



# The challenge of conciliating security of electricity supply and economic signals: the Brazilian case

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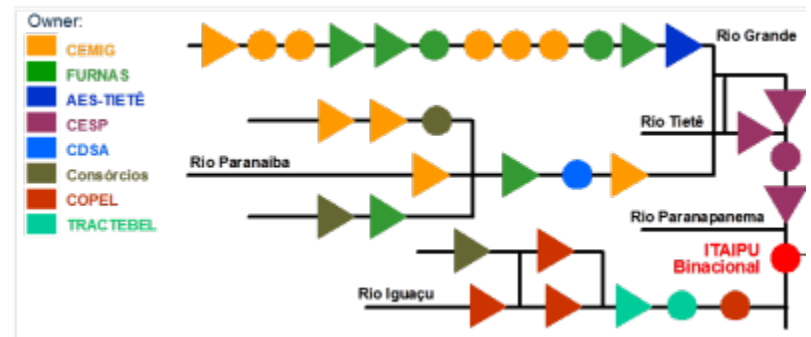
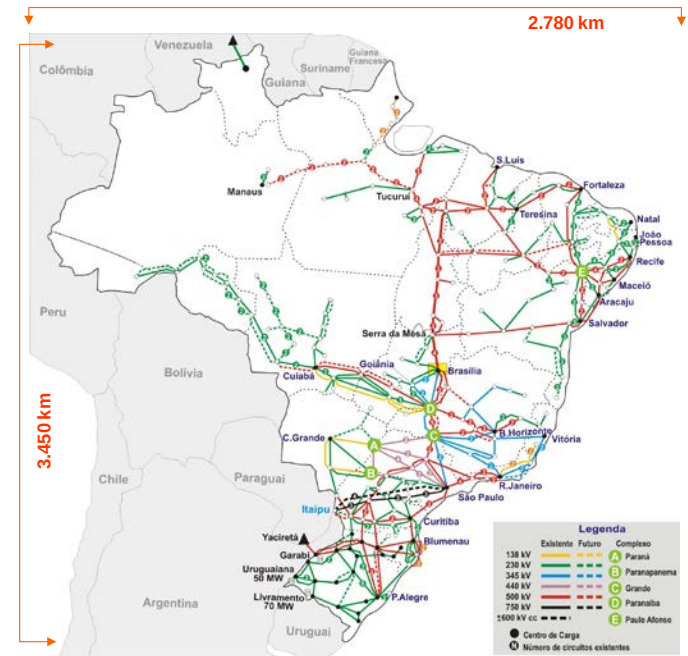
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On behalf of Brazilian C5 committee



# Context: the Brazilian power system

- Surface area: continental US + ½ Alaska
- Population: 201 million
- GDP: US\$ 2,2 trillion (6<sup>th</sup> largest economy)
- 130,000 MW installed capacity
  - 67% hydro, large reservoirs
  - Cascaded hydro system with multiple ownership
- Peak load: 85,000 MW
- 463 TWh/y consumption
- Free consumers: 27% of load
- 106,000 km of HV network
  - 6,000 buses
  - 9,000 circuits





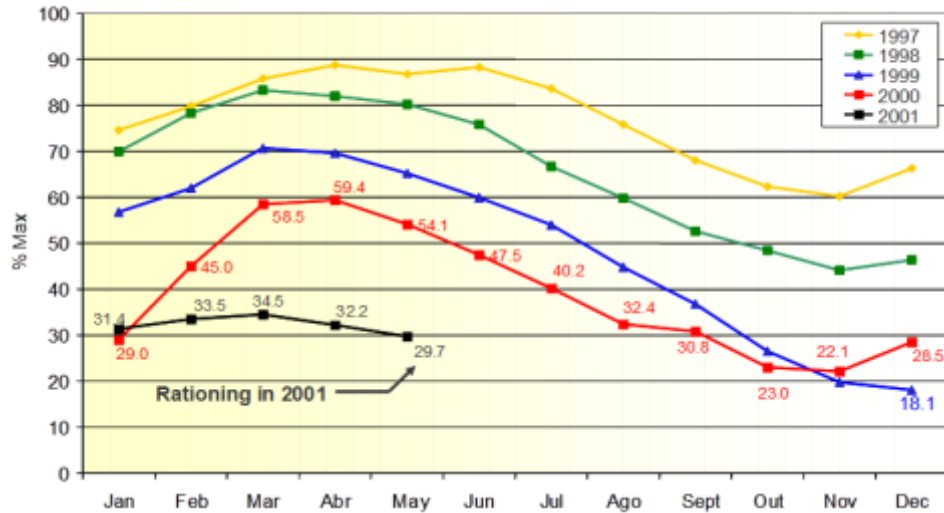
# Context: the Brazilian power “market”

