
Ensuring supply adequacy in South American markets through auctions for forward and option contracts

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Outlook

- Background
- The first “wave” of market reforms in South America
- Difficulties with the first design
- The second “wave” of market reforms in South America
- Examples
- Conclusions

Characteristics of the region

- High (but uncertain) electricity load growths
- Large participation of hydro resources
- Many countries promoting natural gas use, especially for power generation
- Electricity-gas cross-border interconnections

Latin America – global vision

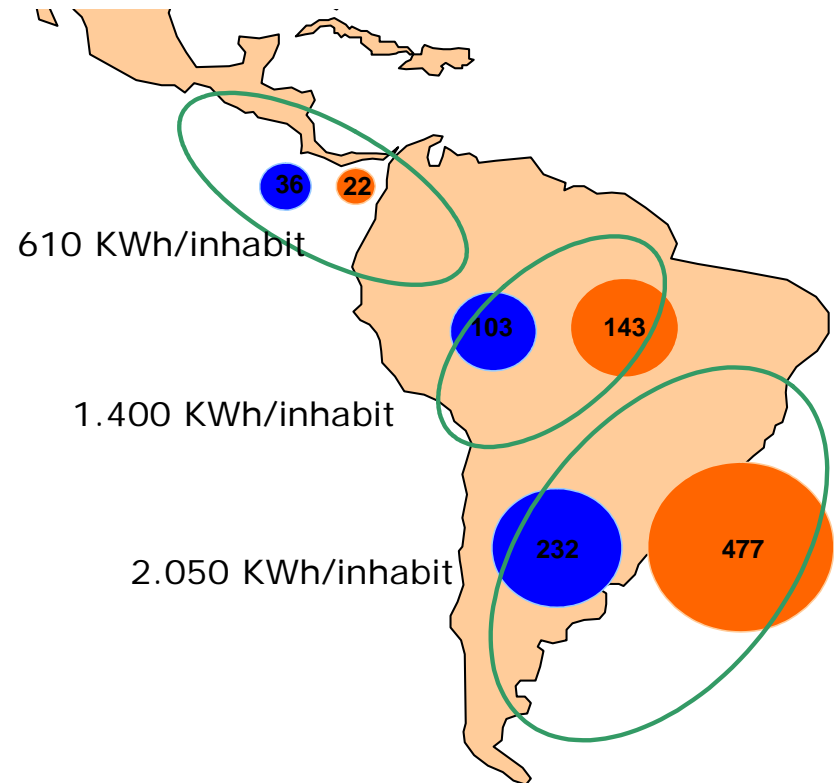
Physical systems



Total Installed Capacity (2003): 238 GW (53%H, 47%T)

Source: EIA (2006)

Electricity markets



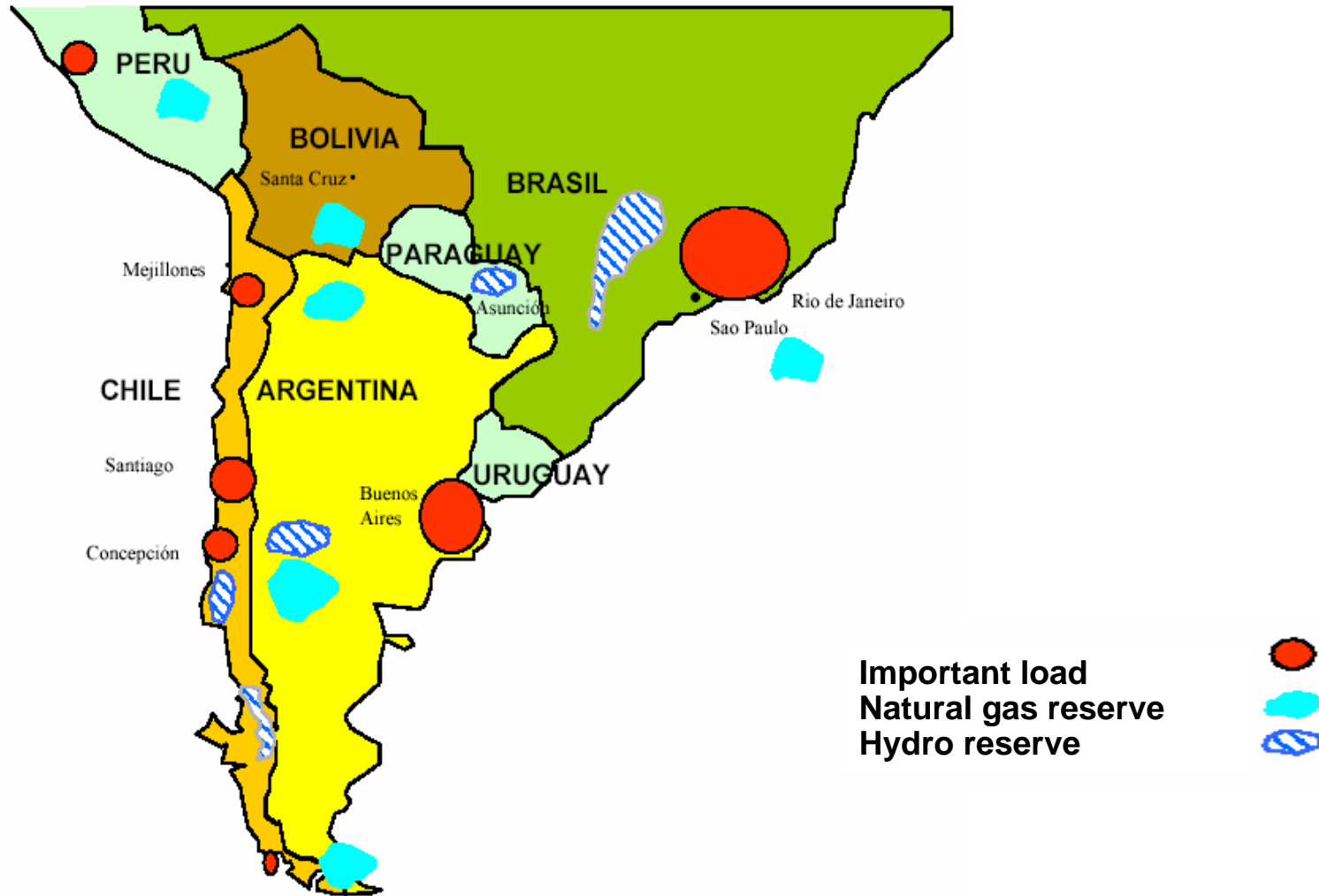
● Population (millions inhabit).

● Electrical consumption (TWh).

A resource-rich region...

- Hydro: competitive option in Brazil; renewed interest in other countries due to oil price increase (e.g. Colombia) or more reliance on generation based on local resources (e.g. Chile)
 - Environmental constraints
 - Restrictions of natural gas international exchanges
- Natural gas: Fast-growing
 - Argentina, Bolivia, Brazil, Peru, Venezuela
- Coal: Available in Colombia, Brazil and Chile
 - Higher cost due to emission controls
- Renewables:
 - Political attractiveness of wind power-incentives being considered (e.g. Brazil & Chile, current reform of Law)
 - biomass (sugarcane) very competitive in Brazil

...but uneven distribution of resources



Motivation for sector reforms

- Difficulties with the previous model (state-owned, verticalized utilities)
 - Few instruments to promote efficiency:
 - “Optimistic” load forecasts (political pressure)
 - Construction cost overruns (transferred to consumers)
 - Inadequate consumer tariffs (political pressure to meet inflation targets)
- Governments did not have enough investment capacity to ensure the supply of an increasing load

Ingredients of the first reform (80's and 90's)

- Privatization
- Competition in generation
- Regulated transmission and distribution
 - In addition of the regulated (wire) business, Discos also buy energy on behalf of end-users (with a pass-through limit for tariffs)
- Short-term (“spot”) wholesale energy markets
 - Colombia with bid-based dispatch; Argentina with price-cap bid-based; all others with cost-based dispatch
- Forward contracts
 - Financial instruments to hedge price-risk
 - Contract obligations in almost all countries except Argentina and Colombia
 - capacity payments in some countries (Argentina, Colombia, Chile) as additional instruments for generation expansion
- National System Operator and Regulatory agencies

The happy years... (1995 – 2001)

