



INVEST IN BRASIL

Energy Expansion Plan (PDE 2016): Perspectives for renewables in Brazil

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Outline

- General Overview
- Renewables in the Brazilian power system
- Business model to attract renewables
- Looking into the future
 - Part I: the 10-y expansion plan and perspectives for renewables
 - Part II: regulatory and policy enhancements
- Conclusions

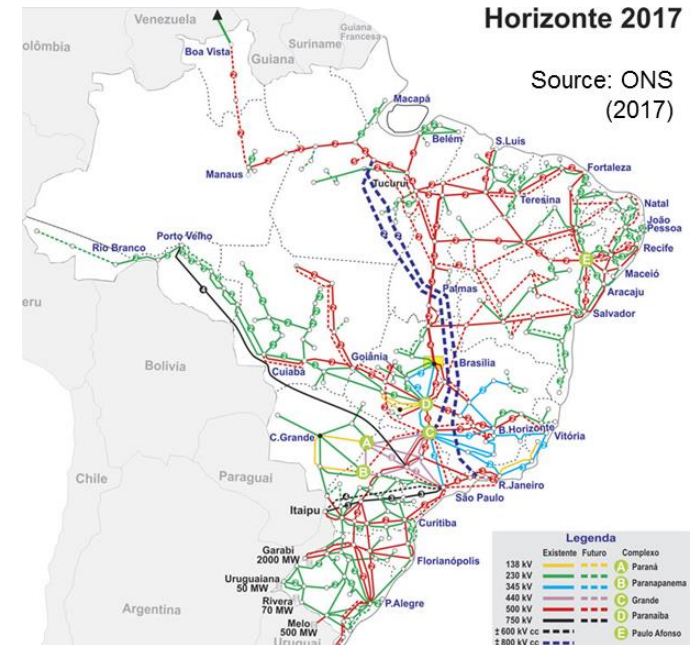
Who are we?

The screenshot shows the EPE website homepage in a browser window. The address bar is highlighted with a red box and contains the URL <http://www.epe.gov.br/en>. The website header includes the EPE logo, the name 'Empresa de Pesquisa Energética', and navigation links for 'Participe', 'Acesso à informação', 'Legislação', and 'Canais'. A search bar and social media icons are also present. The main content area features a large banner with the text 'Electricity' and 'EPE produces studies, analyses and projections to support the development of the electricity industry.' Below the banner are sections for 'News' and 'Videos'. The 'News' section includes articles such as 'Technical Report - Brazilian Electricity Auctions in 2017' and 'Investing in Renewables in Latin America'. The 'Videos' section is currently empty.

- EPE is a governmental company supporting the Ministry of Mines and Energy in its policy decisions, via planning studies for the energy sector
- Technical staff of ~350 people, 65% with MSc or PhD degrees
- Find more about us at : <http://www.epe.gov.br/en>

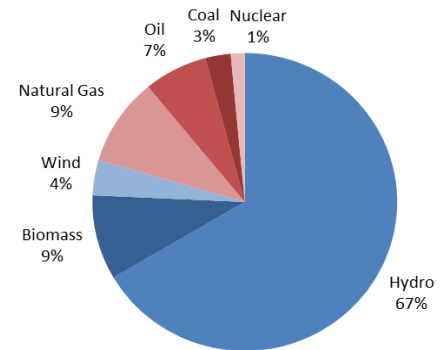
Brazil in big numbers

- Installed generation capacity: 150 GW, 65% hydro
- HV transmission system length: 130,000 km
- Average annual load growth rates:
 - 2004 – 2010: +4.3%; 2010 – 2016: +1.9%
- Private participation in G, T, D and trading
- Investment market:
 - Generation: wholesale energy market in place + auctions of long-term (20+ years) energy contracts for new capacity
 - Transmission: central planning + auctions for 30-year concessions of new transmission facilities
 - Institutions in place & regulatory framework: independent (and federal-level) regulator & ISO & market operator; current framework established in 2004