- Generation: wholesale competition
  - Centralized & cost-based dispatch of generation and transmission resources
  - Hydrothermal coordination via computational models
    - Stochastic dual DP used (risk neutral approach firstly used), software and data are public
    - Short-run marginal costs, set by the computational model used as “energy spot prices”
- Consumption: free and regulated consumers
  - Free consumers: source power in a market (bilateral contracting)
  - Captive consumers: load serving entities (LSE) source power on their behalf
    - LSE regulated by RPI-X regulation
    - Retail tariffs readjusted once a year, reviewed every 4-5 years
- Primary “market” objective is to ensure expansion of generation capacity: trading environment centered in a contract market
  - Energy-only market + obligation of consumers to contract
  - Contracts are financial instruments, but require physical coverage

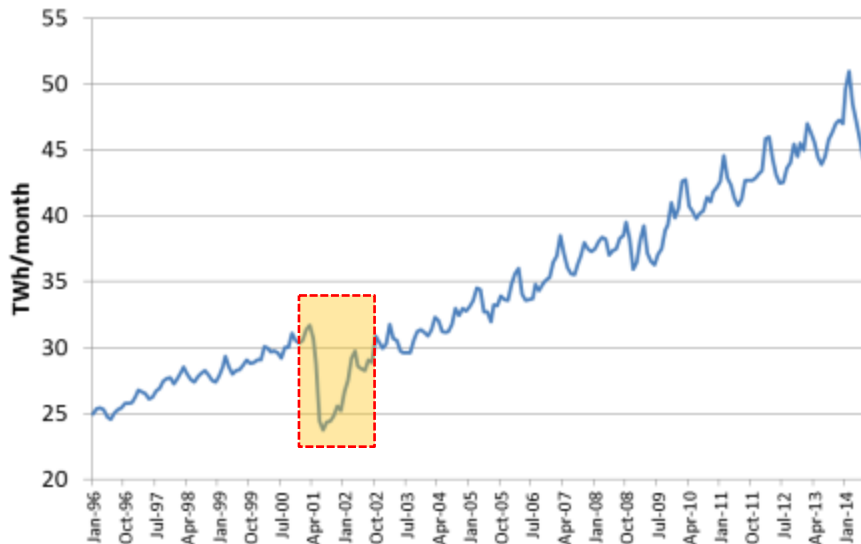


# Driving Event “-1”

Southeast region – Brazil – Stored Energy (%max)



