

The Brazilian Transmission Business model

And the role of private investment in Transmission

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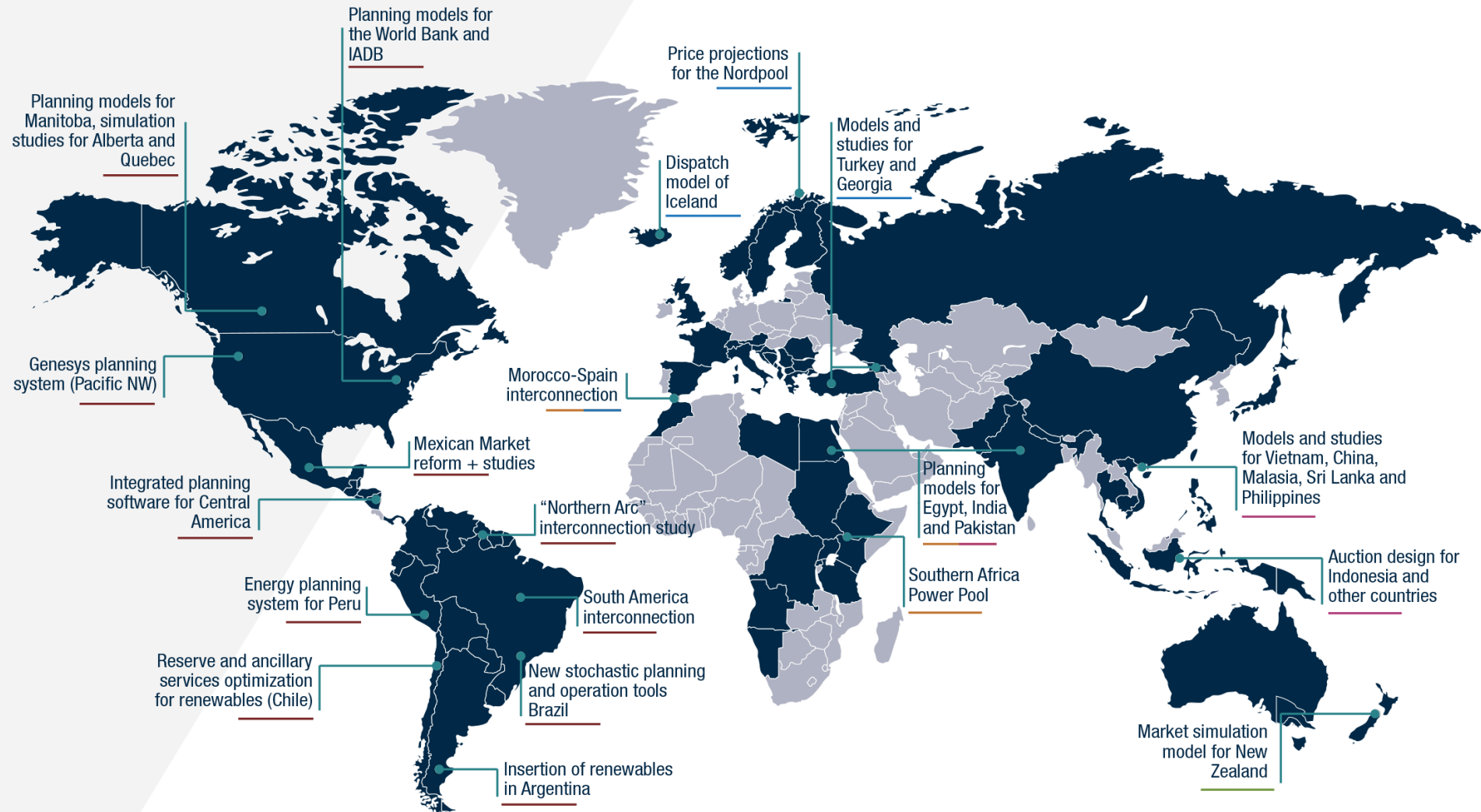
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Some topics presented here have been well documented in the literature

Planning for Big Things in Brazil

Planning and Building Large-Scale Transmission Networks in Competitive Hydrothermal Systems: Technical and Regulatory Challenges

by Luiz A. Barroso, Fernando Porrua, Luiz M. Thomé, and Mario V. Pereira



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By Rafael de Sá Ferreira, Hugh Rudnick, and Luiz Barroso

TRANSMISSION SYSTEM EXPANSION BOOMED IN several South American countries in the 2000s and the early 2010s. Network capacity additions were required to cope with fast-growing electricity demand, prompted by average gross domestic product growth rates of around 5% per year in 2003–2008 and 3% per year in 2008–2013. Following a trend verified in most infrastructure segments, private sector participation in transmission investments increased significantly in the period, which was the result of reforms in the electricity industry that had initiated in the 1990s.

