Reverse Auctions to Scale Renewable Energy: Brazilian Approach

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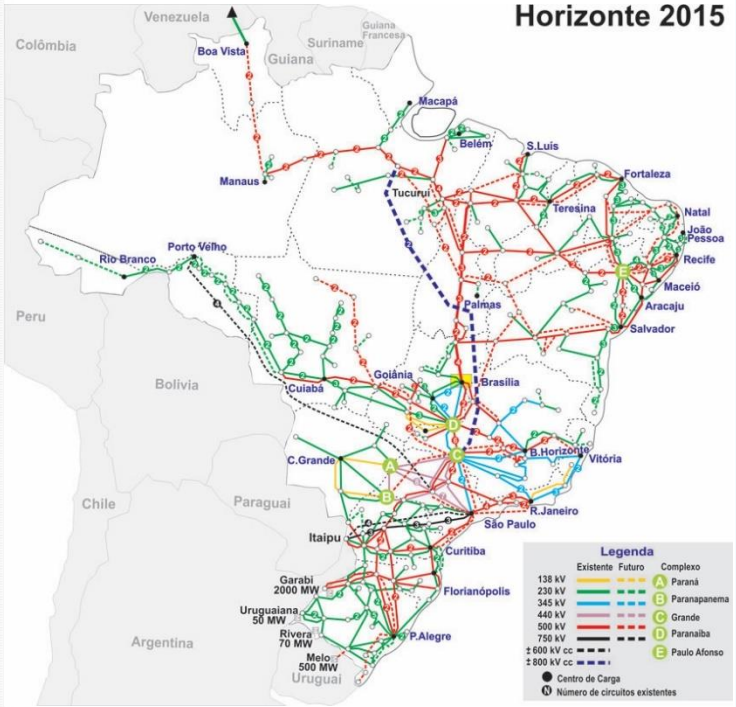
Brazil at a glance

Interconnected System – Map 2015



Main Figures

Brazil

▪ Area	8,514,876 Km²
▪ Population	206 million
▪ GDP 2016	US$1.9 trillion*
▪ GDP 2016 per capita	US$ 9,330*

Electricity Sector

▪ Transmission lines	128,000 Km
▪ Generation Capacity	152.1 GW
• Hydro	64,74%
• Thermal	27,7%
• Wind	6,15%
• Nuclear	1,39%
• Solar PV	0,02%
▪ Consumption	537 TWh
• Regulated Market	76%
• Free Market	24%

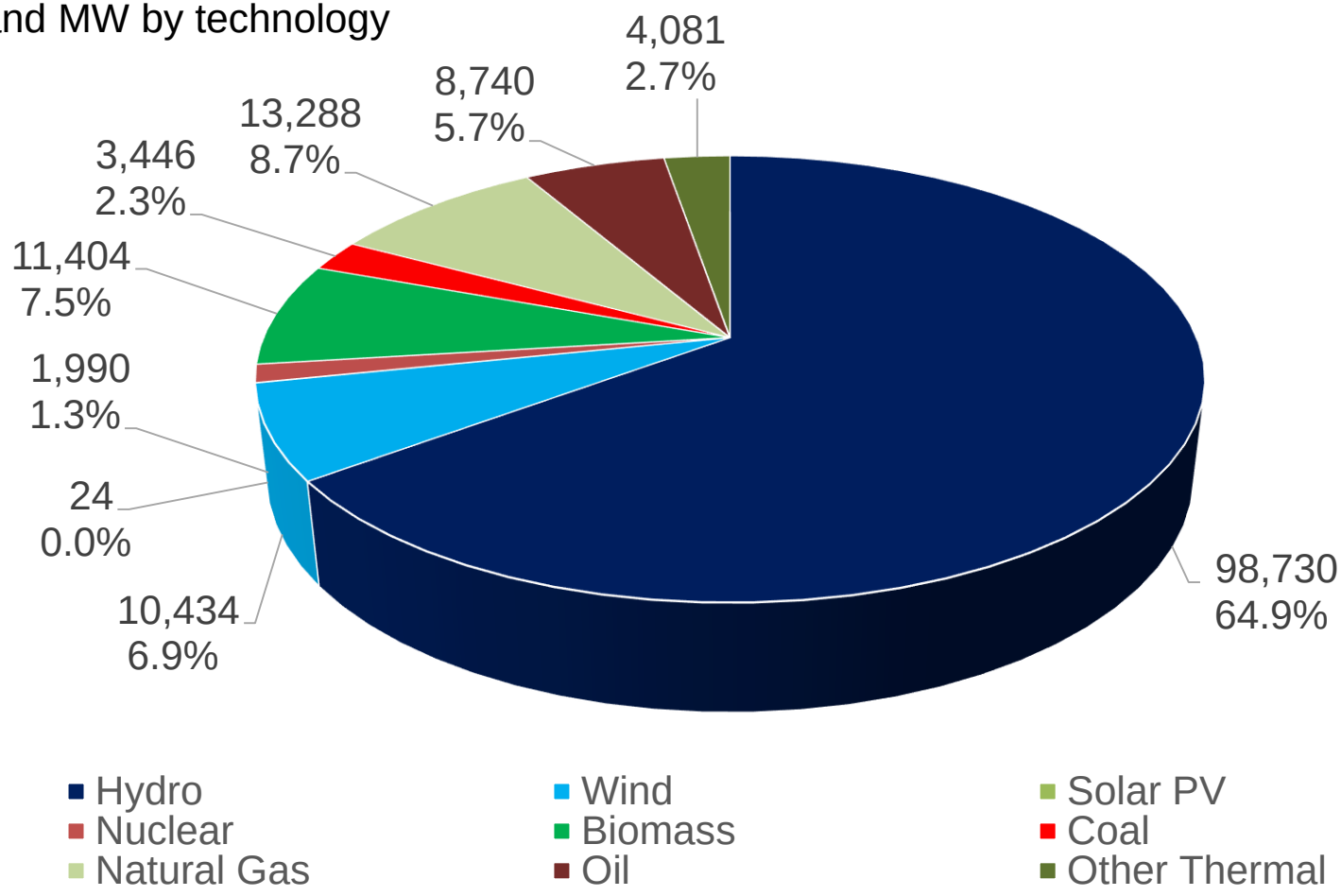
* Exchange rate Dec 31, 2016:R$ 3,2591/USD 1,00