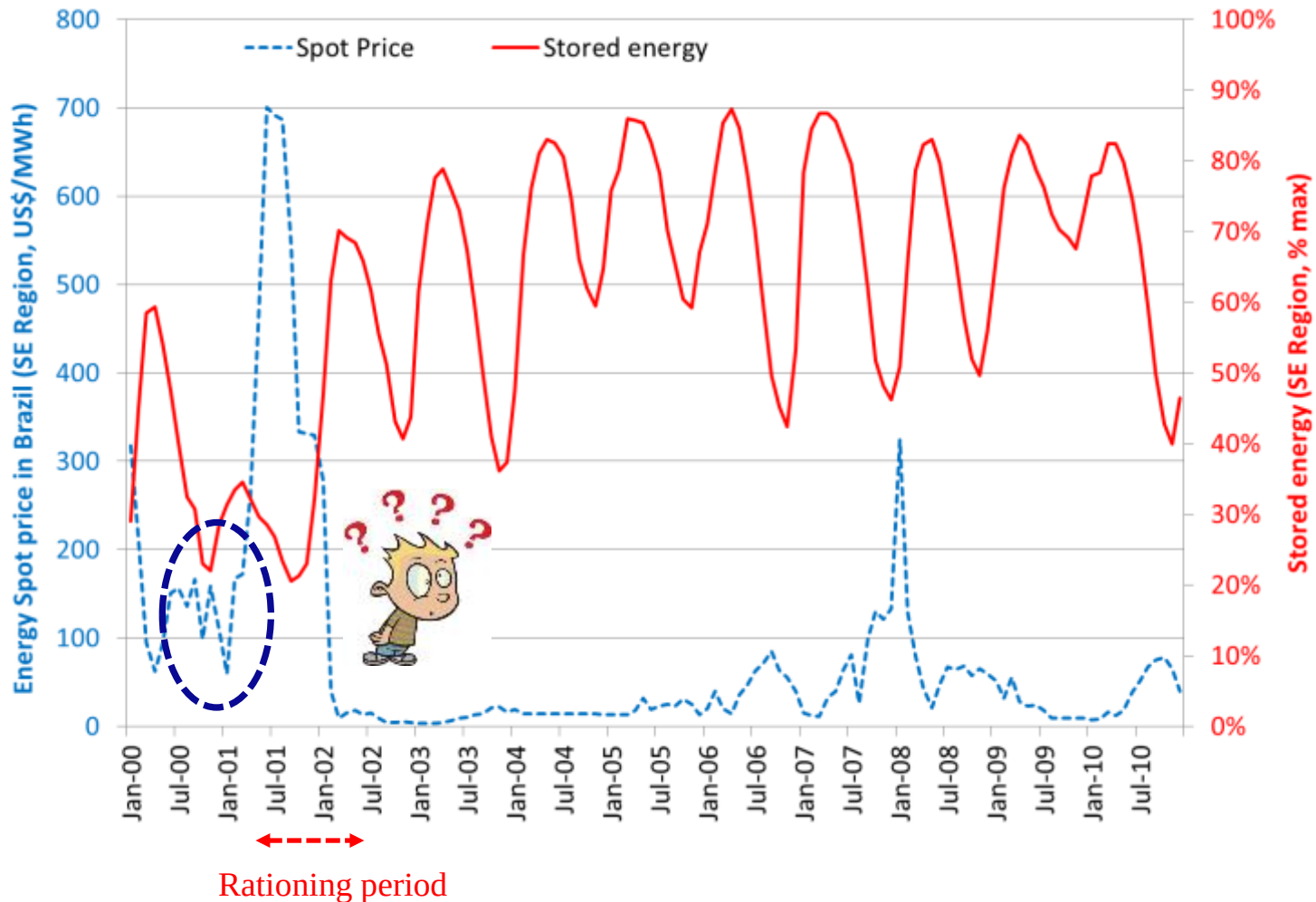
Source: ONS



- June 2001- Feb 2002: energy rationing, affecting 80% of the country
- Political impact: government party lost 2002 presidential election
- Implemented via a quota scheme with penalties/incentives for under/over consumption for all consumers
  - industrials could resell quotas in PX
- Load reduction of +20% for 9 months
- “price” responsiveness of all consumers



Spot prices **did not** respond before the rationing





## Outcome “-1”: evolution in the regulatory/market framework (1/2)

- System expansion/Security of supply (2004)
  - Organized “investment market” with emphasis on forward contracting to serve the regulated market, implemented
    - All contracts must have physical coverage
  - Discos must contract energy to serve 100% of their loads via auctions, organized by the government, who designs the procurement process
    - Separate auctions for existing and new energy, carried out ahead of delivery
    - +65,000 MW contracted since 2005 for delivery until 2018
  - Free market takes care of its own supply
- System surveillance (2004)
  - Establishing of a surveillance committee responsible for monitoring the system’s security of supply and reporting to the presidency

