

EXPERIENCE AND LESSONS LEARNED FROM RENEWABLE ENERGY AUCTIONS IN BRAZIL

34minutos

21st REFORM Group Meeting,
Salzburg, August 28 – September 1, 2017

Mauricio T. Tolmasquim

*Professor at Federal University of Rio de Janeiro
Non-resident Fellow at Harvard Kennedy School*

BRAZILIAN INTENDED NATIONALLY DETERMINED CONTRIBUTION (INDC)

CONTRIBUTION

Reduce greenhouse gas emissions by 37% below 2005 levels in 2025

SUBSEQUENT INDICATIVE CONTRIBUTION

Reduce greenhouse gas emissions by 43% below 2005 levels in 2030

TYPE

Absolute target in relation to a base year

COVERAGE

100% of the territory, economy-wide, including CO₂, CH₄, N₂O, perfluorocarbons, hydrofluorocarbons and SF₆

REFERENCE

2005

TIMEFRAME

Single-year target for 2025; indicative values for 2030 for reference purposes only

METRIC

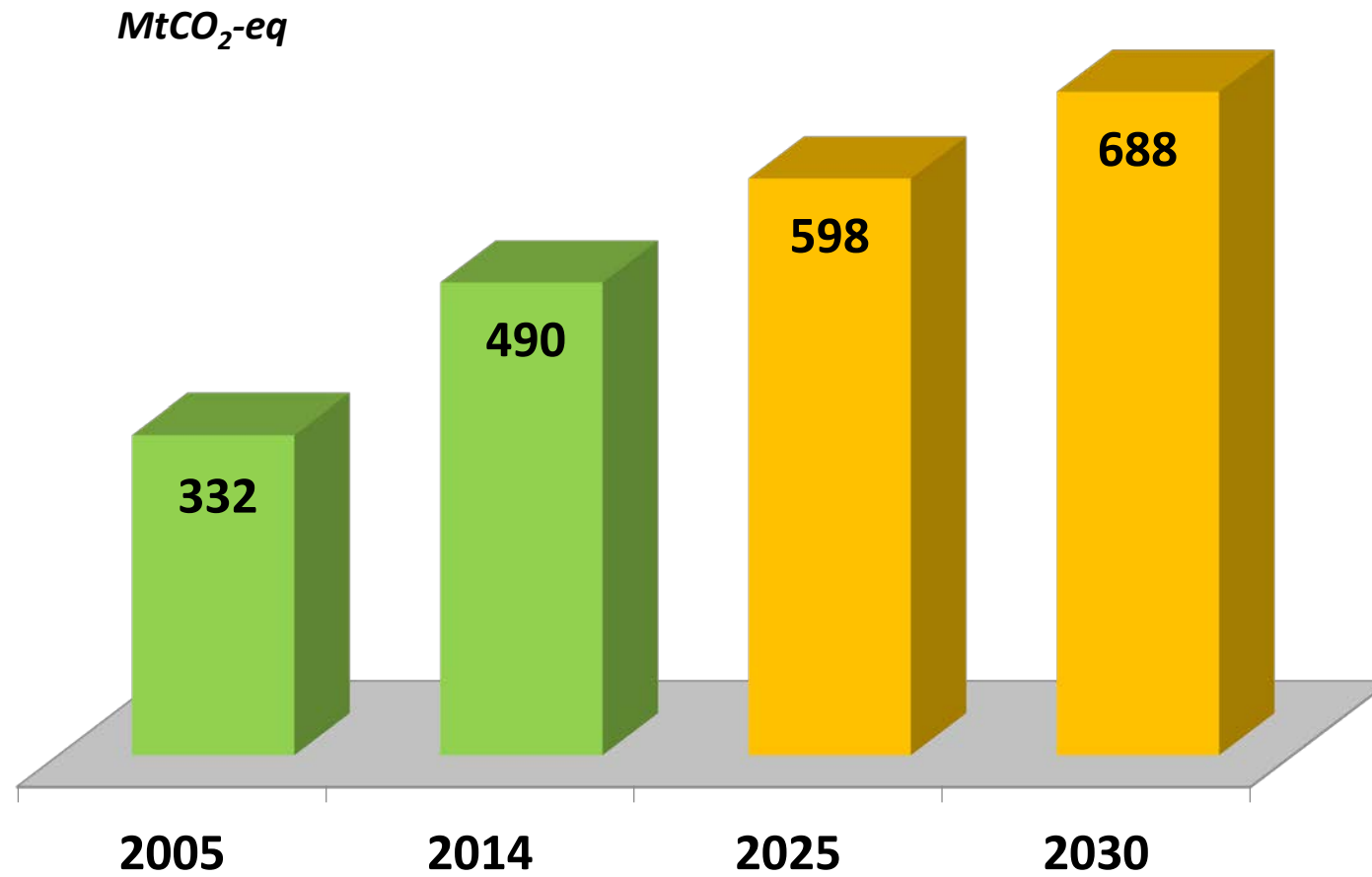
100 year Global Warming Potential, using IPCC AR5 values

Brazil's iNDC is economy wide and therefore is based on flexible pathways to achieve the 2025 and the 2030 objectives.

In that sense, this presentation is meant to be for clarification purposes only.

GHG ANTHROPOGENIC EMISSIONS

ENERGY SECTOR

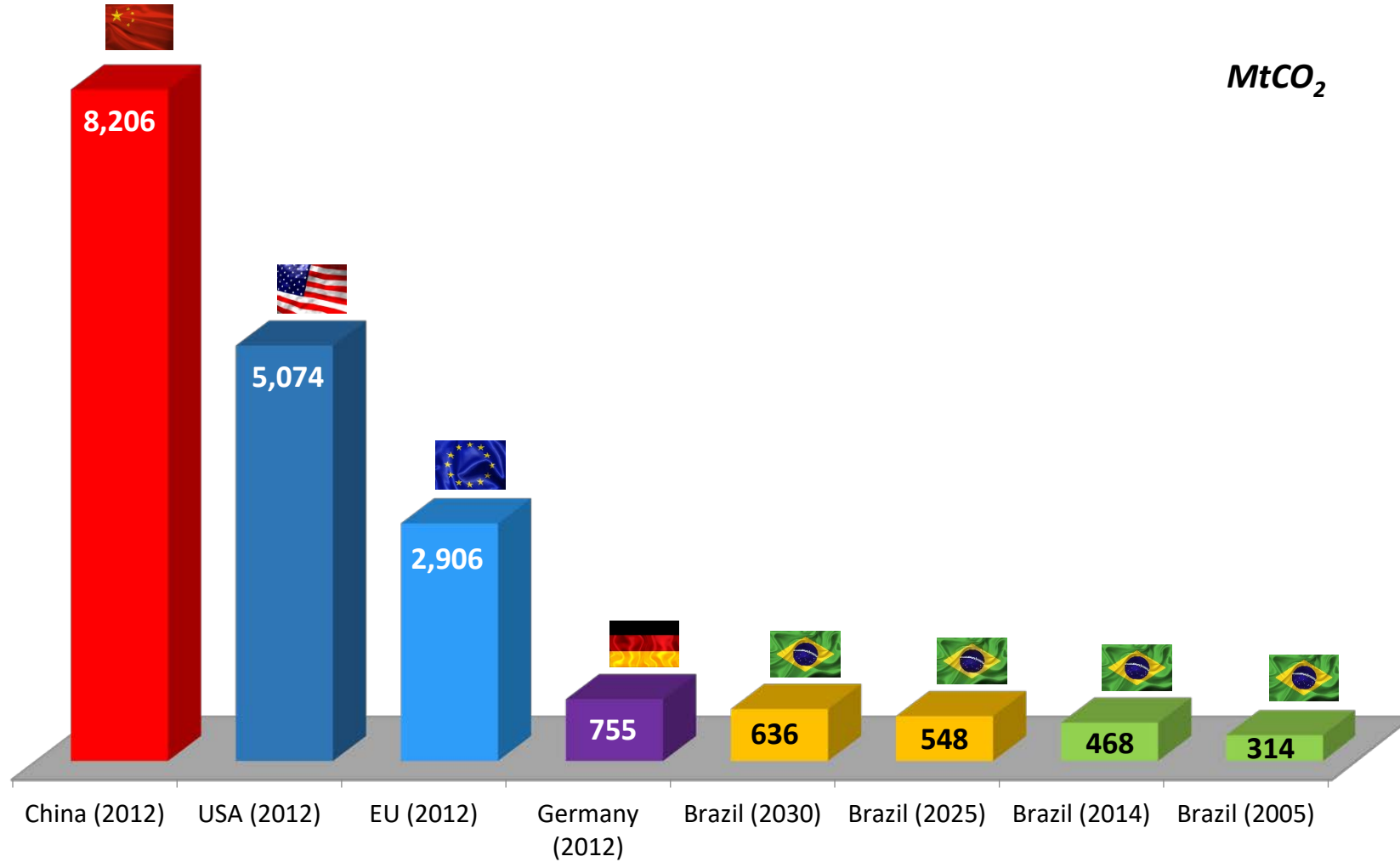


Source: EPE

Note: MtCO₂-eq in GWP AR5. Include all GHG gases.

