

Electricity Market Developments in Brazil

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Joisa Saraiva

The evolution of electricity market

- in three very large economies— Western Europe, China, and Brazil
 - Transmission
 - How open is transmission access?
 - What methods are used in setting transmission prices?
 - How is congestion managed and/or priced?
 - Who does transmission planning, how is it done, and how is it decided? Who will build new lines or enhance existing lines?
 - How much of the market is regulated and how much is competitive?
 - How is market power dealt with in competitive markets?
 - How is demand response handled?

Presentation Outline

- The Brazilian Power System
- Transmission
 - System Expansion
 - Transmission Auctions
 - Connecting Renewables
- Concluding Remarks

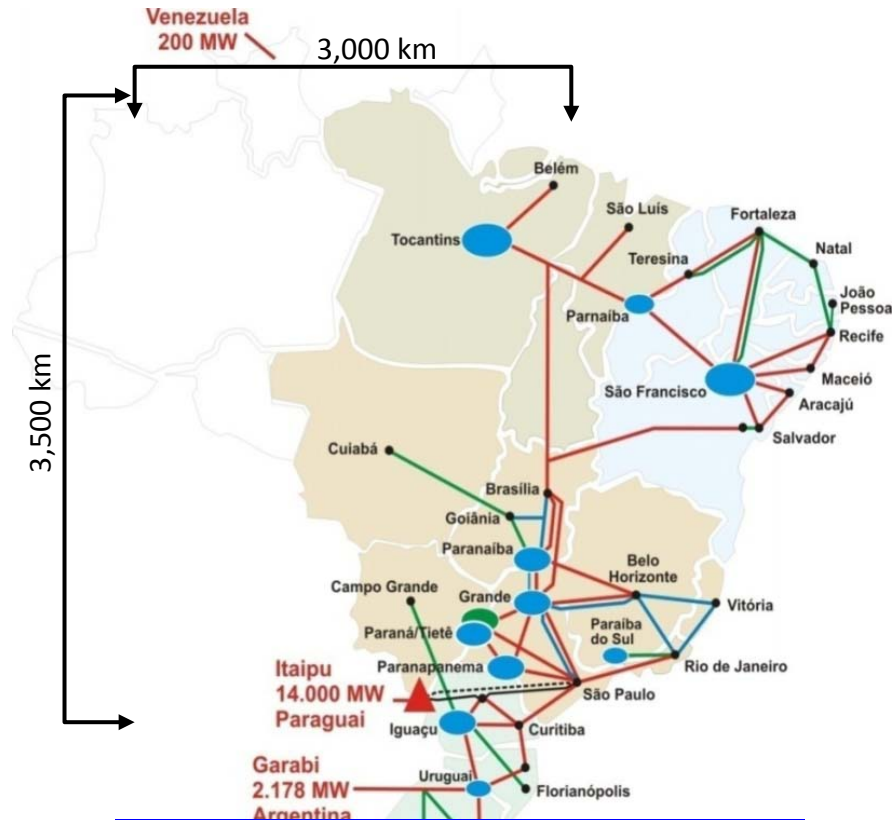
Brazilian Power System

- Brazil has a large-scale power system with over 100 GW of installed capacity interconnected by a vast transmission grid that expands throughout the nation.
- More than 85% of the electricity is generated from hydro resources.
- “Transferring water by wire”.
- There is open access in the transmission system
 - Every power plant has the right to be connected to the system

Electricity Trading

- Electricity is traded in two separate environments
 - In the regulated market energy is procured at auctions designed to contract all the electricity required to meet estimated demand for the next five years. The resulting costs are passed through to consumers.
 - Modified single buyer model
 - Long term contracting through a series of auctions held every year.
 - Roughly 30% of the electricity is traded in the free market