In some of the largest electricity systems in Latin America, these reforms included common elements for the transmission segment: centralized and determinative transmission expansion planning by national-level governmental institutions, combined with decentralized implementation and operation of transmission assets, by agents selected by means of auctions for transmission concessions.

This model experienced great success, but it is currently facing challenges also common to several South American countries. Some of the most important problems are rooted in transmission implementation. Acquisition of rights-of-way and environmental licensing issues are resulting either in centrally planned expansion remaining on paper longer than the central planner would wish or, when the concessions to implement and operate the assets are acquired, in the frustration of the expectations of investors, who may be exposed to cost overruns in implementation or the financial consequences of delays.

The Expansion of Transmission

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Flexible Connections

SOUTH AMERICAN COUNTRIES ACCOUNT FOR A SMALL PORTION OF global greenhouse gas emissions (GHE), as seen in Figure 1, which shows the percentage of worldwide GHE originating in Brazil (1.35%), Argentina (0.64%), Chile (0.24%), and Peru (0.13%). While the low level of GHE is partially due to the relatively low level of economic development of these nations, the main reason is the region's very clean electricity supply mix, with about 50% of installed capacity coming from hydropower sited in the large rivers crossing the continent. The South American region is also among the most promising lands for the development of nonconventional renewable energy (NCRE), encompassing all renewables except large hydro. The strong and persistent wind flows, availability of suitable sites, and thousands of sunny hours a year provide a significant



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Solutions and Challenges for the Integration of Renewables in South America

potential for several types of NCRE. In addition, the region's hydro reservoirs can easily smooth out production fluctuations of intermittent (wind and solar) or seasonal (biomass) energy sources, thus providing operational flexibility and facilitating their reliable and economic integration.

The participation of NCRE in the region's energy matrix has been increasing. The most relevant options are small hydroelectric plants (considered as NCRE) and wind, solar, and biomass power plants, especially cogeneration plants using sugar cane bagasse. Load factors of 40–45% for wind power are common in some countries. NCRE turns out to be attractive due to a number of factors that are not strictly related to emissions reduction:

- ✓ From the security-of-supply perspective, NCRE provides the opportunity to diversify the current generation mix, currently heavily based on large hydro facilities.
- ✓ From an economic perspective, there is a strategic objective of diversifying the generation mix, particularly in countries dependent on foreign energy supplies.
- ✓ Finally, from a portfolio management standpoint, the lack of a coherent policy

for environmental licensing and strong regulatory actions against reservoirs often lead to delays in the construction of conventional hydro plants, which can affect supply reliability. In contrast, renewable generation is usually spread out over several plants with smaller capacities, which provides a "portfolio" effect and thus a hedge against project delays. Also, NCRE construction time is short (about 18 months) in contrast to at least five years for conventional hydro. This allows flexibility in the entrance of new capacity—a valuable hedge against the region's load growth uncertainty.

Certain support mechanisms for NCRE have been in place in the South American region for the past ten years, typically in the form of fiscal or tax incentives for renewable development in states or municipalities. At the beginning of the last decade, Brazil and Argentina implemented costly subsidies (similar to the feed-in tariffs in Europe) to foster renewables. Afterwards, with the implementation of long-term auctions for energy contracts to attract new generation beginning in 2004, auctions gained momentum and also started to be used in several countries as the main explicit support scheme for NCRE beginning in 2007. Auctions function as an indirect price discovery mechanism, and they also result in the right amount of investment and reduce risk aversion with long-term contracting. Moreover, auctions provide transparent and efficient outcomes that are unlikely to be challenged in the future as political and institutional scenarios change. This is the case in Brazil and Peru, where renewable auctions complement the regular auctions to attract conventional generation. Argentina and Uruguay have also implemented specific auction processes to attract NCRE. Chile has opted for a compulsory quota scheme placed on the generators (they have to demonstrate that part of the energy contracted is being supplied by NCRE). Explicit support mechanisms