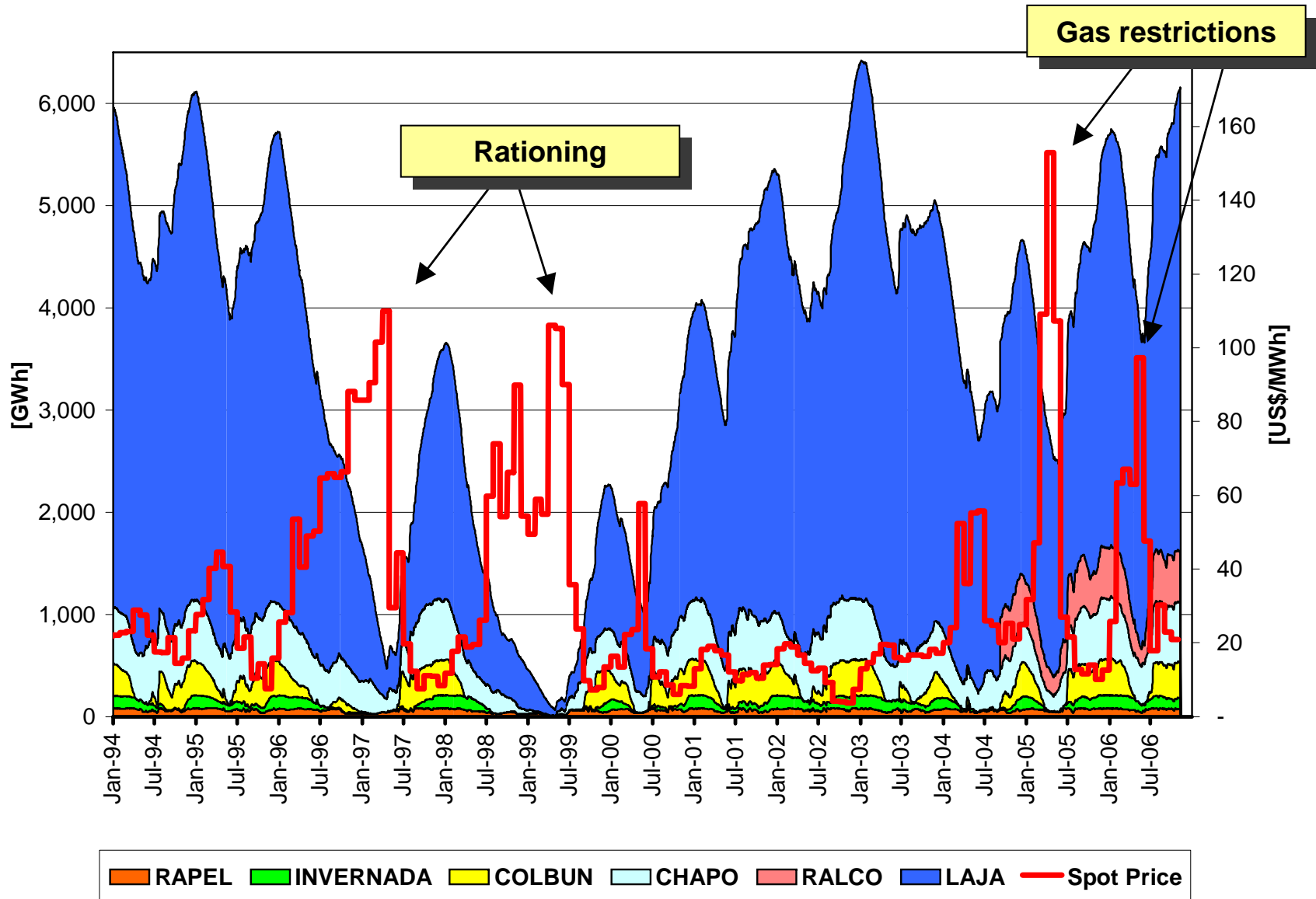
- Very successful privatizations (the electricity “bubble”)
- Efficiency gains in privatized utilities
- Strong private investments in distribution, transmission and generation
- The free market for consumers increases
- Private electricity (E) and Gas (G) international interconnections
 - Argentina-Chile (G); Argentina-Brazil (E); Bolivia – Brazil (G), Argentina-Uruguay (G&E), etc.



Then come the difficulties... (1998 – 2004)

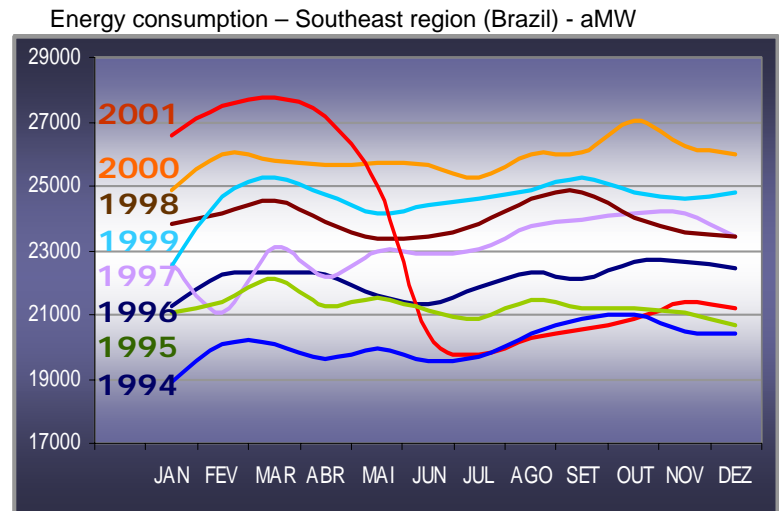
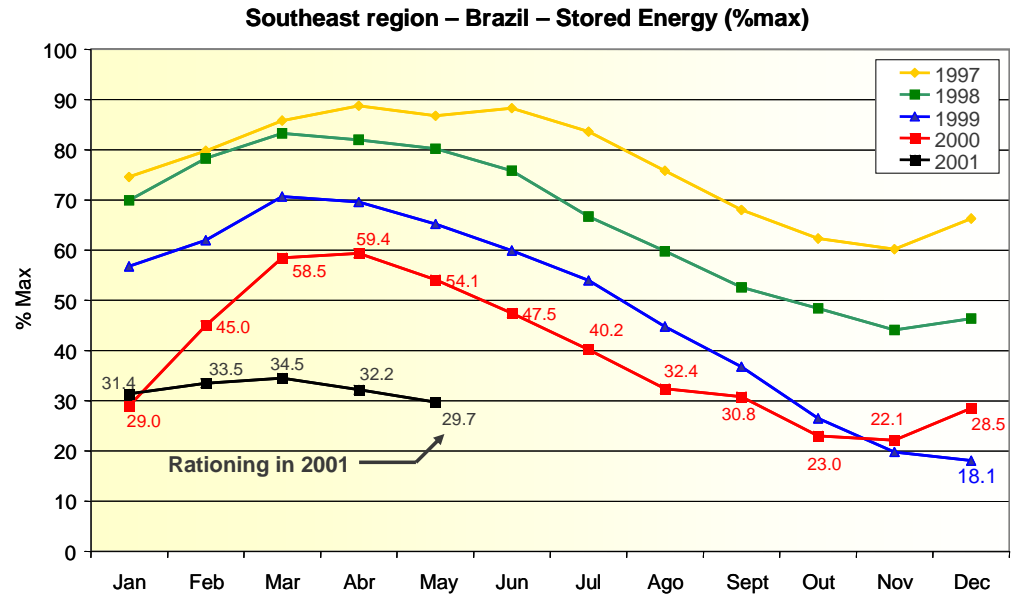
- Severe rationings in Argentina (gas and electricity), Chile (G and E) and Brazil (E)
- Interruption of international exchanges
 - Argentina-Chile (gas)
 - Argentina-Brazil and Argentina-Uruguay (electricity)
 - Bolivia-Brazil and Bolivia-Argentina (gas)
- Inefficient new capacity purchase (example: Brazil), high costs passed to end-users
- Strong political intervention in Argentina

Energy rationing in Chile (1997 and 1999)



Energy rationing in Brazil (2001-2002)

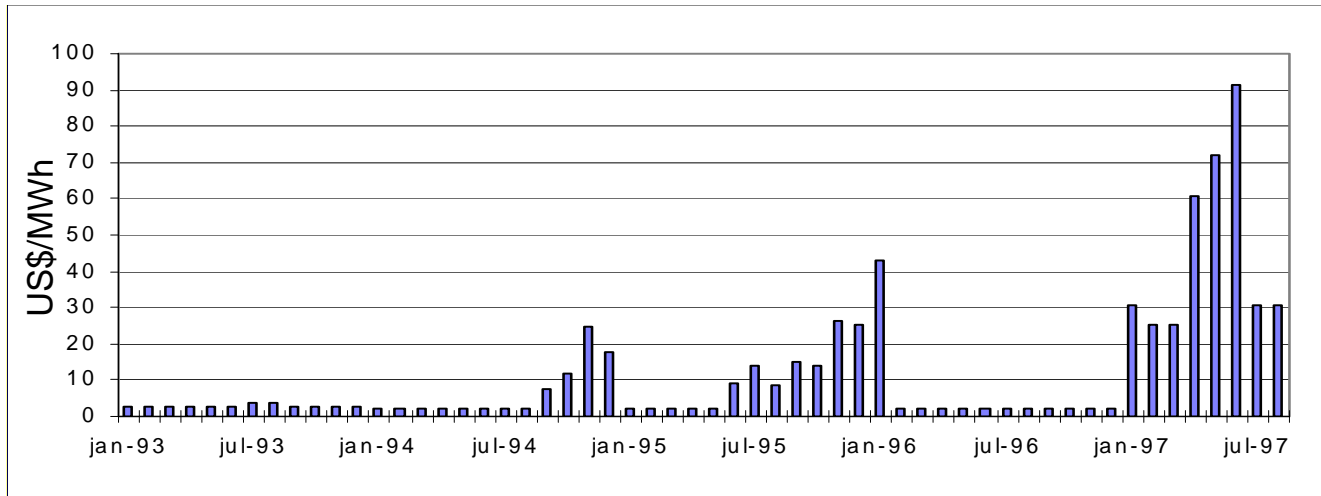
- Energy rationing in Brazil for 9 months (2001-2002)
 - 20% of the load reduced in 80% of the country
 - GDP impact: 15 billion USD
 - After the rationing finished: demand did not recover, jump from scarcity to surplus



What happened?