Brazilian Electricity Power System - BIPS



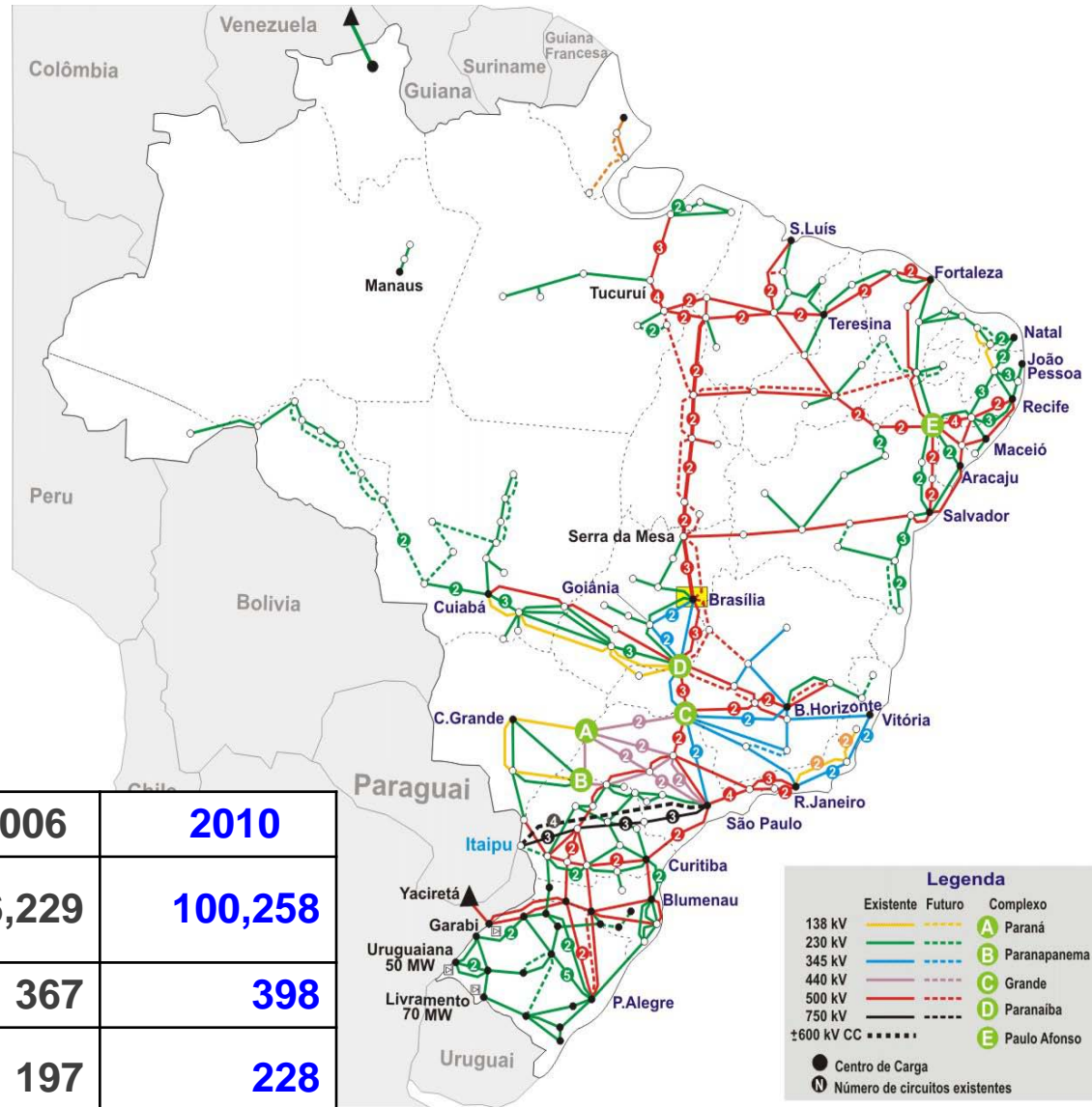
- ✓ Large-scale system
- ✓ East to West = 3,000 km
- ✓ North to South = 3,500 km
- ✓ Multi-owned system
- ✓ Agents (G/T/D/C):
1998: 74
2010: 265
- ✓ Maximum Demand:
2010: 66.5 GW

Installed capacity (MW)	2002	2006	2010	2015
Total	74,670	87,003	107,990	137,860
Hydro	63,834	73,393	85,690	98,035
Thermal-conventional	8,829	11,603	19,467	32,570
Nuclear	2,007	2,007	2,007	2,007
Wind			826	5,248

