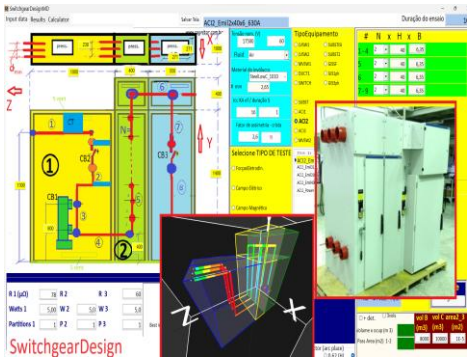
ELECTRICAL TESTING LABORATORY: GOOD OPPORTUNITY FOR PRIVATE INVESTMENT in BRAZIL

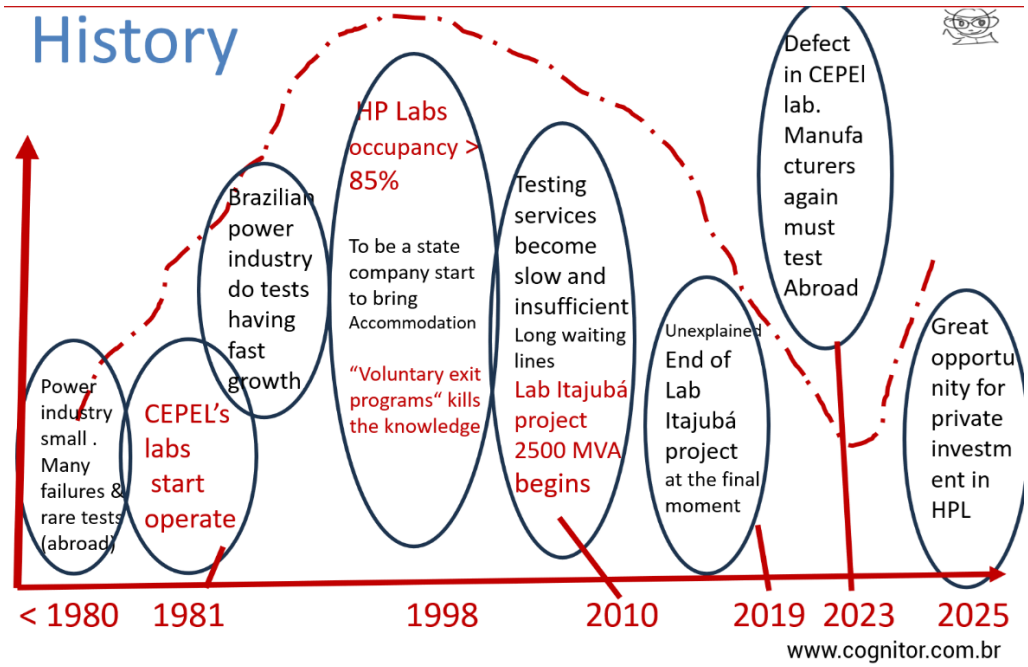
Five days of use of high-power laboratories costs ~USD30,000.00. Type tests on a medium-voltage panel cost around USD100,000.00. At least until mid-2026, Brazil cannot perform these tests on T&D equipment. Performing tests abroad, as before 1981, makes T&D equipment more expensive and electricity bills higher. No competitors in Latin America



Author: Sergio Feitoza Costa

The author of this article helped, for 25 years, to design, build, operate and manage the former 14 CEPEL test laboratories including high power, high voltage, EMC, Ex, ... He also worked on the Ita juba lab project for 8 years. Read international C.V. at the end.