Source: IBGE, BC, ONS, ANEEL, CCEE

Generation

152.1 GW Installed Capacity: Renewables represent approx. 79% of Brazilian electricity mix

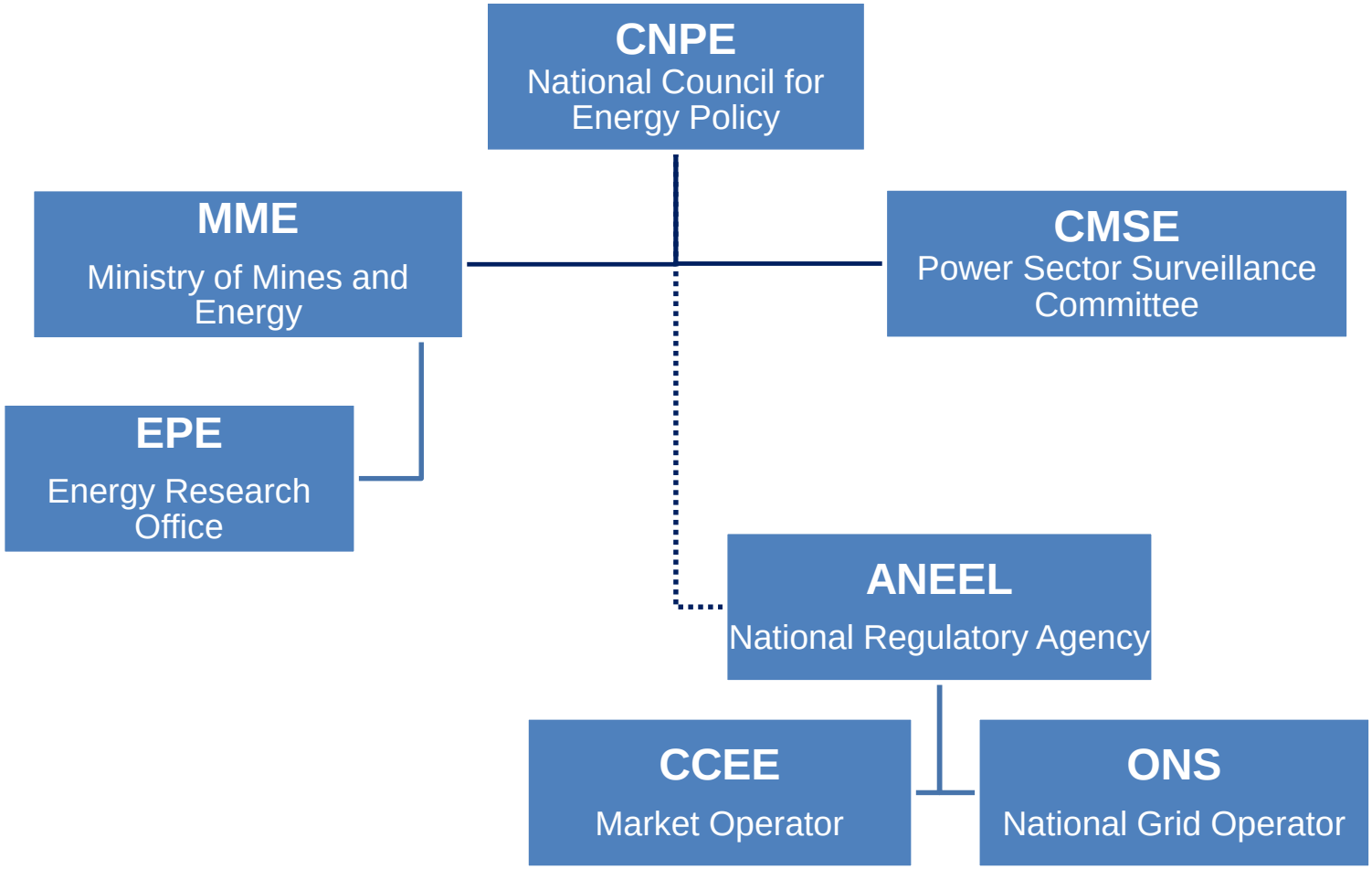
Installed Capacity
% and MW by technology



Source: ANEEL

Sector Governance

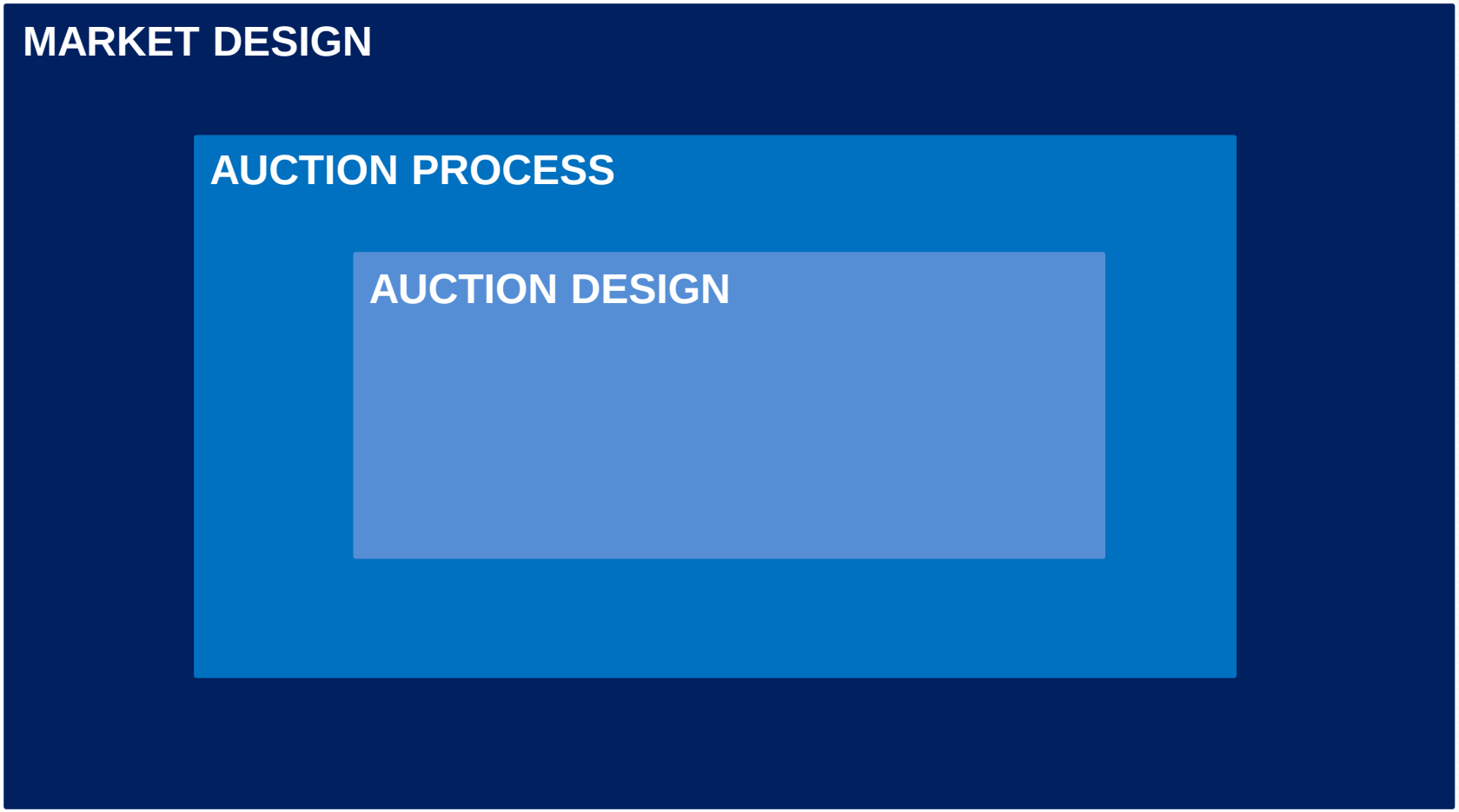
Power Sector Governance gives autonomy to the Regulatory Agency in order to avoid political influence.