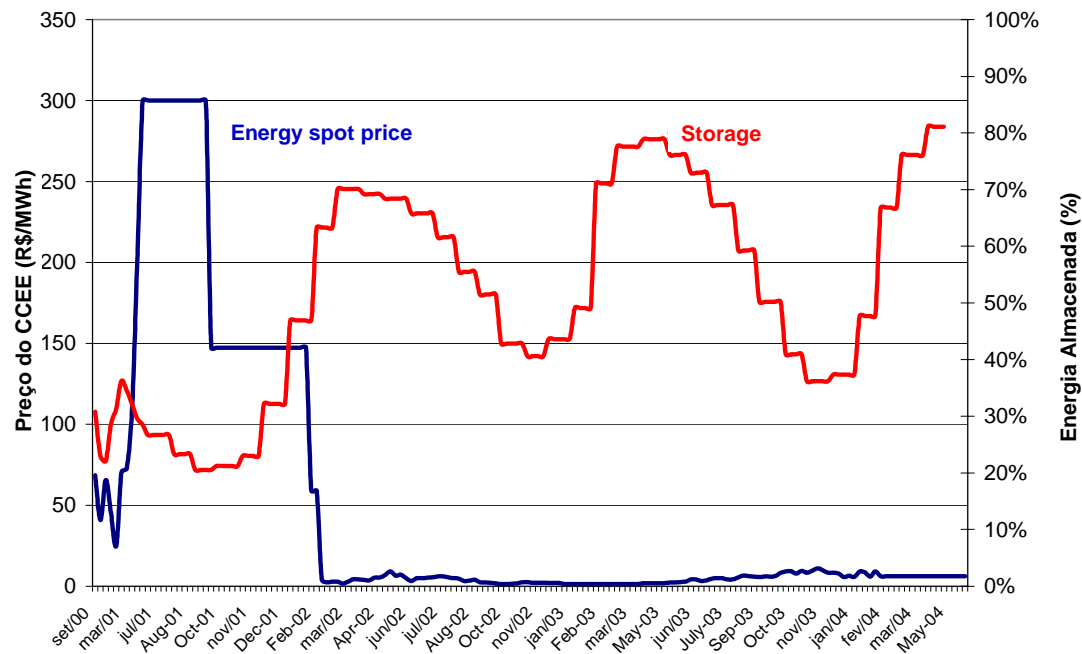
- Economic signals from the spot market for system expansion were not clear
 - Resulted in lack of enough new capacity
 - In addition, new generators need long-term contracts as collateral for financing (project financing structures): active long-term forward market needed
- Difficulties to establish pass-through prices to end-users
 - Resulted in inefficient contracting of new capacity
- Frozen node price in the Chilean market
 - Power crisis, costs of generators are higher than prices to sell in the regulated market (no new generation investments)
- Institutional weakness:
 - Examples: change of rules in Argentina and the role of the activities of Ministry of Energy and Energy regulator in Brazil

Example: Behavior of Brazilian energy spot prices



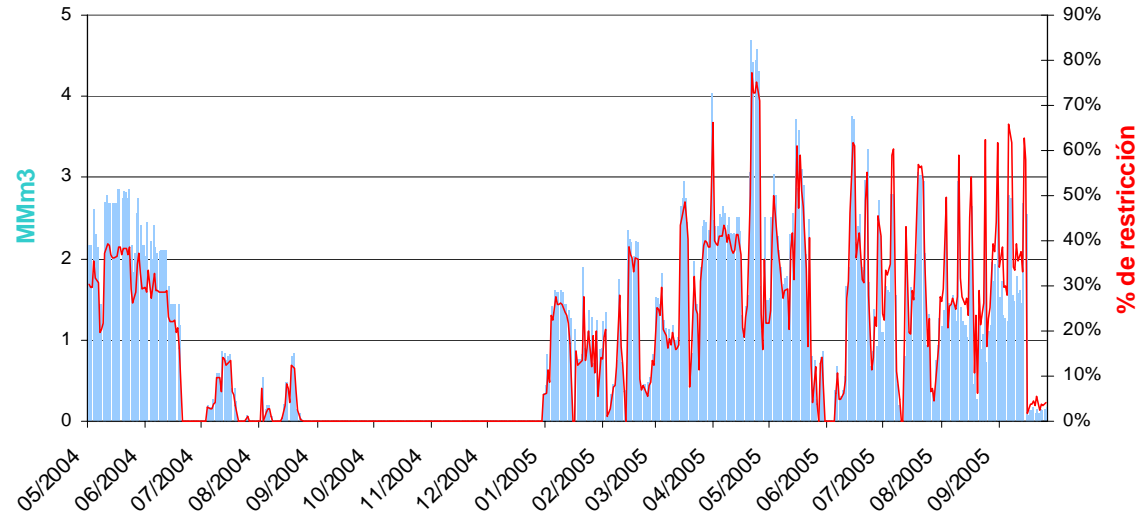
Energy spot prices are very volatile, dependent on the hydrological conditions

It is difficult to identify the optimal timing for new investments...



Example: Difficulties to establish pass-through prices to end-users in the Chilean market

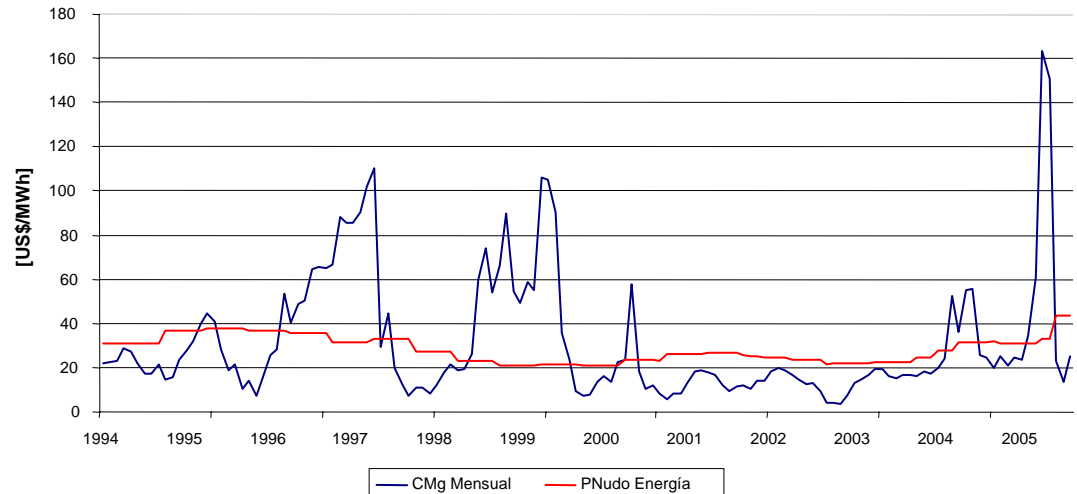
Restrictions of Natural Gas in the Main Interconnected System



**Restrictions of NG
increases costs of
generation**

**Node price does not
transfer higher cost to
consumers**

Node price vs Spot Price



The second “wave” of market reforms in South America

- Less emphasis on the short-term “spot” market as provider of signals for system expansion
 - Spot prices are too volatile to provide reliable signals for expansion
- More emphasis on the long-term forward contract market to induce the entrance of new capacity
 - Competition “for the market” instead of competition “in the market”
- Strengthening of regulatory agencies

Key ingredients

1. Requirements for forward contract coverage (firm capacity certificates - FEC) imposed on loads
 - distribution companies
 - free customers
2. Improvement of contracting process to ensure generation expansion and supply adequacy
 - FEC acquired through procurement auctions
 - forward contracts + energy call options used
 - strategies to deal with uncertainty on the load growth
- (1) + (2) = supply adequacy + efficient contracting

Implementation

Examples: Brazil, Chile, Colombia, Peru, other countries interested



Examples

- Brazil: energy call options and forward contracts auctions for supply adequacy
- Chile: contract auctions to assure supply adequacy in an uncertain gas supply environment
- Colombia: firm energy obligation and auctions

The Brazilian power system

Inst.capacity (2006): ~ 100,000 MW

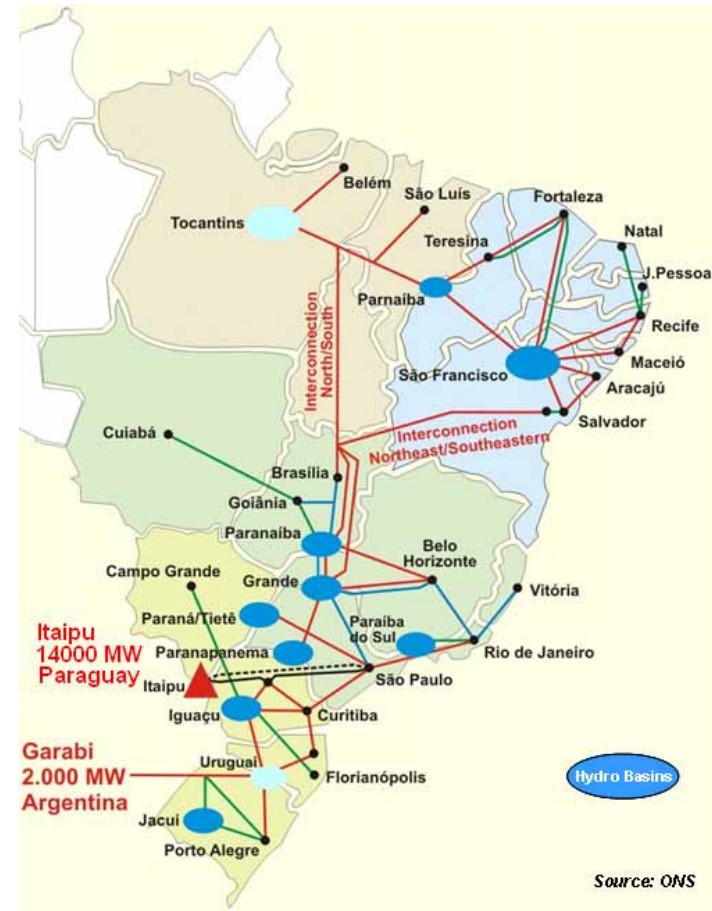
85% hydro: large plants in cascade, in different river basins