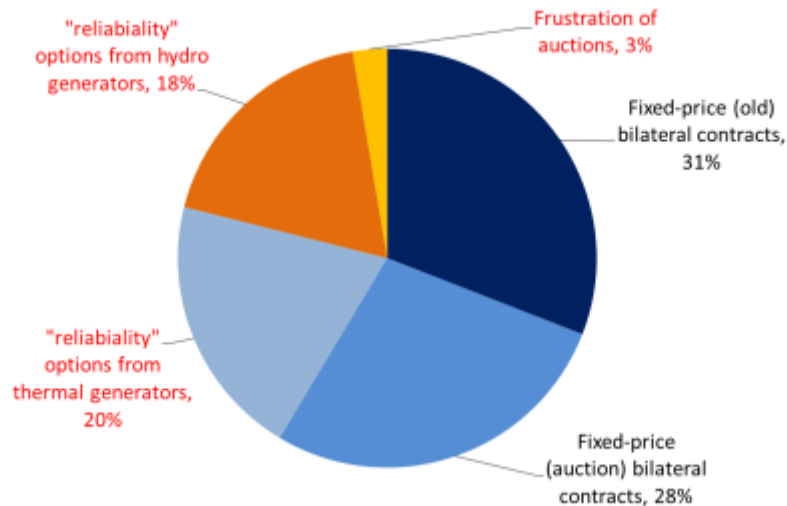


# Outcome “-1”: evolution in the regulatory/market framework (2/2)

- “Spot” price signals in a wholesale level
  - Risk aversion firstly introduced in the dispatch model (2002 - 2008)
    - Minimum monthly storage levels, constraints embedded in the dispatch model
    - Target storage levels at the end of dry season, reached via supplementary thermal dispatch
  - Scheme replaced by a fully integrated mechanism in 2013
    - Conditional-value-at-risk (CVaR) constraints in the hydroscheduling model to represent risk aversion in an integrated and coherent way
- Price signals in a retail level (captive customers)
  - Tariff flags: triggers that connect retail to wholesale prices in a monthly basis
    - Critical peaking price (CPP)-like mechanism
    - Retail tariffs increase according to spot prices: should begin in 2014, postponed to 2015
  - Time-of-use tariff: depends on smart meters roll-out, implementation delayed
- However, no formal market for demand-side products yet created

## Context: LSE contract portfolio

- A significant part of the load serving entities' contract portfolio costs is linked to the short-term price
  - Reliability options-type of contract supplied by hydro and thermal producers
  - Every “failed” contract auction exposes the LSE to spot prices
  - Outlook in 2014:



- Costs of these contracts vary in a monthly basis
- End-use tariffs are readjusted once a year
- The tariff flags are postponed



Brings cash flow **risk** to LSE and **disconnect** price signals to consumers



# Driving Event “1” (1/2)

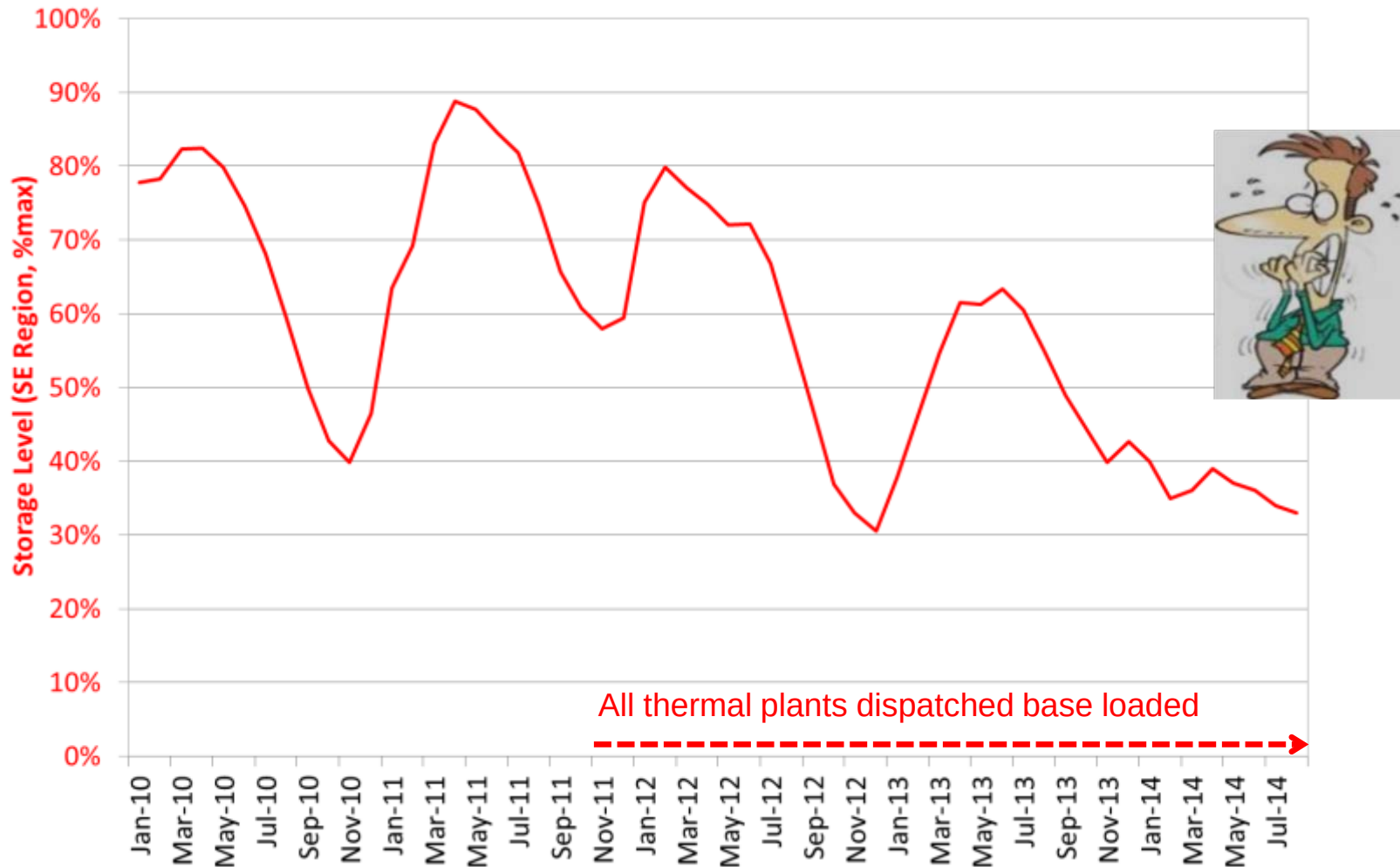
- Inflows have been below historical levels in the rainy season, in 2012 and 2014, in Northeast and Southeast/Midwest regions