Source: CCEE

Dimensions in a Power Auction

Three Dimensions in a Power Auction

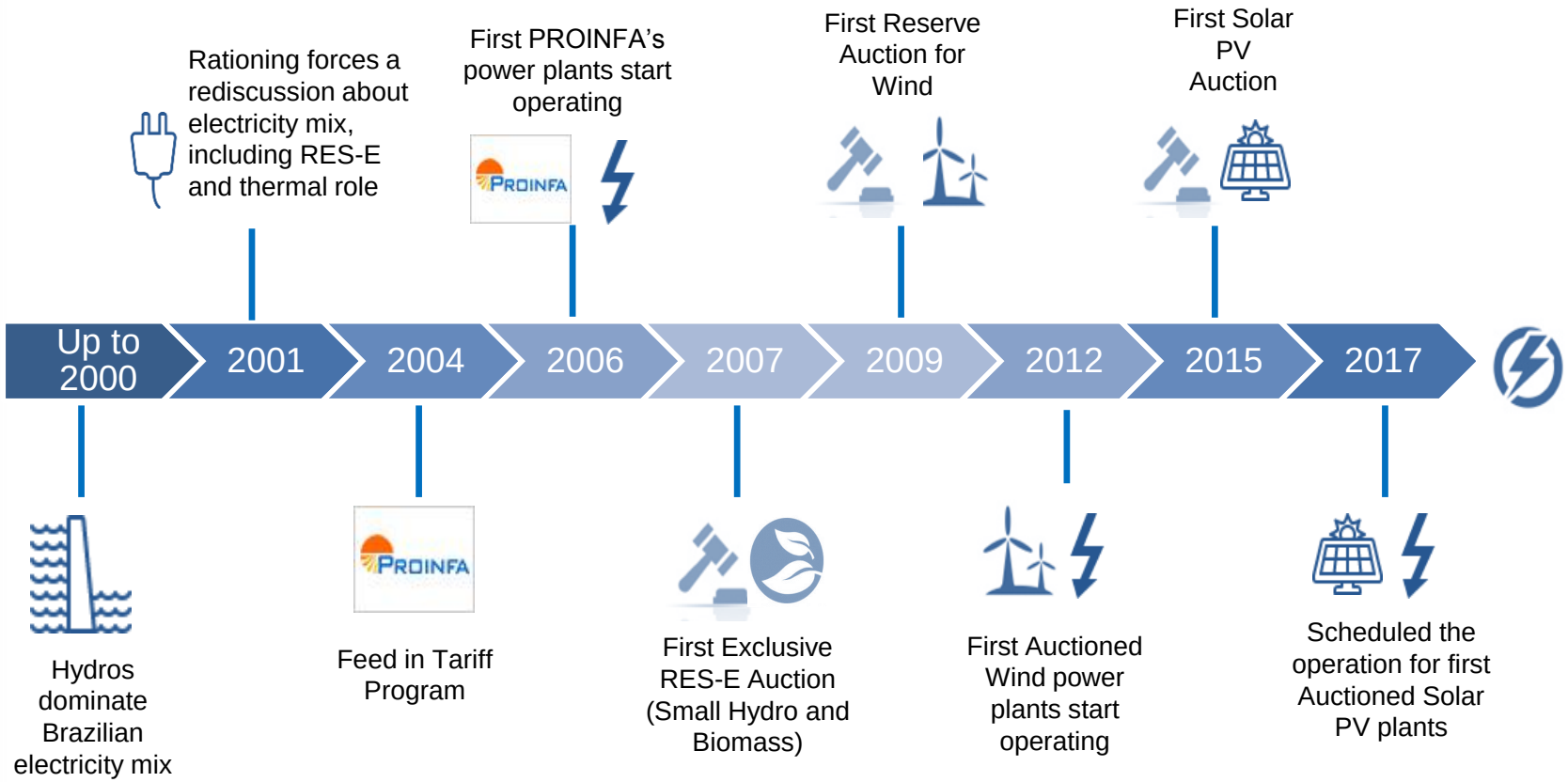


Source: CCEE

Market Design

Evolution of Renewables (RES-E) in Brazil

Small Hydro, Wind, Solar PV and Biomass



Source: CCEE

Market Design

Regulatory Framework

Tailored regulation created a dynamic market in Brazil

RES-E power plants and their consumers are rewarded with discounts on grid tariffs. Biomass, Small Hydro and Wind attracts a 50% discount. Solar PV plants commissioned prior to 2017 are rewarded with an 80% discount, and after 2018 the discount is 50%.

Auctions with specific design characteristics foster RES-E, including contracts indexed to Consumer Price Index and special settlement rules accommodating generation variability.

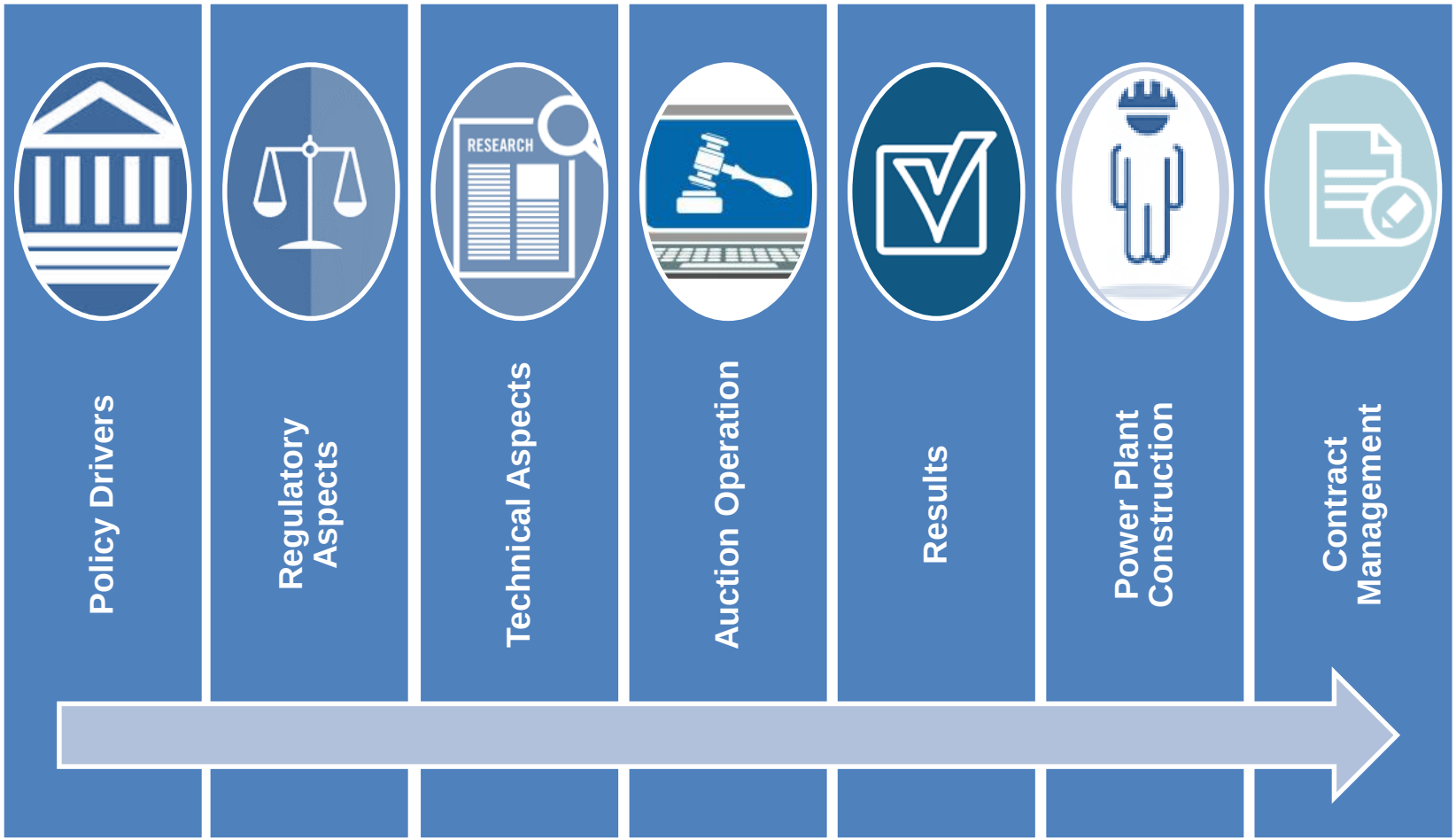
BNDES

Subsidized loans to manufacturers, that abide by Local Content Rules, led to a rapid growth of domestic supply chain. However, the recent economic crisis (2014-2016) ran down BNDES resources and a roll back of this policy has been realized by investors since the beginning of 2016.