Source: ONS

The Main Transmission Grid

- ✓ Long distance Transmission Lines
- ✓ Large-sized :
Around 100,000 km TL
- ✓ Multi-owned Transmission:
88 agents in operation



	2002	2006	2010
TLs \geq 230 kV (km)	72,506	86,229	100,258
Substations	303	367	398
Transf. capacity GVA)	166	197	228

Major Institutions and Their Responsibilities in the System Expansion

- Planning Company (EPE)
 - Supports the compliance studies regarding the planning criteria.
- The National Electricity Regulator (ANEEL)
 - Approves the project technical compliances
 - Runs the auctions
- System Operator (ONS)
 - Evaluates the technical compliances regarding to the bid requirements and to the Grid Procedures;
 - Studies and analyses the integration of the new facilities to the existing transmission system; and
 - Identifies the transmission system reinforcement needs
- Transmission Company (Multiple)
 - Has to demonstrate that the project meets the bid technical requirements

Transmission System Expansion

- Planning the Expansion
 - EPE, a company controlled by the Ministry of Mines and Energy, is in charge of planning the transmission system expansion.
 - Deterministic planning criterion: The planning is essentially driven by the (well known) deterministic $n-1$ security criterion.
- Allocation
 - Once the transmission facilities required to meet the system needs are determined, the regulatory agency (ANEEL, the federal electricity regulator) runs auctions to select agents/concessionaries to Build-Operate and Own (or Transfer at the end of the concession term) these facilities.

Transmission Auctions

- Bidding for the market
 - The auction mechanisms
 - Agents compete for the right to BOO transmission facilities
 - The winner is the qualified bidder who bids (commits to) the lowest annual required revenue for a 30-year concession term.
 - The revenue to be earned by the transmission company is set through auctions.
 - Contracts
 - Concession Contract – ANEEL (30 year period)
 - Transmission System Service (CPST) - ONS

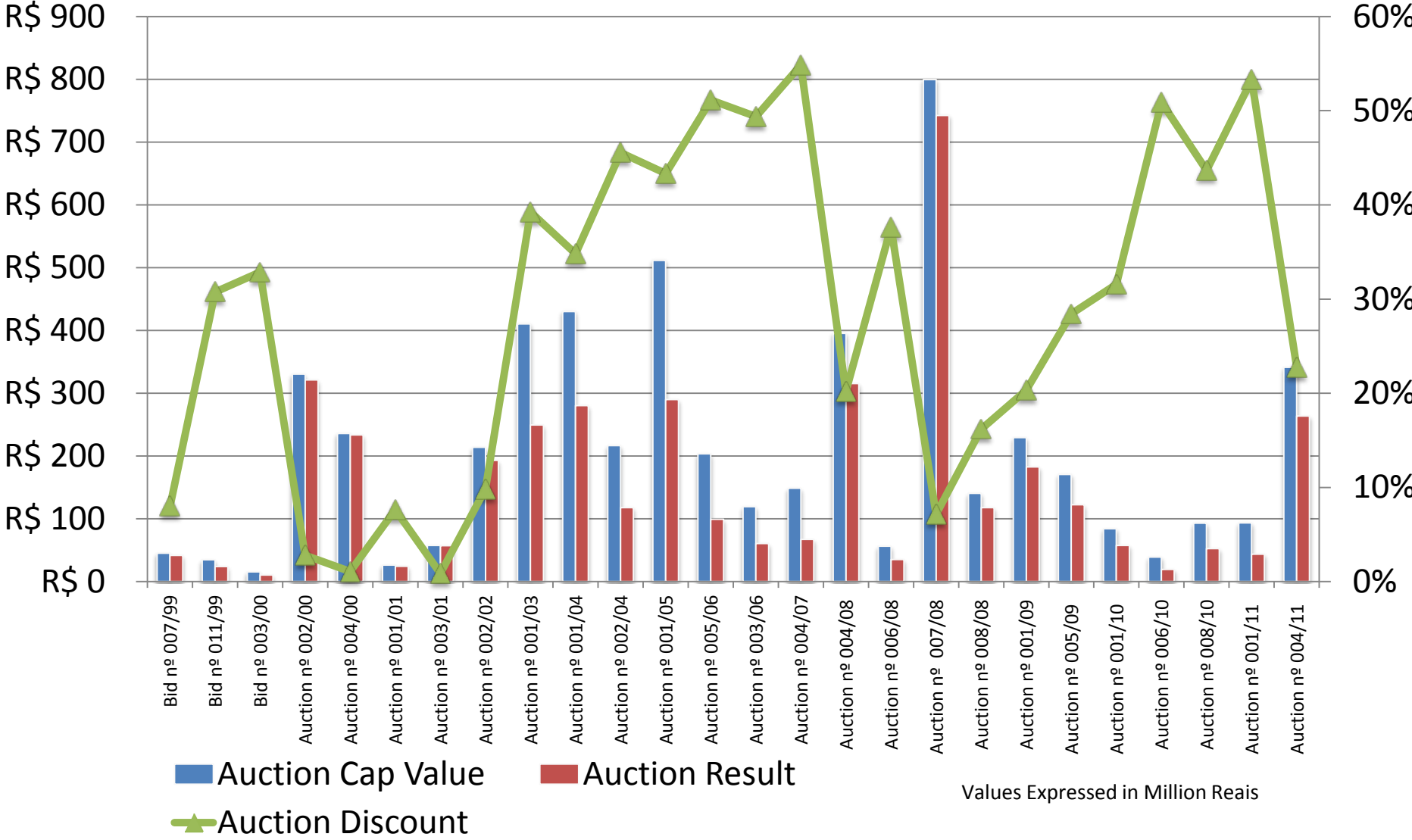
Pricing and Cost Allocation in the Transmission System

