EPOC WINTER WORKSHOP 2012

The Brazilian Electrical Energy Industry: An Overview

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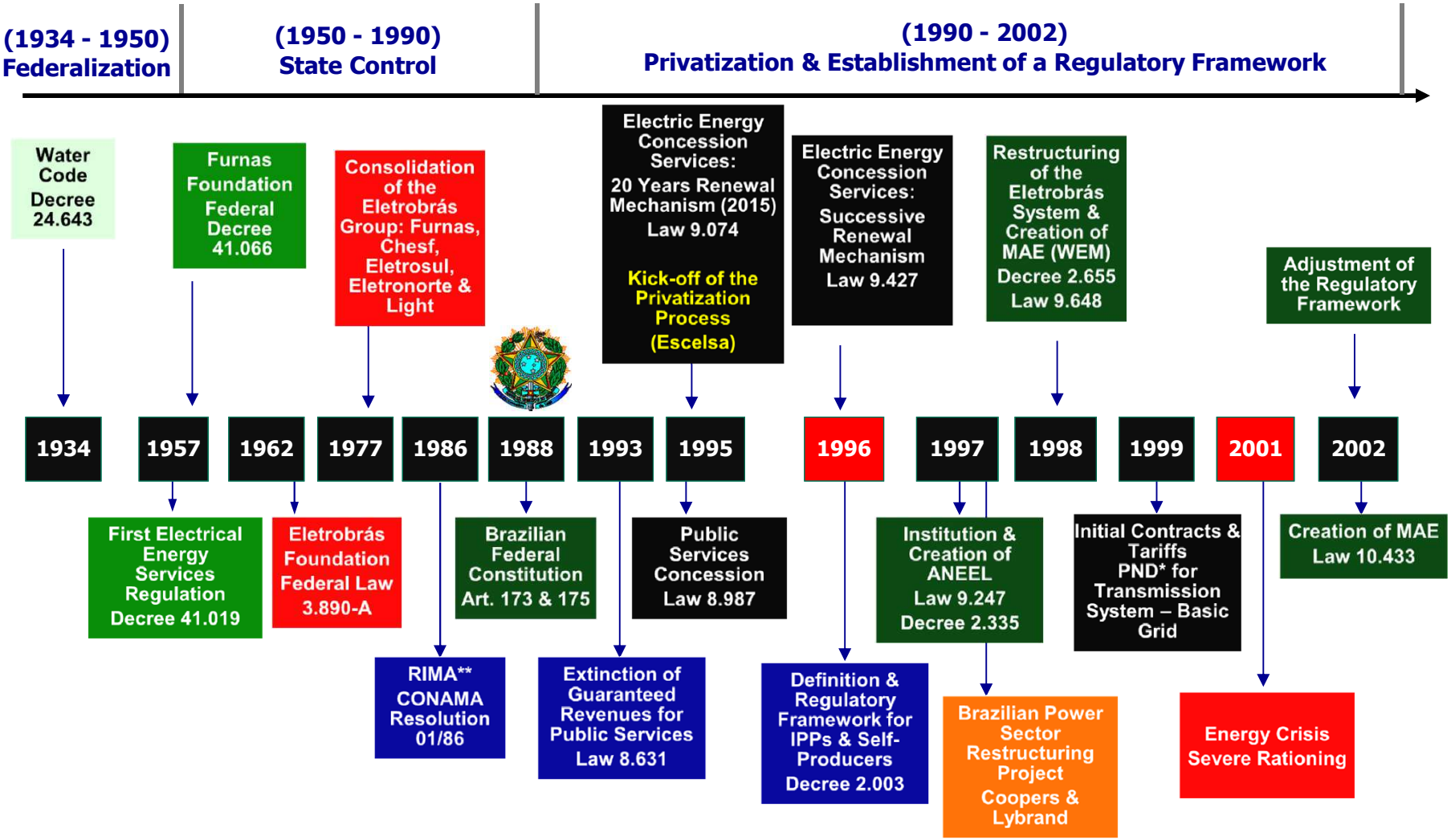
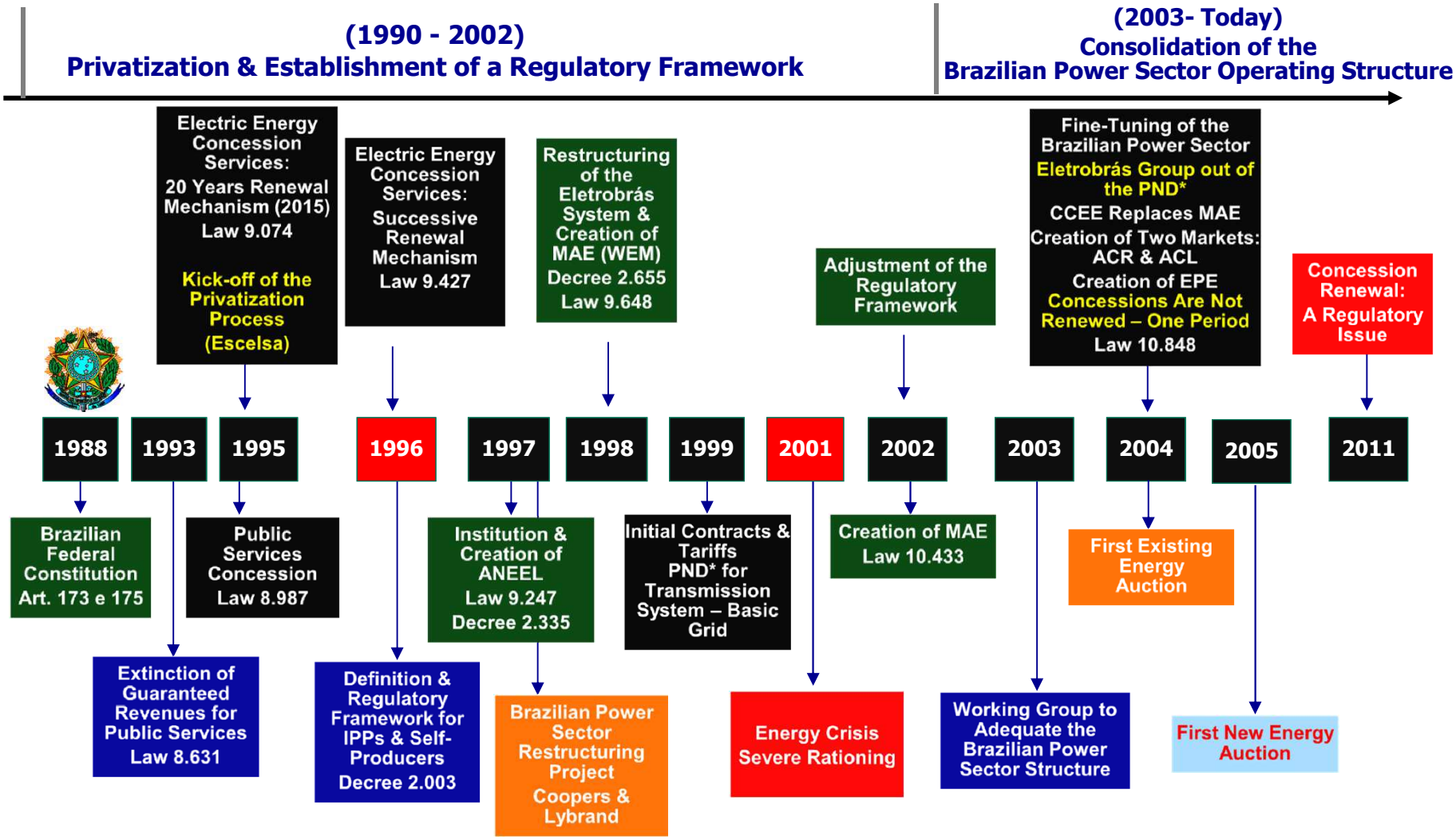
Content