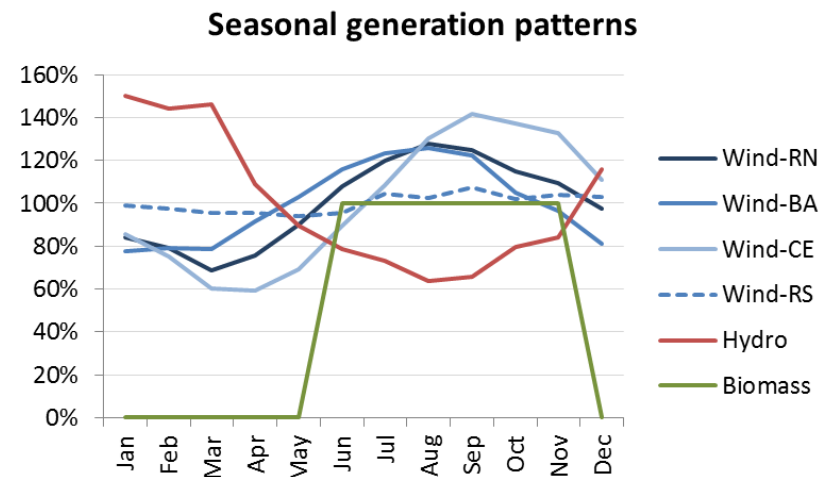
Large contribution from renewable sources already today

- Renewables amount to 42% of Brazilian total primary energy supply (TPES)
- Hydropower accounts for 2/3 of total installed capacity
 - Cascaded plants, with large reservoirs and multiple ownership
 - Thermal stack: gas, coal, nuclear, biomass, fuel and diesel oil
 - “new” renewables are emerging



The role of the “new” renewables in the Brazilian power system

- Renewables have interesting attributes, in addition to its economic competitiveness that make them mainstream technologies for system expansion:
 - Resource potential with geographical complementarity
 - Shorter construction time: hedges load growth uncertainty
 - Location close to load centers
 - The system is well-adapted to absorb inherent fluctuations in wind generation (hydro reservoirs, transmission grid)
 - Production complementarity with hydro:
 - Hydro + bioelectricity (in the Southeast)
 - Hydro + wind (in the Northeast)
 - Wind + small hydros (in the Southeast)



Integration of hydro, solar, wind and bioelectricity



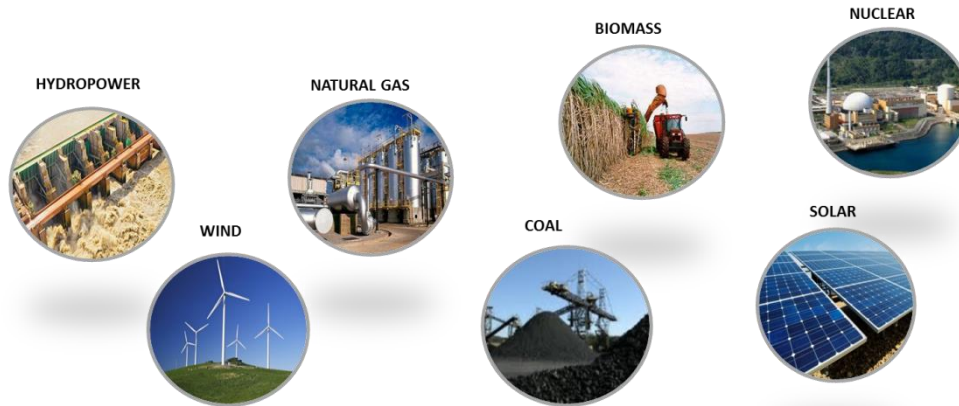
Brazil's hydro reservoirs and the countrywide transmission grid are used to modulate the seasonal production of biomass and the fluctuations of wind power and solar; the system reservoirs are used as "energy warehouses" that may "store" wind, sun and sugarcane
→ Portfolio effect, also with load and in different time scales



The "energy warehouses" of hydropower plants are essential for the economic feasibility of renewable energy sources in Brazil

Capacity expansion strategy

- Brazil needs to build new generation capacity to meet electricity load growth
 - 5,000 MW of new additions needed per year in business as usual years
- The country's resource potential is vast:



Hydro **facilitates** integration of RES, which are located closed to load centers and have shorter-construction time...hydro, wind, solar and biomass portfolio allows the combination of economic of scale and flexibility (dispatchability & construction time)

Business model to develop renewables (centralized generation)