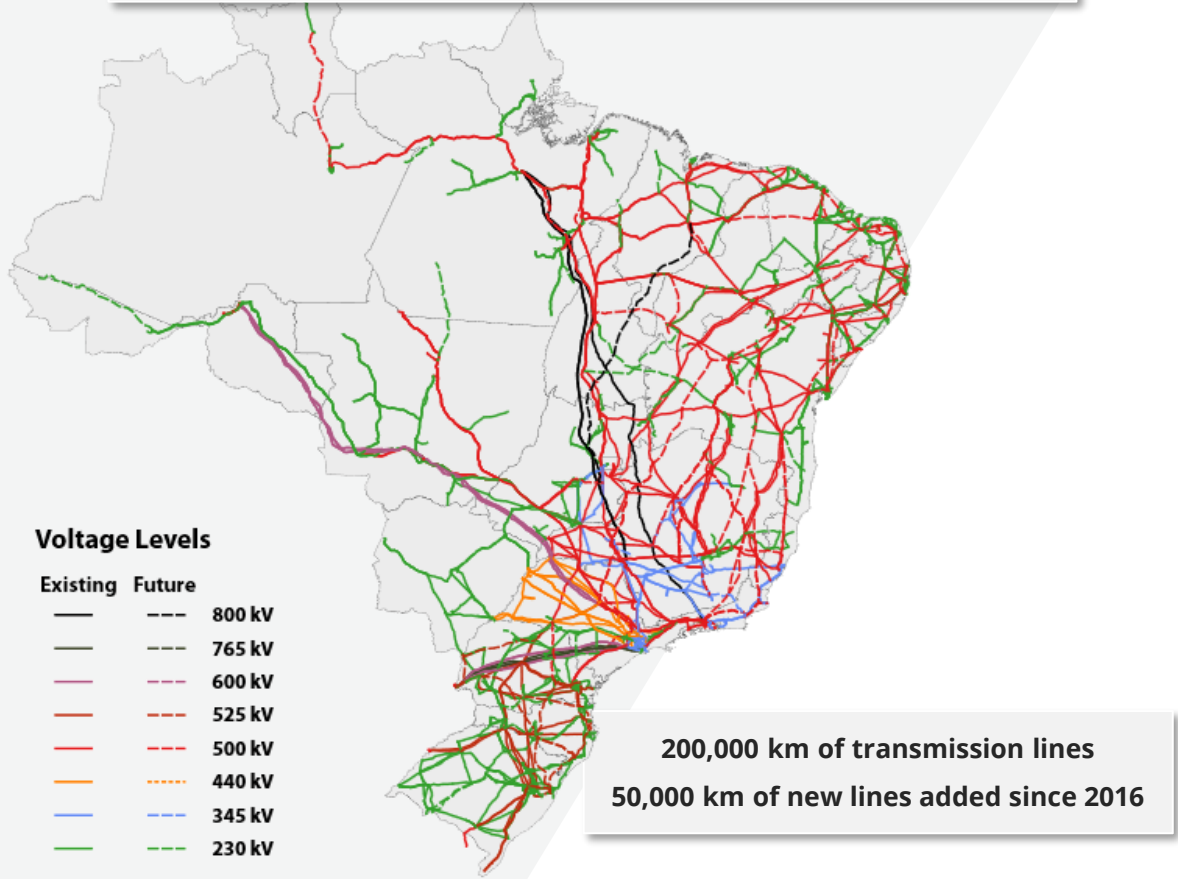
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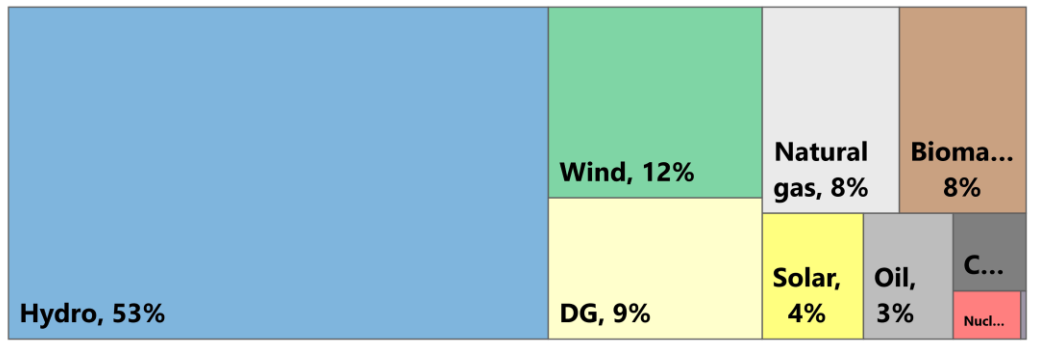