Source: CCEE

Auction Process

Auction Process
Main steps

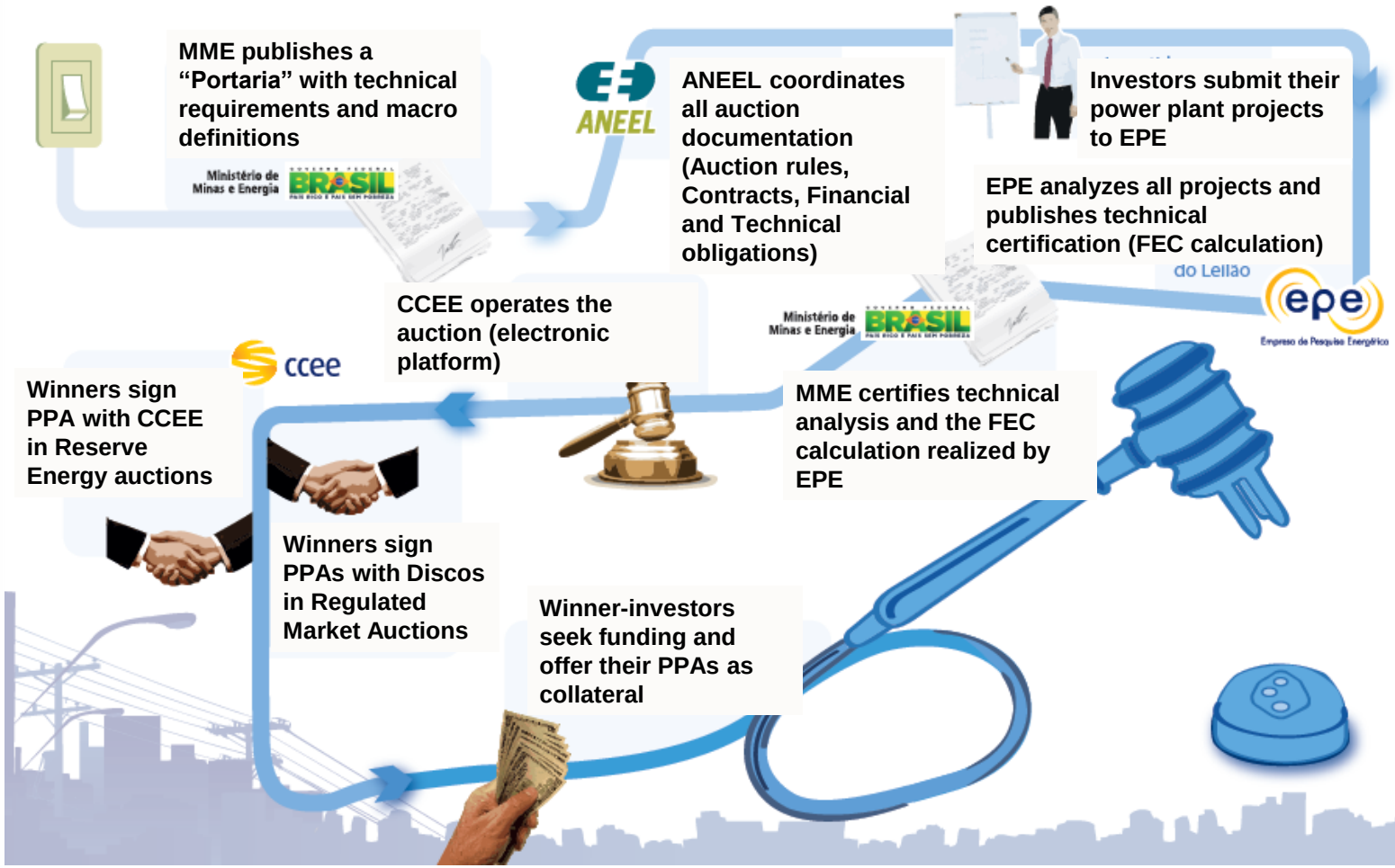


Source: CCEE

Auction Process

How are auctions operated in Brazil?

Summary of Brazilian auctions



FEC = Firm Energy Certificate

Source: CCEE

Auction Design

Auction Design for Regulated Market

Features for fostering RES-E

Exclusive Products

- The Government designs auctions with specific RES-E products
- Price caps are set according to the technology's characteristics

Variable Costs Ceiling

- Even in auctions with multi-products, there is a tough Variable Cost Ceilling that harms fossil fuel plants, especially high polluting ones

Tailored PPAs

- Long-term PPAs indexed by Consumer Price Index
- Generation settlement with a variability range that mitigates investors' risks

Source: CCEE

Auction Summary

Fact Sheet of Brazilian Auctions (1/3)

Item	Description
Why auctions?	Auctions are competitive mechanisms that allow price discovery and can foster new technologies, especially if there is a legal and regulatory framework.
The Buyers	**Regulted Auctions:** Utility companies that need to cover their loads **Reserve Energy:** CCEE with the goal of improving Supply Adequacy.
Sellers	Independent Producers technically certified by EPE and with bid bonds deposited on CCEE.
Forward Period	**New Energy Auctions:** 3 to 7 years **Existing Energy:** 1 to 5 years Renewables tend to participate in 3 year forward auctions
Delivery Period	Hydro: 30 years; Micro Hydro, Wind, Solar PV and Biomass: 20 years

Source: CCEE

Auction Summary

Fact Sheet of Brazilian Auctions (2/3)

Item	Description
Sellers Obligation	Winning bidders are contracted to build the power plant on time, deliver the electricity, and supply the contracted amount. Wind and Solar PV have special settlement terms to accommodate generation variability. Penalties are applied on the generation deficit (Wind and Solar PV have a 15% penalty when the deficit is higher than 10%)
Sellers Financial Guarantees	**Bid Bond:** 1% of the investment to build the power plant **Performance Bond:** 5% of the investment
Power Purchase Agreement (PPA) Guarantee	**Regulated Auctions:** There is a financial guarantee contract that allows the bank to make a direct transfer from Utilities' bank account to generator's account, avoiding Utilities discretionary management. **Reserve Energy:** CCEE has a fund equivalent to 1.5 times the total amount needed to pay all generators for a month; CCEE also uses the settlement of electricity produced to reduce the collection of surcharges from consumers.

Source: CCEE

Auction Summary

Fact Sheet of Brazilian Auctions (3/3)

Item	Description
Role of each entity	**Auction characteristics:** Ministry of Mines and Energy - MME **Certification and Technical Studies:** Energy Research Office – EPE **Regulation:** National Regulatory Agency – ANEEL **Operation and Contract Management:** Market Operator - CCEE **Grid Access:** National Grid Operator - ONS
Environmental licenses	Licenses are obtained from the Federal Ministry of Environment when a river supplying a hydro facility crosses more than one state; Licenses are obtained from the applicable State Agencies for all the other projects.
Time to Organize one auction	It generally takes 4 to 5 months to undertake an auction. However, the legal and regulatory framework took 2 years to be created (2003-2004), and the first auction took 7 months.

Source: CCEE

Auction Results

Auctions Results
Dec-2004 to Apr-2017

Type of auction	Qty	Cld	No Trading	With Trading	USD Billion	Electricity (TWh)
New Energy	23	2		21	295.3	4,656.895
Existing Energy	16	1	2	13	72.5	1,598.558
Adjust Auction	18	2	3	13	2.16	23.367
Reserve Energy	11	1	1	9	47.5	722.932
Alternative Sources	3			3	11.78	176.941
Structuring Projects	3			3	58.6	1,522.811
Total	**74**	**6**	**6**	**62**	**487.84**	**8,701.504**

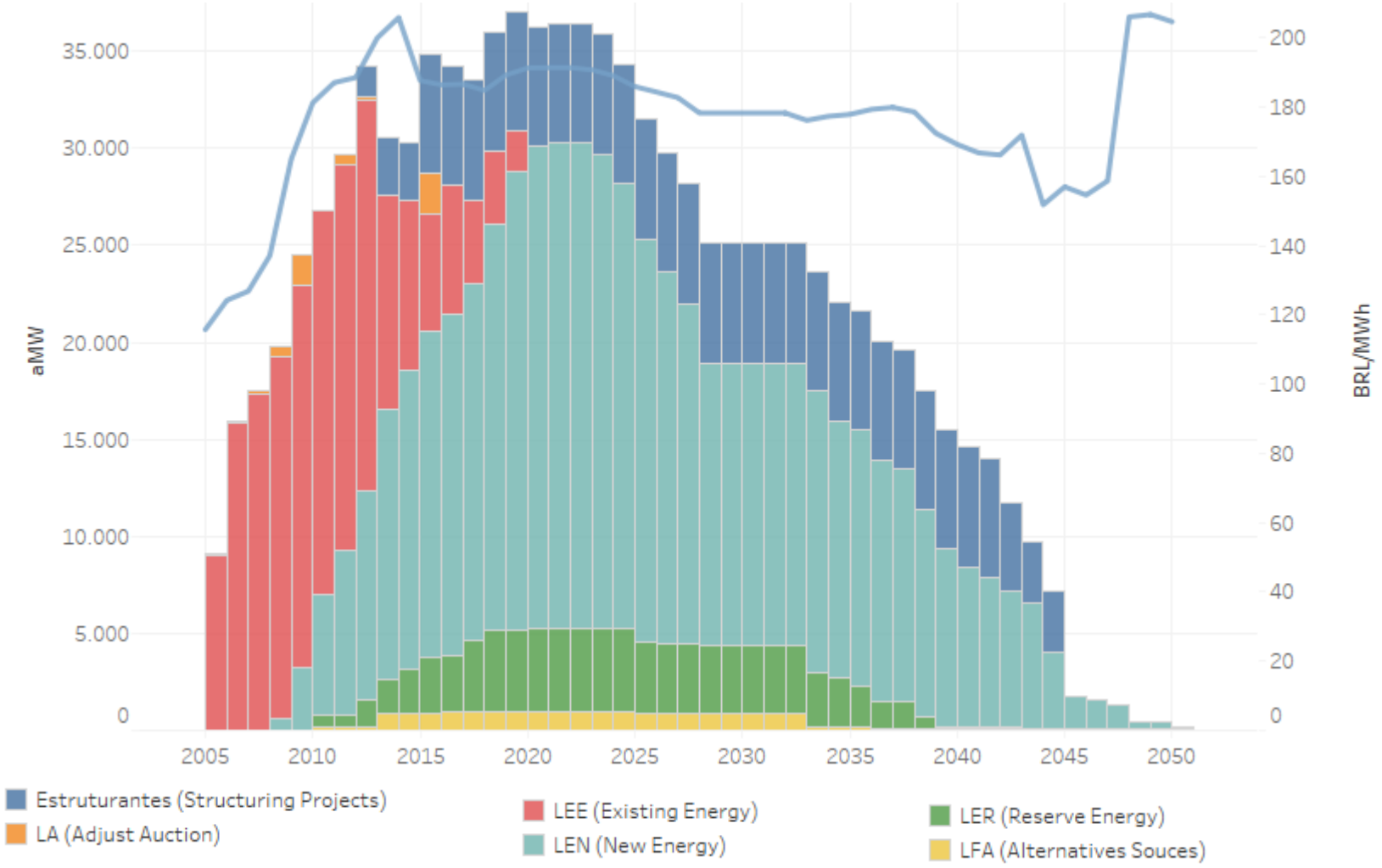
Note: Prices in Reais were updated by inflation rate from the auction day to Apr, 2017. Then, prices are converted into USD with Exchange Rate R$ 3.28 / USD. It differs from prices in USD on the auction day due to Exchange Rate variability.