- Brief history of the Brazilian regulatory framework
- Basic characteristics of the Brazilian System
- Dispatch of the system
- The spot price
- The market model
- Some work by our research group

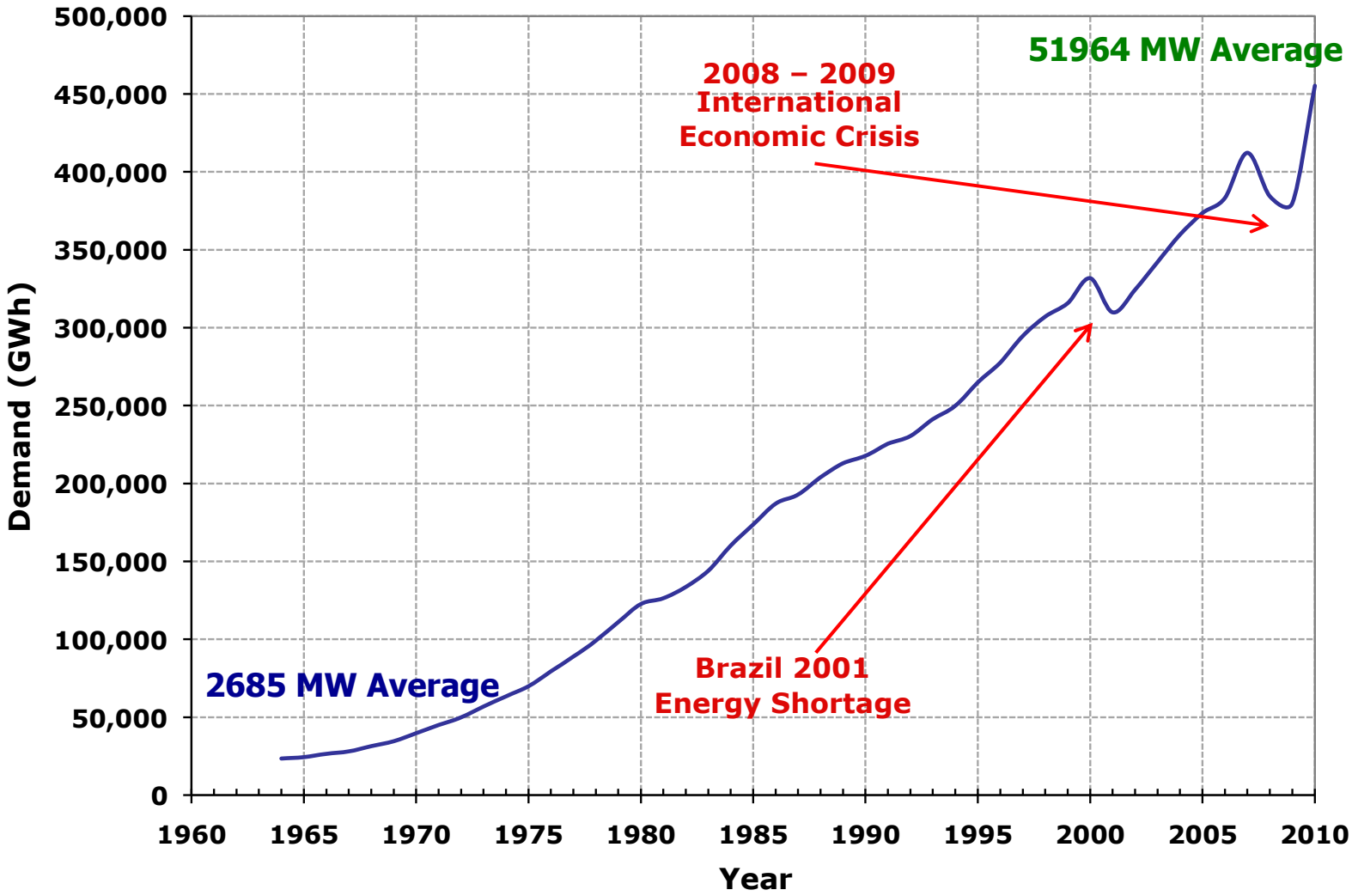
A Timeline Evaluation



The Period Beginning in 2003



Brazilian Demand Growth
The Last 50 Years



Basic Characteristics December 2011

Large Generation Plants

Installed Capacity: 116 GW
Demand 2011: 441 TWh
Basic Grid TLs: 99,555 km