GHG ANTHROPOGENIC EMISSIONS

ENERGY SECTOR (INTERNATIONAL COMPARISONS)



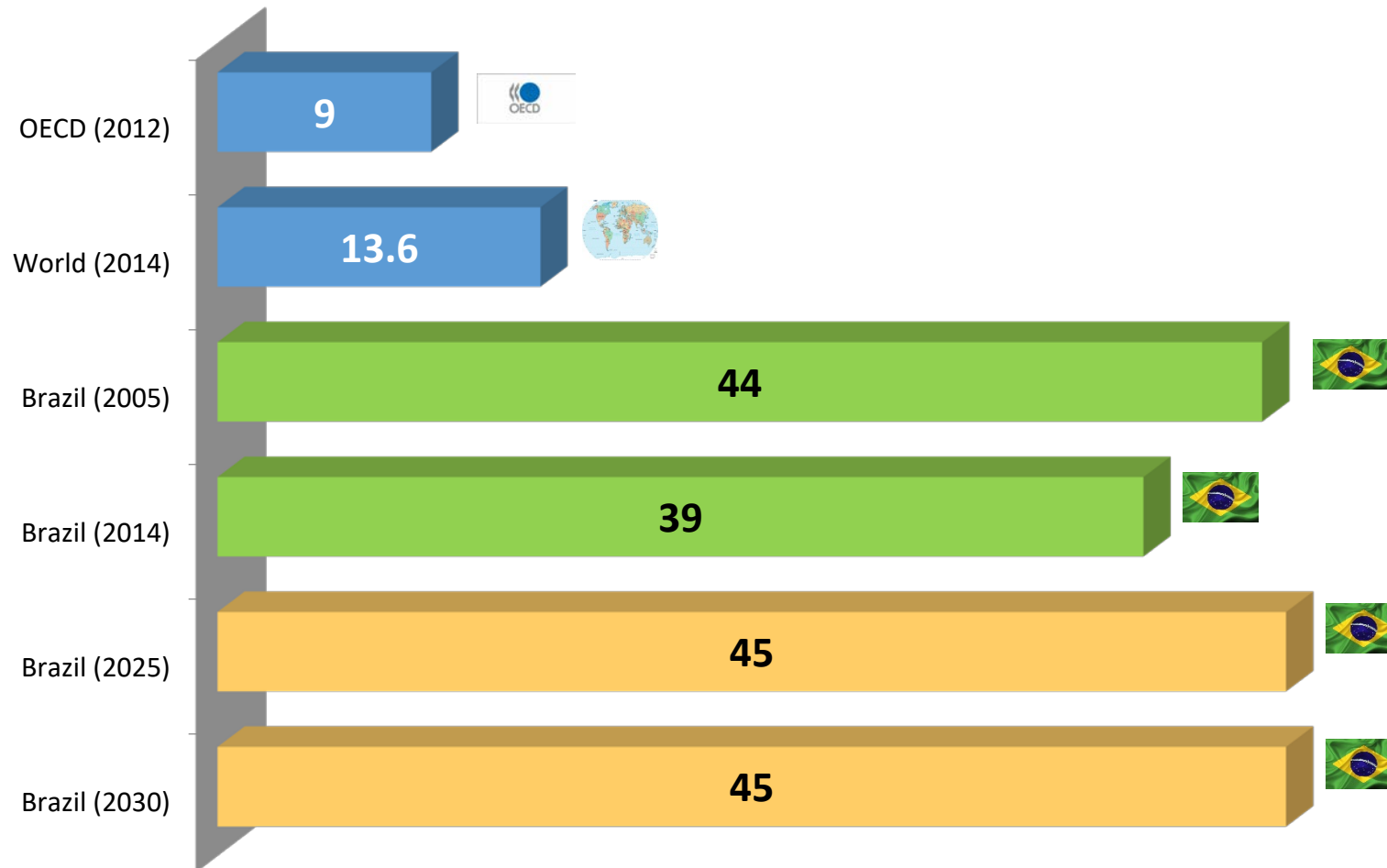
Source: EPE (Brazil data); IEA, 2014 (International data)

Note: Refers only to CO₂

SHARE OF RENEWABLES ON ENERGY MATRIX



iNDC: Achieving 45% of renewables in the energy mix by 2030.



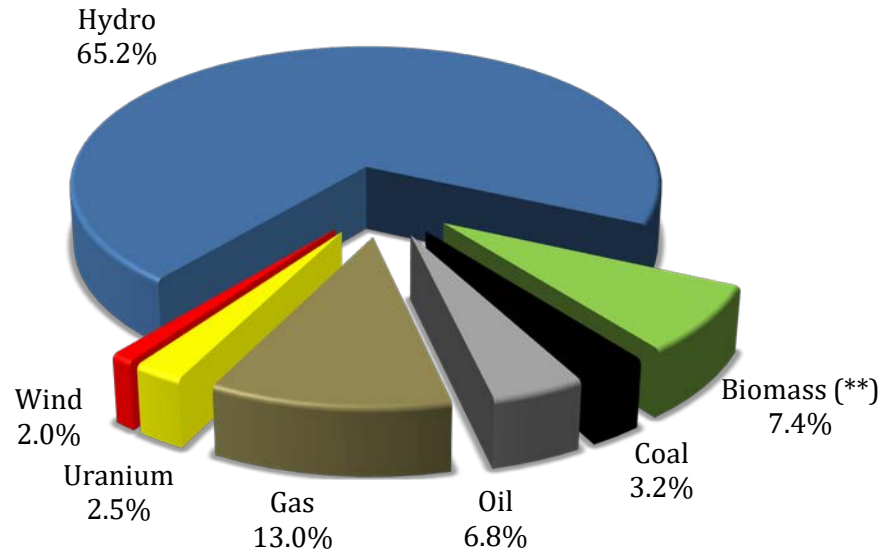
Source: EPE; IEA

POWER GENERATION BY FUEL

BRAZIL VS. WORLD

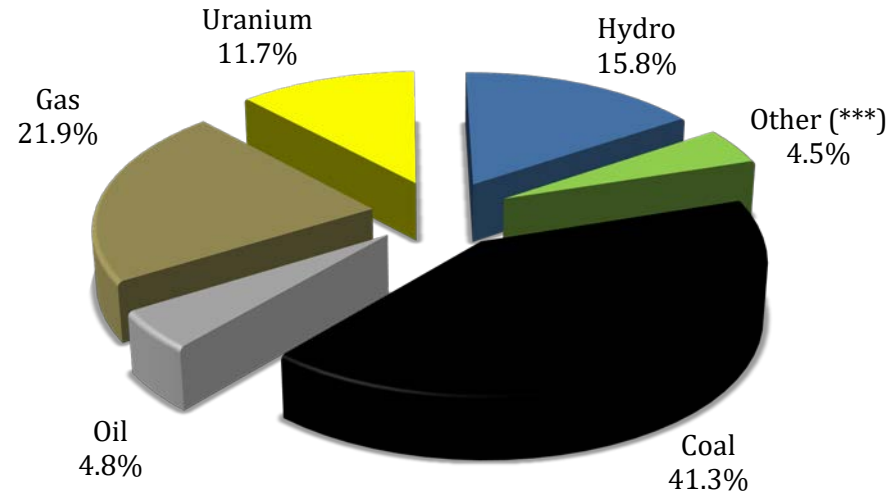
BRAZIL 2014

Renewables = 78.2%



WORLD 2011

Renewables = 20.3%



Year	Share of Renewables
2012	84.6%
2013	79.3%

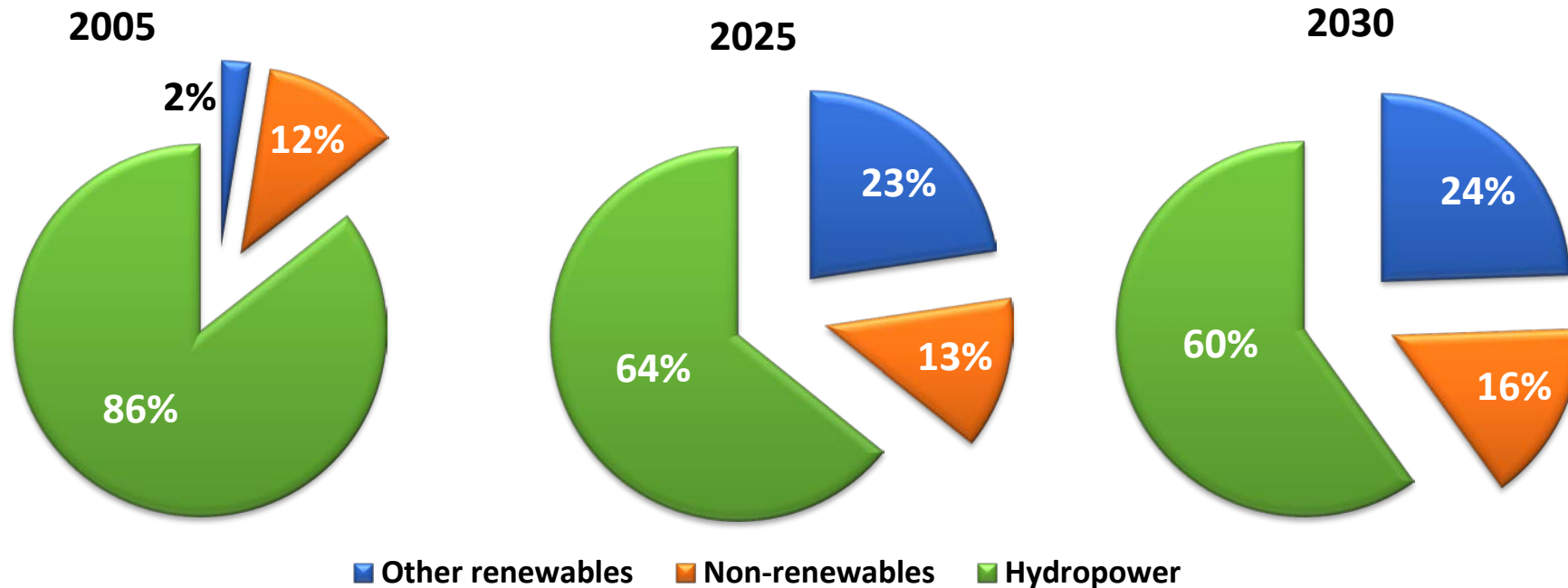
** Mainly generated from the co-generation with sugar cane

*** Other includes geothermal, solar, wind, combustible renewables and waste, and heat.

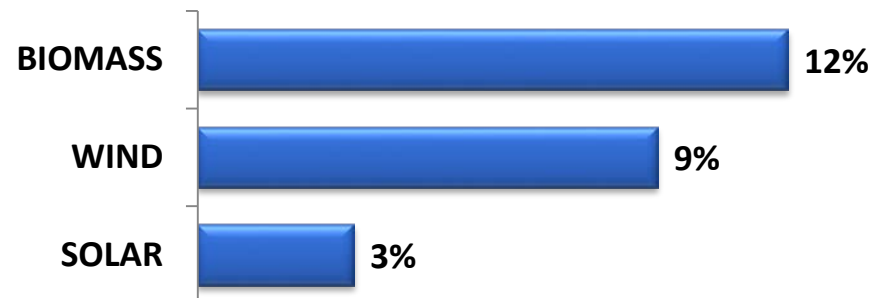
NON CONVENCIONAL RENEWABLES TARGET



iNDC: Increasing the share of renewables (other than hydropower) in the power supply to at least 23% by 2030, including by raising the share of wind, biomass and solar