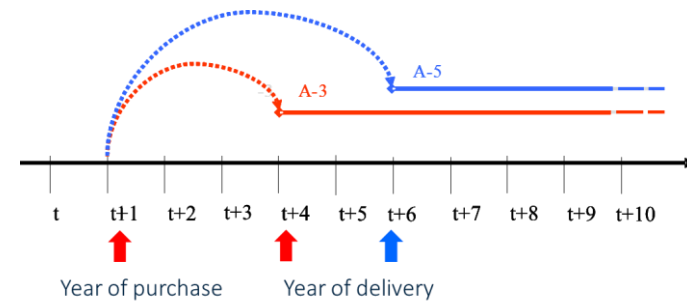
- Due to the energy spot price volatility, the electricity trading in Brazil is centered on the negotiation of electricity contracts
- New generation competes for long-term contracts in auctions to supply the regulated market or bilaterally negotiate their contracts to supply free (eligible) consumers

Target-market	Product	Price-setting mechanism	Who organizes	Volumes definition
Regulated consumers	Firm energy, long-term contract with a performance-incentive mechanism (product tailor-made for the technology)	Auction	Government, auctions organized yearly	Distributors
Free market	Firm energy, contract terms bilaterally defined	Bilateral	Bilateral	Free consumers or traders
Reserve energy	Long-term contract (product tailor-made for the technology)	Auction	Government, auctions organized sporadically	Government

The role of the electricity auctions

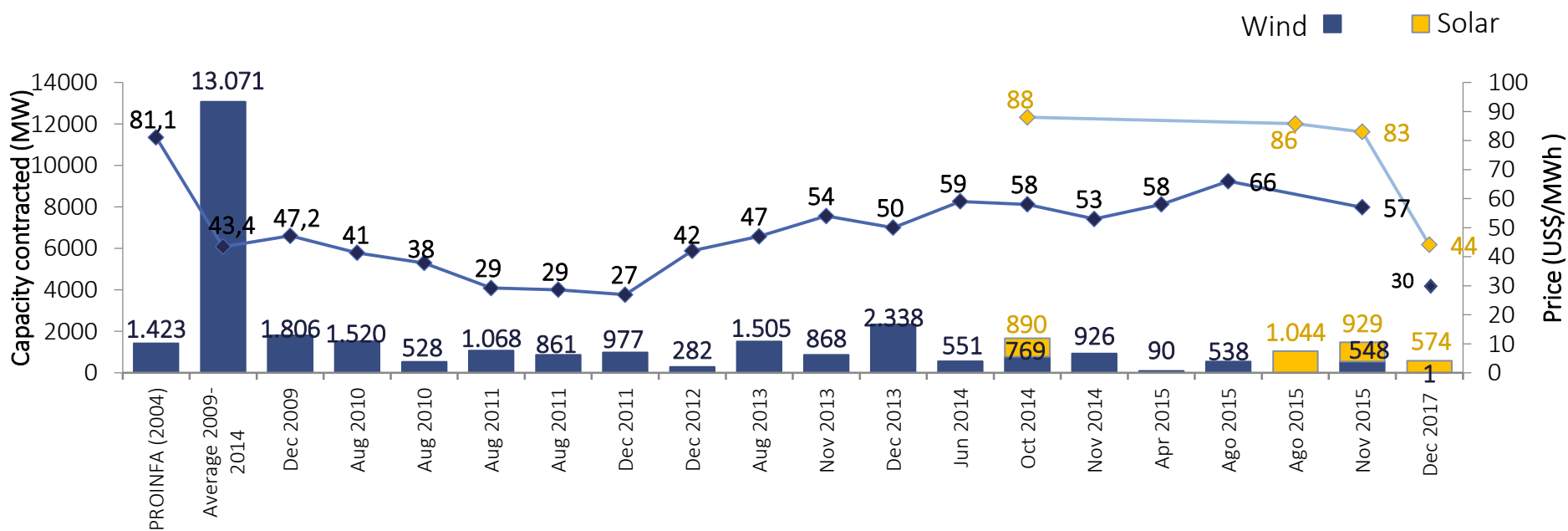
Features

- Periodic auctions are organized every year for future delivery: “A – x”, where x is the delivery year.
- Meet the regulated consumers demand in the long term (as declared by their respective distribution utilities), are price-hedging mechanisms to consumers
- There are auctions exclusive for new generation capacity → investment market
- Provide long term energy contracts for power generators (backed by firm energy)
- Contracts are denominated in BRL and indexed to IPCA (consumer price inflation).
 - For thermal power plants, fuel purchase installments can be indexed to a basket of international fuel prices and exchange rate.
- Technology-specific products and contracts