Distribution Companies: 64

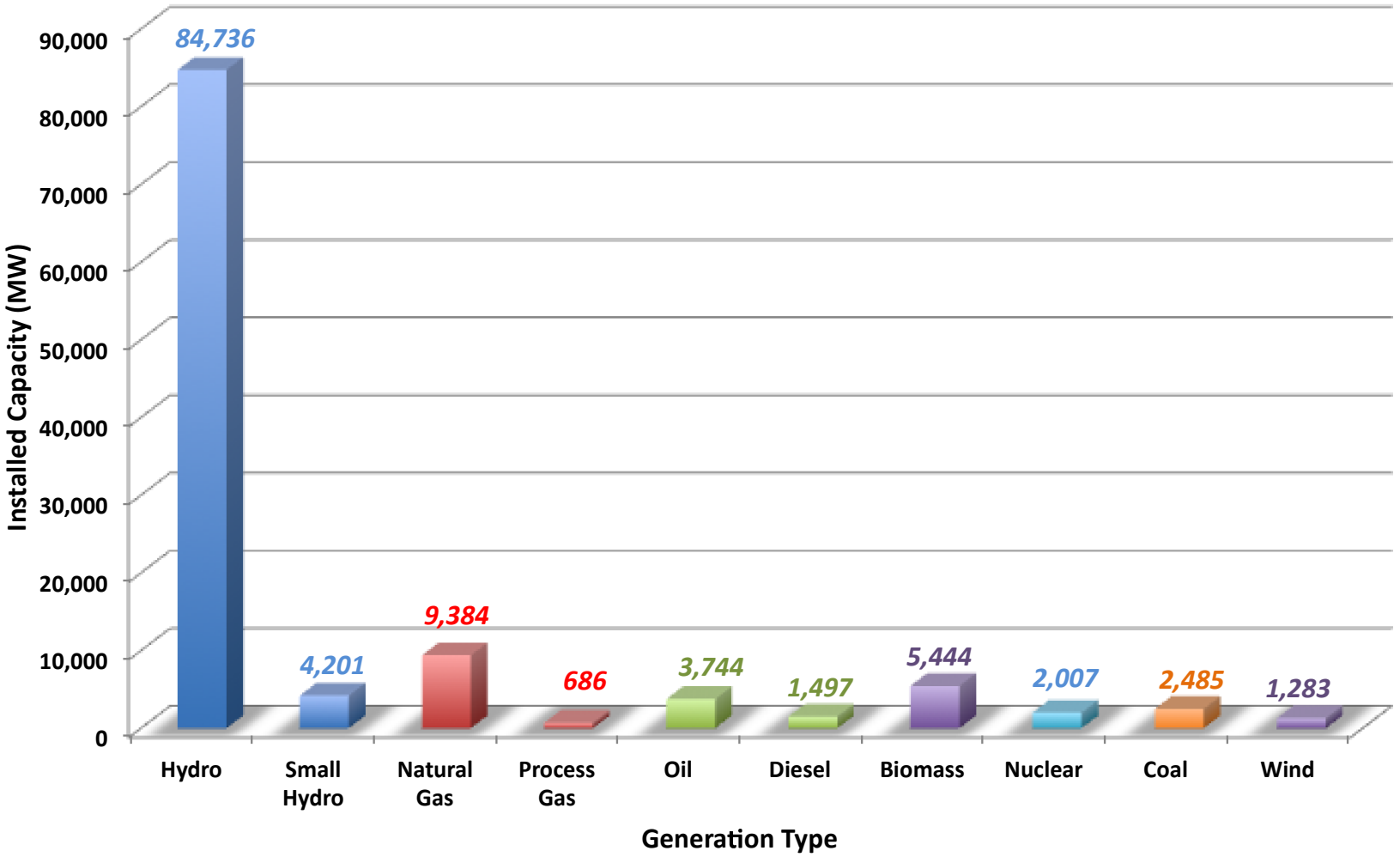
Transmission Companies: 72

Generation Companies: 35
Independent Power Producers: 307
Self-Producers: 39

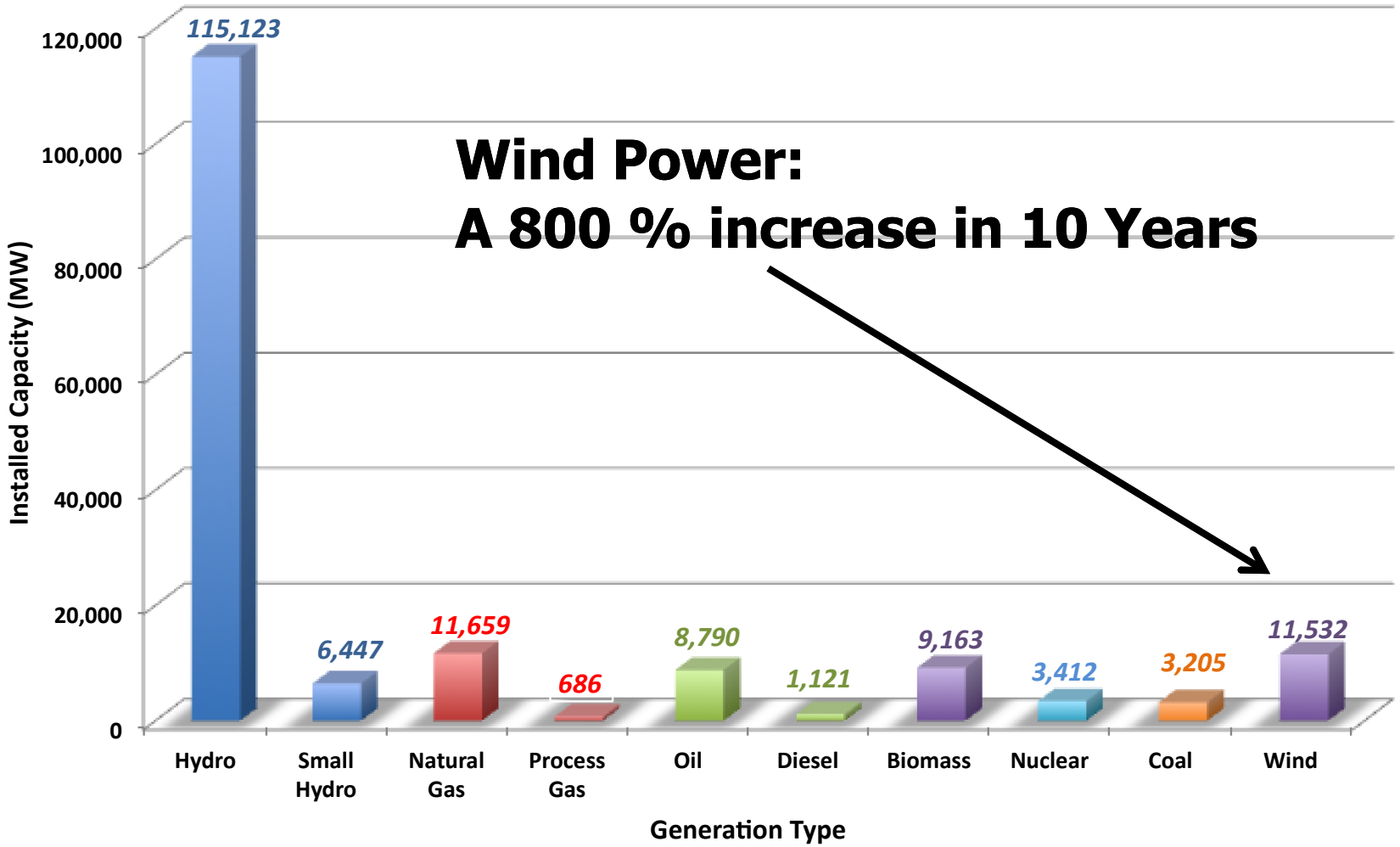
4 SubMarkets

Trading Companies: 106
Free Consumers: 1,067

Generation by Source Type December 2011

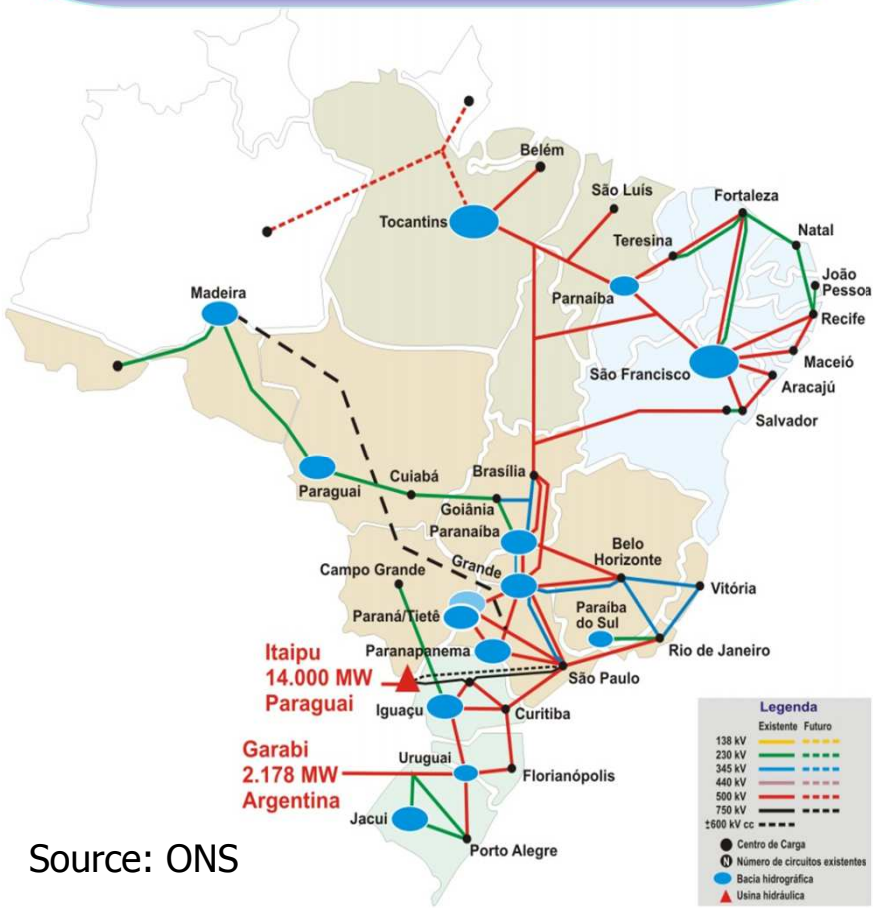


Projection for 2020



Grid of Continental Size

Hydrographic Basins

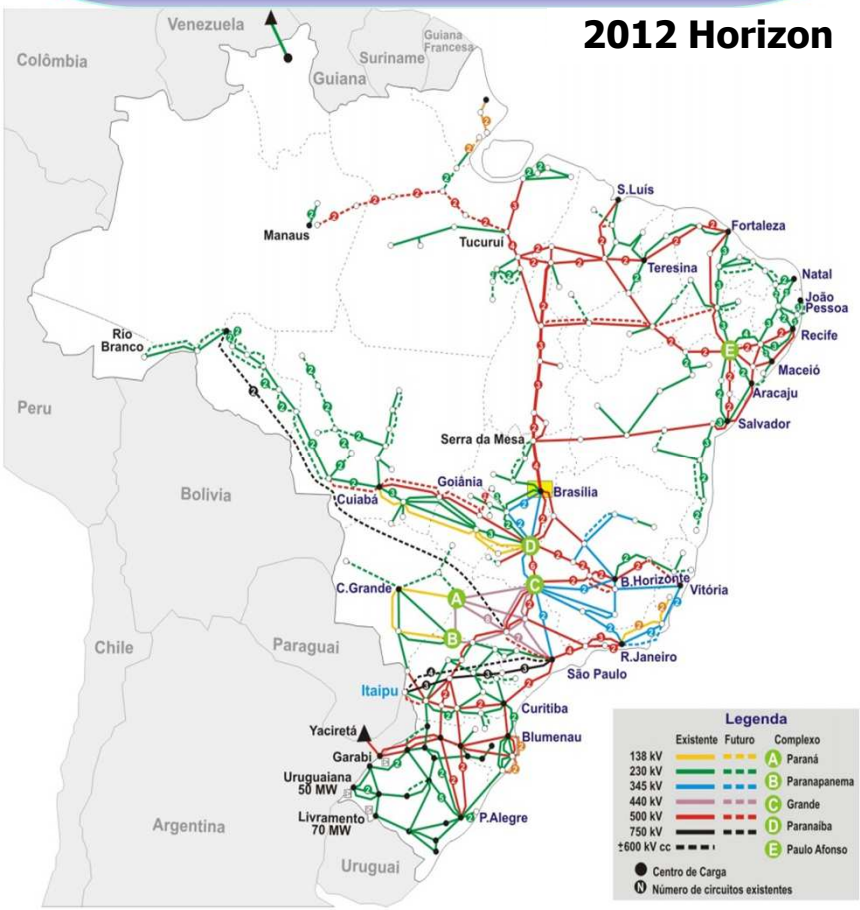


Source: ONS