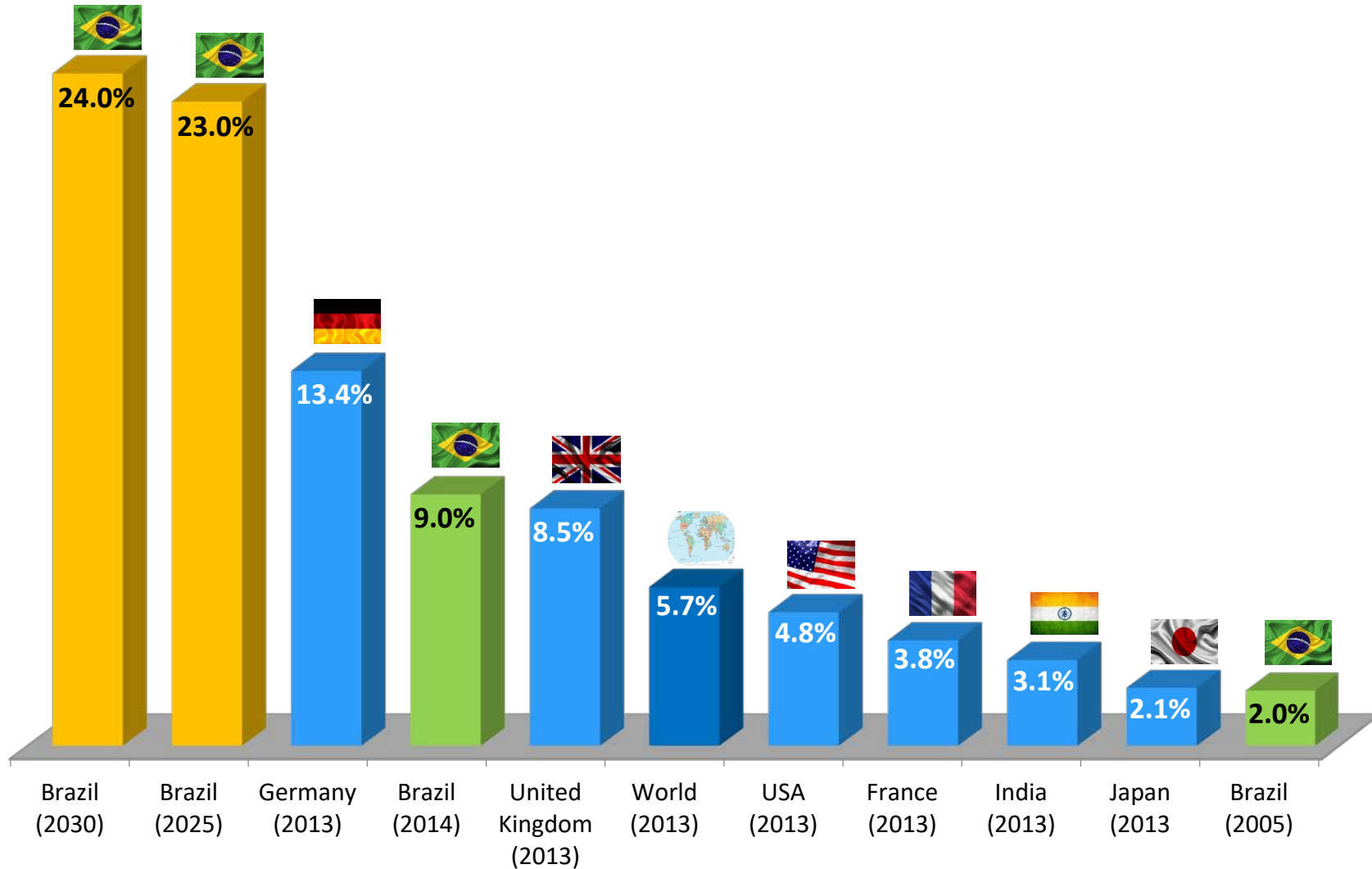


Share of renewables (other than hydropower) in 2030



RENEWABLES IN ELECTRICITY SUPPLY

(% EXCLUDING HYDROPOWER)



Source: EPE (Brazil data); IEA (International data)

ELECTRICITY MARKET DESIGN

Rely on contracts as inducers of system expansion

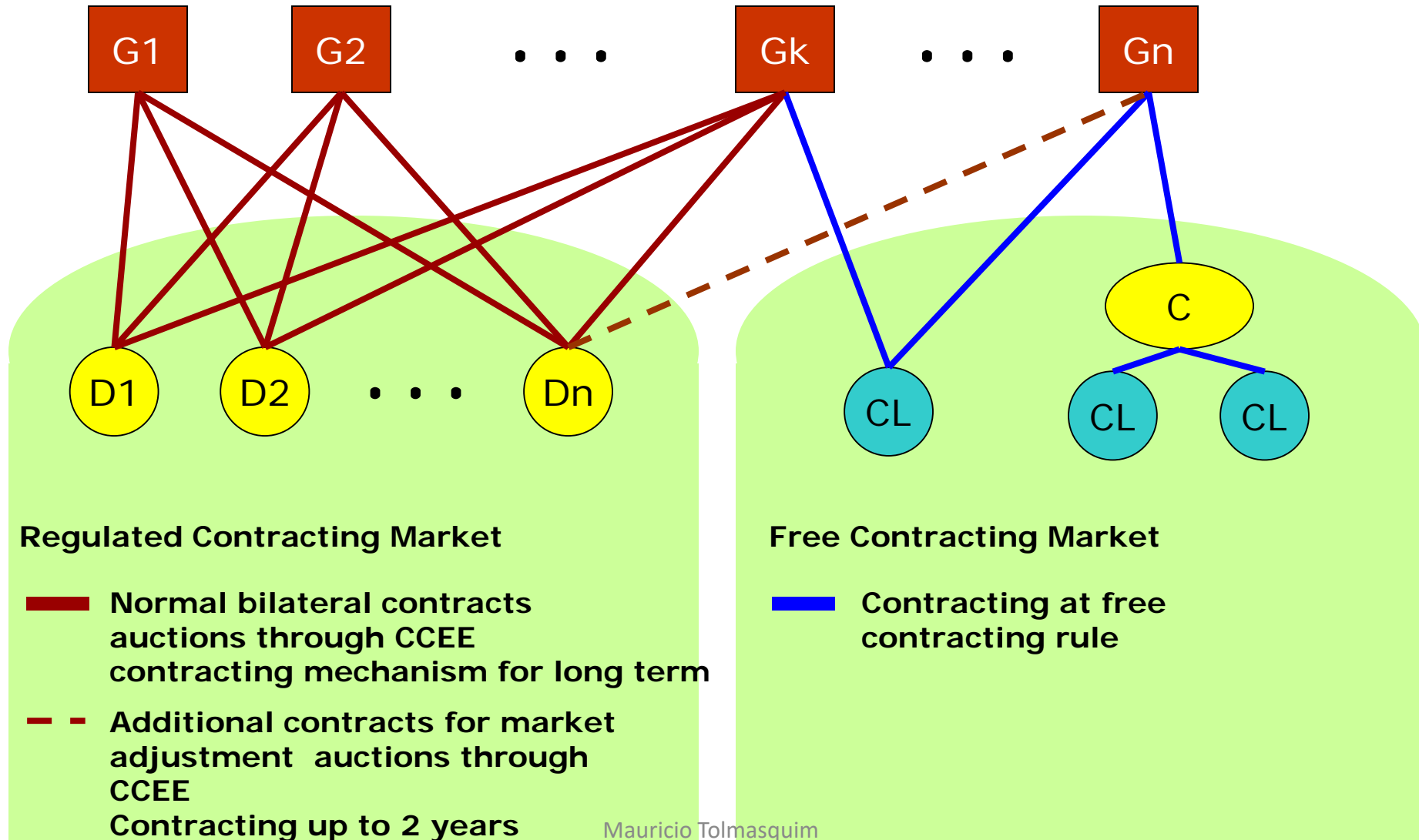
- Every load in the system (Discos and Free Consumers) must be 100% supplied by a financial energy supply contract.
- Every energy financial contract must be backed up by Firm Energy Certificates (FEC).
 - Represent the energy (MWh/y) a power plant delivers for a given reliability level.
 - Sets the maximum volume a generator can sell in energy contracts
 - WIND FECs
 - *Based on P90 certified wind production (3 consecutive years)*
 - *Means that 90% of the year's output is expected to surpass this level*
 - SOLAR FECs
 - *Based on P50 certified solar production (1 year; after 2018: 3 consecutive years)*
 - *Means that half of the year's output is expected to surpass this level.*

Competition not in the spot market but in contracts (competition “for markets” instead of “within markets”).

- Regulated auctions as tool for the induction of efficient purchase for regulated consumers.