1. WHY A MEDIUM-SIZED LABORATORY IN BRAZIL IS A GOOD OPPORTUNITY FOR PRIVATE INVESTMENT;



When everything goes well, 5 days of high-power laboratory use costs around USD35,000.00. Complete type tests on medium-voltage panels can cost around USD100,000.00. At least until mid-2026, Brazil will not be able to perform these tests on T&D equipment as it has done since the early 1980s. Carrying out tests abroad, as before 1981, makes T&D equipment more expensive and electricity bills

Several manufacturers of substation equipment have asked me for the names of laboratories abroad Brazil to perform internal arc tests on medium voltage panels, breaking tests on distribution fuse switches and even short-circuit and temperature rise tests on low voltage panels. It is hard to believe that in the 1980s manufacturers developed and tested 800 kV disconnectors with more than 50 kA at CEPEL. I myself conducted several of these tests there. Brazil has regressed 30 years in its testing capacity, and this is a good opportunity for investors who are close to the electrical industry. The ideal focus is a small to medium-sized high-power laboratory.

There are simply no competing laboratories in Latin America. The only one was CEPEL, which was not prepared to survive outside the state companies environment. I know this because I had the honour of helping to build and manage those large laboratories that opened in 1981. They were a source of national pride and were in the same level of the

best laboratories in the world. They were the reason for the consolidation of the Brazilian electrical industry. If the forgotten official planners of the Brazilian electricity sector want to understand why the industry went backwards when it had to carry out tests in Europe or North America again, they just need to read what the electricity industry was like until 1980. In Annex 1 we show historical indexes.

It is sad to note that, after CEPEL had a first-world laboratory capacity in the late 1990s, a large part of those facilities were deactivated, partly due to a lack of personnel to operate them. The competent and well-trained team of about 250 people that existed before now has less than 30. The only serious initiative to improve this situation was the high-power laboratory project in Itajubá, Minas Gerais. The ISI-CEDIIEE, a good initiative by FIEMG, was no longer of interest to FIEMG after a change in presidency. It was supposed to be a complete G7-level laboratory. It was then transferred to the national SENAI and, although it was in the final stages of implementation, with the purchase of the main equipment and even with the substation energized, it was suddenly halted in early 2019. I do not believe it was due to a lack of money. The input substation was already energized, and we had entered the phase of major bidding processes. **This article,** presented in lectures to potential investors, describes an idea to reverse the process that is weakening the electrical industry day by day. I provide details to motivate companies interested in building an economically sustainable private laboratory. Understand the history, testing capabilities, investment size, possible locations for the laboratory and the general implementation strategy.

2. UNDERSTAND THE HISTORY AND CENTRAL IDEA OF A SELF-SUSTAINABLE TESTING LABORATORY.

The world's main testing laboratories were built in the 1950s and 1980s with the aim of encouraging regional development. Few have been created in the last two decades because, from the point of view of private agents, there are more comfortable ways to invest amounts such as 15 to 100 million dollars. However, for those who operate in the large electrical industry market, not having competing laboratories in South America is very attractive.

A growing electrical industry produces positive results in development, employment and income. At a time when the global focus is on seeking greater efficiency and reducing climate change, there are many opportunities for innovation, patents and cost reduction of equipment for substations and lines.

However, in Brazil, unlike in the 1970s and 1980s, there is no longer a vision of national planning on the subject of “testing laboratories”. At that time, Eletrobras, as part of the government, did this with rare competence. However, this ended after the privatizations began and no one else took on this role. Today, the way is through private initiatives.

I participated intensely in the entire process of strengthening the electrical industry in Brazil, in the 1980s and 1990s. The results were very good, visible and verifiable via the web. Compare the profile of the electrical industry in the early 1970s and now (Appendix 1). The results were remarkable, from the technological improvement of products for substations to the good electrification program for areas without access to electrical energy. The incipient electrical industry of the 1970s grew, becoming solid and competitive, generating employment and development. The catalyst was the creation of CEPEL's testing laboratories, which I helped to create and coordinated for more than 20 years.

The project focuses on a medium-power laboratory on a smaller scale than CEPEL, financially self-sustainable, using less investment, but with a world-class innovation. The idea is, in addition to carrying out real tests, to support manufacturers in developing products through the use of test simulations. No laboratory in the world does this.
It would provide support services to manufacturers in developing innovative products. In addition to the testing team, there would be a team focused on R&D to develop innovations in substation equipment (60% testing team + 40% R&D services team).