14 Hydrographic Basins with a Complementary Water Regime

Interconnected System

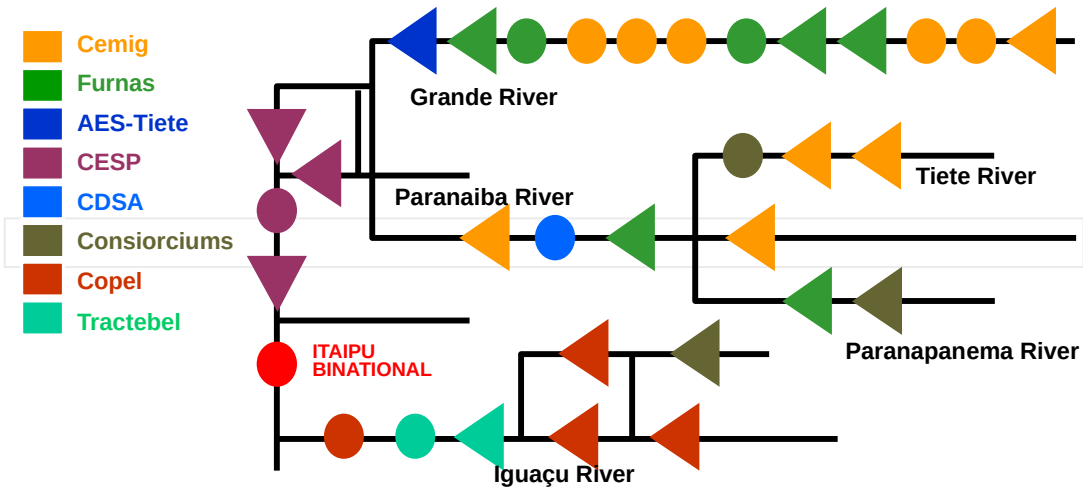
2012 Horizon



Approximately 99,555 km of Transmission Lines at the Basic Grid

Multi-Owned Generating Units

- 35 Public & Private Companies own 141 Hydro Power Plants (>30MW) in 14 Large Basins
- 69 Hydro Plants with Reservoirs, 68 Run-of-River Plants and 4 Pumping Storage Power Stations are in Operation Today



Altogether, the Brazilian Hydrothermal System has 200 Hydro Power Plants above 30 MW, and over 1,000 Generation Units