Energy demand: ~400 TWh

Peak Demand: ~63,000 MW

Hydro plants are jointly operated, to take advantage of hydrological diversity (export from "wet" to "dry" basins)

cost-based dispatch, spot prices based on marginal costs



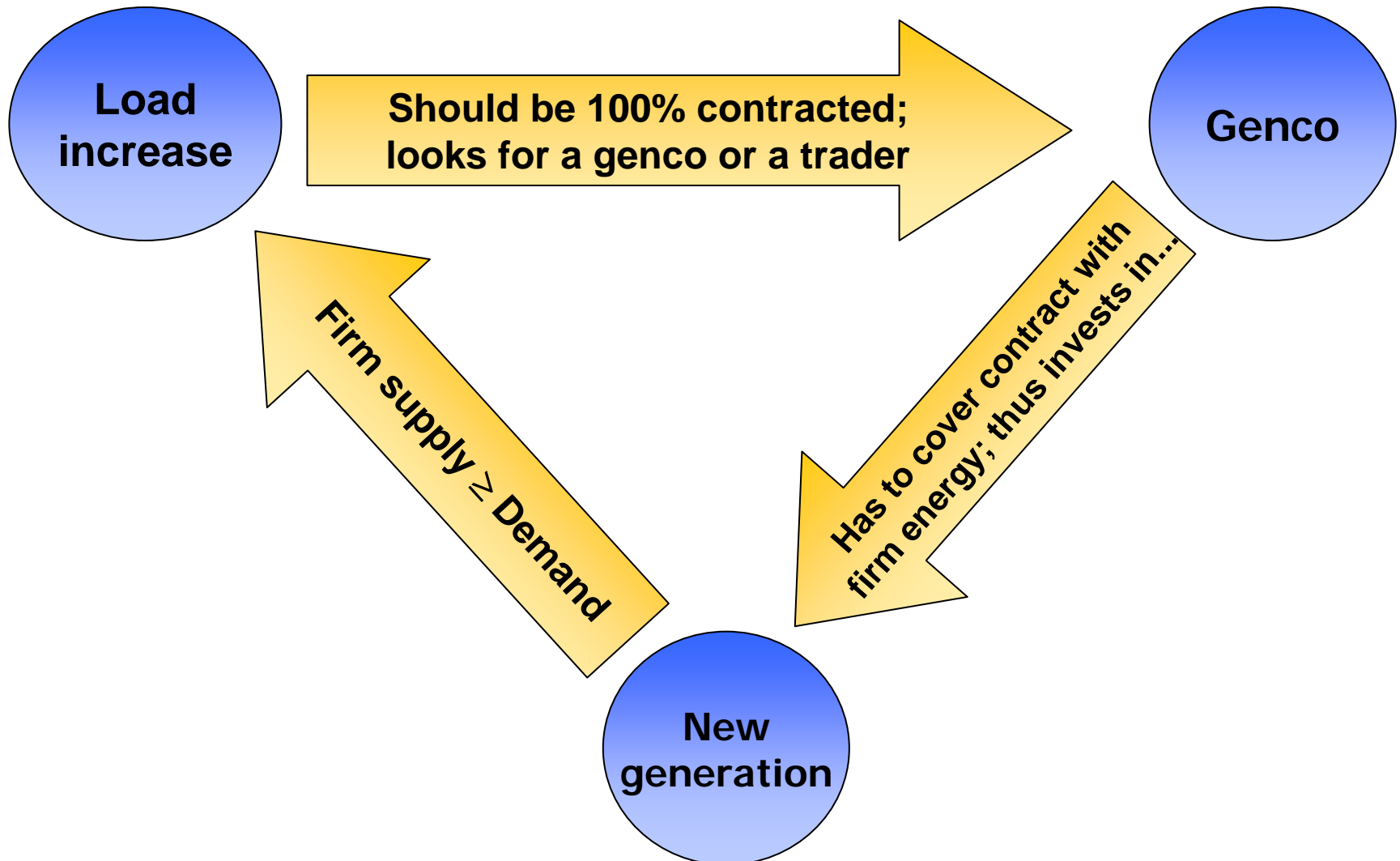
Need for additional generation

- Projected annual load growth: 5%
 - ⇒ 3,200 ave. MW / year
 - ⇒ US\$ 6 billion/year in investments
- Brazil's challenge: to promote efficient energy growth

1. How to contract new capacity

- All consumers (free and regulated) should be 100% contracted
 - Verified ex-post, for the cumulative energy consumption in the previous year
- Although contracts are financial instruments (forward or call options), they must be “backed” by a firm energy “certificate”

100% contract + firm energy \Rightarrow expansion

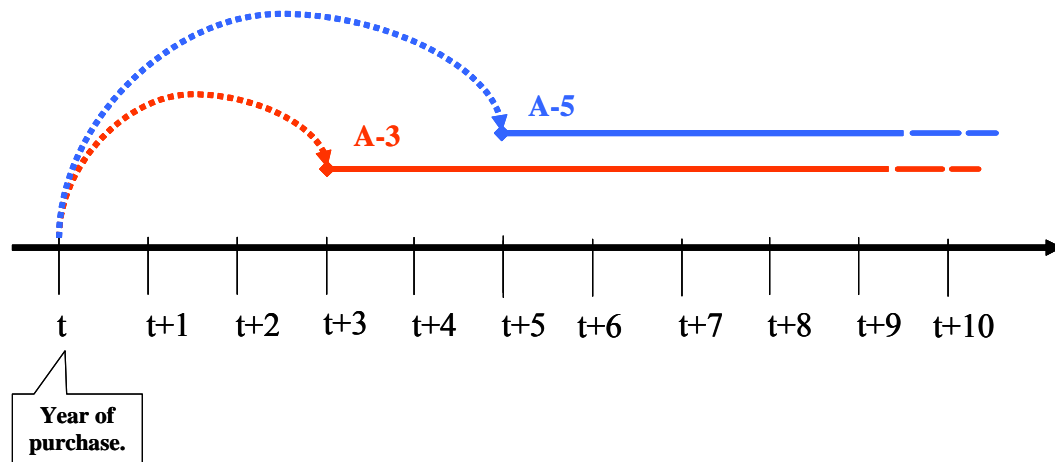


2. How to ensure efficiency: contract auctions

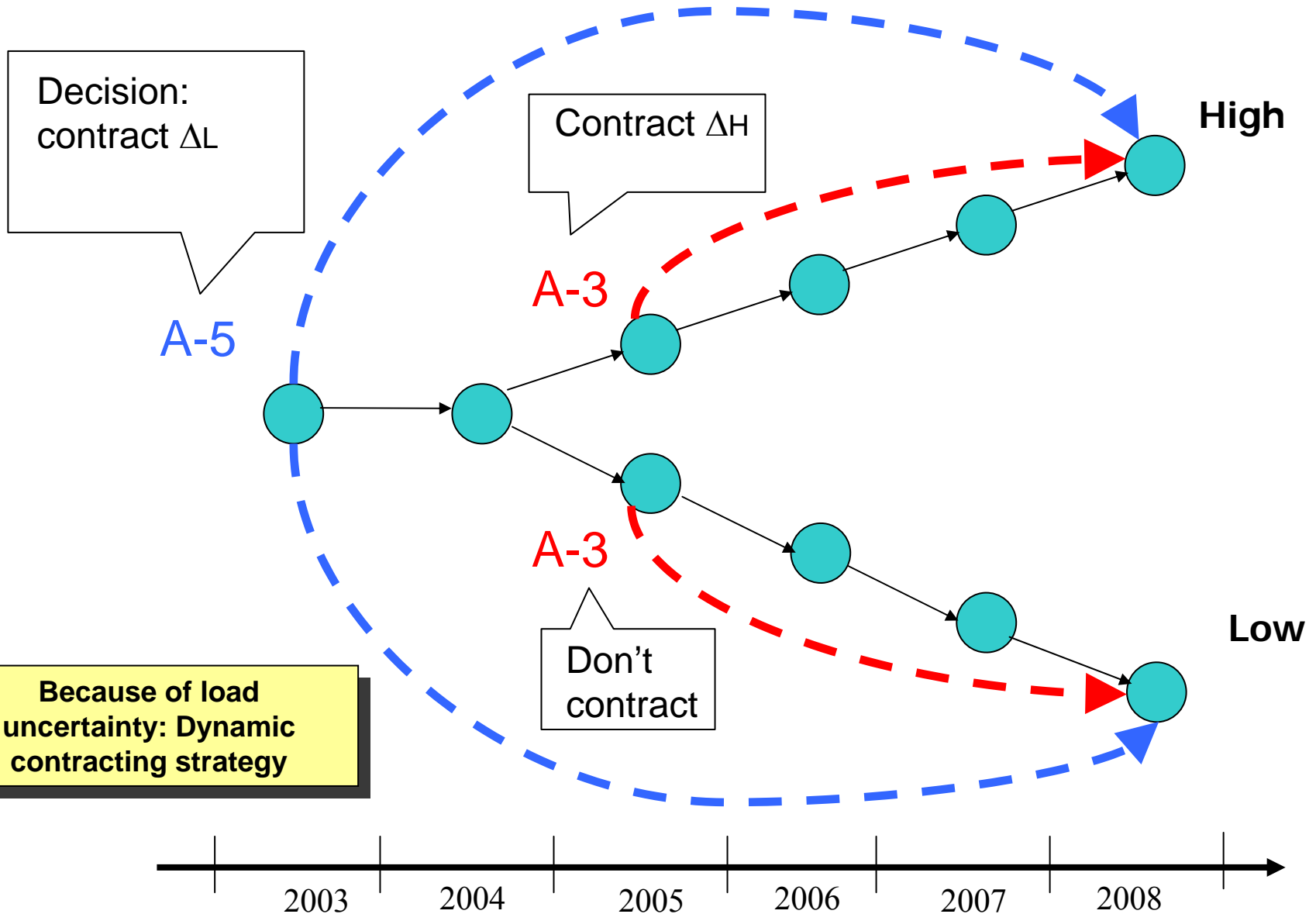
- Discos contract energy through auctions
 - Discos are responsible for load forecast; avoids government planners' "optimism"
 - Contracting is carried out jointly (for all discos)
 - Contracts reduce risks for investors; lower prices
- Free consumers can contract as they wish, as long as they remain 100% covered
 - Free consumers are 25% of the market
 - They serve as "checks and balances" for the regulated sector

Types of auctions for new energy (carried out yearly)