The focus of the new venture is to support manufacturers in the electrical industry to design and develop more efficient equipment (with lower Kg/MVA, see Ref. [6] below). It would become an economically sustainable business in 3 to 5 years. There is a market without competitors in South America. If the investor and the location are already involved in electrical testing and installations, for example to carry out dielectric tests, this would facilitate implementation.

OPERATING STRATEGY FOR THE NEW LABORATORY: The concept is to combine a group of experienced specialists (20%) with a group of professionals with average experience (50%) and a group of recent or future university graduates (30%). Initially, the "experienced" ones would perform the R&D tasks. The "intermediate" group would be responsible for the regular testing activities. Depending on the skills they demonstrated, the members of the younger group would work in the testing or R&D groups. The laboratories I managed in Brazil until the end of the 1990s operated this way, with recognized success.

FINANCING FOR THE INITIAL STAGES: The initial idea is to bring together 5 to 10 companies (manufacturers, certifiers, universities, 1 or 2 electrical industry associations) to create a third-party company and start the project. If well planned and dimensioned, as the Itajubá laboratory would have been – if completed – it would be attractive from an economic point of view.

The few laboratories that survive in the todays market base their living by providing testing services. Many of them have many employees because they are large facilities. This is where the mistake lies. Instead, we plan to have around 20 to 30 people, trained to be highly qualified. We are talking about investments of around 8 to 20 million US dollars. If it were a generator-powered laboratory, this amount could reach 40 million US dollars. We are not talking about investments like the one in the Itajubá laboratory of 100 million US dollars (would be powered by generators), where the substation was ready, civil works and the purchase of the main equipment would begin. I participated in this entire project and carried out the initial feasibility study.

> In short, the main idea is to implement the construction of a medium-sized third-party laboratory. In addition to conventional testing services, an R&D team will support substation and line equipment manufacturers and equipment certifiers.
>
> A well-sized and managed laboratory from the perspective of private companies will immediately conquer a large market because (a) in South America there is little or no availability of laboratories (b) the focus is to create conditions for the growth of the electrical industry (c) the growth of the renewable energy market (d) large buyers such as oil, gas and mining companies, needing to take care of their environmental image, will prefer to buy products with lower kg/MVA

3. HOW TO START AND CARRY OUT

The implementation of a third-party laboratory that goes beyond conventional testing services and additionally provides support to manufacturers in the development of energy products is a real innovation. If the staff and facilities are well-sized, and the laboratory is run like a private business, it will be a self-sustaining enterprise selling testing services and R&D services.

Most laboratories around the world still have a conservative view that "everything should be tested" and, furthermore, that a third-party laboratory should not help manufacturers develop products because it would conflict with the interest of "neutral testing". They still think like they did 40 years ago and forget that more than 95% of their customers go to the laboratory just to have a test report in hand. There is no conflict in supporting manufacturers throughout their developments. It is good for their pockets and for the local industry.

For those with limited financial resources for testing, there are new useful tools. The best of these is the use of low-cost test simulations to develop products. (Appendix 2) I see in the working groups in which I participate in Cigrè and IEC that the main global manufacturers use these tools intensively. In References [2,3,4] there are CIGRE publications demonstrating applications and validations. In IEC, openings for test simulations were created as in IEC TR 62271-307 (Reference 5). I am a co-author of these Cigrè / IEC documents.

4. THE IMPLEMENTATION OF THE SERVICES

The following aspects will be detailed in the presentation with figures and evidence. The focus is to implement the project with an acceptable return on investment for investors. In the feasibility study, it should be considered that the

return on investment involves revenues from the sale of tests and development support services, patents and other R&D consequences such as improvements in the system's quality indices.

The project will have two lines of action:

• A small/medium-sized laboratory to perform the high-power tests described below and,

• Parallel activity of "Support for the development of substation equipment" with worldwide operations, including lower-cost solutions to expand the use of renewable energy. This market is not yet explored by testing laboratories and can generate even greater revenues than test sales.