Optimal Dispatch of the Brazilian Power System

ONS Minimizes the Total Operation Cost
Horizon: 5 Years

Controlling Dispatch of:

- **Thermal Generation**
- **Hydro Generation**
- **National & International Interconnections**
- **Load Curtailment**

Main Products of the ONS Chain

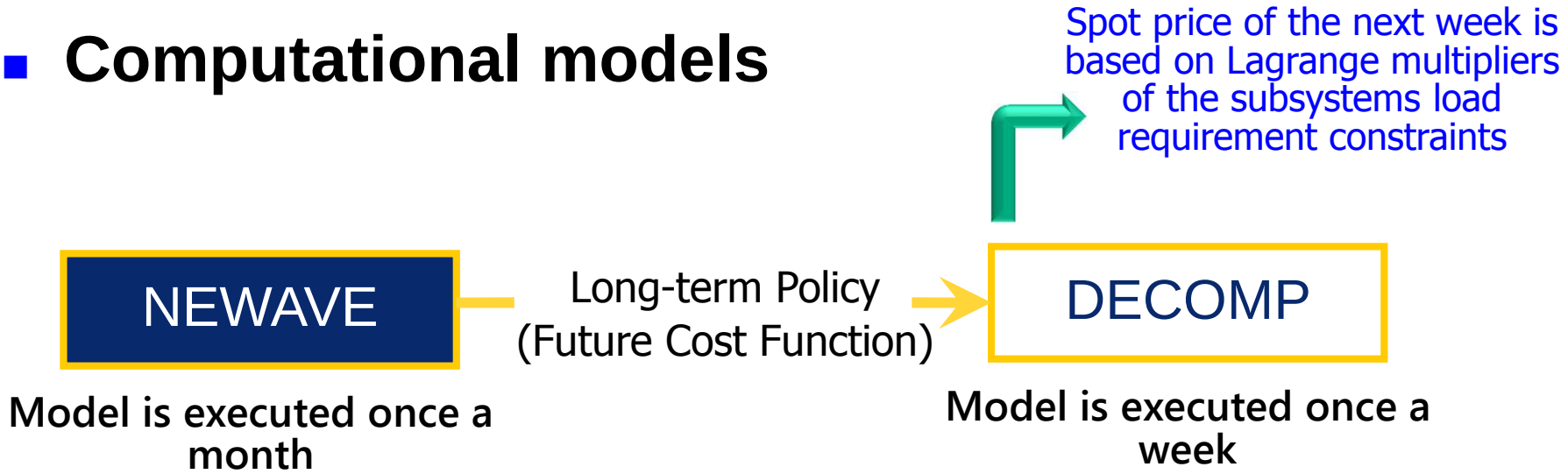
- **PEN – Annual Energy Program**
- **PMO – Monthly Operational Program**
- **PDE – Daily Electro energetic Program**