Brazil's electricity supply mix is mostly renewable and highly interconnected

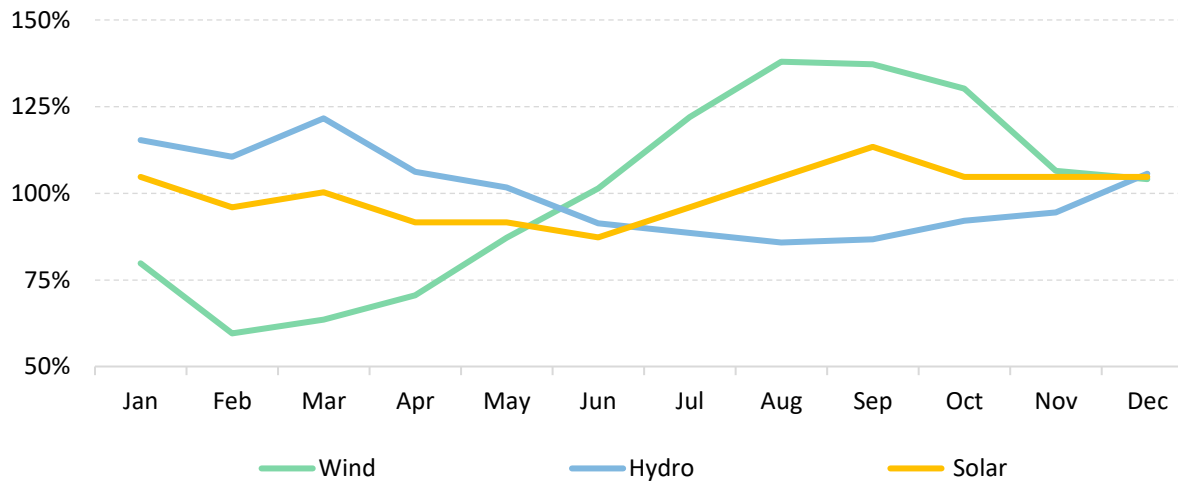
The transmission network is part of the portfolio of complementary renewable generation sources.



Supply mix 2023 (% installed capacity)



Renewable output profile (monthly production in % of yearly average – 2017 to 2022)



Source: National System Operator (ONS), ANEEL

The transmission business model

The transmission, planning and operation is **centralized**

COORDINATION

Central planning

Least cost expansion planning

- Aim to optimize the use of system resources
- Aim to maximize systemic benefits