The direct revenue from the business will come from

(a) performing conventional tests as listed below,

(b) providing manufacturers with technical support for the development of more efficient products,

(c) using simulations and training to reduce development costs, and

(d) neutral lectures, on behalf of manufacturers, on products that help to improve energy efficiency.

Test Laboratory: the main tests to be performed will be:

• Tests on distribution transformers up to 1000 kVA and distribution fuse switches and similar up to 10 kA.
• Type tests on low and medium voltage panels and busbars.
• Short-time and peak withstand current tests (short-circuit) up to 80 kAef - 1s
• Temperature rise up to 10,000 A permanent in MV/LV.
• Internal arc in medium and low voltage panels
• Low voltage interruption tests and electrical and mechanical life (including some in medium voltage)
• Dielectric tests on low and medium voltage equipment.
• Remote viewing of tests.

5. FINAL COMMENTS

Brazil needs to act quickly to be able to start testing in Brazil again instead of sending equipment abroad for testing, as before 1981, when there was no way to test here. The electrical industry needs to organize itself to make this project or something similar happen. The idea presented here is feasible, economically viable and can be quickly implemented.

For those who are really interested in acting as investors, we can present, under a confidentiality agreement, information about:

• Technical and economic feasibility study and business plan
• Detailed market study
• Estimated implementation costs and future revenues
• Team size

About the author
• Author's CV (in Portuguese) https://www.cognitor.com.br/Curriculum.html

• Projects I helped to carry out (in English) https://www.cognitor.com.br/HelpedToDo.pdf

---------- END OF THE ARTICLE ----------
Red references next page

REFERENCES

[1] CIGRÈ Brochure 740 (2018) "CONTEMPORARY SOLUTIONS FOR LOW-COST SUBSTATIONS". (Sérgio is coauthor)

[2] Article "ELECTRIC PANELS DESIGN USING LESS MATERIALS"
https://www.cognitor.com.br/trainingweek1.pdf

[3] FREE BOOK "SWITCHGEAR, BUSWAYS & ISOLATORS: about T&D SUBSTATIONS & LINES EQUIPMENT"
https://www.cognitor.com.br/Book_SE_SW_2013_ENG.pdf

[4] Article ELECTRICAL TESTING LABORATORY: GOOD OPPORTUNITY FOR PRIVATE INVESTMENT in BRAZIL
https://www.cognitor.com.br/hplENG.pdf

[5] Article "UNDERSTANDING WHY SAVING COPPER, ALUMINUM & INSULATORS MITIGATES CLIMATE CHANGE AND COMPANIES CAN PROFIT FROM THIS"
https://www.cognitor.com.br/certificate.pdf

[6] Free Book "TEMPERATURE RISE LIMITS used in I E C / IEEE SWITCHGEAR TECHNICAL STANDARDS"
https://www.cognitor.com.br/TemperatureRiseLimits.pdf
Adding ideas to IEC TR 60943:1998 - Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals. Issued by IEC Technical Committee TC 32

[7] LV CIRCUIT BREAKERS DEVELOPMENT. WHY HAVING A LOWER POWER DISSIPATION IS BETTER.
https://www.cognitor.com.br/LVcircuitBreakerDevelopment.pdf
https://www.cognitor.com.br/DevelopingCircuitBreakers.pdf

[8] IEC 62271-307 – EXTENSION OF THE VALIDITY OF TYPE TESTS TO AVOID TESTS REPETITIONS. UNDERSTANDING THE CONCEPTS AND OPPORTUNITIES. Sergio is coauthor of IEC62271-307
https://www.cognitor.com.br/IEC62271307ENG.pdf

Brochures CIGRÈ in which Sergio Feitoza Costa is coauthor.