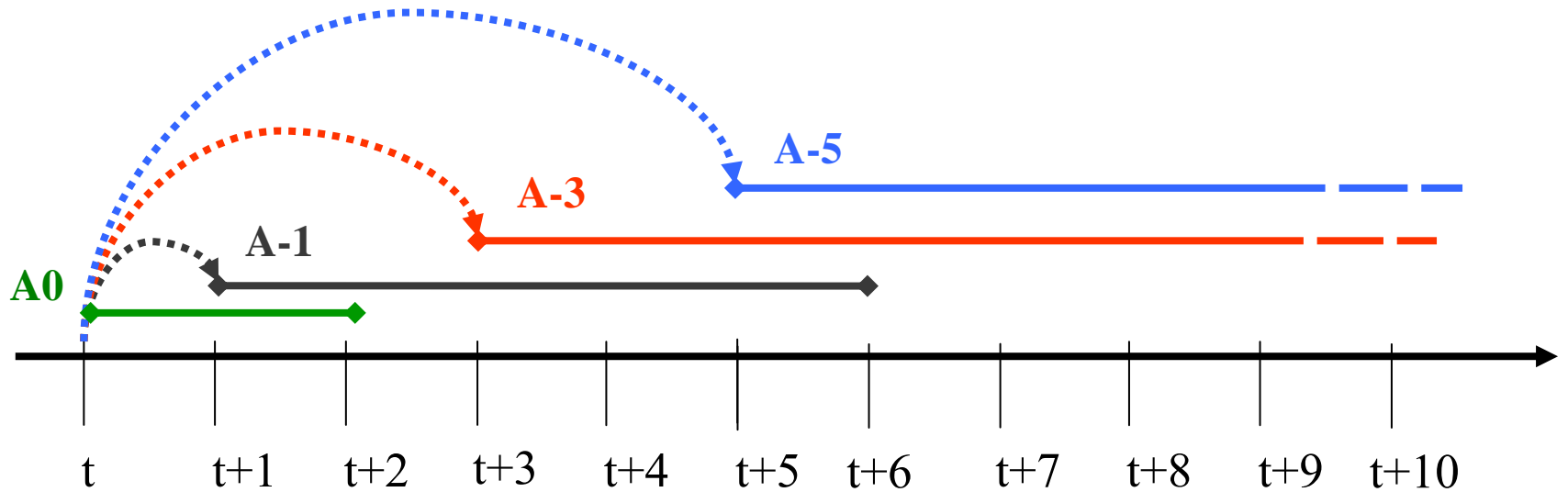
- Two auctions are carried out every year, for entrance in operation five (A_{-5}) and three (A_{-3}) years later
 - long-term contracts (15 years) are offered
 - this allows auction winners enough time to build plants and to have project finance
 - criterion for contracting in auctions is the smallest tariff (\$/MWh)



Why do we have two auctions?



Summary of the yearly auction process



Year of contract.

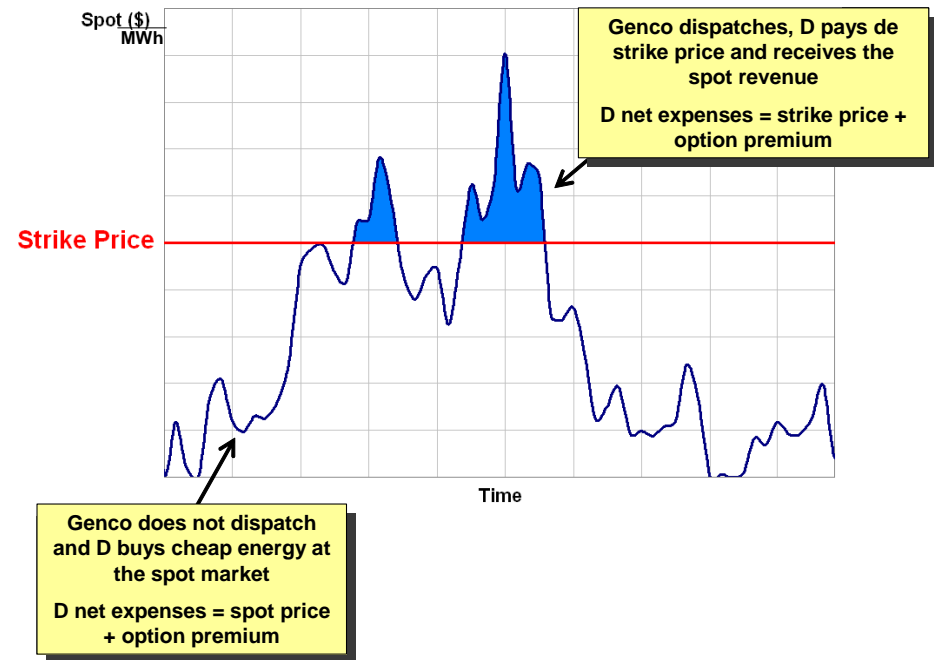
A0 / A-1: Existing Energy Auctions
A-3 / A-5: New Energy Auctions

Types of contract (financial hedges)

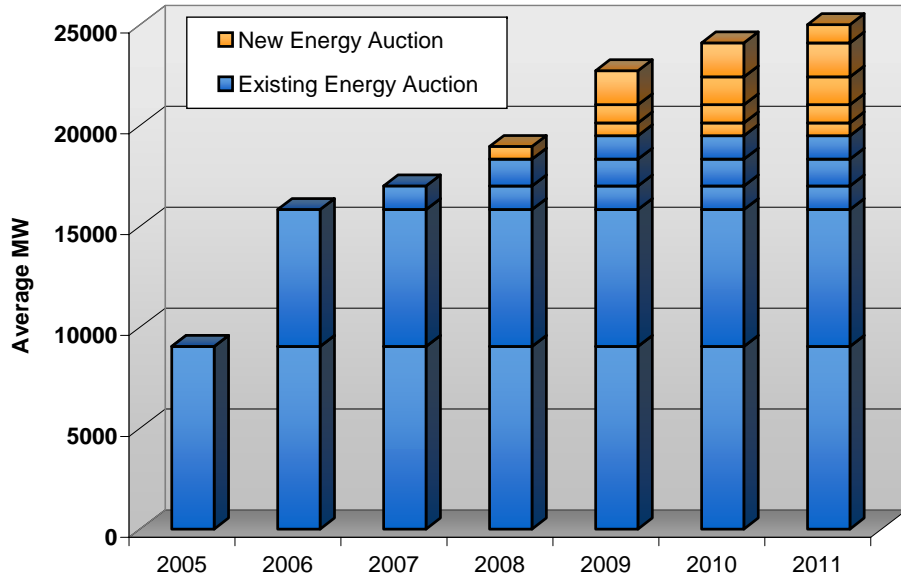
- **Forward contracts:** generator is responsible for either producing the contracted energy amount or for purchasing the difference between contract and production in the spot market (generator has price/quantity risk)
- **Call options:** the consumer “rents” the plant, paying a fixed amount (**premium**) for its availability and a variable amount (**strike price**) whenever the plant is dispatched. The consumer is now responsible for any spot market transaction and for all price/quantity risks
 - Objective: transfer benefits (and risks) of hydrothermal optimization to consumers

Auctions for “Call option” contracts

- “Call option” contract auctions for thermal plants have been used since 2005
 - Plants bid both the “premium” (fixed annual revenue) and the “strike price” (used as the variable operating cost in the HT dispatch)
- Bids are compared with basis on the estimated benefit for consumers
 - [low premium, high strike] x [high premium, low strike]