Source: CCEE

Auction Results

Contracted Energy

aMW in Firm Energy Certificates and BRL/MWh

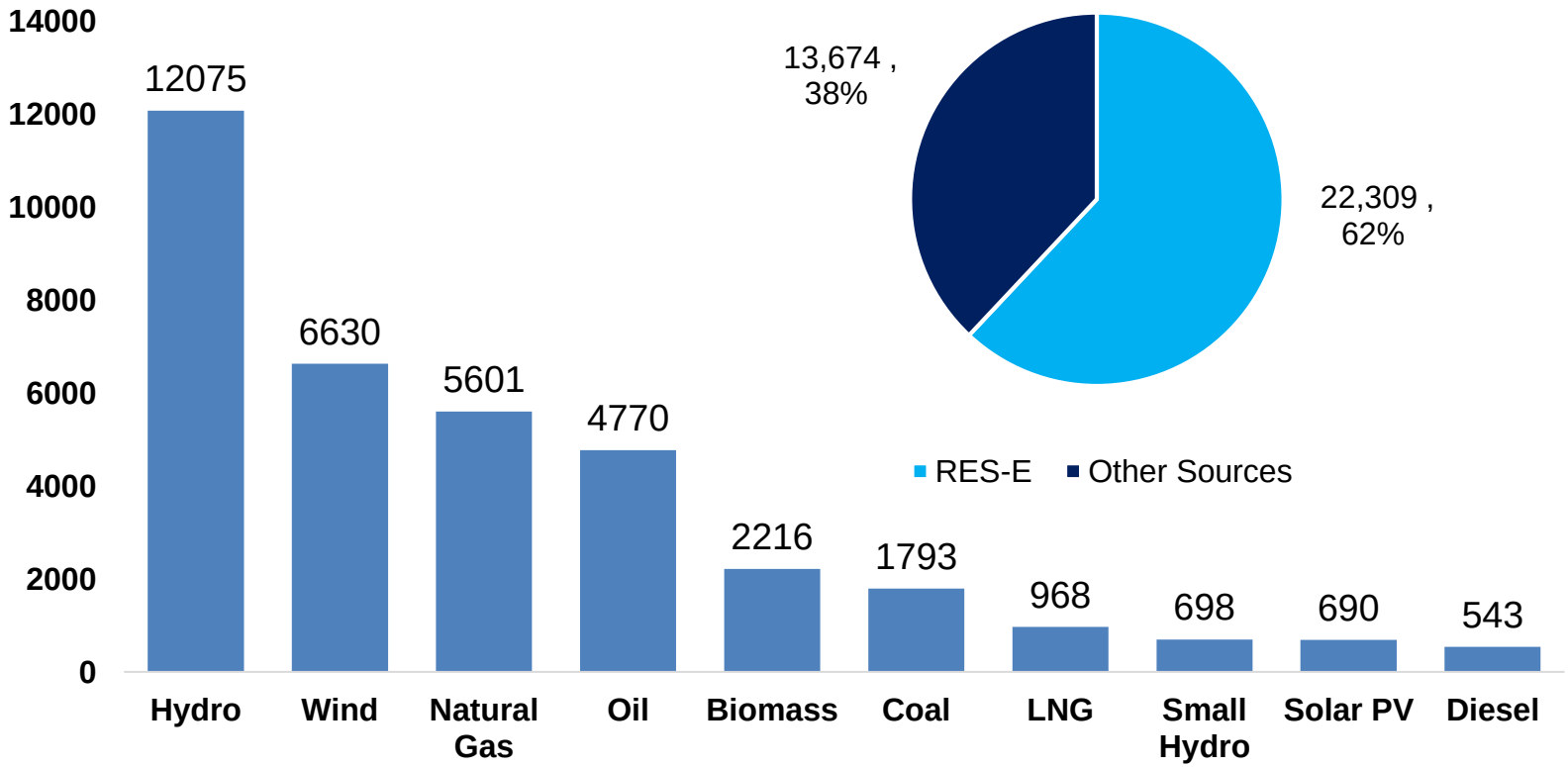


Source: CCEE

Auction Results

Contracted Energy in Supply Adequacy Auctions

aMW in Firm Energy Certificates – by Technology

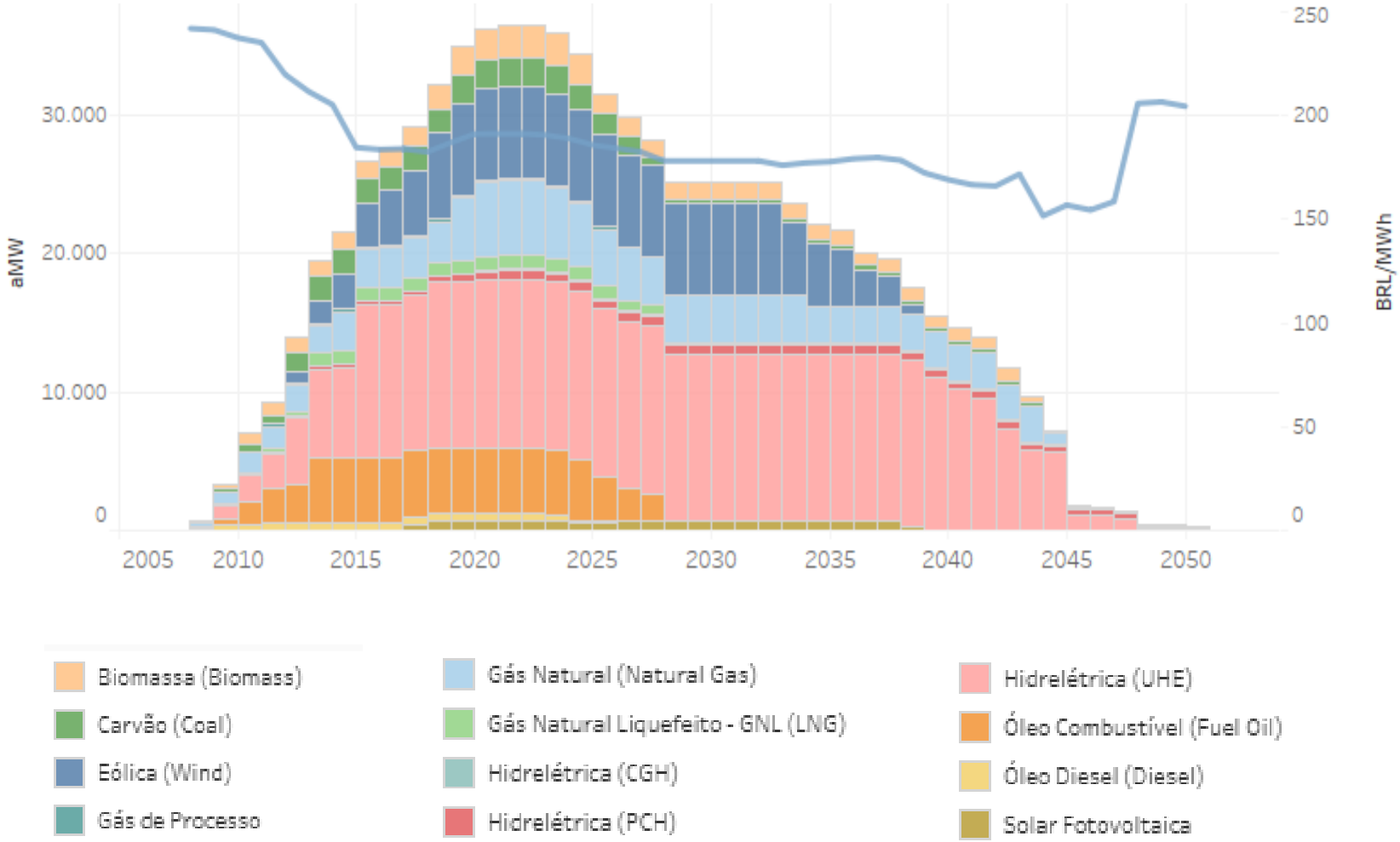


Source: CCEE

Auction Results

Contracted Energy by Technology in Supply Adequacy Auctions

Long-term evolution – aMW FEC and BRL/MWh

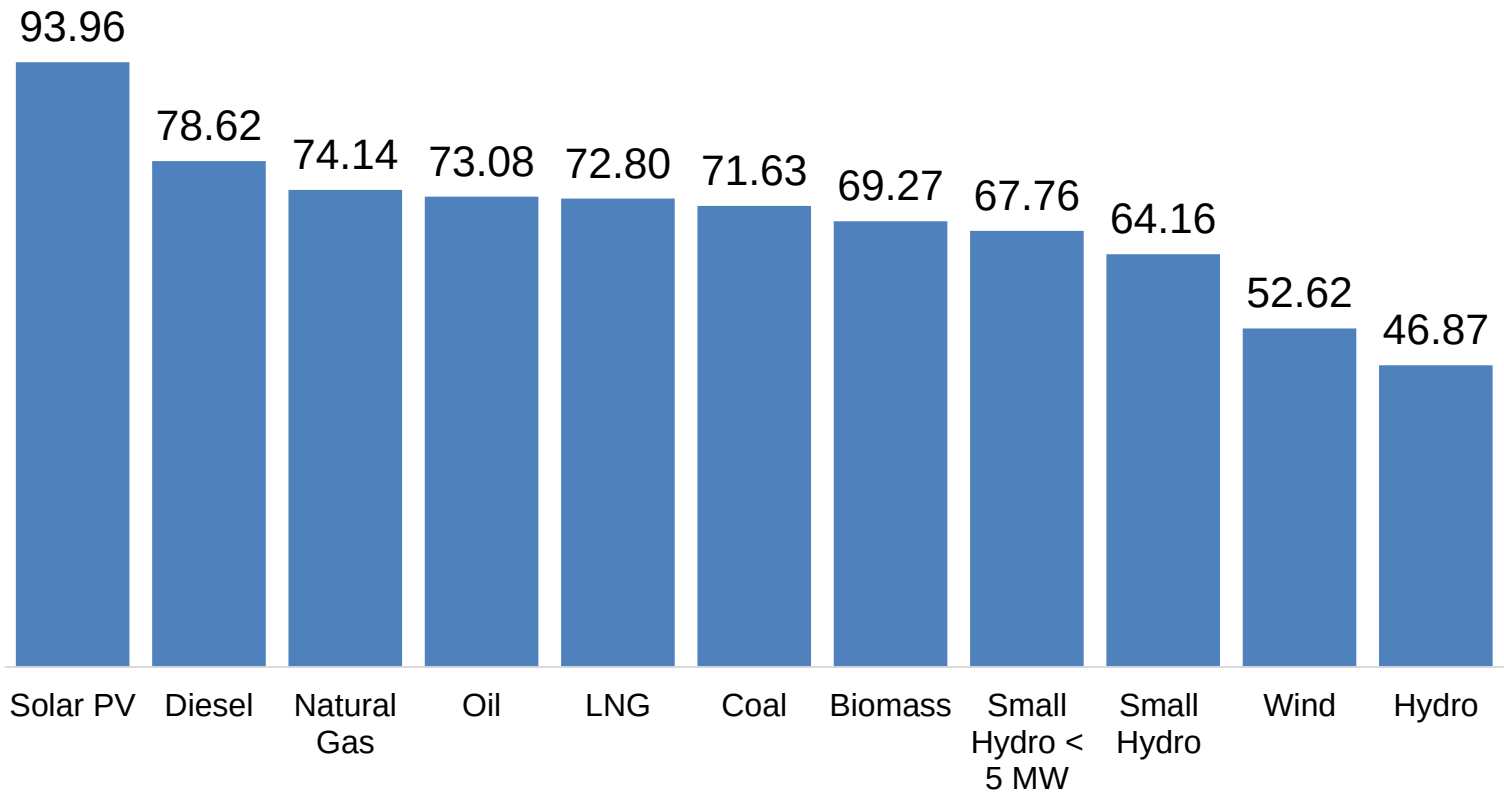


Source: CCEE

Auction Results

Prices by Technology

USD/MWh



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Source: CCEE

Renewable Auction Lessons

Learned Lessons

Contract : Brazil created contracts with special features for Renewables, including Settlement rules to accommodate generation variability of wind and solar PV.

Financial Guarantees: Players demand that off-takers are creditworthy. It is a cornerstone to the success of an auction.

Bid Mechanism: Electronic platforms and bid mechanism increased the competition and got expressive price reductions per MWh. We used a descending clock mechanism on 2004-2016 period and this year we are starting the tests with continuous trading methodology.

Introduction of new technologies: Well designed auctions attract new players and introduce technologies. Wind is a good example, before the commencement of auctions the Installed Capacity was lower than 1 GW and currently it is 10.5 GW.

Source: CCEE

Renewable Auction Lessons

Pitfalls

Cancelling auctions near to date: In 2016 Brazil made the decision of organizing an auction even with a surplus of contracts and on the eve of the auction decided to cancel the procurement.

Construction and No-Completion Rates: The **delay rate is around 27.3%** and the **No-Completion rate is 10%**. At the end the most of power plants are built but we have many administrative and legal disputes on the process, especially about the accountability of penalties (i.e. Environmental licenses, manufacturers delays).

Generation and Transmission mismatch: We decided to speed up the auctions for Wind between 2010-2013; however, the power plants were completed before the transmission lines. The responsibility of this mismatch laid with the State and at the end **it cost the consumers about USD 1 billion**.