The implementation of assets is **decentralized**

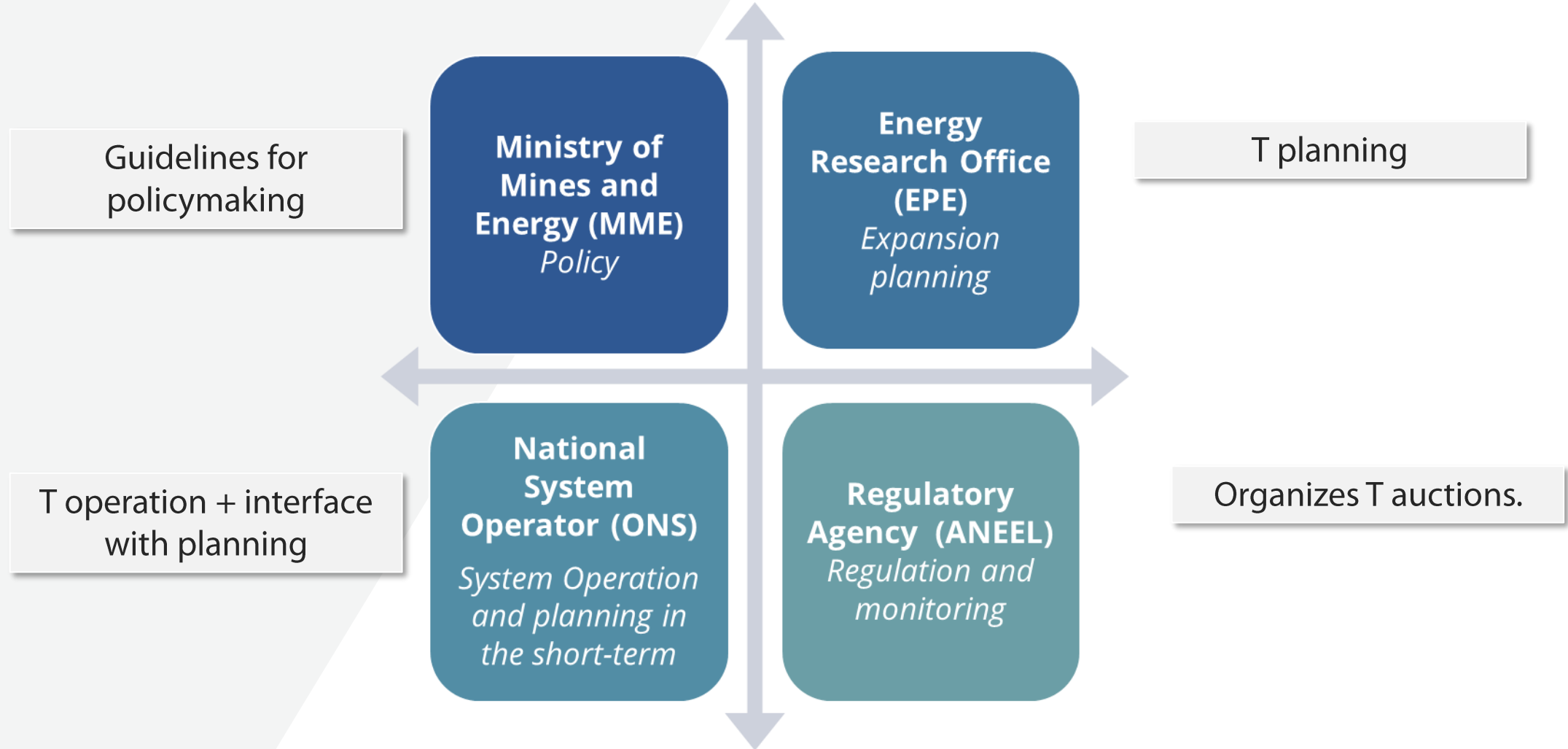
EFFICIENCY

Transmission auctions

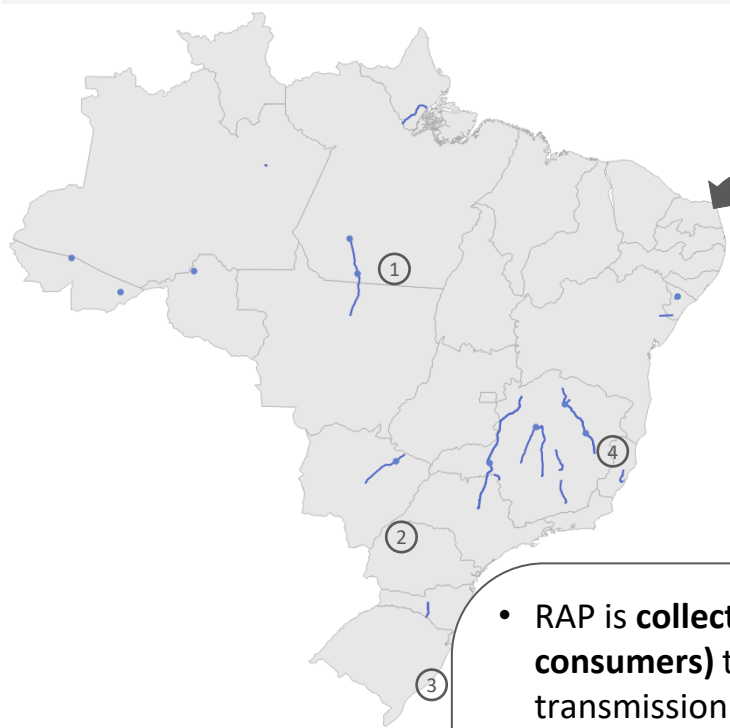
Auctions - decentralized execution:

- Price discovery for the CAPEX
- Assigning responsibility for construction and O&M to transmission companies, which can be private

Institutional framework



Transmission auctions as a **low-risk business model**: long-term concessions awarded through public auctions based on a revenue cap model



- EPE plans the expansion of the grid according to system needs.
- The (new) assets needed are divided into lots and put up for auction.



- RAP is **collected from all grid users (generators & consumers)** through a charge known as the transmission tariff (**TUST**).
- **Credit risk is negligible** due to diversification.
- ANEEL may (unilaterally) require that certain **improvements or reinforcements** are implemented, in which case it will grant an additional RAP.
- At the **end of the concession, assets are reverted** to the State but can also be renewed by ANEEL.



- Players compete for an annual revenue stream (RAP¹) granted to build, maintain and operate the assets.
- ANEEL sets the auction's **cap for RAP**
- Whoever offers the **smallest RAP**, wins the right to develop the projects and becomes a "Transco"