WHOLESALE COMPETITION

Generators must contract with all distributors,
in proportion to their energy needs



NEW ENERGY AUCTIONS

	Regular New Energy Auction (A-3, A-5)	Reserve Auction
Main Goal	Ensure adequate Energy Expansion.	Increase system's reserve margin, by contracting energy "in addition" to the energy procured in the new energy auctions
Lead Time	Two kinds: A-5 (5 years); A-3 (3 years)	Usually, 3 years
Periodicity	Twice per year	Sporadically at the government discretion (Every year since 2008)
Demand	Volume declared by the Distribution Companies, which are pooled (not publicly disclosed before the auction)	Volume determined by the Government (not publicly disclosed before the auction)
Who sign the PPA	Distribution Companies	Electricity Trading Chamber (CCEE) representing the consumers
Procurement Process	Centralized but not a "single buyer" model. (Government does not interfere in contracts or gives guarantees)	Centralized but not a "single buyer" model. (CCEE is not liable for the default risk)
Who pay	Consumers of the Regulated Market (tariff)	All the Consumers (Tariff Surcharge)
Supply Specification	Technological neutral, Technological Specific, Location Specific	Technological Specific
Spot Market	The difference between the contracted and the produced or consumed amount is settled on the spot market by the consumer	All the energy produced is settled on the spot market by CCEE

QUALIFICATION CRITERIA

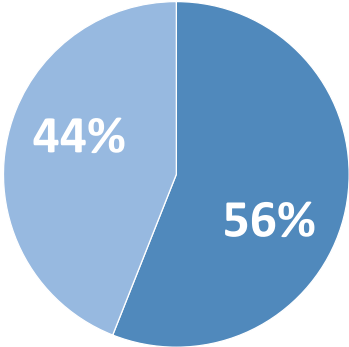
MAIN TECHNICAL REQUIREMENTS FOR PARTICIPATION

TYPE	ANEEL REGISTRY	PRIOR ENVIRONMENTAL LICENSE	ELECTRICAL CONNECTION INFORMATION	ENERGY PRODUCTION CERTIFICATE	LAND USE CONTRACT	FUEL SUPPLY CONTRACT OR TERM OF COMMITMENT	WATER USE GRANT
HYDROPOWER PLANT (HPP and Small Hydro)	X	X	X				X
THERMAL POWER PLANT (BIOMASS and FOSSIL)	X	X	X		X	X	X
WIND POWER PLANT	X	X	X	X	X		
SOLAR PV PLANT	X	X	X	X	X		

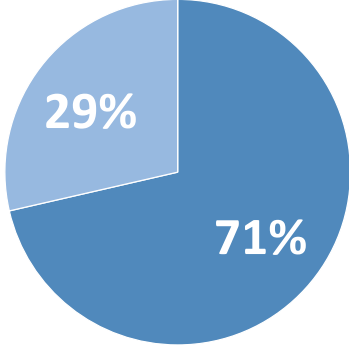
Source: EPE

PROJECTS QUALIFIED TO PARTICIPATE OF THE AUCTION

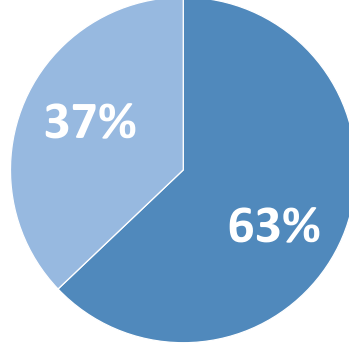
2011



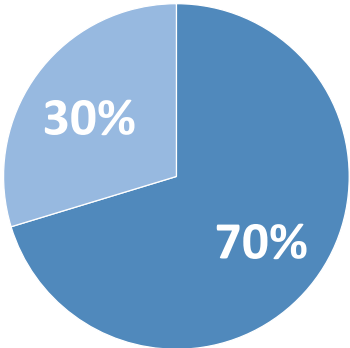
2012



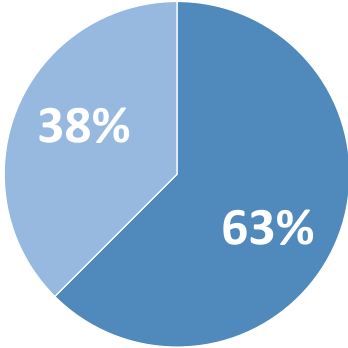
2013



2014



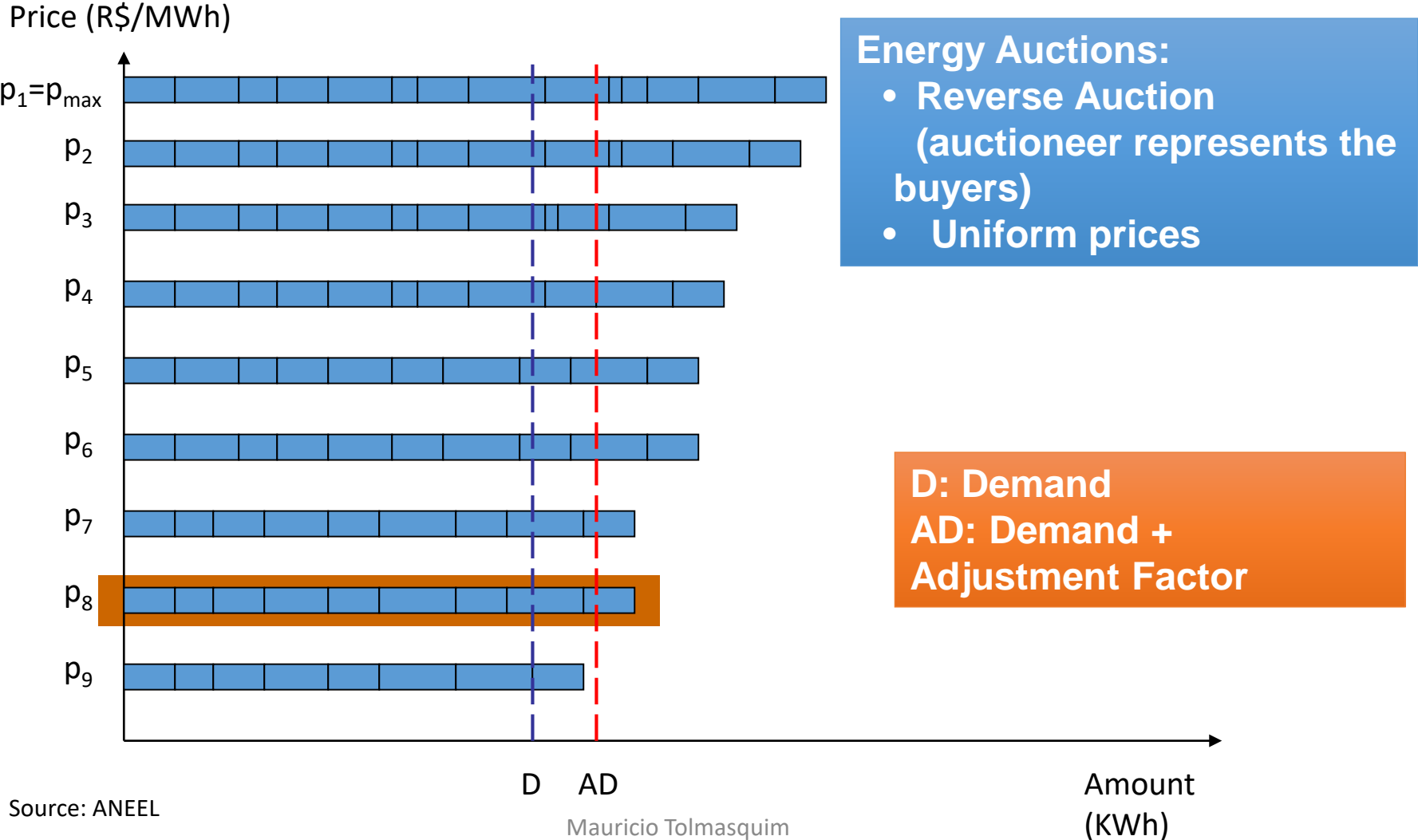
2015



* Number of Projects

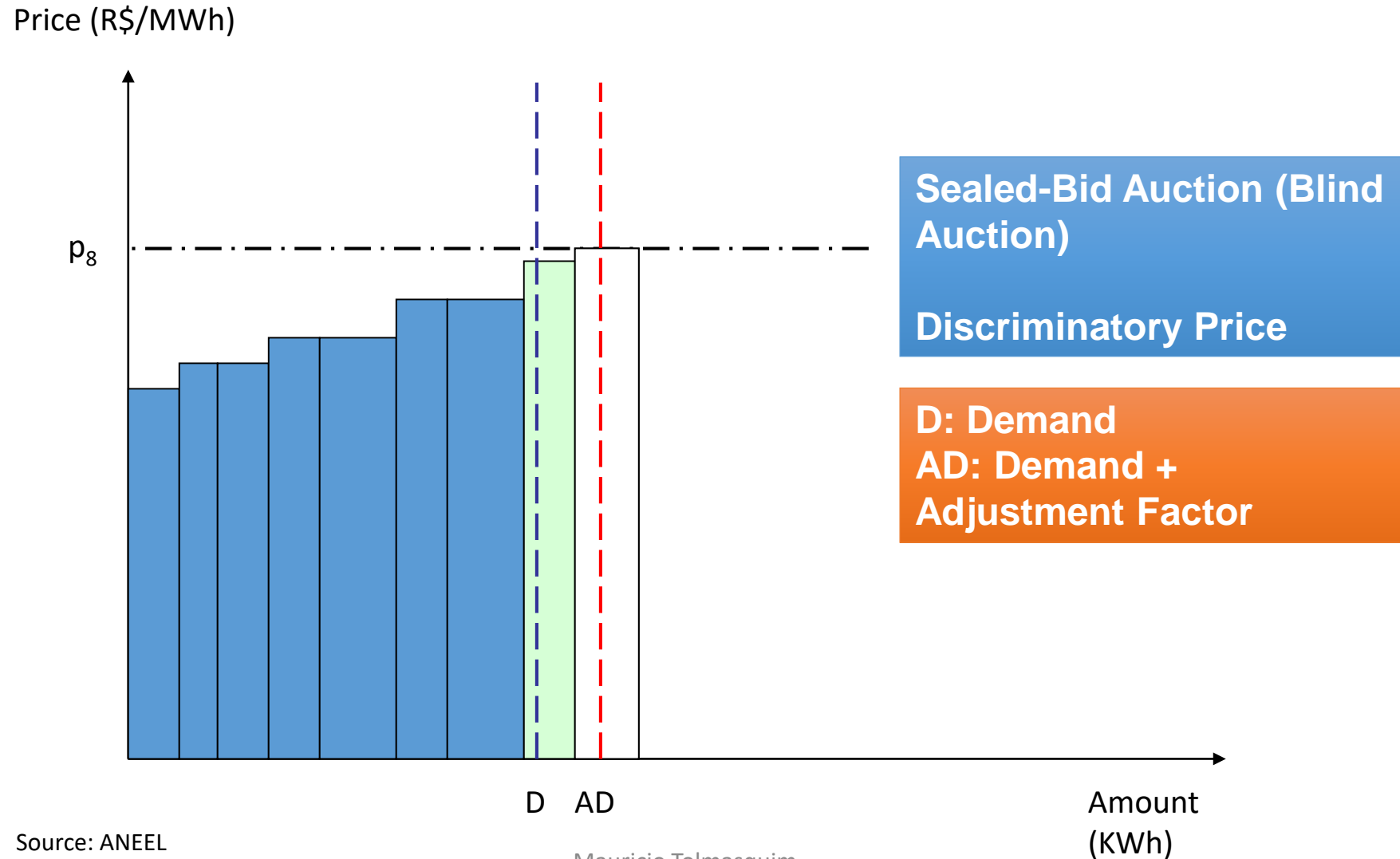
WINNER SELECTION PROCESS (HYBRID SYSTEM)

