Item	Value
Total Investment	US\$ 6 million
Equity as a % of Total Capital	30%
Energy Capacity Deployed	5 MW
Number of Households Addressed	2,900
Avg. Monthly Rental Fee per Household	US\$ 32.70
Effective Discount to Clients	20%
Assumed Default Rate	10%
Cost of Debt (nominal)	9.9% (junior) / 7% (senior)
IRR – Equity (nominal)	15.8%

A second phase of the instrument will focus on developing the countryside of the states that have already been targeted. A new investment phase will be required to fund this expansion at approximately US\$ 1 million per MW of energy generation capacity deployed. It is estimated that this phase could accommodate US\$ 15 million in investments, enabling 15 MW of energy generation capacity. The instrument could also be replicated in countries other than Brazil, especially those that provide a solid institutional framework for distributed generation and have developed low-income housing programs.

4.2 IMPLEMENTATION TIMELINE

The pilot will take 1.5 years to be implemented, including negotiation with potential suppliers and development of a robust pipeline and investor base. After a three year run, the pilot will have been able to validate the model. At this point, a second round of investments will be made, with the expansion of the instrument and the possible phase-out of public capital.

Table 3: Implementation timeline

Event	Date
Negotiate with fund service suppliers	Q2 2019
Roadshow with potential funders	Q4 2019
Development of 5 MW pilot	Q1 2020
Pilot results and second round of investments	Q1 2023
Possible phase-out of public capital tranche	Q2 2023

4.3 INVESTORS TARGETED AND STRATEGY TO PHASE OUT

The first phase of the instrument targets both concessional and commercial capital providers interested in financing socio-climate initiatives that may be more flexible in their return and guarantee demands. Concessional capital providers are allocated in a first-loss tranche while commercial capital takes a senior position.

On the concessional capital side, the instrument targets development finance institutions, seed/angel investors, philanthropic donors, impact investment funds and multilateral organizations. Concessional capital is needed at this phase due to the general market perception that low-income households have high credit risk. The target group, however, shows a low 1.8% default rate on their condominium fee. On the commercial capital side, it aims at companies and funds interested in green investments, enhancing their CSR activities and that understand the parameters of low-income credit.

As the instrument scales up and is able to provide market-level returns with reasonable risk, most concessional capital support can be either phased out or diluted, which should happen within a 2-3-year timespan. However, it is likely that some level of public support in the form of guarantees will still be needed as low-income households are generally not able to achieve the same credit worthiness as other off-takers.

4.4 IMPLEMENTATION CHALLENGES

The main challenges for the implementation of the pilot, as well as DESH's strategy to address them, are:

Modelling: Obtaining actual consumption data from low-income tenants, which is necessary to inform the current models and confirm findings, is an important challenge in the set-up of the DESH, especially as access to individual level data is scarce. The proponent is exploring different channels to obtain this data, but with limited success so far.

Distribution: Potential clients are scattered. To mitigate this, the proponent will be using the heads of homeowner associations as interfaces between the clients and the instrument, as well as allocation of a considerable marketing budget to the instrument (2% of assets). A potential association with the largest low-income housing developer in Brazil) and an agreement with SECOVI (national housing association) are also important strategies for distribution.

Another challenge is that, although the instrument ultimately provides savings in the clients' energy bills, potential clients might perceive it as 'another bill' to their list and prefer to keep their current payment routine. To address this issue, the continuous education of potential clients and creation of awareness regarding the economic benefit potentials of solar energies will be an integral part of the sale process.

Development: Solar projects might also suffer bureaucratic or development delays and there can be supplier risks. The proponent is mitigating this risk by already incorporating delays in its financial model, accounting for one year of project development, and applying strict criteria for the selection of suppliers, based on previous experience and market reliability.

Fundraising: Finally, raising capital for the instrument considering a poor market-perception of low-income lending might also be a challenge. To counter this, DESH will have the ability

to re-allocate its energy credits, shifting them away from defaulting clients within 90-120 days. There is also the possibility of the instrument purchasing a layer of guarantees for the receivables or having a DFI provide these guarantees. Conservatively, the current models already assume a 10% default, even though the average rate for low-income condominium bills is 1.8%.

5. IMPACT

The 5 MW pilot has the potential to avoid the emission of 105,000 tons of CO₂e (~17 tons per US\$ 1,000 invested) and provide savings of US\$ 20 million to 2,900 low-income households.