Brazilian renewable energy auctions

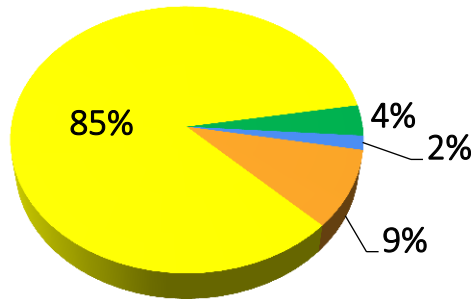
- The auction-based framework has provided price competitiveness and boosted the renewable energy industry in the country



Examples: Electricity Auctions in 2017

A-4

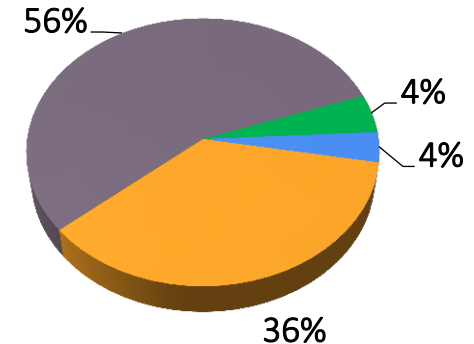
MW



Wind PV Solar Biomass Hydro

A-6

MW



Wind Natural Gas Biomass Hydro

Source	Registered (MW)	Qualified (MW)	Sold (MW)	Final Price (US\$/MWh)
Wind	26,604	8,907	64	32,7
PV Solar	18,352	14,030	574	44,1
Biomass	1,974	742	25	71,2
Small Hydro	1,035	616	11,5	55,0
Total	47,965	24,296	674	44,1

Source	Registered (MW)	Qualified (MW)	Sold (MW)	Final Price (US\$/MWh)
Natural Gas	21,560	9,178	2,138	64,7
Coal	1,880	340	-	-
Wind	26,651	22,200	1,386	29,9
Biomass	2,068	1,197	177	65,7
Small Hydro	1,266	836	139	66,4
Total	53,424	33,751	3,841	57,4

More information about the auctions in our web

The image shows a screenshot of the EPE website. The main page features a navigation bar with 'BRASIL', 'Serviços', 'Participe', 'Acesso à informação', 'Legislação', and 'Canais'. Below this is a search bar and a 'Português' language selector. The main content area has a large banner for 'Electricity' with the headline 'EPE produces studies, analyses and projections to support the development of the electricity system'. Below the banner is a 'News' section with several articles. A red box highlights the article 'Technical Report - Brazilian Electricity Auctions in 2017'. A blue arrow points from this article to an inset window showing a detailed report page titled 'Report Electricity Auctions' dated December 28th 2017. The report page includes the EPE logo, a search bar, and the main title 'Brazilian Electricity Auctions in 2017' with the subtitle 'Presenting the results and how they influence energy planning studies'. The report text discusses the contracting of energy from new power generation plants in Brazil in December 2017, the 'A-4' and 'A-6' auctions, and the impact on energy planning studies. It also mentions the 'MAIN GUIDELINES' and the role of EPE in the process.

Electricity
EPE produces studies, analyses and projections to support the development of the electricity system

News

Technical Report - Brazilian Electricity Auctions in 2017
28/12/2017 - In December 2017 the contracting of energy from new power generation plants in Brazil was resumed, with two auctions that took place under the guidelines of the Ministry of Mines and Energy (MME): the A-4 auction and A-6 auction.

Investing in Renewables in Latin America
23/11/2017 - On 22nd November, Ambassador Eduardo dos Santos, together with the UK Minister for Trade & Export Promotion, Baroness Fairhead, opened the seminar 'Investing in Renewables in Latin America'.

Technical Report - Auction N° 02/2017 and the Planning Studies
15/12/2017 - This report summarizes the outcome of last transmission auction held on December 15th, showing the favourable impacts on the Brazilian power system as a result of the planning process carried out by EPE.

The Latin America and Caribbean Gas Options 2017 held November 16
17/11/2017 - The Latin America and Caribbean Gas Options 2017 held in November 16-17 was attended by more than 150 high-level representatives from the gas industry in the region. The conference's main goal was to map the opportunities and challenges of the industry in different countries of the region, as

Report Electricity Auctions
December 28th 2017

Brazilian Electricity Auctions in 2017
Presenting the results and how they influence energy planning studies

In December 2017 the contracting of energy from new power generation plants in Brazil was resumed, with two auctions that took place under the guidelines of the Ministry of Mines and Energy (MME). On the 18th, the "A-4" auction was conducted, for supply to begin in January 2021, while on the 20th it was time for the "A-6" auction, for energy supply to begin in January 2023¹.