FIRST PHASE: UNIFORM-PRICE AUCTION (Dutch Auction or Clock Auction)



WINNER SELECTION PROCESS: HYBRID SYSTEM

SECOND PHASE: PAY-AS-BID AUCTION



WINNER SELECTION PROCESS

PRICES IN THE FIRST AND SECOND PHASE OF BRAZILIAN AUCTIONS

Auction ^{1,2}	LER 2009	LFA 2010	LER 2010	A-3 2011	LER 2011	LER 2014
Renewable energy source	Wind	Wind, biomass ³	Wind	Wind, biomass	Wind, biomass	Solar
Total volume contracted (MW)	753	666	255.1	468	460	202
Final price in the first phase (descending clock) – USD/MWh	77.6	69.8	63.6	52.5	51.5	110.5
Maximum winning price in the auction (after second phase) – USD/MWh	76.5	69.0	63.1	52.4	51.0	110.4
Minimum winning price in the auction (after second phase) – USD/MWh	65.5	65.3	60.5	48.2	47.5	100.4

¹ Brazilian auctions are named A-5 and A-3, meaning that the lead time is five and three years, respectively, for the winning projects. LER and LFA are the Portuguese abbreviations for Reserve Energy Auction and Alternative Sources Auction (renewable energy sources), respectively.

² Prices in Brazilian reais were converted to US dollars using a fixed exchange rate of 2 BRL/USD for all values in this table. However, the market exchange rate was approximately 1.7 BRL/USD during 2009-2011 and 2.2 BRL/USD during 2014.

³ In LFA 2010, A-3 2011 and LER 2011 wind and biomass competed with each other and the prices represent the results of the whole auction, they are not per technology.

Source: IRENE

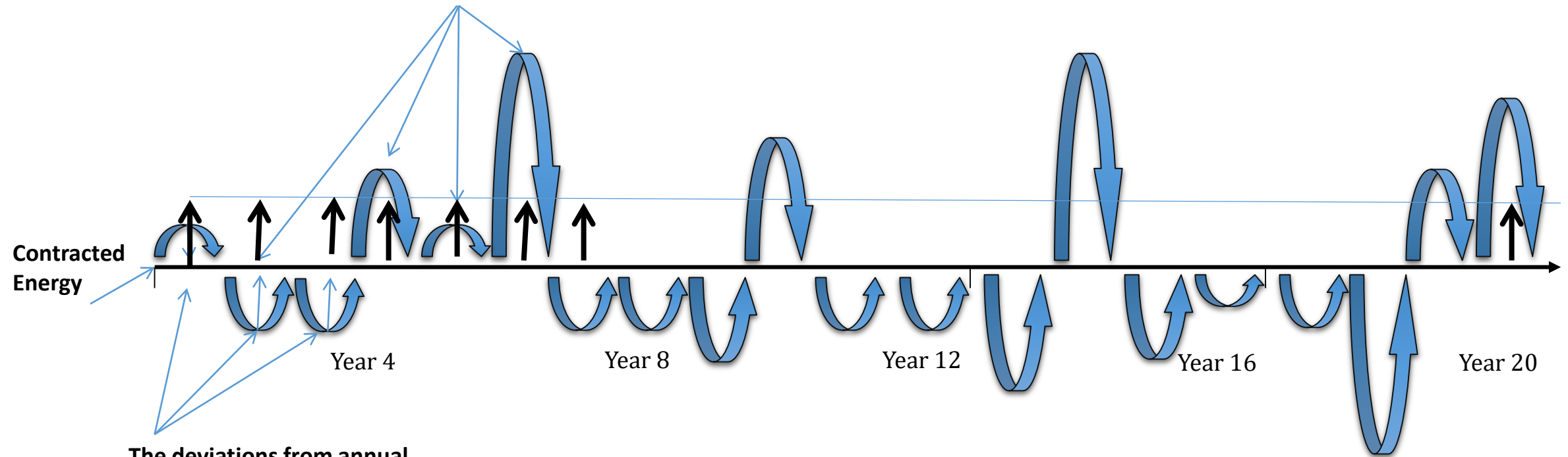
SELLERS LIABILITIES: COMMITTEMENTS, CONTRACT SCHEDULE AND FINANTIAL RISKS

- **COMMITMENT TO PARTICIPATE OF THE AUCTION**
 - Bidders are required to deposit a bid bond equal to 1% of the investment value
- **CONTRACT DURATION**
 - 20 -30 years
- **POST-CONTRACT PROVISIONS**
 - HYDRO: The plant is transferred to the government after contract's end date
 - OTHERS PLANTS: Investors maintain ownership of the generation assets after contracts end date
- **MITIGATION OF INFLATION RISKS**
 - Contracts are adjusted yearly for domestic price inflation
- **NO MITIGATION OF CURRENCY EXCHANGE RISKS**
 - Contracts are nominated in Reals (national currency)

RESERVE AUCTION: WIND*

FIXED INCOME, UNDEPERPERFORMANCE PENALTIES AND OVER PERFORMANCE COMPENSATION

Annual Energy Generation



The deviations from annual production in relation to the contractual obligation will be settle at fix prices.

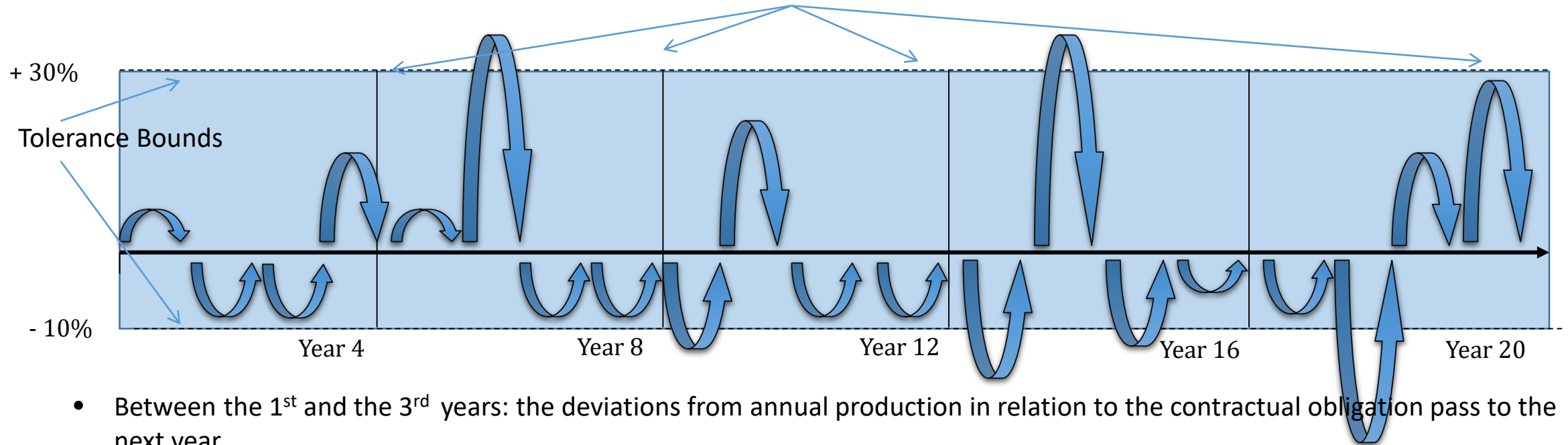
Fixed income to cover the operational and maintenance costs of the plant, and the return of the investment

* Solar has similar contracts with different tolerance bounds

RESERVE AUCTION: WIND

FIXED INCOME, UNDEPERFORMANCE PENALTIES AND OVER PERFORMANCE COMPENSATION

Inside the tolerance bounds the deviations from annual production can be offset by the generation from the previous year

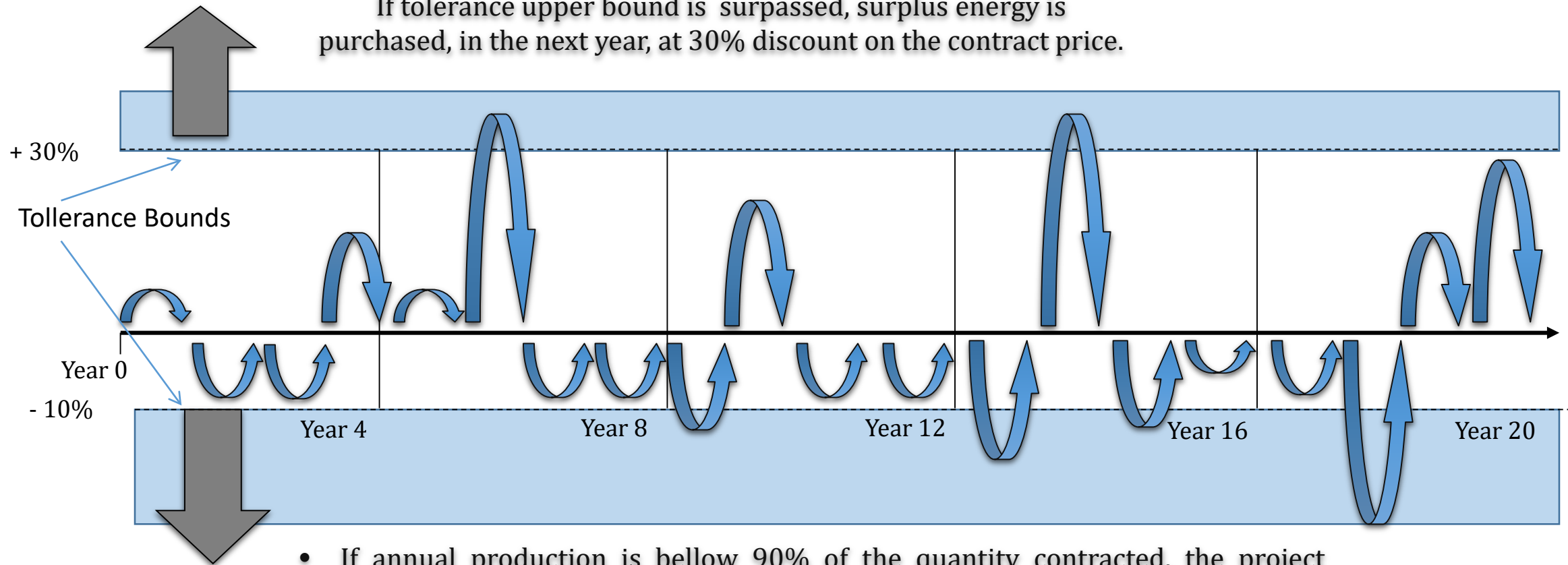


- Between the 1st and the 3rd years: the deviations from annual production in relation to the contractual obligation pass to the next year.
- In 4th year:
 - The surplus can be passed on to the next four years, or by the entrepreneur choice, evaluated at the value of contract
 - The deficit will be evaluated at a 6% premium over the contract price and paid in the next year