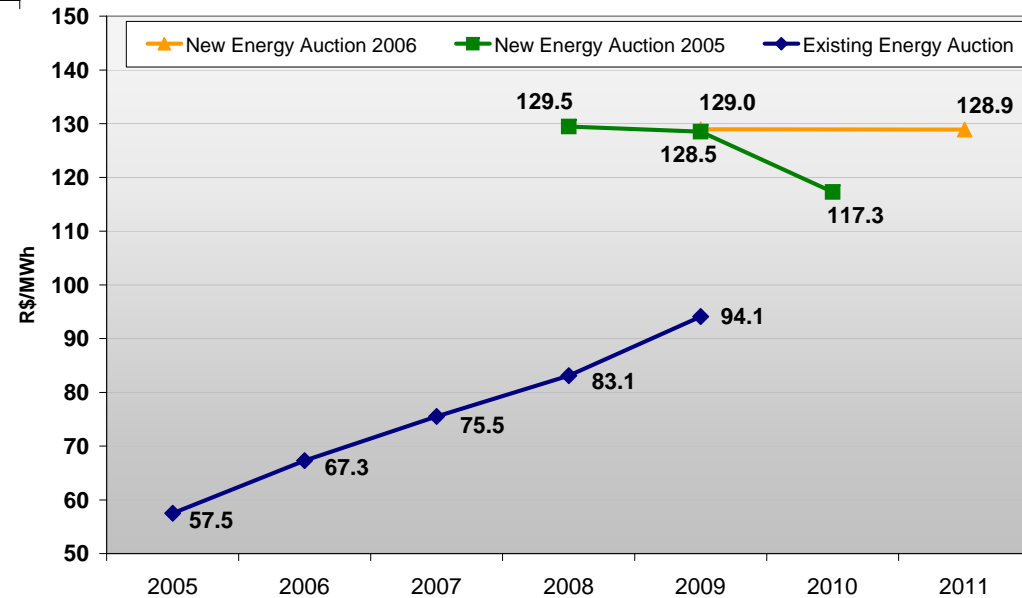


Overall auction results 2004 - 2006



← Contracted volumes

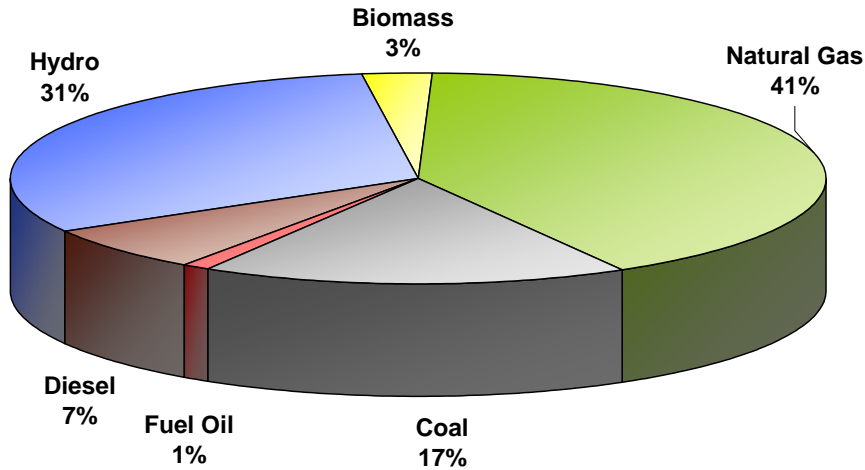
Auction prices →



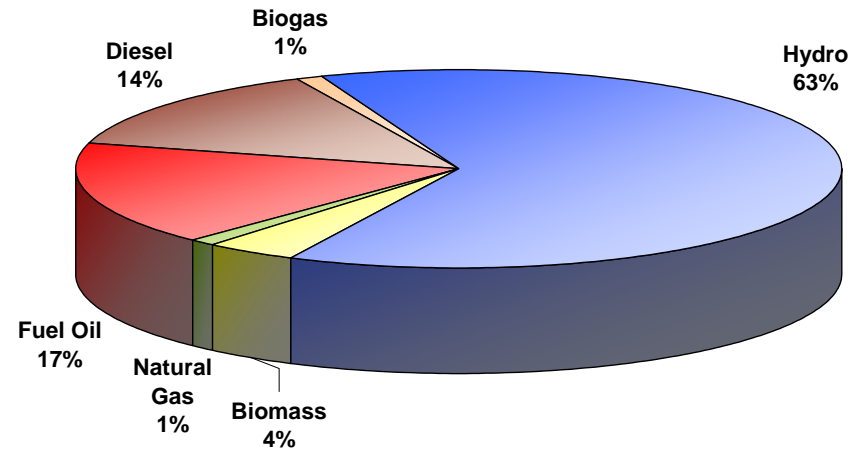
- 5 auctions = US\$ 50 billion in contracts

New Energy auction results (2005 – 2006)

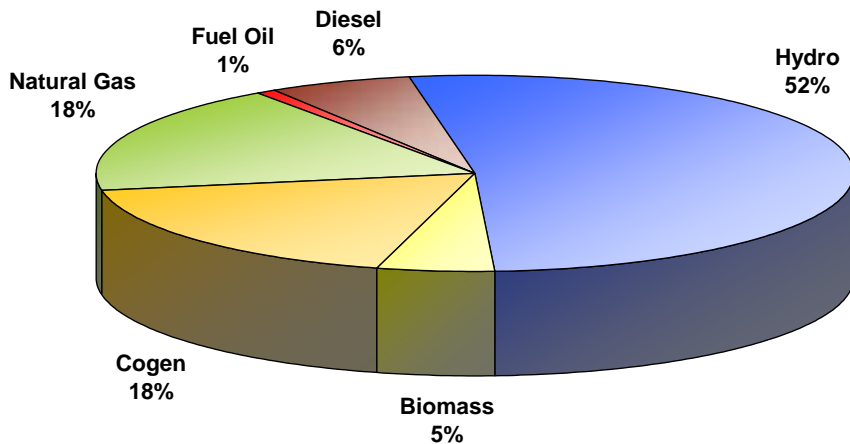
New capacity – breakdown per energy source:



← 1st New Energy Auction

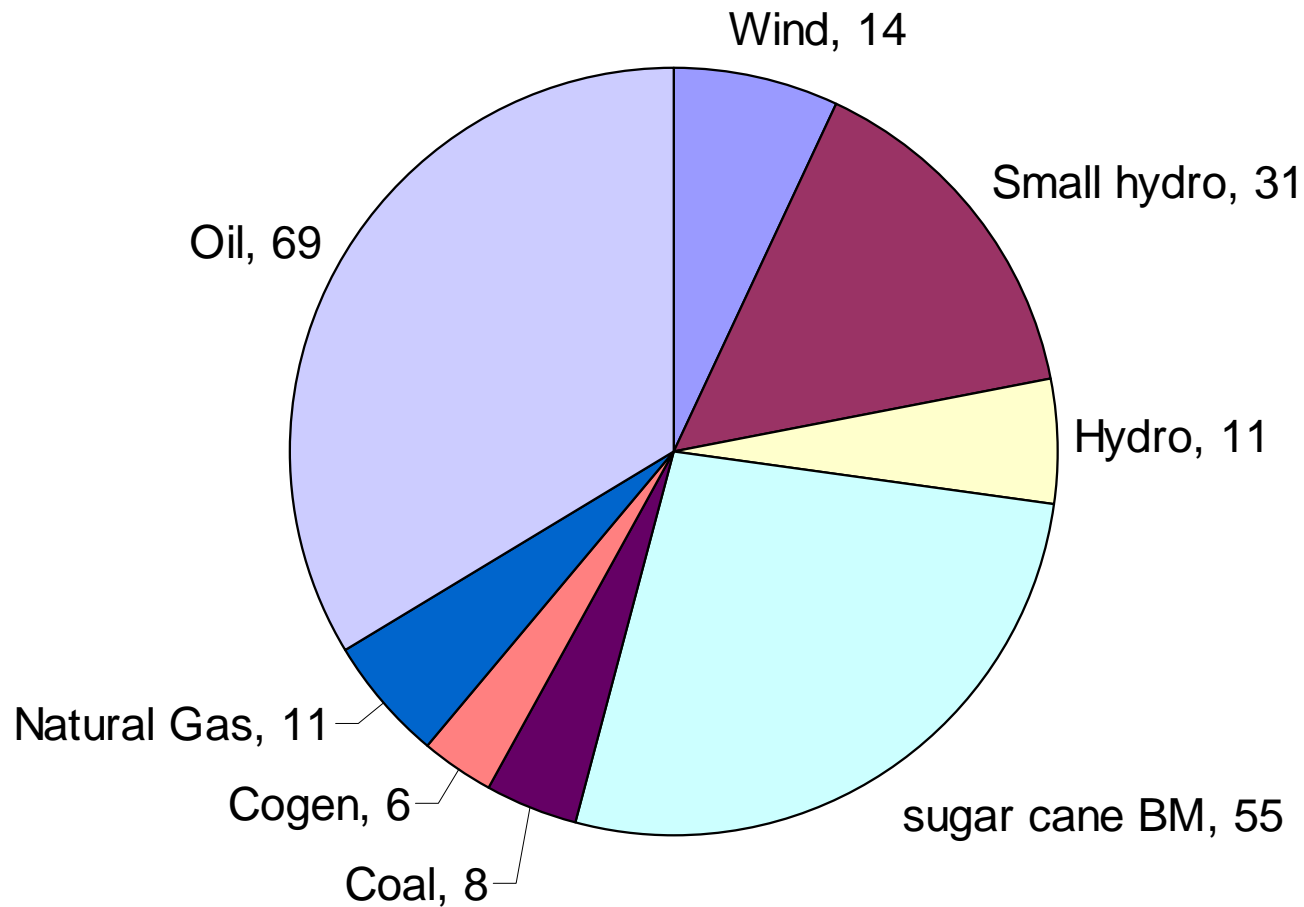


2nd New Energy Auction →



← 3rd New Energy Auction

Next auctions are scheduled for June 2007



205 candidate projects; 25 thousand MWs

Chile: power market characteristics

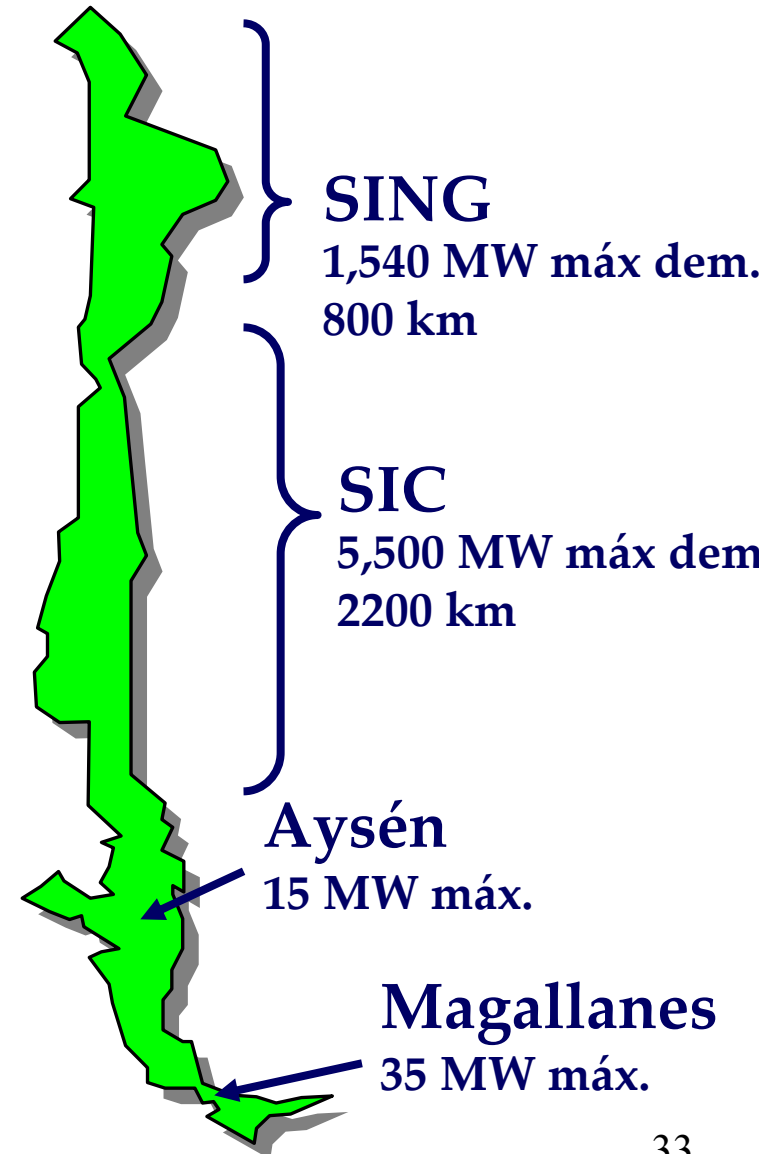
Two main interconnected systems:

SING: mining over 90% demand, natural gas and coal (3 ,300 MW installed, 99% thermal)

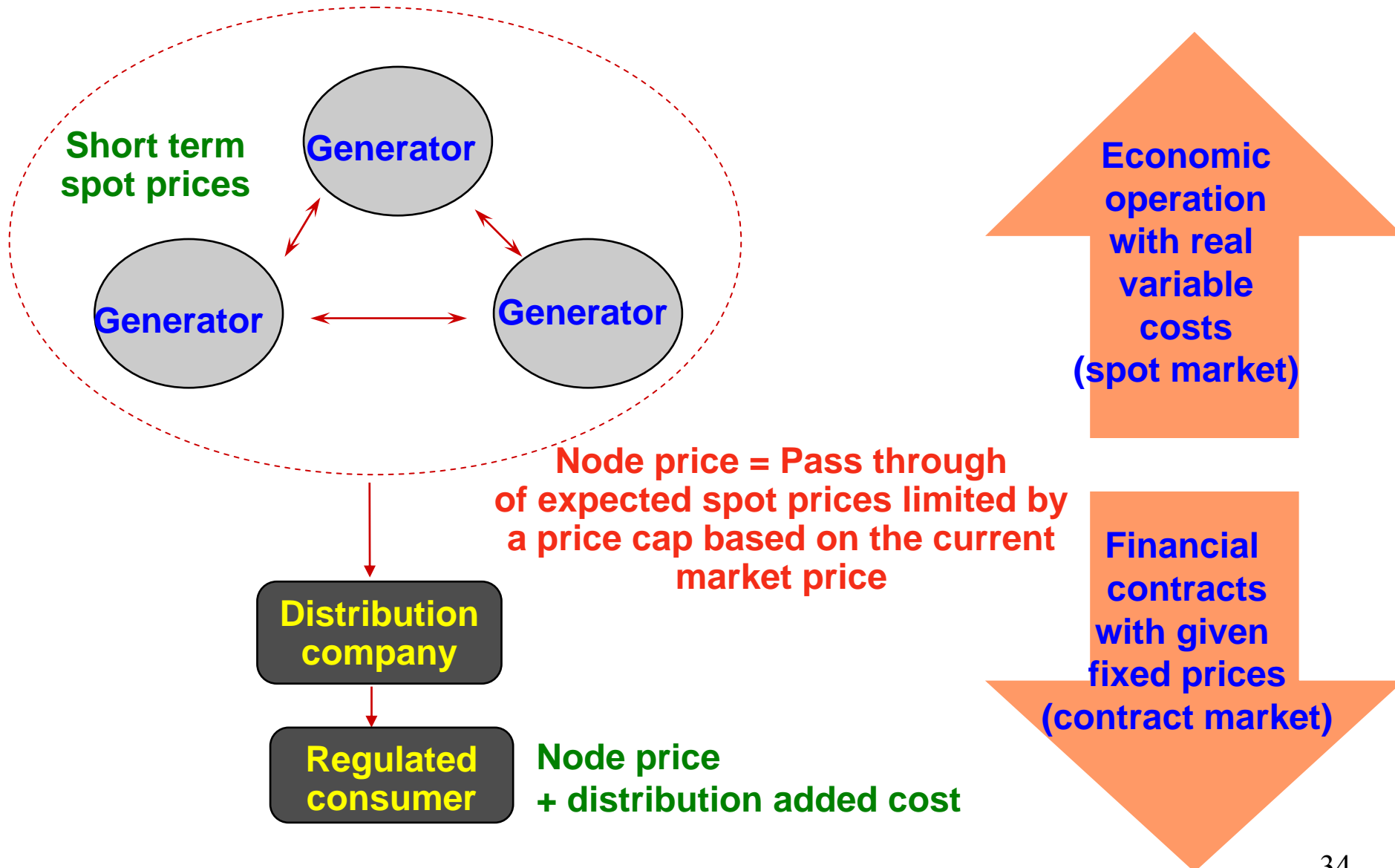
SIC: over 93% of population, important hydro resources, natural gas and coal (8 ,000 MW installed, 60% hydro)

Competitive wholesale market
Cost based central dispatch
Locational marginal pricing

Projected annual growth: 6%

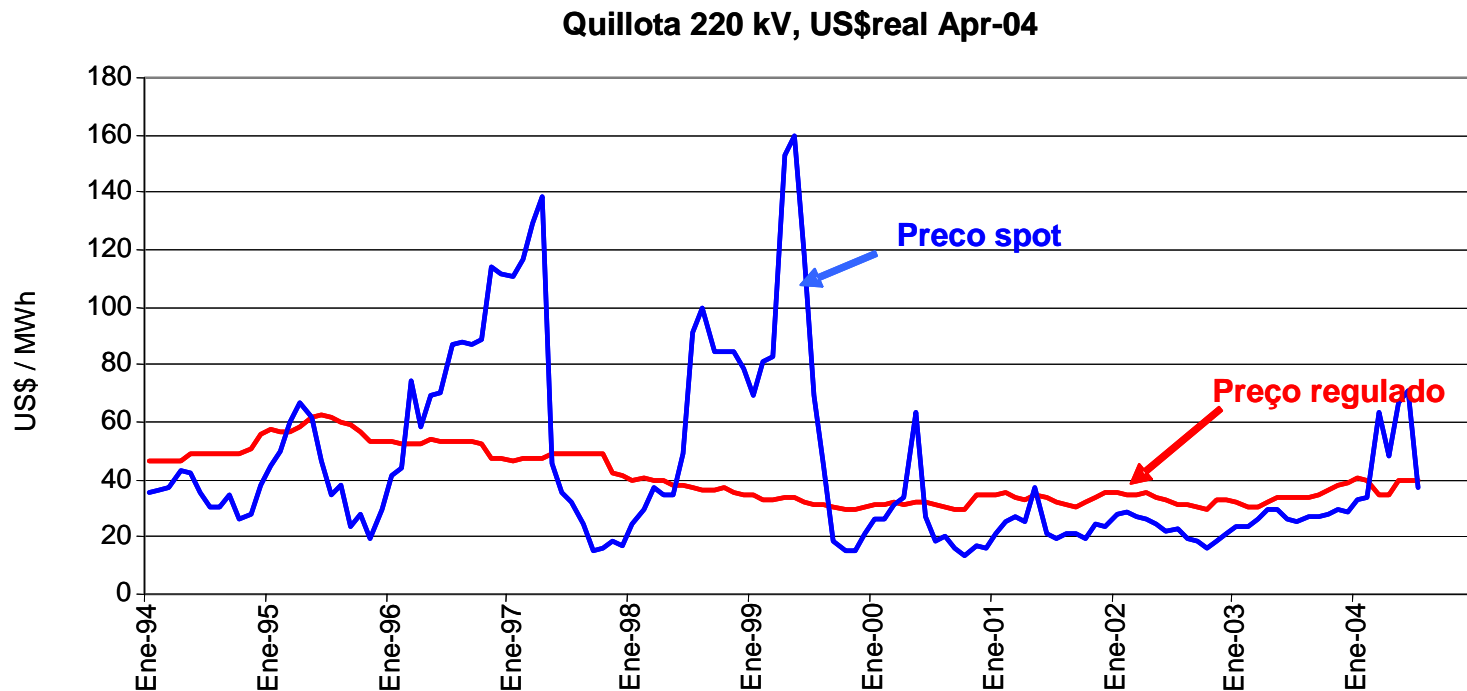


Spot prices all through the chain - previous



Result: uncertainty for G investments

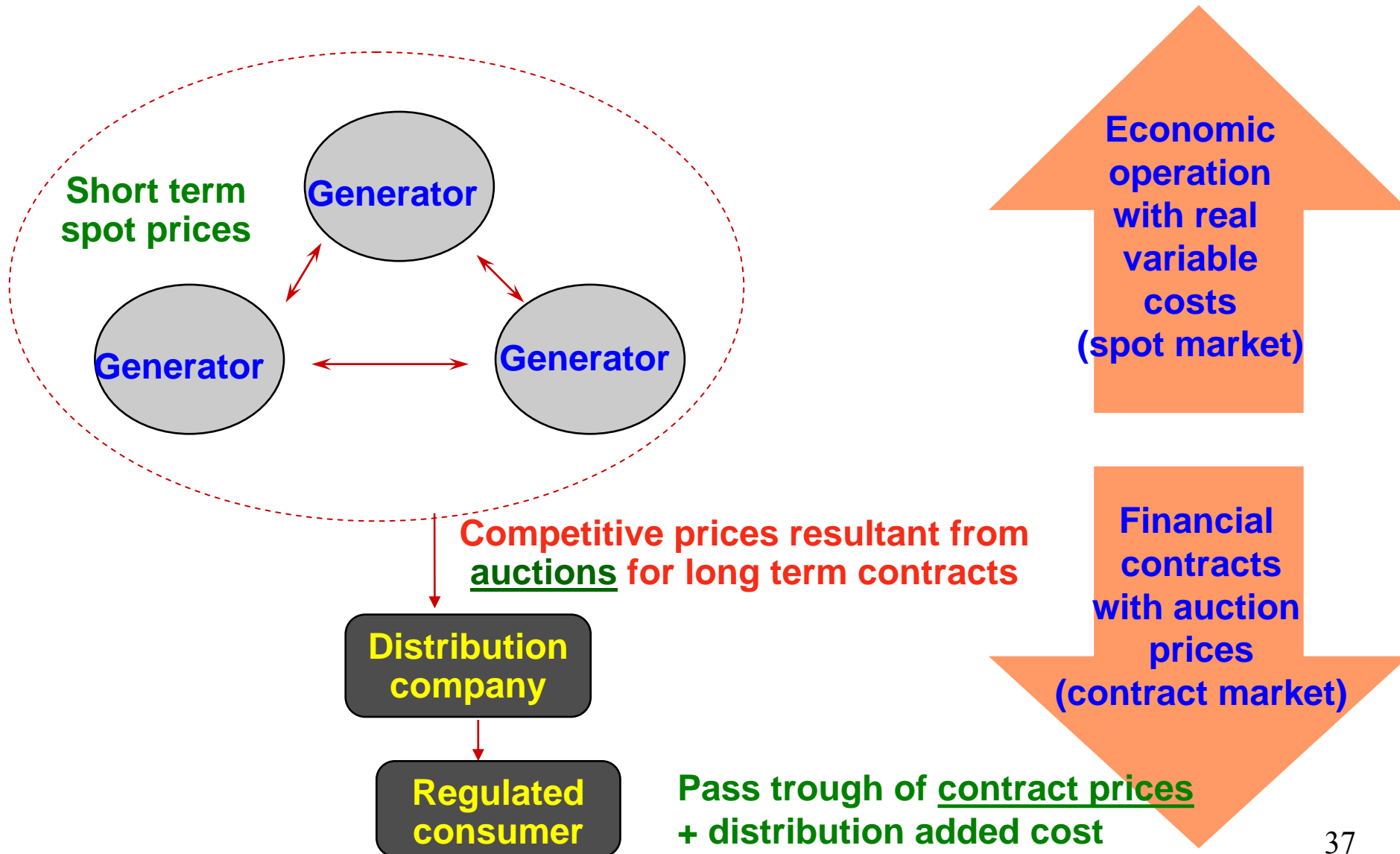
- Market regulation and prices, based on evolution of spot prices and node prices:
 - created uncertainty for future generation investments
 - Lately, node price can not reflect the real cost of generation