These auctions are part of the electricity supply adequacy mechanisms in Brazil. They have the objective of supplying the regulated market, providing long term energy contracts for power generators, that must be backed by firm energy.

These two auctions were relevant because they have consolidated a couple of features that had been tested in previous years, such as a preliminary phase of competition for the available capacity in the transmission grid. At the same time, they were useful for promoting, successfully, a number of new features, such as a new auction systematic (or "mechanism"), stricter qualification requirements and changes in the production obligation rules for wind and for the must-run limits of thermal power plants.

In this report we describe the most relevant aspects regarding the two auctions held in December 2017 for contracting energy from new power plants, the role of EPE and bring insights on how the results are likely to influence the energy planning studies in the country.

MAIN GUIDELINES

Both auctions were scheduled by the MME on the 4th of August 2017, according to Ordinance 293/2017. Afterwards, Ordinance 390/2017 set the guidelines for the auction systematic. The objective of these auctions is to contract energy for meeting the demand declared by distribution utilities, responsible for supplying its captive consumers.

According to the set of guidelines by the MME, both auctions were held with technology-specific products and contracts.

In the "A-4", there were 4 distinct products, which are long-term contracts catered per technology : (i) windpower; (ii) solar PV; (iii) biomass-fired thermal; and (iv) small hydro (1 to 50 MW). Each technology competed exclusively within its own product, according to the previously allocated share of the total demand. In the "A-6", there were also 4 products: (i) windpower; (ii) biomass and coal-fired thermal; (iii) gas-fired thermal; and (iv) hydro (above 50 MW) and small hydro (5-50 MW).

Contractual terms last between 20 and 30 years, depending on the auction and on the technology. Contracts are Real-denominated (BRL) and indexed to national inflation. For thermal power plants, the fuel purchase installments can be indexed to a basket of international fuel prices and exchange rate.

In the case of the "A-4" auction, taking into account that electricity supply must begin before transmission planning can guarantee the provision of grid access to every project at every place, a preliminary phase was held for competition over the

¹The auctions that offer contracts for existing electricity generators are not subject of this report.
EPE-DEE-IT-102/2017-0 (English version)

New Electricity Auctions in 2018

Main Features

- 2 New Electricity Auctions to be held in 2018.
 - “A-4” auction: supply to begin in January 2022 (scheduled for April, 4th).
 - “A-6” auction: supply to begin in January 2024 (TBA until March, 30th).
- “A-4” auction with 4 “products”:
 - Wind; solar PV; biomass-fired thermal; and small hydro

Source	Number of Projects Registered	Registered Capacity (MW)	Price Cap (US\$/MWh)
Wind	931	26,198	78
Hydro	3	114	88
Solar	620	20,021	95
Biomass	28	1,422	100
Total	1,672	48,713	-

And what about **distributed** RES generation?

- Brazil has a framework for distributed generation in place
- Today, solar is already competitive as DG against the retail tariff and a regulatory framework for net metering is available and functioning
 - The challenge for this market is the business model (leasing, financing, etc)
- Distribution companies may also cover up to 10% of their loads with (renewable) distributed generation where the procurement is carried out by auctions organized by the distributors themselves
 - Auction price-caps for these auctions are defined by the government and factor externalities of distributed resources
 - They were released last Tuesday by MME, distributors may now organize their auctions and DG has a new market