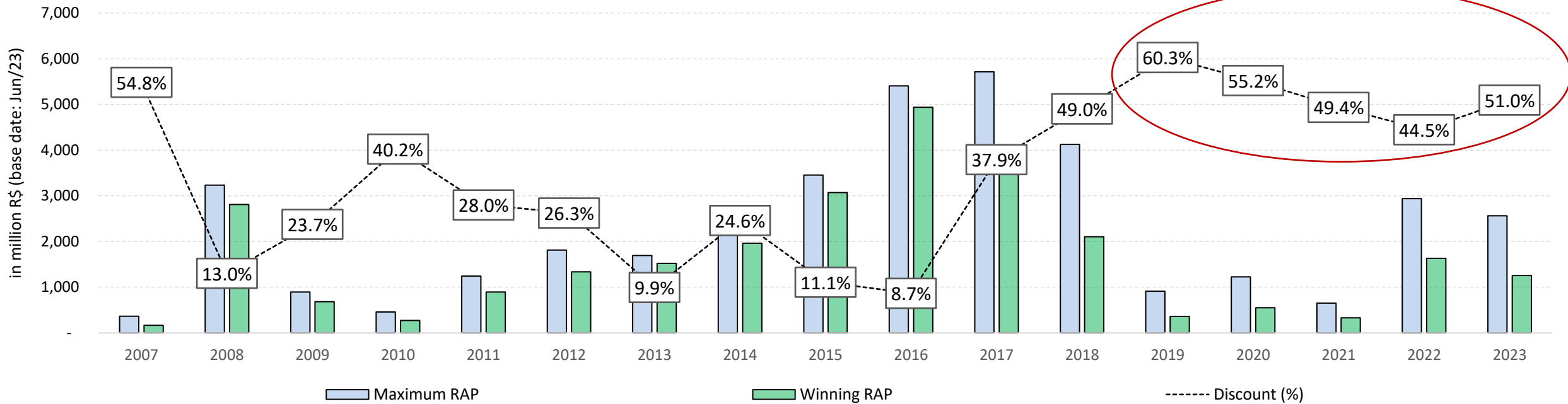
- **30-year concession** contracts are awarded.
- Transco commit to **build, maintain and operate** the assets.
- In return, they are paid a **fixed revenue stream**, starting at the asset's COD, is **adjusted for inflation** on a yearly basis, and **revised every 5 years**².
- Revenues are independent from the actual power flow through the facilities (**there is no volume risk**).
- Outage events can temporarily reduce the RAP (**penalty for unavailability**).

[1] RAP stands for Annual Allowed Revenue (*Receita Anual Permitida*, in Portuguese).

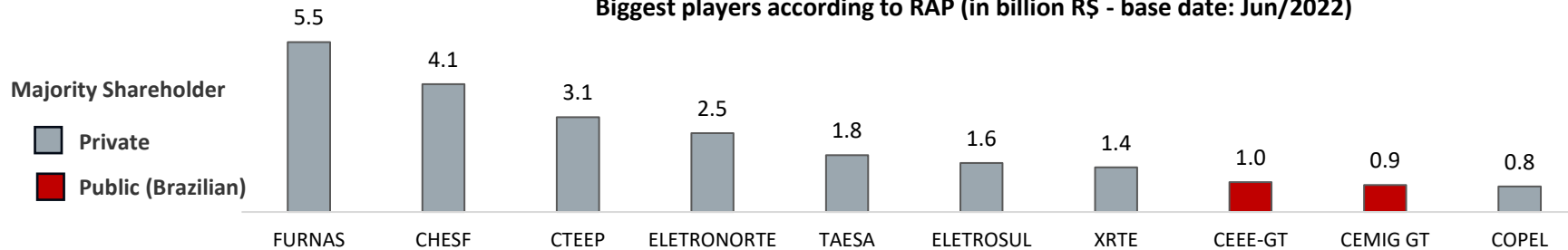
[2] Revisions, which consist in updating the regulatory cost of debt and operating & maintenance costs, are intended to share potential gains derived from technological improvements or better macroeconomic conditions with the public.

In the last 16 years, approximately 86,000 km of high-voltage lines and 223k MVA have been auctioned (~ USD 40 billion in new investments) ⁹