RESERVE AUCTION: WIND

FIXED INCOME, UNDEPERPERFORMANCE PENALTIES AND OVER PERFORMANCE COMPENSATION

If tolerance upper bound is surpassed, surplus energy is purchased, in the next year, at 30% discount on the contract price.



- If annual production is below 90% of the quantity contracted, the project developer has to refund, in the next year, the difference at a 15% premium over the contract price.

RESERVE AUCTION: SALES REVENUE

Sales revenue		Characteristics
Fixed Income		Fixed amount to cover the operational and maintenance costs of the plant, and the return of the investment
Variable Income (over performance compensation*)	Surplus between 100% and 130% in the 40 year	Amount generated in excess valued at contract price
	Surplus bigger than 130%:	Amount generated in excess valued at 30% discount on the contract price
Refund (underperformance penalties*)	Quadrennial: Deficit between 90% and 100%	the quantity not delivery valued at 106% of the contract price
	Annual generation inferior to 90%	Quantity not delivery valued at 15% premium of the contract price (the generator must "buy back")

* Plants with energy contracts from the same auction may negotiate their deficits and surpluses to avoid penalties in the 4-year settlement

AUCTION PROCESS OVERVIEW



LIABILITIES FOR TRANSMISSION DELAY

IN THE PAST:

- The Energy Planning Agency used the location and size of the winners of the wind energy auction to plan the lines
- The lines were put in auction
- However, in many cases: generation facilities was ready to operate, but the transmission capacity reinforcement were not ready
- The risk of such transmission constrains were allocated to the buyers

EVOLUTION OF GRID ACCESS:

- The Energy Planning Agency seeks to plan the transmission grid before the auction.
- Auction: the maximum generation capacity to be contract at any given transmission substation was limited by the capacity that could be drained by the network.
- Fully allocated the risks of the unavailability of transmission capacity to the seller.

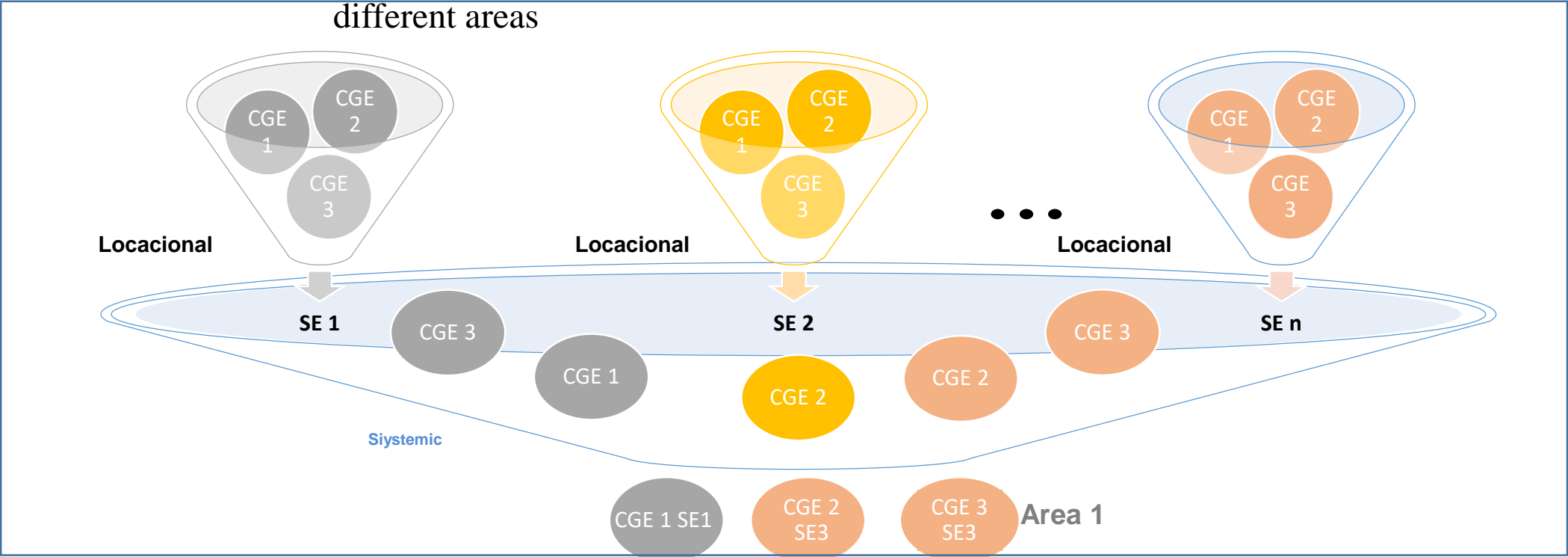
EVOLUTION OF GRID ACCESS: INTRODUCTION OF A PRELIMINARY PHASE

Preliminary Phase: auction to select projects that can participate of the first traditional auction (Analysis in two steps)

Locacional – take in account the idle capacity of transformers and transmission lines.

Systemic – take in account the capacity that can be drained by the transmission network between

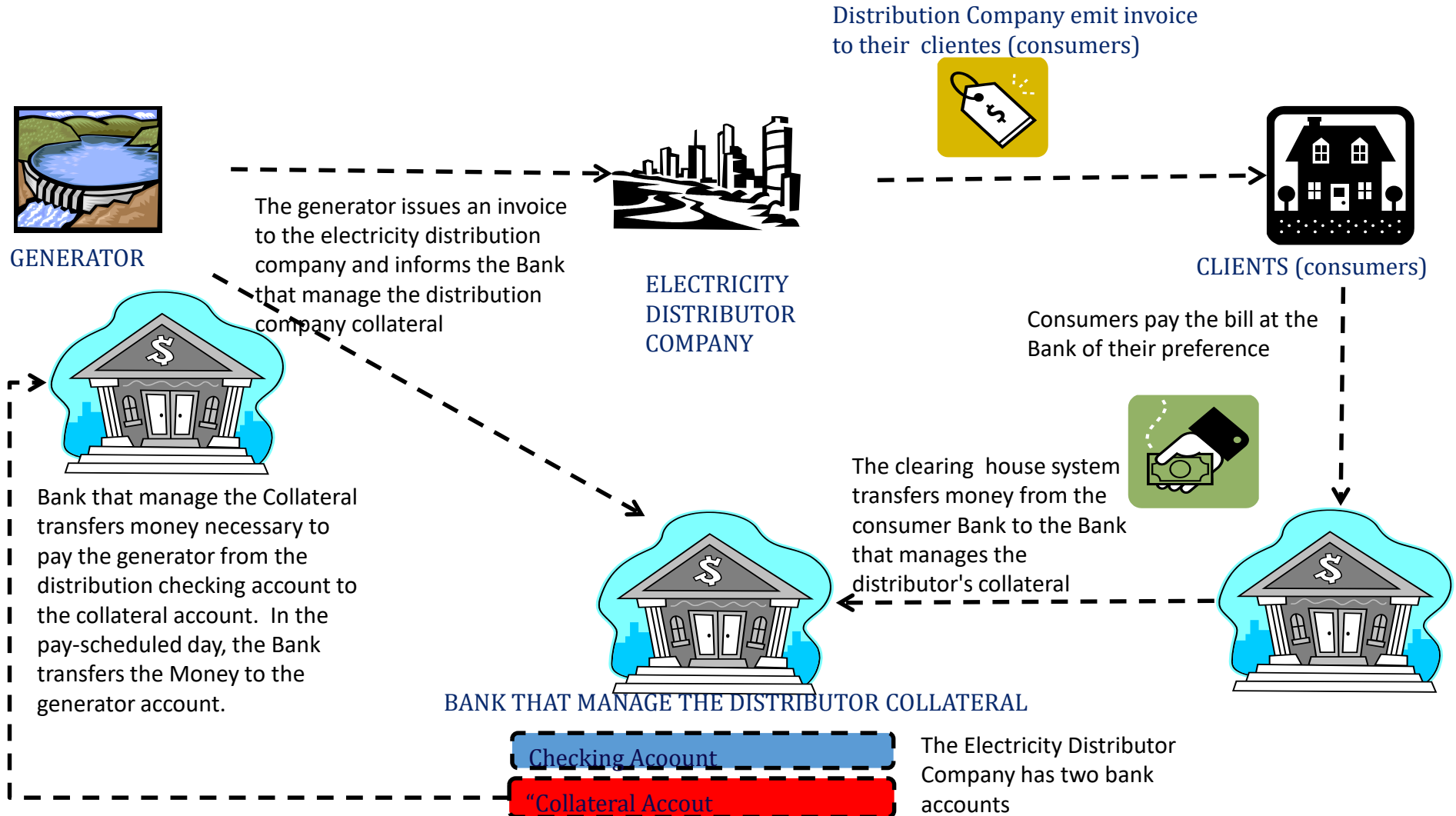
different areas



HOW TO GUARANTEE THE NEW PROJECTS WILL BE BUILT?