[9] CIGRÈ BROCHURE 830 (2021) – "SIMULATIONS FOR TEMPERATURE RISE CALCULATION".
[10] CIGRÈ BROCHURE 740 (2018) Contemporary design of low-cost substations in developing countries.
[11] CIGRÈ BROCHURE 602 (2014) Tools for Simulation of The Effects of the Internal Arc in T&D Switchgear,

[12] Other reference articles free downloads
https://www.cognitor.com.br/Downloads1.html

[13] A (unique in the World) TRAINING FOR SWITCHGEAR / ELECTRIC PANELS DEVELOPERS:
https://www.cognitor.com.br/trainingENG.pdf

[14] Design Review for LV + HV Switchgear and Controlgear https://www.cognitor.com.br/proposal.pdf

Site https://www.cognitor.com.br E-mail: sergiofeitozacosta@gmail.com

LinkedIn profile (32K+ followers) : linkedin.com/in/sergiofeitozacosta

C.V.: https://www.cognitor.com.br/HelpedToDo.pdf

****

ANNEX 1 -INDICATORS OF THE QUALITY OF ELECTRICITY DISTRIBUTION SERVICES in BRAZIL and some other countries

Here are some indicators of the quality of electricity distribution services from the late 80's to recent years. I got this data in the web, just to present orders of magnitude. In the case of Brazil, they give an idea of how the distribution systems improved after the program Proquip and NBR7282. I used as indicators:

- SAIDI (System Average Interruption Duration Index) ,= total duration of interruptions / Number of customers
- SAIFI (System Average Interruption Frequency Index) = total amount of interruptions/ Number of customers
- Electricity price (USD/KWh or USD / MWh)
- Electricity price divided by the country minimum wage, to understand the difficulty to pay the electricity bill

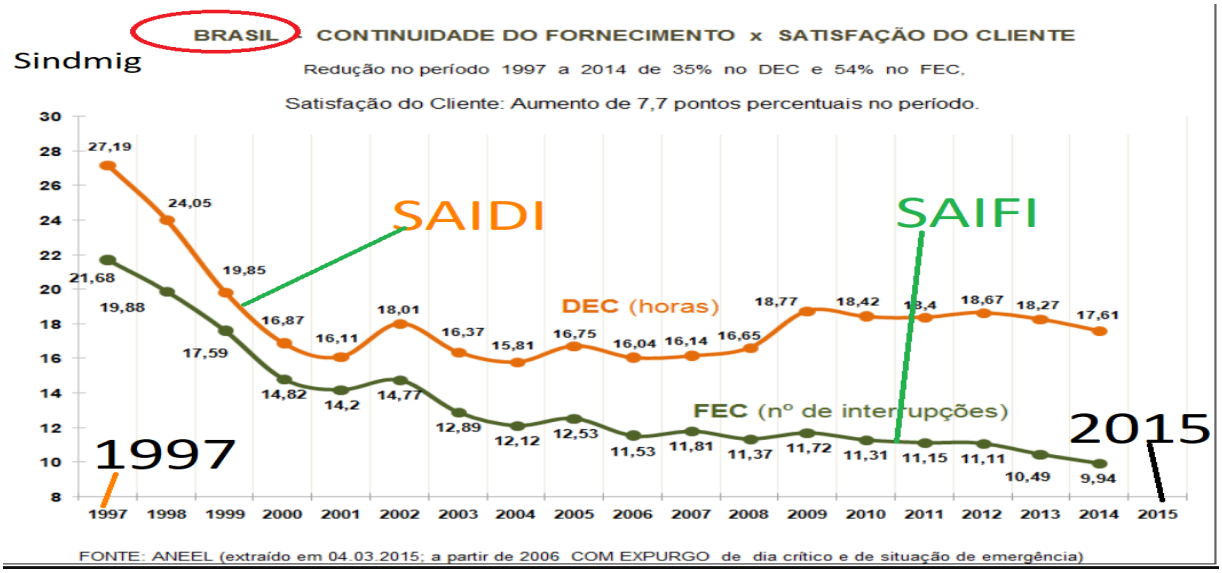
Table 1 - ELECTRICITY QUALITY & COSTS indicators: ORDER of MAGNITUDE