- Annually the regulator estimates the total cost of the interconnected system setting transmission rates accordingly.
- The total revenue required by the basic grid in a given year is the sum of the fixed remunerations of all transmission equipments in operation in that year
- This total revenue is collected from the generators and loads through a (fixed) access charge
 - Transmission-use-of-the-system tariff, TUST
- New generation companies face a previously known transmission rate for the first ten years – according to the expected connection to the grid potential bidders are informed of the rates to be applied to the first ten years of operation
 - This is the result of a ruling that came into effect in 2007 designed to mitigate risks (lower volatility) to GENCOs.

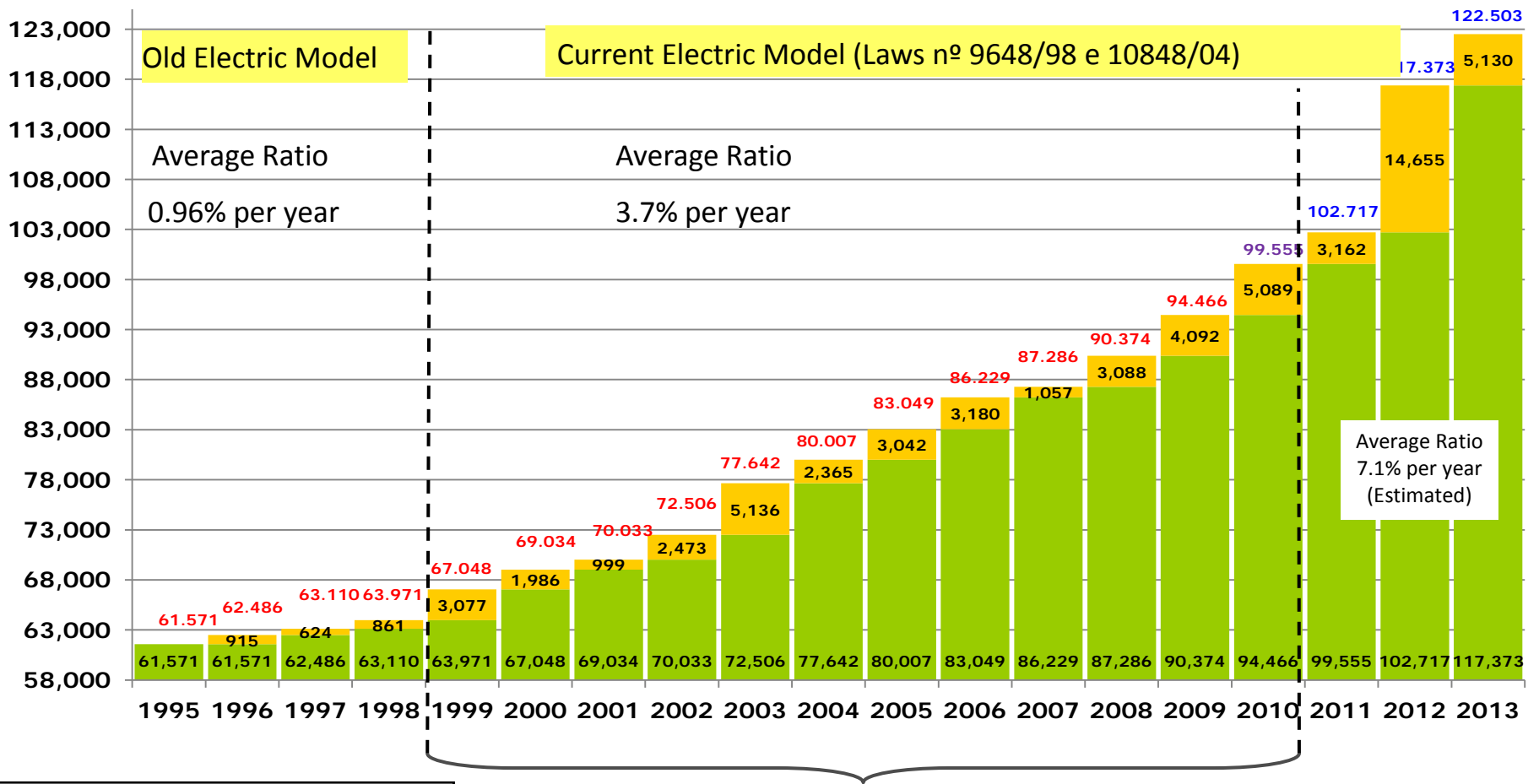
The Experience with Transmission Auctions

- Participation
 - Increased. At first the auctions were able to attract participation from foreign capital but more recently investors associated with the Eletrobras subsidiaries are being able to win in a considerable amount of auctions.
- Observed Prices
 - Picture
- Environmental licensing
 - In the generation auctions (auctions for PPA-like contracts in the regulated environment) environmental licenses are a required. In turn, in the transmission auctions the environmental permits are to be obtained by the concessionaries. There is a recent trend of delays in this process leading to delays in the beginning of the commercial operation.
- Delivering the facilities in time
 - There are incentives to deliver the facilities ahead of time – the right to earn for na additional period and this incentive is coupled with the incentive for the generation company to trade the electricity in the free market.