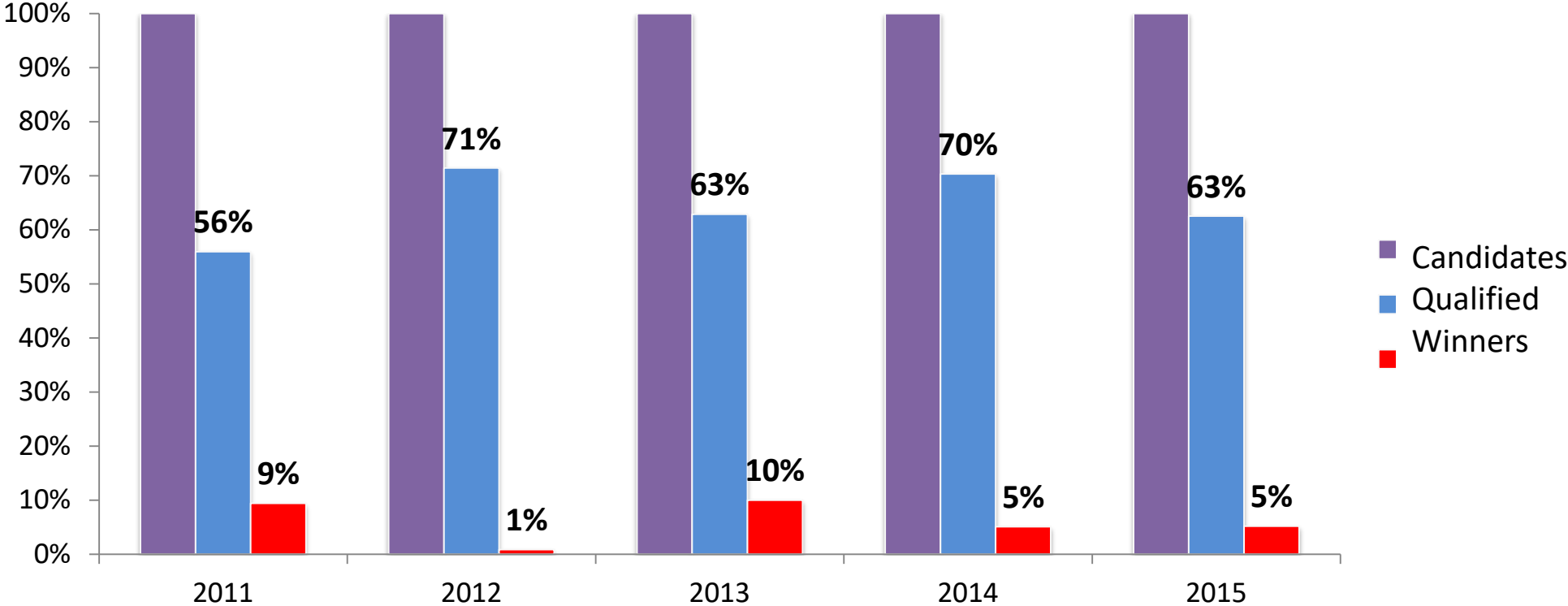
- The qualification process
- Penalties in case of delay in plant operation:
 - Long delay
 - Execution of the completion Bond (5% of the estimated investment)
 - Contract termination by regulator if project is severely delayed.
 - Short delay (between 6 months and 1 year)
 - Reserve Auctions:
 - The generator's contract revenue is delayed until the plant start to operate
 - Seller can only buy energy from plants contracted in the same auction to compensate for its unmet obligations.
 - Regular Auctions:
 - Seller must procure contracts in the market to meet its obligations, even if the plant is operational but not the connection to the grid
 - Contract payment is reduced by at least 15% (delays bigger than 3 month)

DEFAULT RISK MITIGATION



AUCTION PERFORMANCE

PROJECTS: CANDIDATES, QUALIFIED AND WINNERS



Source: EPE

POWER AUCTIONS RESULTS

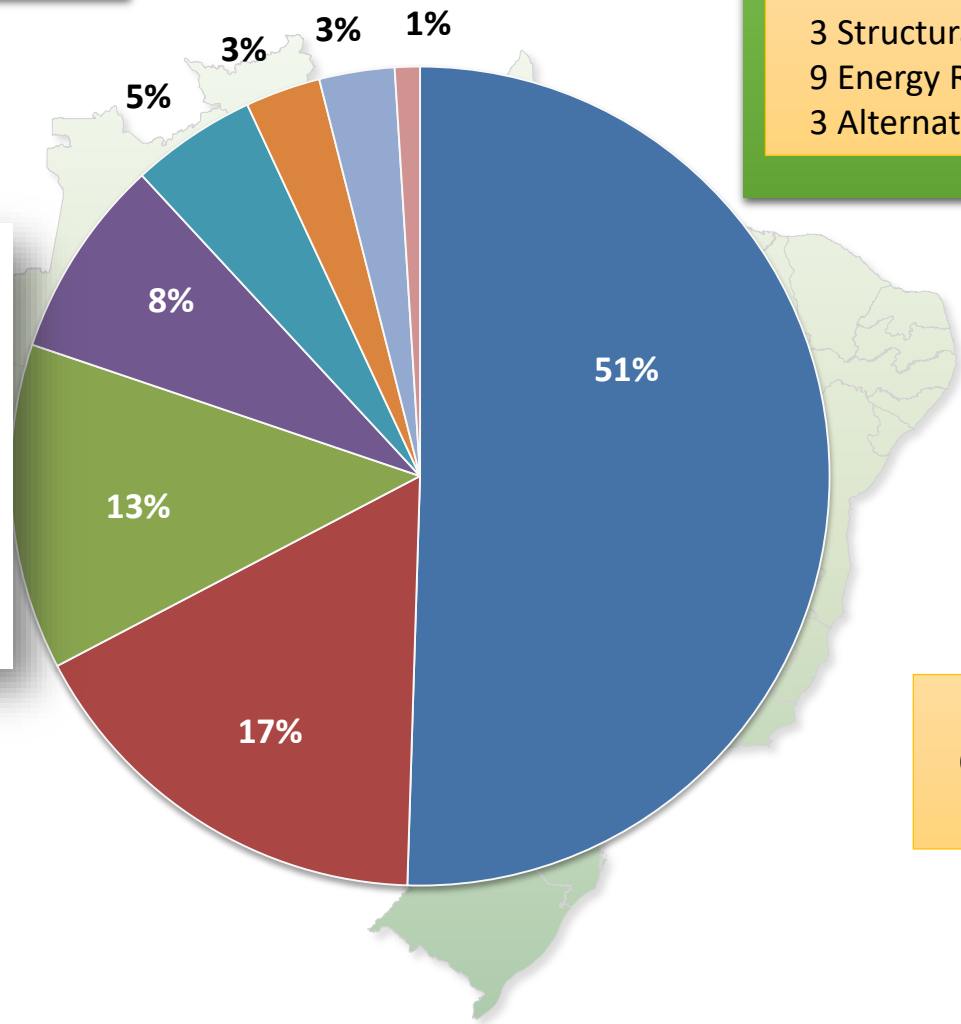
2005 - 2016

TOTAL
1,040 PLANTS – 84,650 MW

34 AUCTIONS

- 21 New Energy Auctions
- 3 Structural Projects Auction
- 9 Energy Reserve Auction
- 3 Alternative Source Energy Auction

- Hydro (large and small)
- Wind
- Natural Gas
- Biomass
- Fuel Oil and Diesel
- Coal
- PV
- Cogeneration

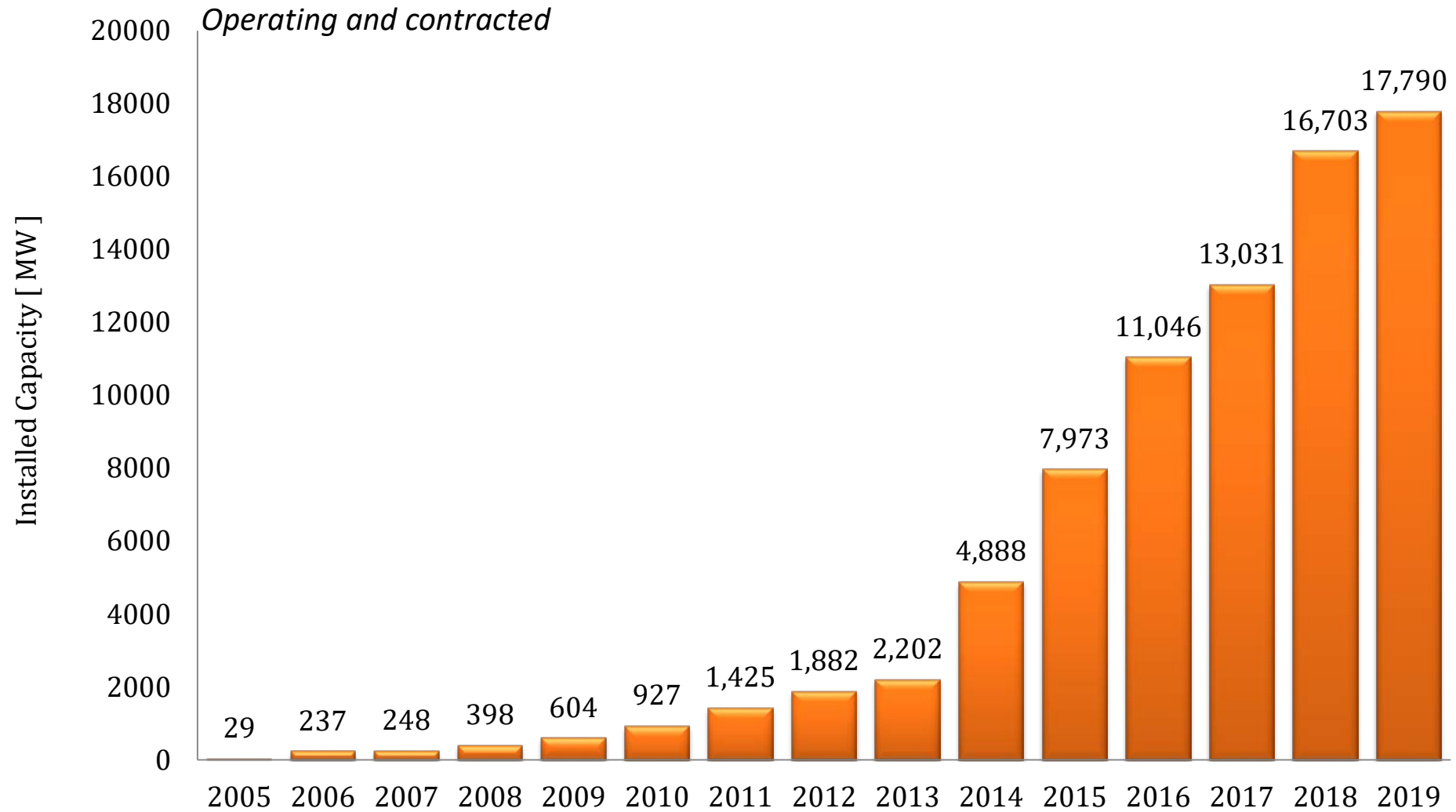


RENEWABLE SOURCES
CONTRACTED 59,843 MW
[79%]