Source: CCEE

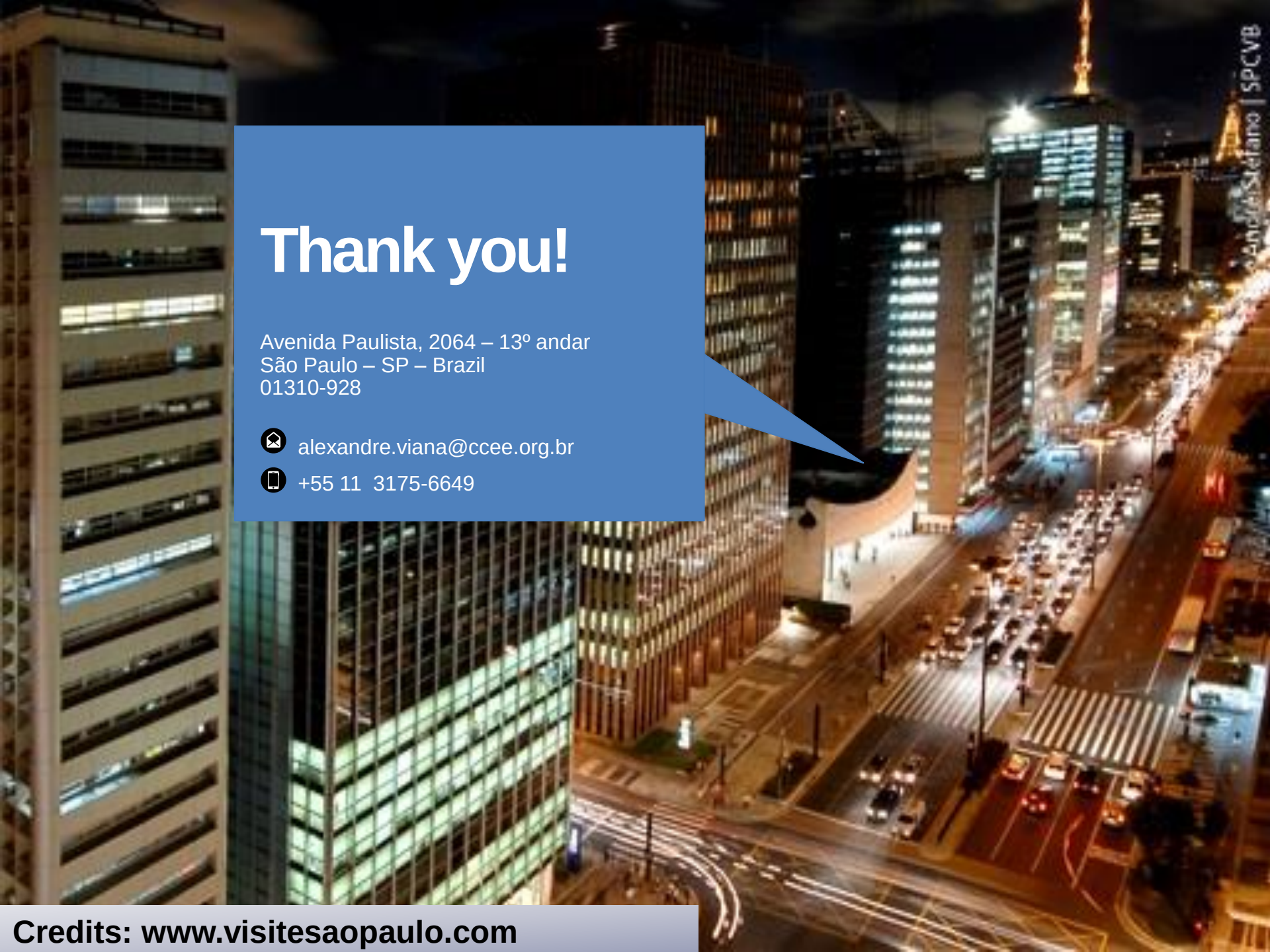
Conclusion

Conclusion

There is no “one size fits all”

- Reverse power auctions are powerful tools to promote the Supply Adequacy and to scale up renewables, as well.
- The auction should be carefully organized in order to assure the transparency and fairness of the process.
- Auction design matters, but it is not enough to correct market and regulatory failures.
- There is no “one size fits all” approach. Each market (country) is unique; it is necessary to adopt a specific approach with the goal to increase the efficiency of the auction.

Source: CCEE



Thank you!

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(Phd Thesis - work in progress)

Anexus

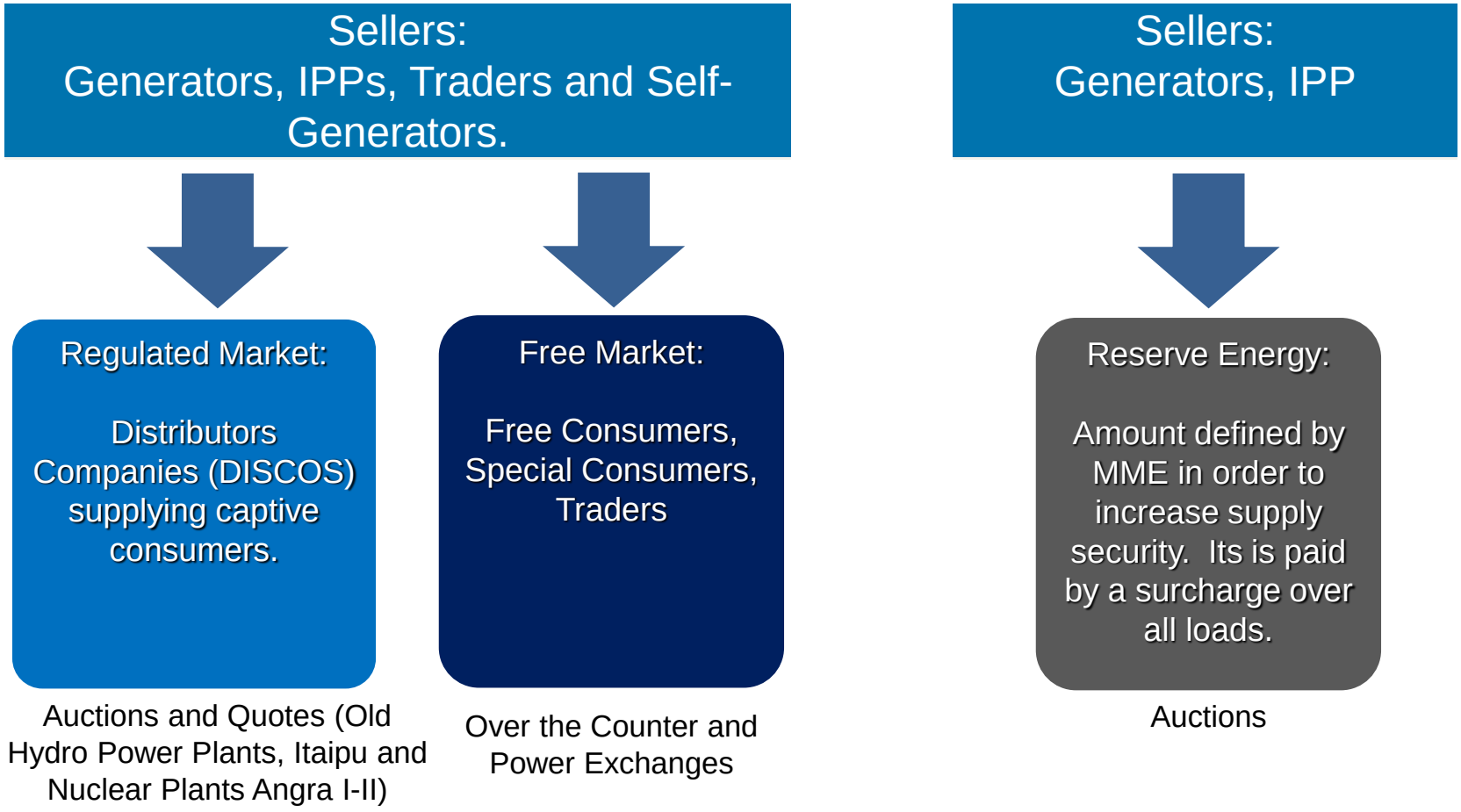
I. Market Design
II. Financial Guarantees for Regulated Market Auctions