Computational Models

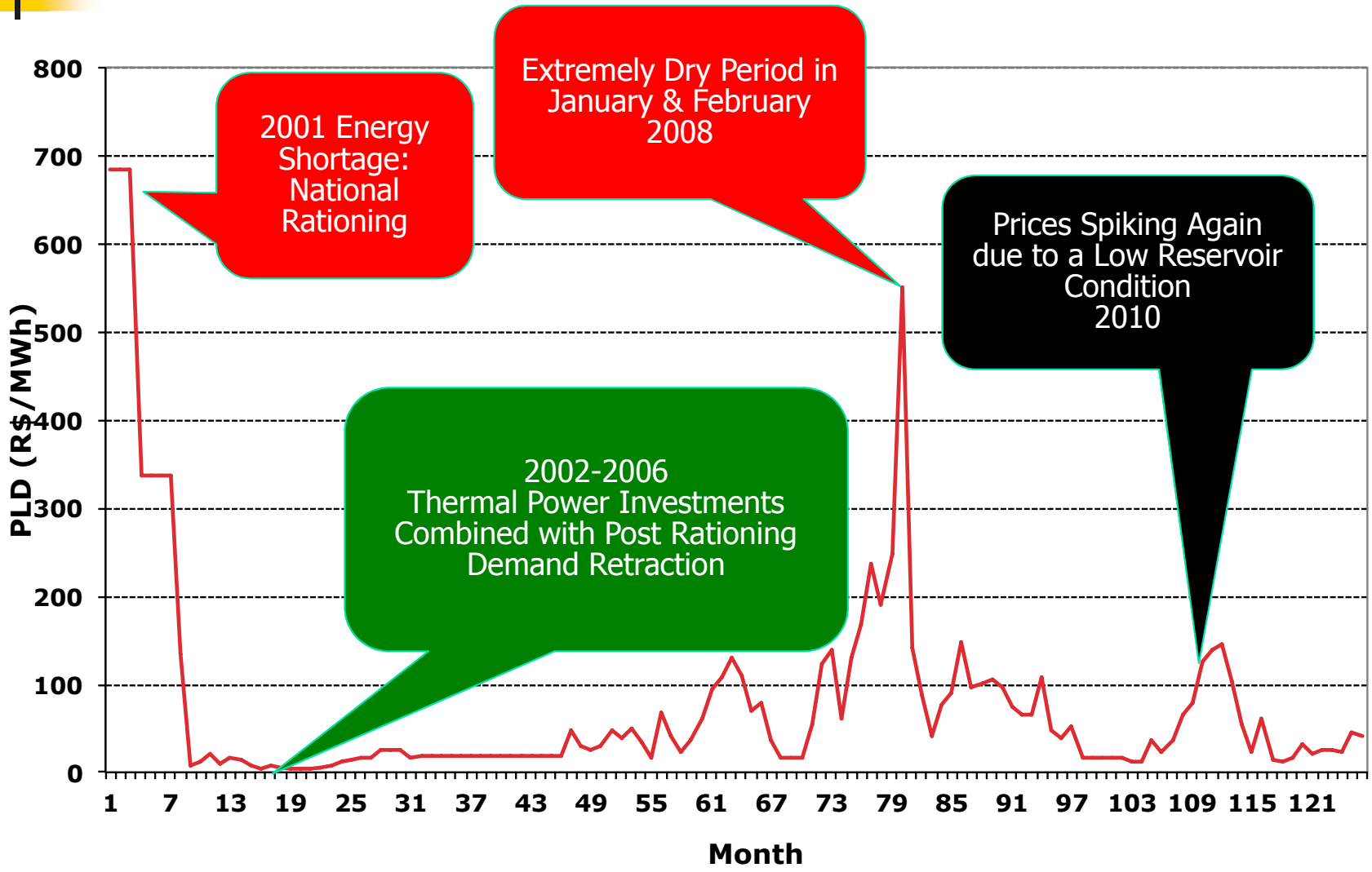
- **NEWAVE – 05 Years - Monthly Basis**
- **DECOMP – 01-06 Months - Weekly Basis**
- **DESSEM – 01 Week - 1/2 Hour Basis**