- What is being built at this very moment?

Revenue and Discount Levels Evolution



Transmission System Expansion



xxx = Total km at the end of the year
 xxx = Increased km per year
 xxx = Estimated up to 2013

Increase of 35,584 km in a 12 year period

Managing and Pricing Congestion

- Zonal pricing
 - There are four regions in the country
- Congestion surcharges are allocated to all consumers within a given region on a lump-sum basis.
- There has been a considerable amount of out of merit order dispatch to meet reliability of supply in the system.
 - The associated costs are borne by consumers.

Building transmission to integrate remotely located renewables into the system

The ICG Experience -

- The initial conception
 - Competitive bidding procedure inspired by the open season in the natural gas industry
- First ICG auctions
 - Trying to connect biomass (from sugar cane) power plants
- What is happening now?
 - The procurement process for intermittent renewables remotely located is similar to the regular transmission auctions
 - It has been applied to connect wind power plants
 - The procedure may be considered complex: planning
 - Environmental permits are lagging behind

Concluding Remarks

- The transmission expansion combines central planning and competition
- (Residual) Risks allocated to the load
- Successful experience in terms of its ability to deliver the system expansion
- New Model has been able to connect (remotely located) renewables mainly wind power plants
- This electricity system could really benefit from Demand Response Mechanisms

Thank You!

joisa@fgv.br

Fundação Getulio Vargas, Brazil