5.1 QUANTITATIVE MODELLING (FINANCIAL IMPACT)

The pilot will mobilize US\$ 6 million in investments and enable 5 MW of solar energy to low-income households. When compared to the baseline scenario for distributed generation financing in Brazil, DESH presents several advantages to potential clients, including a longer term of agreement, no guarantee requirements, no additional costs, no performance risk and no equity or guarantee obligations.

Table 4: Financial advantages of DESH

Item	DESH	Baseline in Brazil
Loan Rate	-	20-30%
Term (years)	25	5
Monthly Payment (% of savings)	80%	120%
Guarantees	DFI as guarantor	Bank guarantee
Equity/collateral required	None	Up to 50%
System performance risk	DESH	Tenant

5.2 ENVIRONMENTAL AND SOCIAL IMPACT

Considering that the pilot instrument will enable 5 MW in energy capacity – and a factor of ~21,000 tons of carbon emissions for the lifetime of each MW enabled – it has the potential of mitigating ~105,000 tons of carbon emissions. This means an avoidance of 17 tons of carbon for each US\$ 1,000 invested.

Moreover, the pilot will have a direct impact on the monthly expenses of low-income tenants, providing savings of approximately US\$ 20 million to 2,900 households throughout its lifetime. Considering that an average low-income household earns two minimum wages per month (R\$ 1900 or US\$ 477), this means 10% of the household budget.

5.3 PRIVATE FINANCE MOBILIZATION AND REPLICATION POTENTIAL

The 5 MW pilot will mobilize US\$ 1.7 million in private finance and provide a 15.8% nominal IRR for commercial equity holders and a 10% service for commercial debt holders by early 2020. It is estimated that after three years the instrument will have gathered enough consumer credit data to potentially phase out or dilute the public finance portion and be replicated to other cities/regions in Brazil.

DESH has the potential to reach 677,901 households in 12 years (approximately the population of Fortaleza, Brazil's 5th largest city), enabling 1,125 MW of energy and mobilizing US\$ 1.1 billion. The replication potential is calculated using the potential demand from low-income households, as seen below:

Table 5: Calculation of DESH's replication potential

Calculation	Value
Number of low-income condominiums in Brazil	180,000 condominiums
Growth of 10% per year for 12 years	564,917 condominiums
Number of units per condominium	60 units
Total number of units	33,895,026 units
Market penetration	2%
Addressable market	677,901 units
Avg. kWp/unit	1.66
Total kWp capacity	1,125,315 kWp
Cost of kWp	US\$ 975/ kWp
Total Investment	US\$ 1.1 billion

6. KEY TAKEAWAYS

DESH will enable access to discounted distributed solar energy for low-income households, helping mitigate 105,000 tons of carbon emissions and providing US\$ 20 million in savings to 2,900 households in its initial 5 MW pilot phase. It has the potential to reach 677,901 households in 12 years, enabling 1,125 MW of energy and mobilizing US\$ 1.1 billion.

Innovative: DESH will be the first instrument in Brazil to enable distributed energy for low-income households, funding 100% of projects without any additional requirements and no efforts for the end-customers. Currently available financing options for this category of investments in Brazil charge very high interest rates, fund only part of the projects or impose 'local content' and collateral requirements, deeming most projects unfeasible.

Financially Sustainable: DESH aims to provide a 15.8% nominal IRR to equity holders and a 10% nominal service to debt holders. About US\$ 4.3 million of public finance will be required for the 5 MW pilot phase. This tranche should be phased out or diluted by the third year of the pilot as the structure is proven effective and enough data on low-income credit is gathered.

Catalytic: The pilot will leverage US\$ 1.7 million in private investments in its first three years and up to US\$ 5 million thereafter. Private investors will be allocated in a second-loss tranche, de-risking their investments of potential defaults from low-income clients.

Actionable: The pilot will take 1.5 years to be implemented, including negotiation with potential suppliers and development of a robust pipeline and investor base. Potential partnerships with MRV (largest low-income housing developer in Brazil), Caixa (largest low-income housing funder) and the municipality of Belo Horizonte will help increase the actionability of the instrument.

7. REFERENCES

Brazil Solar Atlas 2006, INPE - [Link](#)

Anuário Estatístico de Energia Elétrica 2017 , EPE - [Link](#)

ANEEL website - [Link](#)