Spot Price

- **Methodology**
  - Ex-ante (information about generators availability, inflows and loads forecast, etc.)
  - Weekly price for each load level and subsystem
  - Based on the marginal operation cost
- **Computational models**

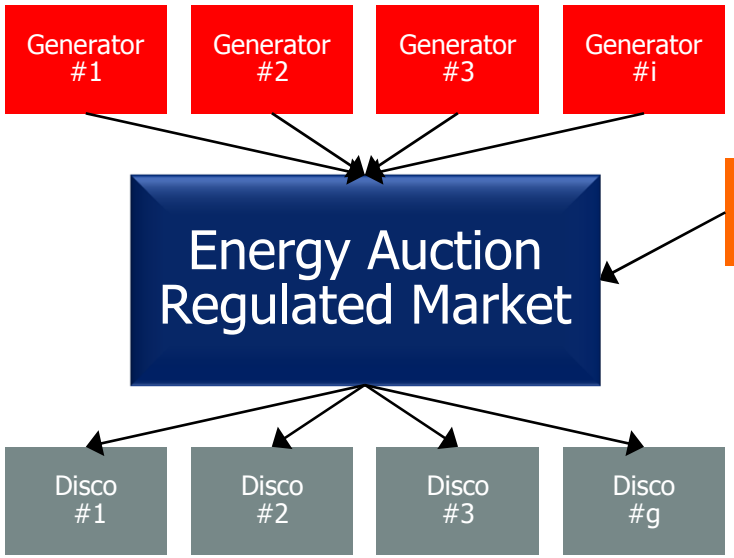


Spot Prices – High Volatility



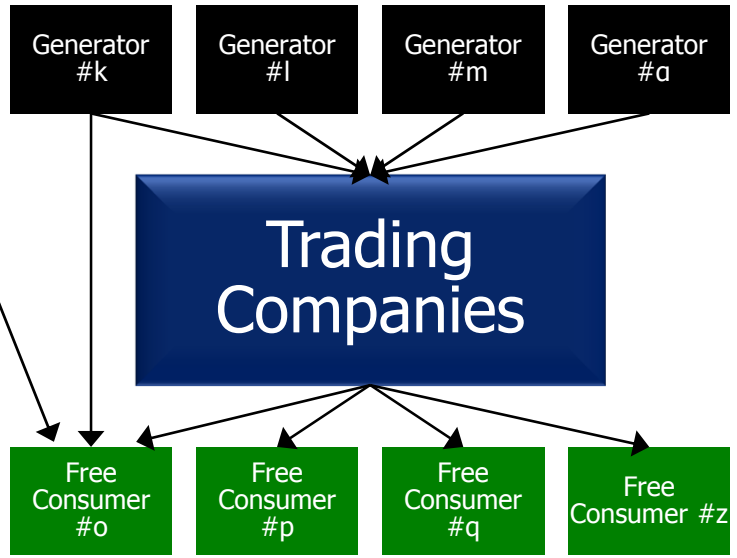
Two Regulated Markets

ACR: Captive Market



Energy is Negotiated on a Pool Basis
Distribution Companies Buy Energy From:
- Generators
- Independent Power Producers

ACL: Free Market



Energy is Negotiated on an Individual Basis
Free Consumers Buy Energy From:
- Generators
- Independent Power Producers
- Trading Companies
- Self-Producers

Energy Auction Structures: A-5, A-3 & Bilateral

Generators



CAPTIVE MARKET
ACR

Distribution Energy Supply

Time Line

A-5 Years A-3 A-1 A

- **New Energy Auction**
  - 5 Years Before Energy Supply : Energy Auction - Hydro Plants
  - 3 Years Before Energy Supply : Auction - Thermal Plants
- **Existent Energy Auction**
  - 1 Year Before Supply : Old Energy Auction
- **Old & New Available Energy**
  - Monthly, if Necessary: Energy Auctions to Balance Demand x Supply

FREE MARKET
ACL

Free Consumers Supply

Bilateral Contracts Freely Negotiated Between Agents Defining Prices, Volumes, Duration & Delivery Terms

The Brazilian Free Market
Who is Eligible ?

CONSUMERS		DEMAND	VOLTAGE LEVEL
POTENTIALY FREE	Connected to the Grid before July 8th 1995	Higher or Equal to 3 MW	Higher or Equal to 69 kV
	Connected to the Grid After July 8th 1995	Higher or Equal to 3 MW	Any Level
SPECIAL CONSUMERS	Supllied by Renewable Energy Sources (Biomass, Solar & Wind)	Higher or Equal to 0.5 MW	Any Level

ACL represents 24% of the total market

Some Areas of LabPLan

- **Stochastic Programming algorithms for long and medium term operational planning models**
  - Stochastic Dual Dynamic Programming
  - Progressive Hedging and Stochastic Lagrangian Relaxation
- **Risk Management of a distribution company in a regulated market**
  - Stochastic model with risk aversion
- **Hydrothermal Unit Commitment**
  - Decomposition optimization techniques

Muito Obrigado!
“Thank you very much!”

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