Country	SAIDI (minutes)		SAIFI		Quality of electricity supply Index (World Bank GovData360)	Price (*) of residential consumer bill (USD / MWh)	(USD / MWh) divided by minimum month wage in the country
USA/Canada	> 92 (2019) IEA		1,25 (2016) IEA		**6,2 -6,6**	140 - 170	**0,12**
France	48,0 (2002) 70,0 (2016) CEER methodology		0,11 (2002) 0,22 (2002) CEER methodology		**6,7**	267	**0,13**
Netherlands	31,5 (2012) 27,3 (2016) CEER methodology		0,33 (2012) 0,32 (2016) CEER methodology		**6,8**	259 - 316	**0,14**
Australia					**5,7**	176	**0,14**
Turkey					**4,4**	77	**0,23**
Philippines					**4,2**	150	**0,50**
South Africa					**3,9**	208-230	**0,70**
B R A Z I L	**26 (1996) 16 (2016)** DEC - GESEL		**22 (1996) 8 (2016)** FEC - GESEL		**4,5**	280-314 (*)	**0,85**

(*) Order of magnitude of values. In Rio de Janeiro - Brazil I paid the electricity bill in April 2022 (apartment for 3 people) ~ USD 206.00 for 654 kWh (USD 314.00/MWh). Taxes are 33% of the total bill.

(**) CEER -Table 9 - Electricity: planned and unplanned SAIDI, including exceptional events (minutes per customer)

(***) CEER - Table 17 – Electricity: planned and unplanned SAIFI, including exceptional events (interruptions per customer



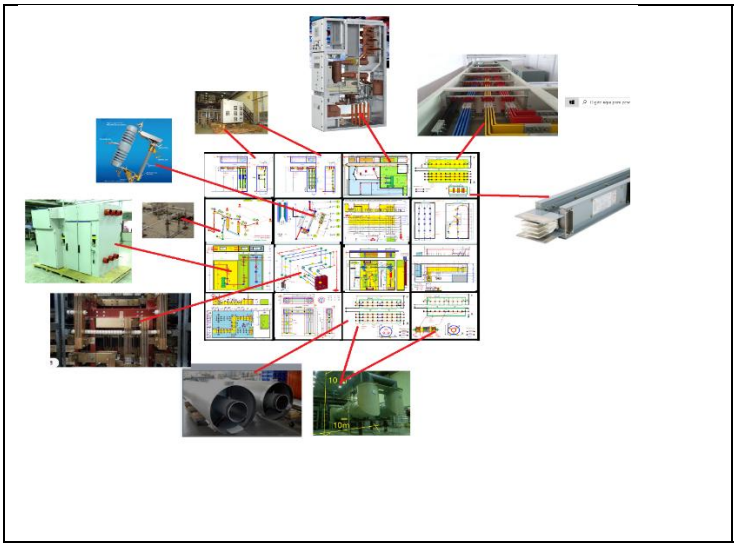
SINDIMIG: http://www.sindimig.com.br/wp-content/uploads/2016/04/dec-e-fec-aneel.bmp

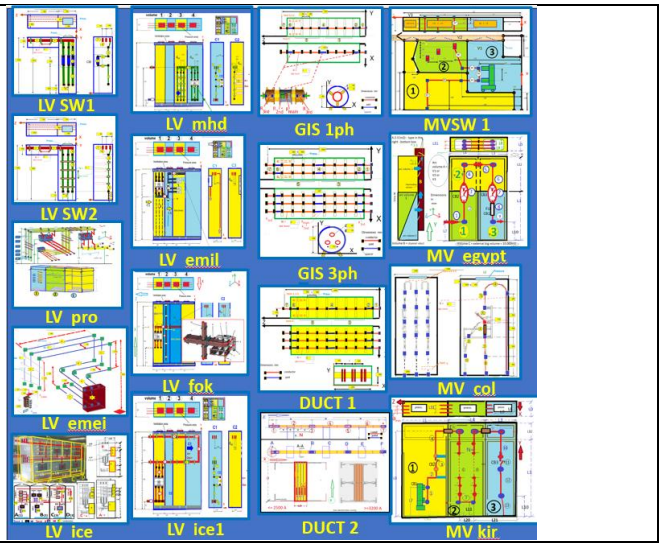
Cell phone. 55-21-9 88874600
E-mail: sergiofeitozacosta@gmail.com Site: http://www.cognitor.com.br