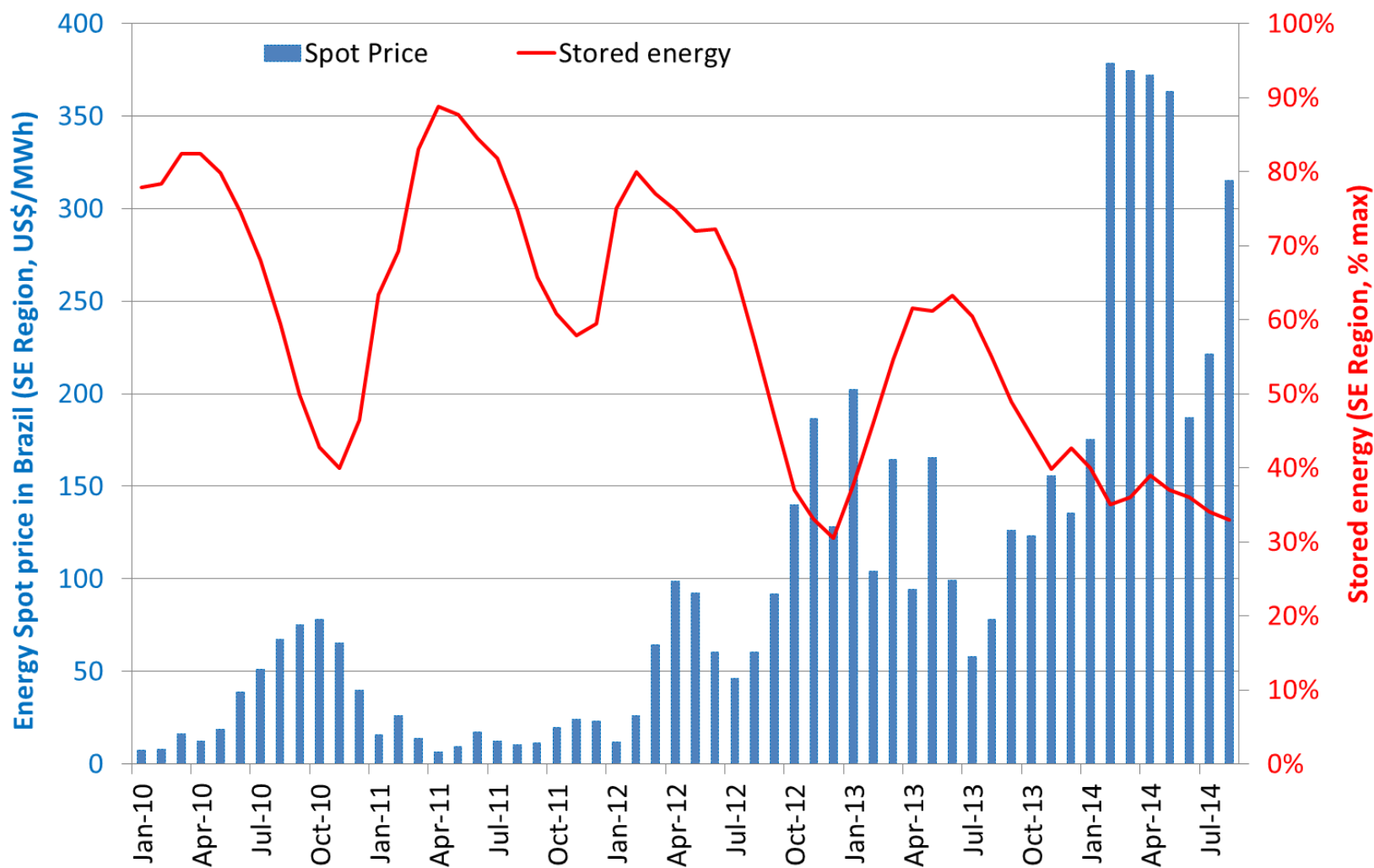
# Driving Event “1” (2/2)