A look into the future

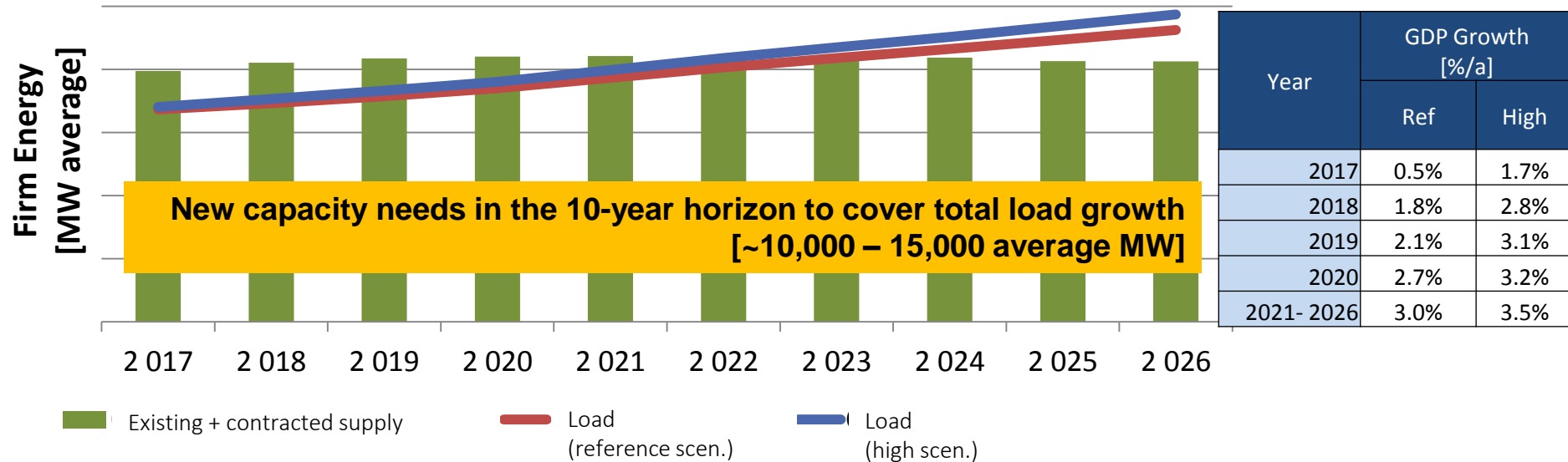
The Ten-Year Expansion Plan (PDE 2026)

An *indicative* outlook for the future of the energy matrix of Brazil



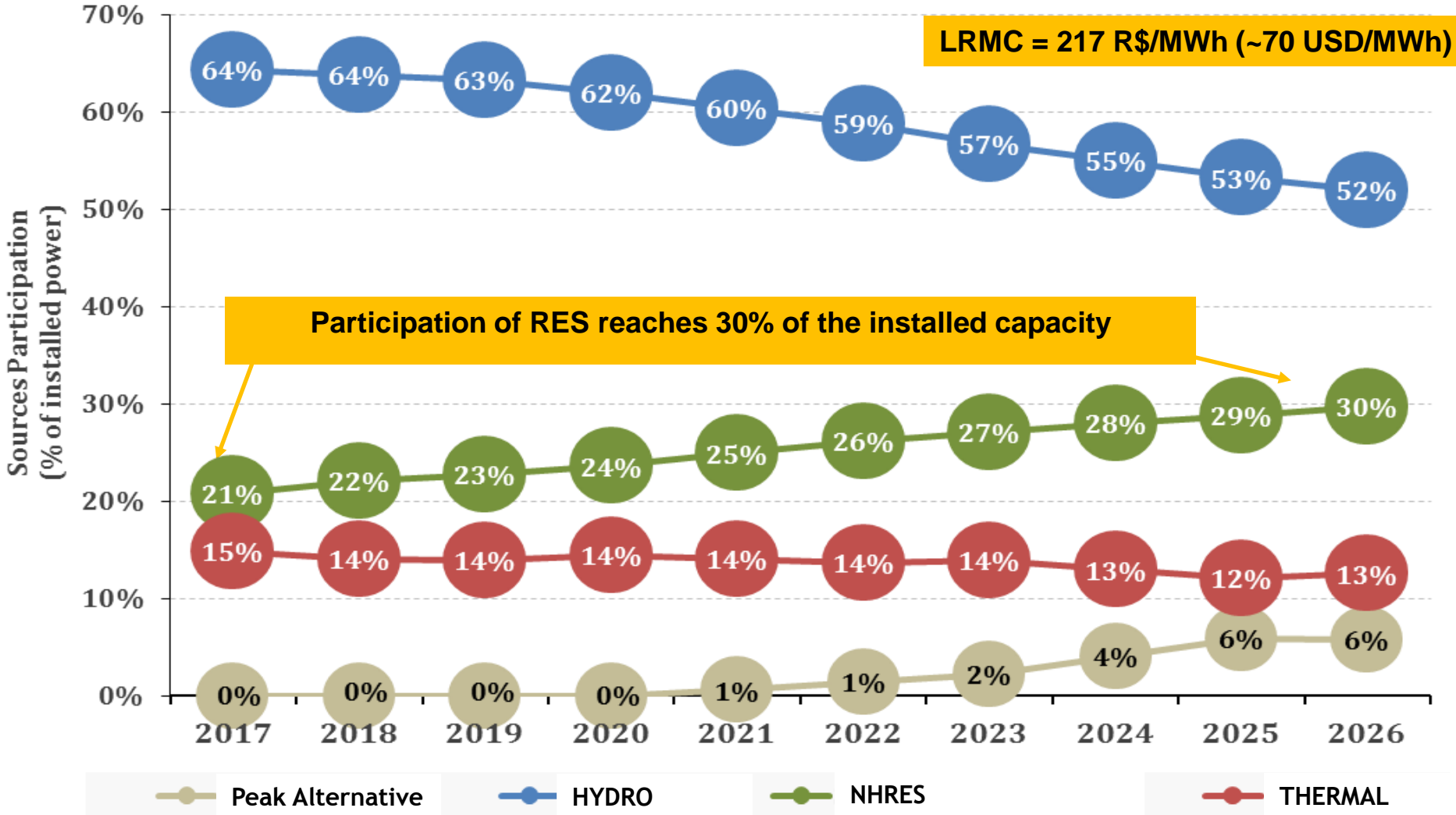
- PDE 2026 offers an indicative outlook expansion of the energy industry in Brazil from the perspective of the Government.
- Based on an integrated view of the various energy sources, PDE 2026 serves as support for planning the energy sector over a 10-year horizon.
- The final objective is to provide a market with better information to support investors investment decisions.