Source: EPE

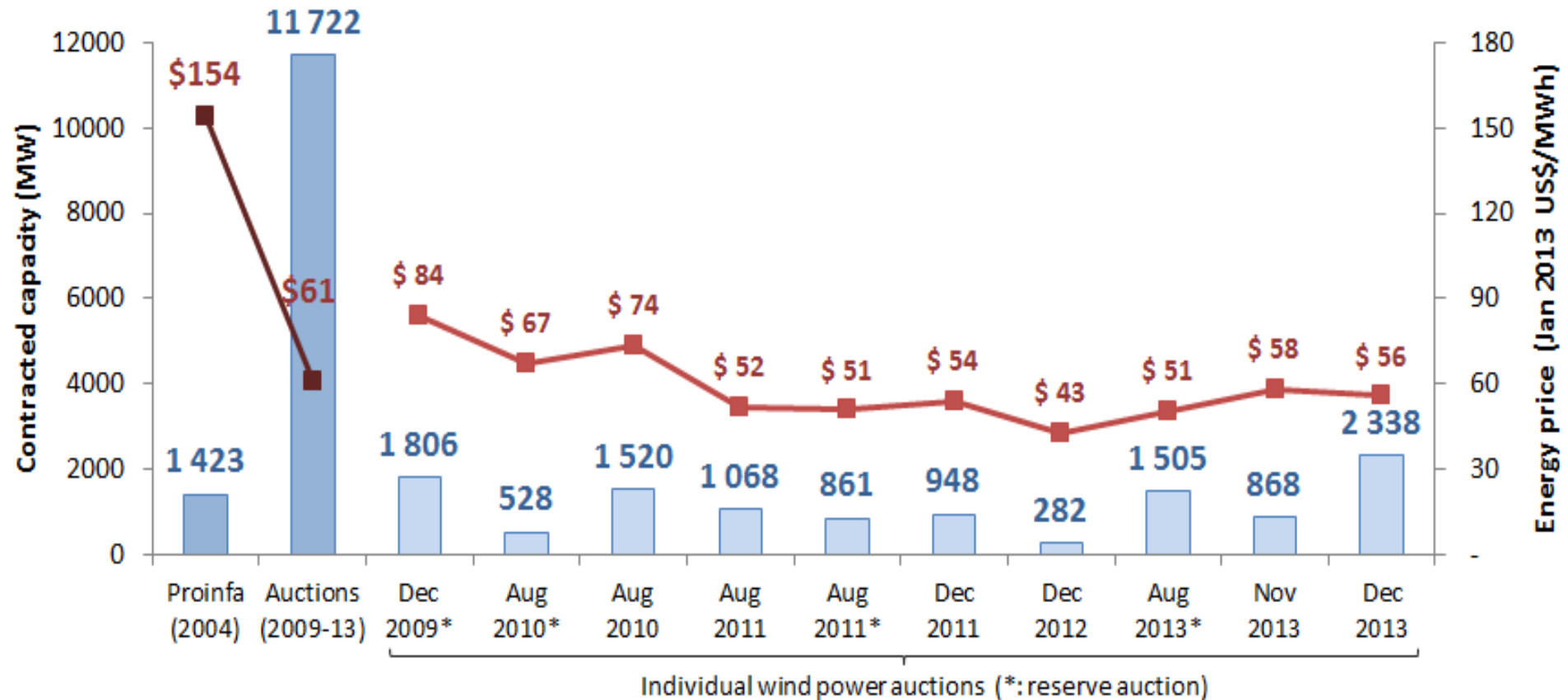
Mauricio Tolmasquim

WIND POWER DEVELOPING IN BRAZIL



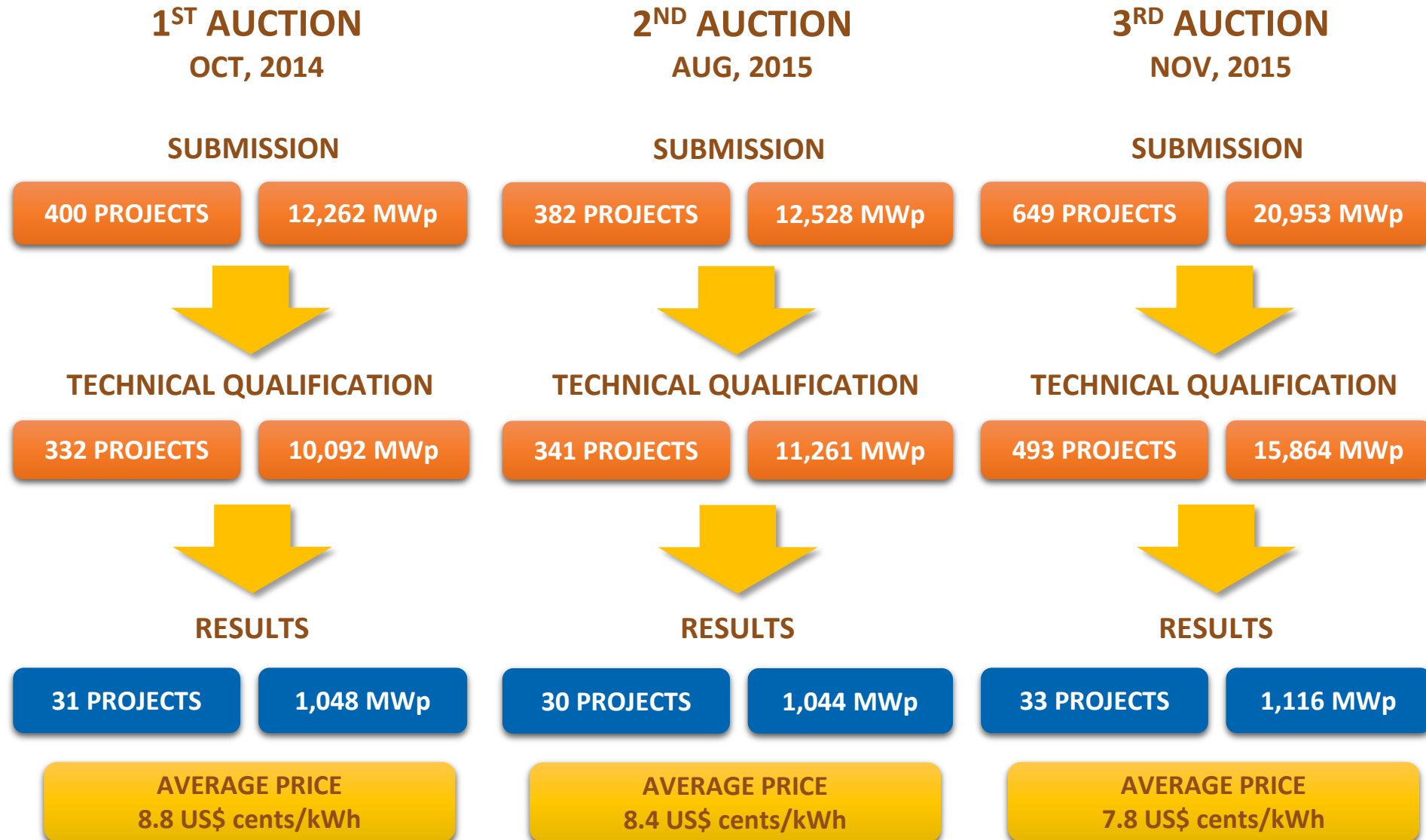
Sources: ANEEL and EPE

Highlight on auctions involving wind power: Contracted amount and prices



Source: World Bank

SOLAR POWER AUCTIONS IN BRAZIL



LESSONS AND RECOMMENDATIONS

➤ **Sector reform**

- has unlocked much needed private sector investment.
- has address sector bottlenecks and meet power demand growth.

➤ **Long term agreements**

- boosted the financing available for the generation expansion
- represented more stable flows of receivables for investors and less exposure on the short term market.

➤ **Auctions**

- have established a credible market mechanism for the allocation of energy contracts.
- represent a transparent, competitive and efficient form of procuring electricity.
- provided a solution to the regulatory challenge of defining what “prudent” costs of generation should be passed on to end-use customers.
- An effective auction depends on the existence of competition.

LESSONS AND RECOMMENDATIONS

- **Key Factors for Successes:**
 - **Institutional capability and coordination**, in order to handle the complexities of the auctions process
 - **Regulatory stability**, in order to attract investors to participate in competitive auctions
 - **Qualification Process**: too easy qualification norm increases risk of non-compliance; draconian procedures can reduce the competition
 - **Criterion to set the maximum volume a plant can sell in a energy contract**, avoiding overestimation of capacity factors
 - **Risk allocation**: balance between under performance penalty and over performance premium
 - **Coordination with transmission planning**, in other to avoid transmissions constraints

Thank you

mauricio_tolmasquim@hks.harvard.edu

tolmasquim@gmail.com