Reverse Auctions to Scale Renewable Energy: Brazilian Approach

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Renewable Energy Auctions
June 06, 2017
Manila, Philippines
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Brazil at a glance

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

Installed Capacity
% and MW by technology

- **Hydro**: 98,730 (64.9%)
- **Wind**: 13,288 (8.7%)
- **Solar PV**: 8,740 (5.7%)
- **Nuclear**: 4,081 (2.7%)
- **Biomass**: 13,446 (8.7%)
- **Natural Gas**: 11,404 (7.5%)
- **Coal**: 1,990 (1.3%)
- **Oil**: 24 (0.0%)
- **Other Thermal**: 10,434 (6.9%)

Source: ANEEL

DISCUSSION PURPOSES ONLY
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

MARKET DESIGN

AUCTION PROCESS

AUCTION DESIGN

Source: CCEE
Evolution of Renewables (RES-E) in Brazil
Small Hydro, Wind, Solar PV and Biomass

- Rationing forces a rediscussion about electricity mix, including RES-E and thermal role
- First PROINFA’s power plants start operating
- First Reserve Auction for Wind
- First Solar PV Auction

<table>
<thead>
<tr>
<th>Period</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2000</td>
<td>Hydros dominate Brazilian electricity mix</td>
</tr>
<tr>
<td>2001</td>
<td>Feed in Tariff Program</td>
</tr>
<tr>
<td>2004</td>
<td>First Exclusive RES-E Auction (Small Hydro and Biomass)</td>
</tr>
<tr>
<td>2006</td>
<td>First Auctioned Wind power plants start operating</td>
</tr>
<tr>
<td>2007</td>
<td>Scheduled the operation for first Auctioned Solar PV plants</td>
</tr>
<tr>
<td>2009</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td></td>
</tr>
</tbody>
</table>

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 attract 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.

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

Main steps

Policy Drivers
Regulatory Aspects
Technical Aspects
Auction Operation
Results
Power Plant Construction
Contract Management

Source: CCEE
How are auctions operated in Brazil?

Summary of Brazilian auctions

MME publishes a “Portaria” with technical requirements and macro definitions.

ANEEL coordinates all auction documentation (Auction rules, Contracts, Financial and Technical obligations).

EPE analyzes all projects and publishes technical certification (FEC calculation).

Investors submit their power plant projects to EPE.

CCEE operates the auction (electronic platform).

MME certifies technical analysis and the FEC calculation realized by EPE.

Winners sign PPA with CCEE in Reserve Energy auctions.

Winners sign PPAs with Discos in Regulated Market Auctions.

Winner-investors seek funding and offer their PPAs as collateral.

FEC = Firm Energy Certificate
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 Ceiling 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

DISCUSSION PURPOSES ONLY
### Auction Summary

#### Fact Sheet of Brazilian Auctions (1/3)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Why auctions?</strong></td>
<td>Auctions are competitive mechanisms that allow price discovery and can foster new technologies, especially if there is a legal and regulatory framework.</td>
</tr>
</tbody>
</table>
| **The Buyers**        | **Regulated 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)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sellers Obligation</td>
<td>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%)</td>
</tr>
</tbody>
</table>
| 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)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
</table>
| **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

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

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

DISCUSSION PURPOSES ONLY
### Auction Results

#### Contracted Energy in Supply Adequacy Auctions

aMW in Firm Energy Certificates – by Technology

<table>
<thead>
<tr>
<th>Technology</th>
<th>Amount (aMW)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>12075</td>
<td>38%</td>
</tr>
<tr>
<td>Wind</td>
<td>6630</td>
<td>22%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>5601</td>
<td>19%</td>
</tr>
<tr>
<td>Oil</td>
<td>4770</td>
<td>16%</td>
</tr>
<tr>
<td>Biomass</td>
<td>2216</td>
<td>7%</td>
</tr>
<tr>
<td>Coal</td>
<td>1793</td>
<td>6%</td>
</tr>
<tr>
<td>LNG</td>
<td>968</td>
<td>3%</td>
</tr>
<tr>
<td>Small Hydro</td>
<td>698</td>
<td>2%</td>
</tr>
<tr>
<td>Solar PV</td>
<td>690</td>
<td>2%</td>
</tr>
<tr>
<td>Diesel</td>
<td>543</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Total RES-E: 22,309 aMW, 62%**

**Total Other Sources: 13,674 aMW, 38%**

Source: CCEE  
DISCUSSION PURPOSES ONLY
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

<table>
<thead>
<tr>
<th>Technology</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>93.96</td>
</tr>
<tr>
<td>Diesel</td>
<td>78.62</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>74.14</td>
</tr>
<tr>
<td>Oil</td>
<td>73.08</td>
</tr>
<tr>
<td>LNG</td>
<td>72.80</td>
</tr>
<tr>
<td>Coal</td>
<td>71.63</td>
</tr>
<tr>
<td>Biomass</td>
<td>69.27</td>
</tr>
<tr>
<td>Small Hydro &lt; 5 MW</td>
<td>67.76</td>
</tr>
<tr>
<td>Small Hydro</td>
<td>64.16</td>
</tr>
<tr>
<td>Wind</td>
<td>52.62</td>
</tr>
<tr>
<td>Hydro</td>
<td>46.87</td>
</tr>
</tbody>
</table>

Note: Prices in Reais were updated by inflation rate from the auction day until Apr, 2017. Then the 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
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

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.
Thank you!

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References


I. Market Design
II. Financial Guarantees for Regulated Market Auctions
Brazilian Market Design
Wholesale Competition with a tight pool dispatch
Reserve Energy is contracted in a Single Buyer approach

**Sellers:** Generators, IPPs, Traders and Self-Generators.

**Regulated Market:**
Distributors Companies (DISCOS) supplying captive consumers.
Auctions and Quotes (Old Hydro Power Plants, Itaipu and Nuclear Plants Angra I-II)

**Free Market:**
Free Consumers, Special Consumers, Traders
Over the Counter and Power Exchanges

**Reserve Energy:**
Amount defined by MME in order to increase supply security. It's paid by a surcharge over all loads.
Auctions

Source: CCEE
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).
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.
**Financial Guarantees**

**Contract’s Financial Guarantee**

- **Generator** issues the invoice to Distributor and sends this information to the Management Bank.
- **Distributor** sends the power bill to their customers.
- **Customers** pay their bills in commercial banks.
- **Brazilian Financial System** makes the transfers from customers' banks to the Management Bank.
- **Management Bank** makes the transfer from Current Account to Consolidation Account up to the amount of the invoice. At the date the amount is transferred to the Generator’s account and the remaining funds of the Distributor are allocated to the Current Account.
- **Consolidation Account**

Distributor has up to 4 accounts, here we highlight only 2.

Source: CCEE

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