- Recent evolution of hydro storage level



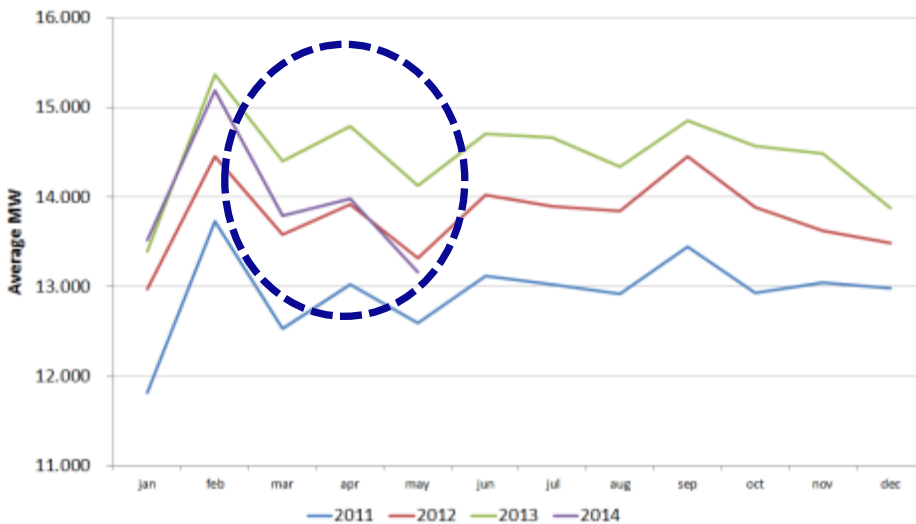


# Outcome: short term prices evolution



# Responding to prices: regulated market

Energy consumption - Free customers



Energy consumption - Captive customers



- The free market **has responded** to the price signal
- The captive market **has not** responded to the price signal (the captive market doesn't have signals of what is happening in the wholesale market)



## Outcome: tariffs becoming not cost reflective

- High short term prices are putting a lot of pressure on the costs of load serving entities
- Regulated tariffs have lost its cost reflectiveness
  - Part of the supply costs were assumed by the Federal Treasury
  - Another part has been financed via a loan from a pool of banks
  - All pass-through transferred to 2015
- Insufficient price signals to captive customers now
- Unhealthy mix between ratepayer x taxpayer x lack of economic signals



# Observations/ Lessons/ Opportunities

- What observations can be made?
  - Price signals can enhance market efficiency
  - The lack of price signals may adversely affect market efficiency
    - Captive customers “indifferent” to the market and security of supply conditions
    - 73% of the market is disconnected to the wholesale prices on frequent terms
- What were the lessons?
  - Price signals can also help the hydro scheduling process and avoid reservoir depletion: formal demand response mechanisms (yet absent) could be powerful tools



# Observations/ Lessons/ Opportunities

- What issues still exist?
  - Is it worthy to mix tax and rate payers as well as to implement other creative solutions in an attempt to avoid price hikes?
  - How much tariffs have to increase in order to recovery the cost reflectiveness? Will tariffs really increase or other solutions be devised (with a regulatory cost)?
- What challenges lie ahead?
  - What is the most effective way to send price signals to consumers? RTP? CPP? ToU tariffs?
  - Is sending price signals to retail customers a politically viable option?