The market space for new investments



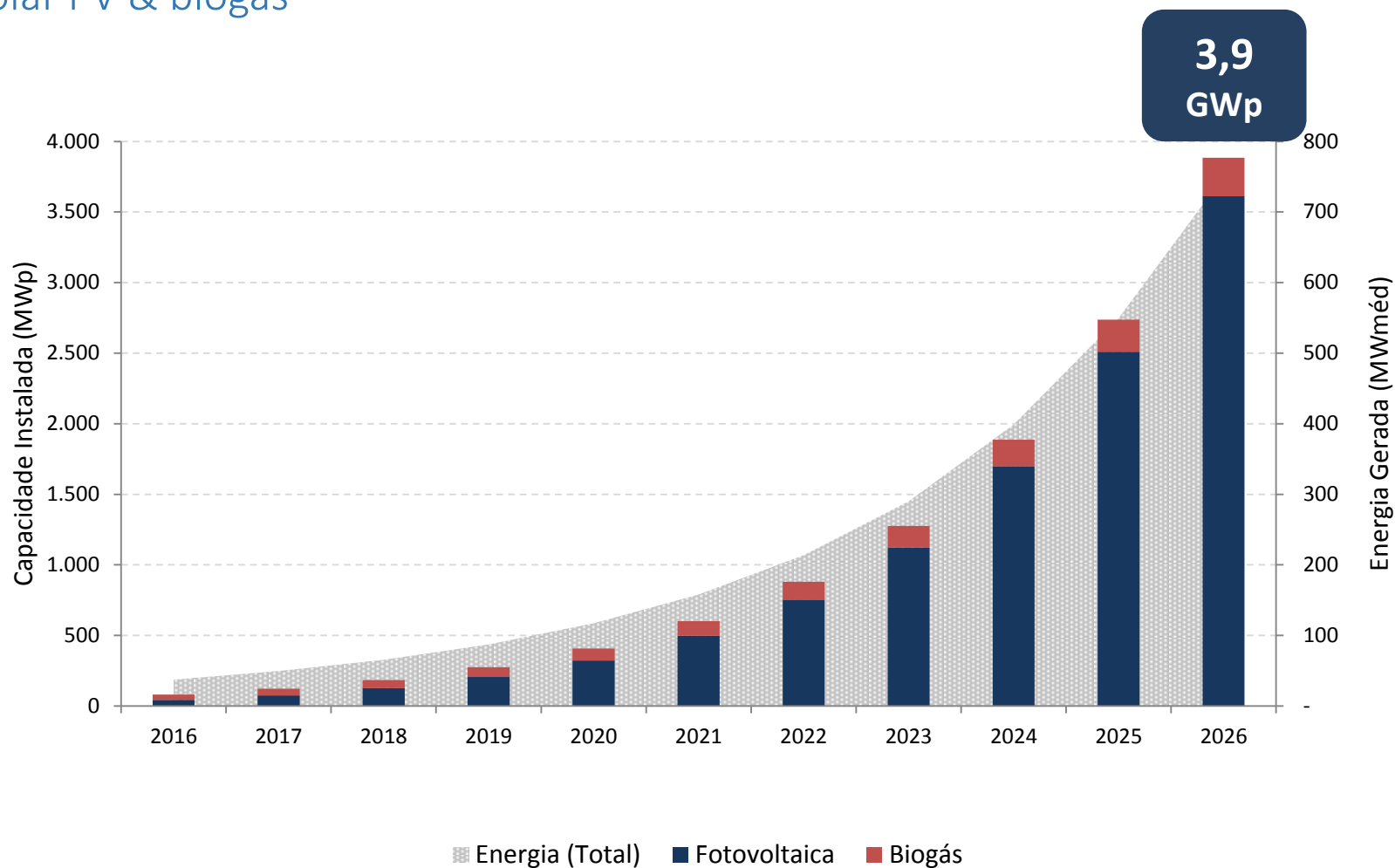
- Hydropower is not the predominant technology in the expansion anymore, reflecting the needs to revisit the hydro development process
- Renewables (Solar, Wind, Small Hydro, Biomass) are the leading technologies in the system expansion complemented by thermal generation (gas-fired)
- Commercial mechanisms to integrate this expansion were discussed before