Market Design

Brazilian Market Design

Wholesale Competition with a tight pool dispatch

Reserve Energy is contracted in a Single Buyer approach



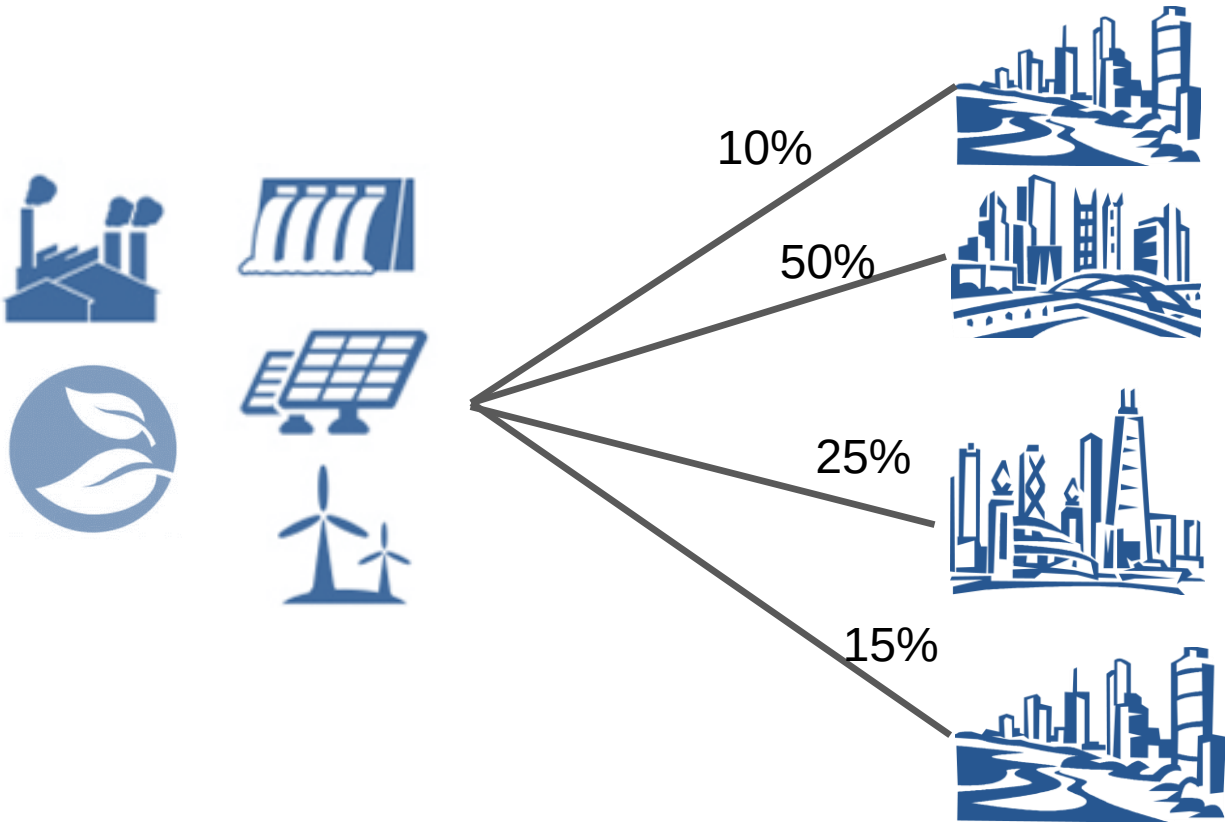
Source: CCEE

Financial Guarantees

Winners sign direct contracts

Pool contracting

Winners sign direct bilateral contracts with the Distributors, despite the centralized auction. Amounts are divided in several contracts by the proportion of Distributions' needs declared to MME. (Pool Contracting scheme).



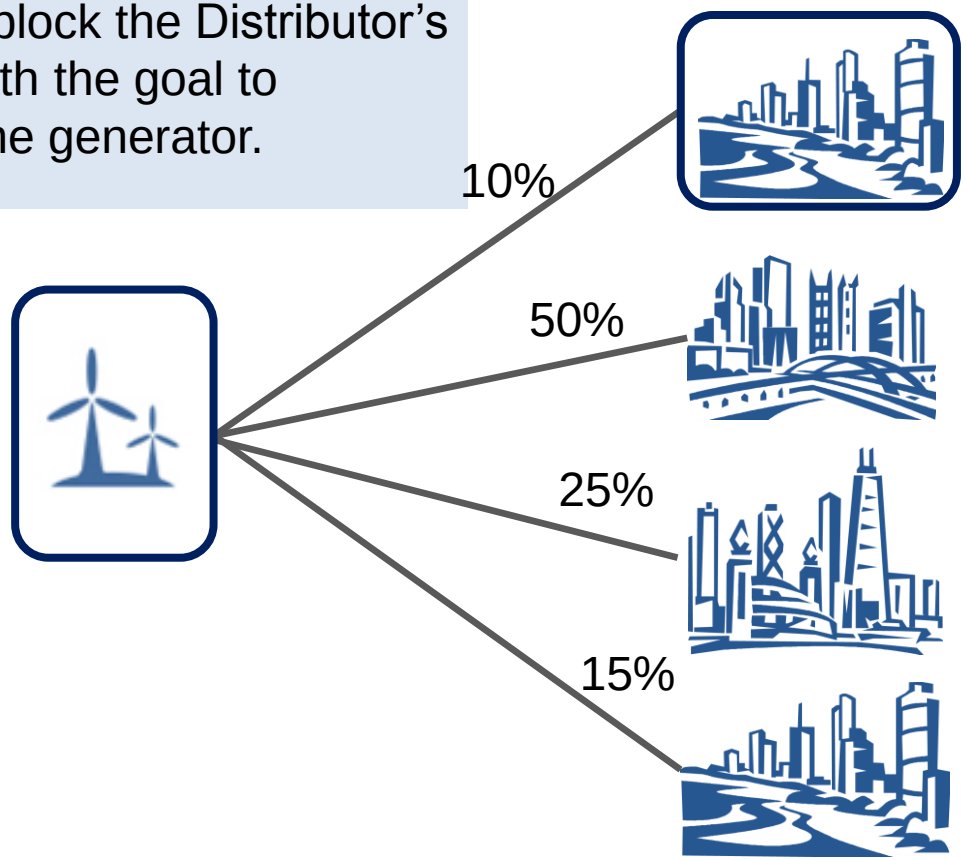
Source: CCEE

Financial Guarantees

Winners sign direct contracts

Attached to PPA there is a contract called Guarantee Contract (CCG in Portuguese).

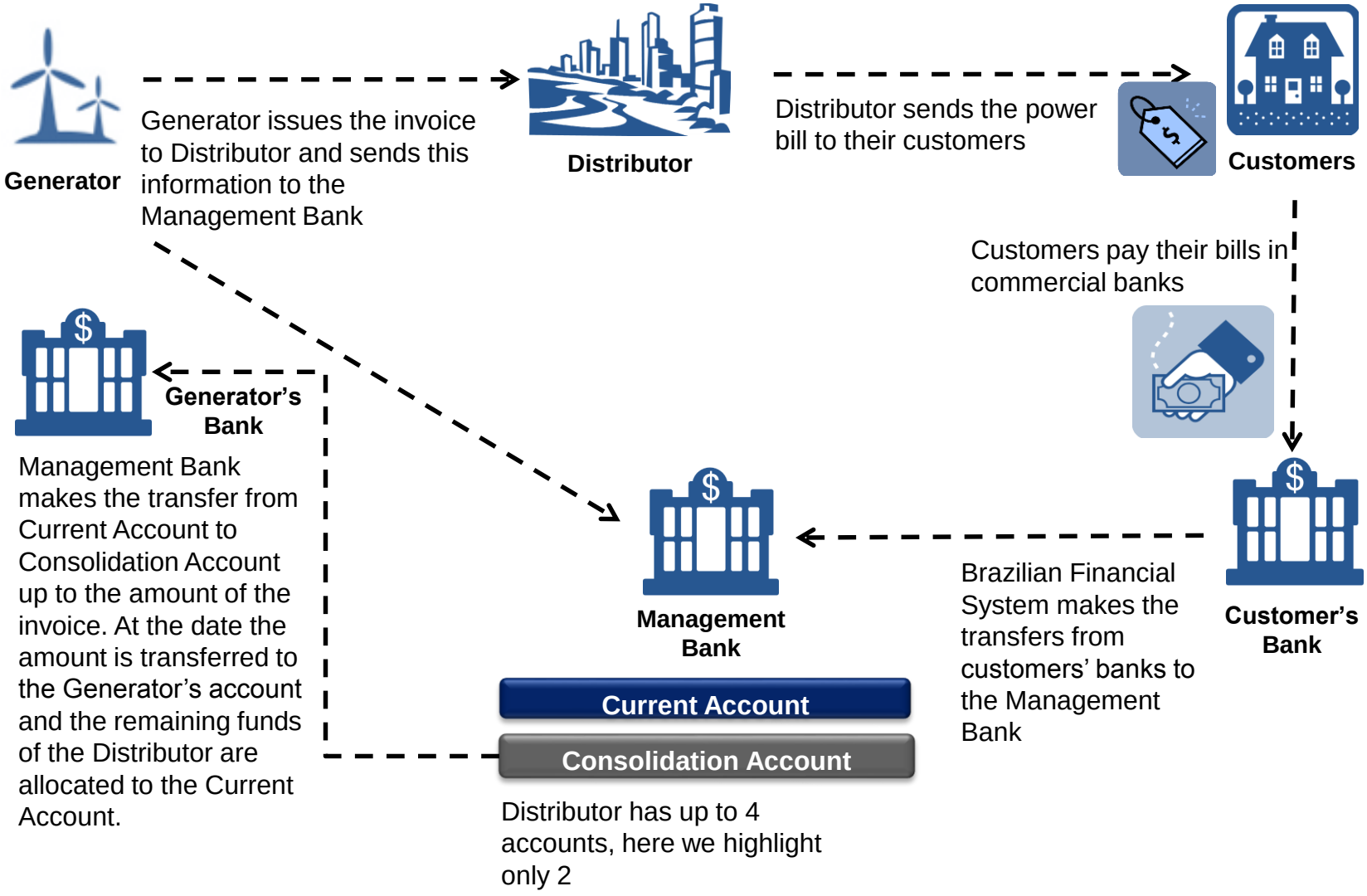
This contract gives authority to a Bank to block the Distributor's account with the goal to prioritize the generator.



Source: CCEE

Financial Guarantees

Contract's Financial Guarantee



Source: CCEE