SOME INTERESTING SOURCES OF INFORMATION:

Minimum Wage by Country 2022 (worldpopulationreview.com)	https://worldpopulationreview.com/country-rankings/minimum-wage-by-country OECD https://stats.oecd.org/Index.aspx?DataSetCode=RMW
Quality of electricity supply - GovData360 (worldbank.org)	https://govdata360.worldbank.org/indicators/heb130a3c?country=BRA&indicator=547&viz=line_chart&years=2007,2017
IEA - Statistics report - Key World Energy - Statistics 2021 - September 202 + EIA	https://iea.blob.core.windows.net/assets/52f66a88-0b63-4ad2-94a5-29d36e864b82/KeyWorldEnergyStatistics2021.pdf EIA methodology USA https://www.eia.gov/todayinenergy/detail.php?id=45796
MAIFI , SAID, SAIFI (Wikipedia)	https://en.wikipedia.org/wiki/MAIFI#:~:text=The%20Momentary%20Average%20Interruption%20Frequency,period%20(typically%20a%20year).
International electricity prices: How does Australia compare? (energycouncil.com.au)	https://www.energycouncil.com.au/analysis/international-electricity-prices-how-does-australia-compare/#:~:text=The%20average%20annual%20cost%20of,costs%20(down%20by%20%2467)
Energy Quality of Supply Work Stream (EQS WS) - **CEER** Benchmarking Report 6.1 on the Continuity of Electricity and Gas Supply - Data update 2015/2016	https://www.ceer.eu/documents/104400/-/-/963153e6-2f42-78eb-22a4-06f1552dd34c
ERIA Research project report 2017 Nr.12 Comparative Power Prices in the Philippines and selected Asian Countries	https://www.eria.org/research/comparative-analysis-of-power-prices-in-the-philippines-and-selected-asean-countries/
ANEEL – Indicadores coletivos de continuidade	https://www.eia.gov/todayinenergy/detail.php?id=45796
Dados Energéticos – São Paulo	https://dadosenergeticos.energia.sp.gov.br/portalcev2/intranet/Eletricidade/index.html
SINDMIG (chart above 1997 – 2015)	http://www.sindimig.com.br/wp-content/uploads/2016/04/dec-e-fec-aneel.bmp

ANNEX 2






Some training bibliography (Sergio Feitoza Costa is author or coauthor)
Renewable Energy + Environmental Education to try to save the Planet
Need to reforest !!
(About Energy Transition, H2 Green, Hydrogen and how to ride this wave)
By Sergio Feitoza Costa
January 2023
Rio de Janeiro - Brazil
(*)
602
Tools for the Simulation of the Effects of the Internal Arc in Transmission and Distribution Switchgear
Working Group A3.24
December 2014
B3
Substations and electrical installations
Contemporary design of low cost substations in developing countries
A3 TECHNICAL BROCHURE
Transmission and distribution equipment
Application and Benchmark of Multiphysics Simulation Tools for Temperature Rise Calculations
IEC TR 62271-307
TECHNICAL REPORT
RAPPORT TECHNIQUE
(*)
Reference text for the courses
SWITCHGEAR, BUSWAYS & ISOLATORS
and
SUBSTATIONS AND LINES EQUIPMENT
Sergio Feitoza Costa
Read the free book "Project Save RIO in 10 years"
70% reforestation + City of Arts & Inclusion + City of Agriculture & Health
+ City of Environmental Education & Energy
Project "Save Rio in 10 years"
(the size of a mustard seed)
Sérgio Feitoza Costa
Read in www.cognitor.com.br #sergiofeitozacosta
(*)
(*)
The cosmic engineers in the country of TransAmazon
Sérgio Feitoza Costa
Read Free
Patent by Sergio
METAL FOAM in SWITCHGEAR, switchboards & bus ducts:
Why didn't I think of this .. before other panel manufacturers?
(*) free download in www.cognitor.com.br