An outlook of the matrix in the 10y horizon



Distributed generation expansion

Solar PV & biogas



Improving the regulatory framework to attract (more) investment to the country

Another round of policy innovation is happening in the country...

- The future of the power system is towards renewables, distributed energy resources, consumer empowerment and digitalization
- Capacity expansion did occur in Brazil in recent years but there were signals of exhaustion of the current model
 - Interventionism in resource allocation, prices
 - Centrally managing agent's risk contributed to exposure to judicial disputes
 - Market signals lost role as investment drivers
 - Lack of transparency and predictability
 - Legal and regulatory barriers to innovation
- The current legal framework needs an overhauling to be adapted for the power system of the future

Fundamental propositions for setting a long-term view were set...

- Increased incentives to efficient, decentralized decision-making
- Market signals as mechanism to align individual and societal goals with mechanisms for individual risk management
- Dialogue & public consultations were the vehicles to build a proposal
 - Improvements on spot price formation: higher granularity, incorporation of security constraints on price-formation model.
 - Separation of products (energy, reliability product, ancillary services) and use of market mechanisms to correctly price them.
 - Clean energy certificates as a replacer of the (inefficient) current incentive structure for new renewable projects (discounts on T&D tariffs)
 - Expansion of the deregulated (free) market
- Respect to property rights and contract sanctity: mechanisms to accommodate legacy as important as long-term view

MME has just released a Bill project to modernize the electricity regulatory framework

- Released on February 9th, built upon more than 200 contributions under a public consultation process
- Bill project and relevant documentation available at www.mme.gov.br
- The main proposals take into account:
 - Increase of consumer's choice options; supply adequacy mechanisms; mechanisms to deal to a sustained RES expansion; appropriate risk and cost allocation instruments.
 - Possibility for a more detailed discussion on issues such as the development of energy exchanges, the improvement of price formation mechanism, the reduction of costs for the implementation of smart meters and the liberalization conditions for the residential consumers.
- Next step is the submission of the project to the congress for a wide discussion with the society

The screenshot shows the official website of the Ministry of Minas and Energy (MME). The header is green with the MME logo and navigation links. The main content area is white and features a sidebar on the left with a list of topics (ASSUNTOS) including 'Consultas Públicas', 'Agendamento Usina Solar', and 'Acesso a Informação'. The main content area displays the title 'Projeto de Lei de Modernização e Abertura do Mercado Livre de Energia Elétrica' and provides details about the public consultation process, including the date of publication (09/02/2018) and the date of the last modification (09/02/2018). There are also social media sharing buttons for Twitter and Facebook.

Conclusions

Conclusions

- The future of the electricity industry in Brazil is towards keeping its low-carbon matrix and renewables are the means to meet this goal
- Although the recent economic downturn and *inertia* in commencement of operations of generation capacity contracted in the past results in some structural oversupply currently, the future prospects are positive (Brazil has scale)
- Brazil's capacity adequacy mechanism and auction-based NHRES procurement have worked properly and been of great interest to many countries
 - Provide economically efficient outcomes that are **unlikely to be challenged** in the future as political and institutional scenarios change
- The current reform package aims at bringing more efficiency, enabling the penetration of new technologies to bring benefits to all stakeholders and consumers

Integratedly with all other institutions, MME and EPE remain open to
deepen these (and other!) topics with everyone

Thank you!

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