More recently, the auctions have seen fierce competition

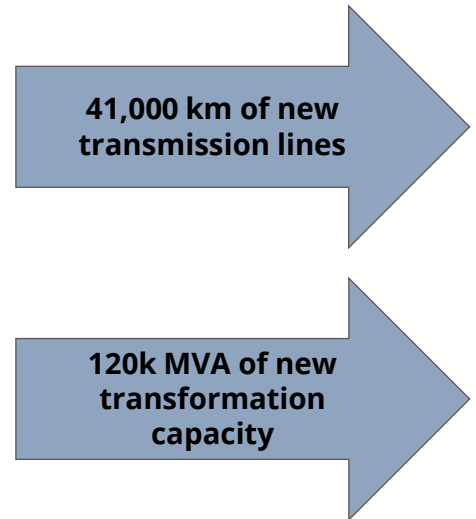
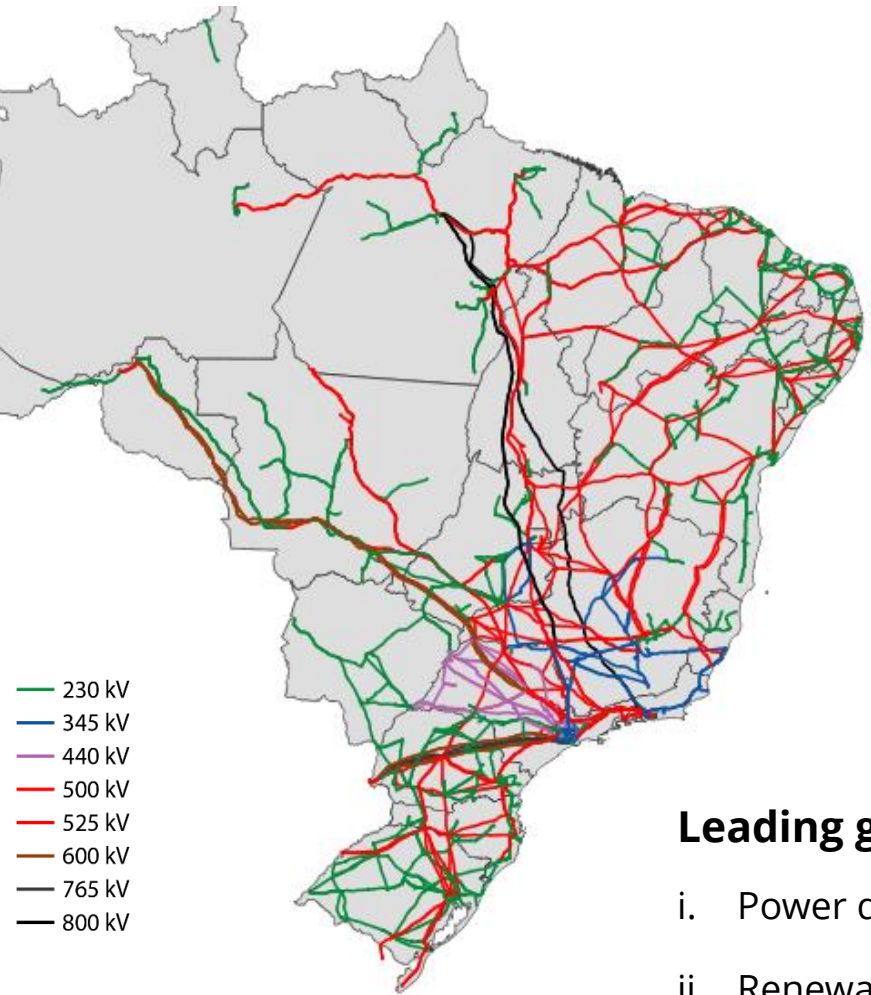


Biggest players according to RAP (in billion R\$ - base date: Jun/2022)

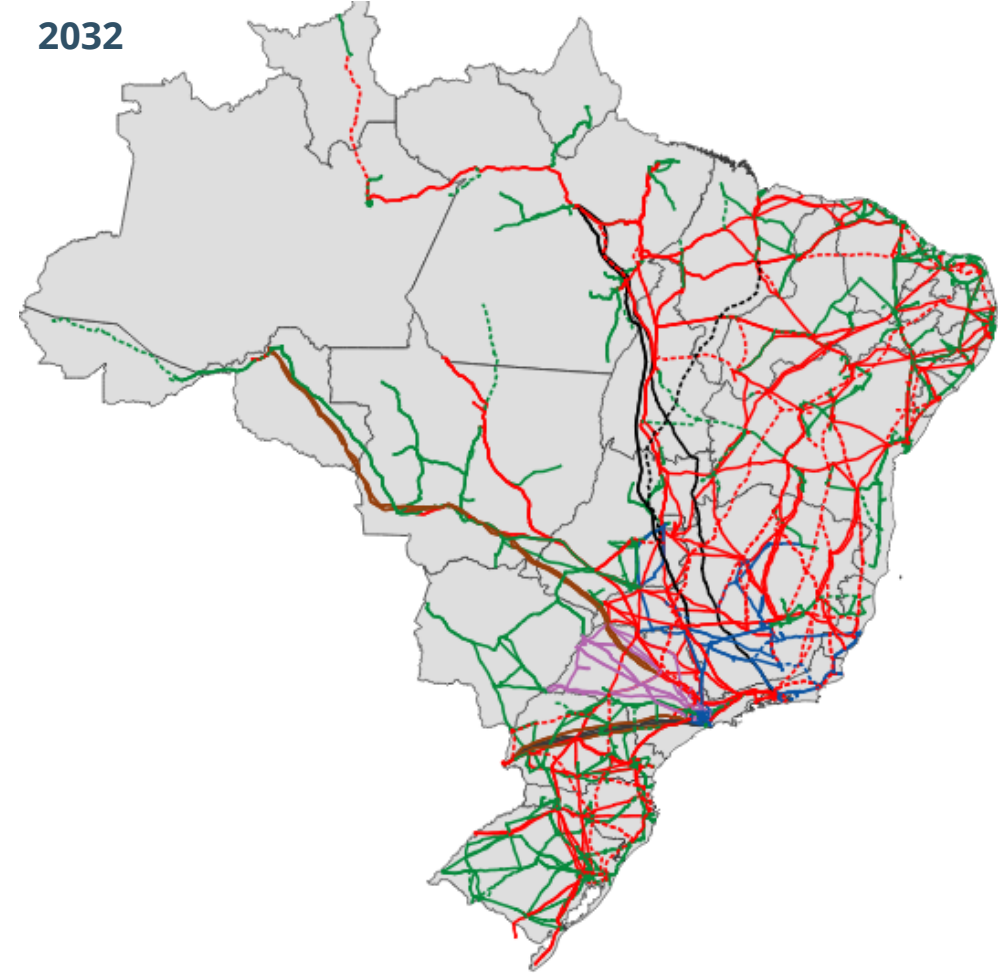


The grid is expected to grow significantly over the next 10 years, requiring USD 20 billion of new investments

2023



2032

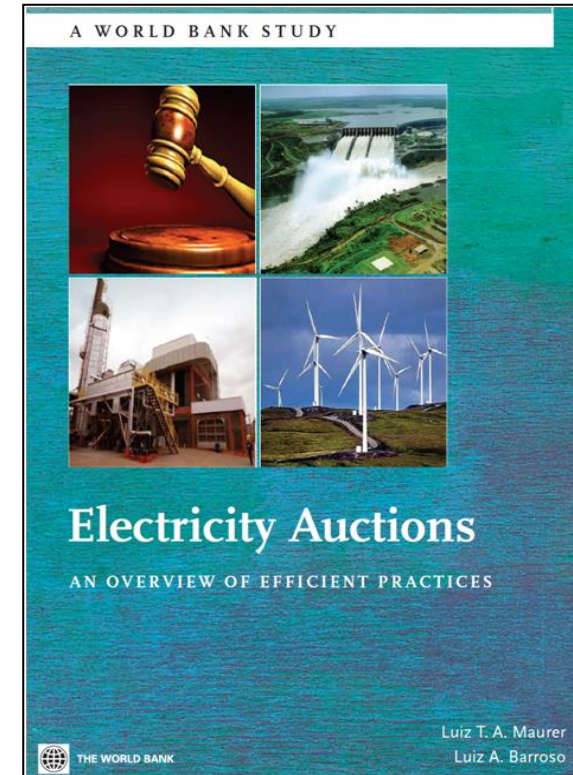


Leading growth drivers:

- i. Power demand growth
- ii. Renewables' growth
- iii. Reliability & resiliency.

Other topics not covered here

- How to carry out the auctions?
- Locational signals in the transmission tariffs
- How to increase competition in the auctions
- How to mitigate delays in the implementation of transmission facilities
- How to address the mismatch between generation and transmission expansion
- How to plan a transmission system with flexibility
- How to unlock renewable interconnection queues



Private ownership in T has been incentivized in other Latin American countries

- ▶ Transmission auctions have played an increasing role in grid expansion, coexisting with classic regulated remuneration schemes (cost-based, RPI-X, yardstick,...)

Private Ownership (%)	Generation	Transmission	Distribution
Mexico	25%	0%	0%
Colombia	60%	45%	45%
Brazil	90%	90%	90%
Peru	60%	45%	45%
Chile	100%	100%	100%
Argentina	75%	75%	75%

Planner defines transmission assets to be built

Bidders submit offers in a formal auction process

Winner is awarded concession (revenue+liabilities)

$$\text{Total risk} = \text{Construction risk} + \text{Operational risk} + \text{Regulatory risk}$$

Some common questions

1

How do you guarantee that the annuity of the remuneration to the private investor will be guaranteed with a low risk?

There is a system of guarantees (escrow accounts, etc.) that ensures the bankability of payments. The system has never had a default since the implementation of the business model. Financing has come from private lenders, debenture holders and transmission companies have been listed in the stock exchange.

2

Does the fact that some transmission infrastructure is privately owned represent a security risk for the power system?

No. The system operator dispatches generation and transmission resources independently of ownership.

3

Has private participation in transmission made transmission more expensive than paying for it with public funds?

No. Auctions have been competitive, financing has come from public and private lenders, and public funds, instead, have been destined to other uses.

Conclusion

1

Brazil has experience in building an extensive transmission system that allows it to integrate renewable generation and portfolio optimization

2

In the country, the regulatory framework of the transmission business has been successful – It demands a constant balance of stronger incentives, stricter rules and solid institutions to secure the enforcement

3

A good and strong regulatory framework combines security to investors while encouraging efficiency

4

Private participation has always been significant in the transmission business environment



Thank you!

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