New electricity Law (2005)

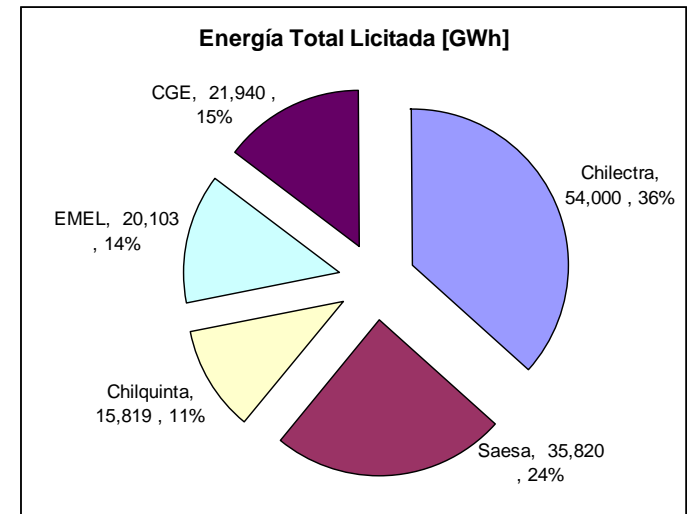
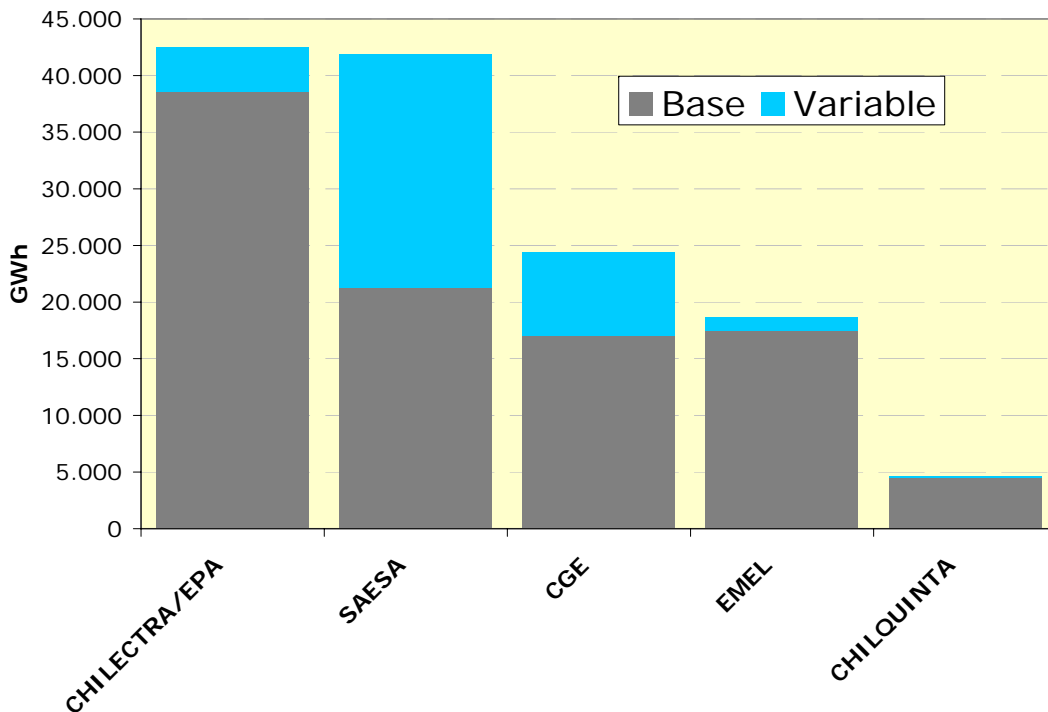
- Chile implemented an auction process where distributors offer up to 15 year contracts to generator investors
- Change of regulation introduced and discontinued node prices to regulated consumers
 - Distributors must be 100% contracted all the time and must contract their energy through auctions
 - Each distributor must design and manage its own auction but several distributors can organize an auction
 - Distributors can offer contracts for 15 years at a fixed price
 - Fixed capacity payments are also offered but regulated

Contracts through market to stabilize revenues- after



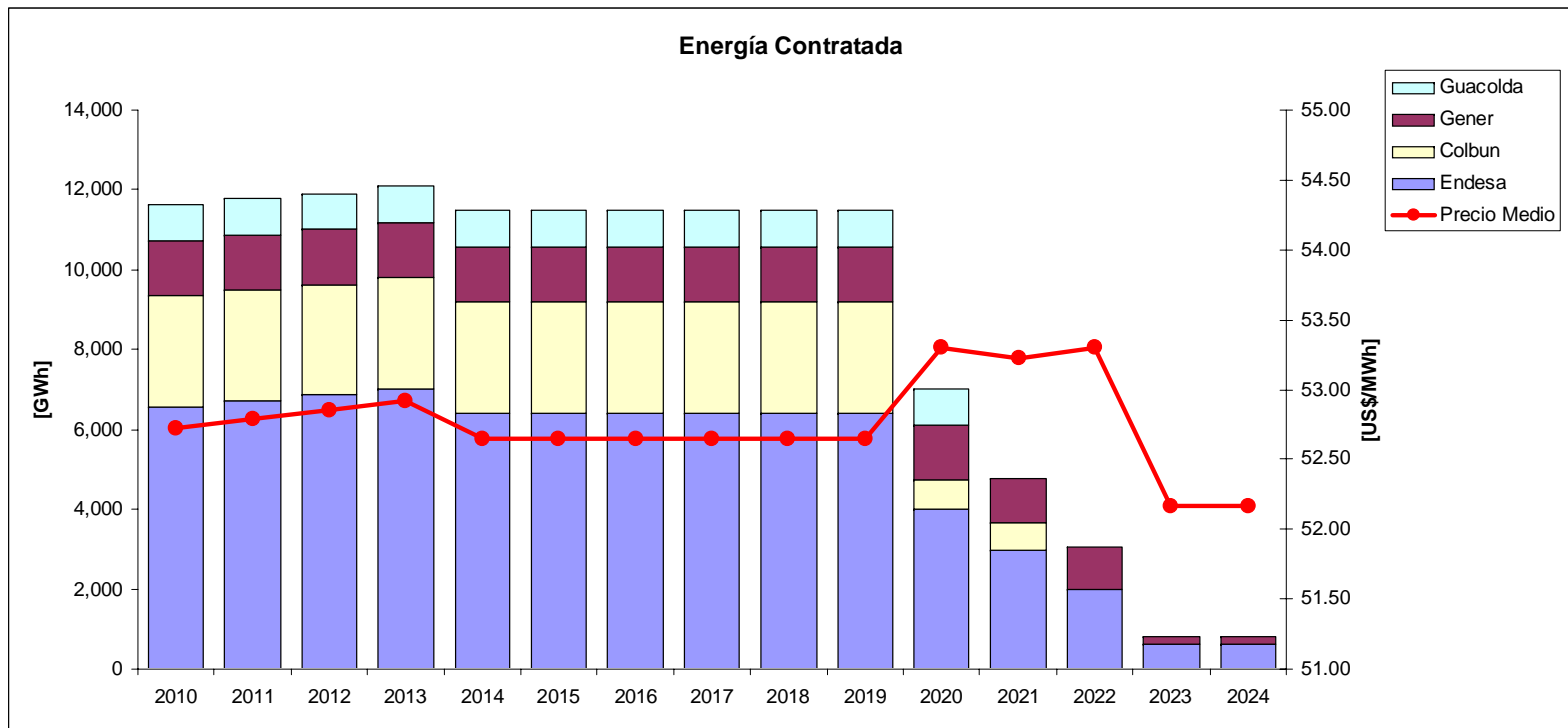
Long term contracts for distribution supply

- Supply starting 1 January 2010, minimum 10 year contracts
- Bids in 31 October 2006
- Chilquinta, Emel, Saesa, CGE Distribución & Chilectra, aprox. 2,000 MW.

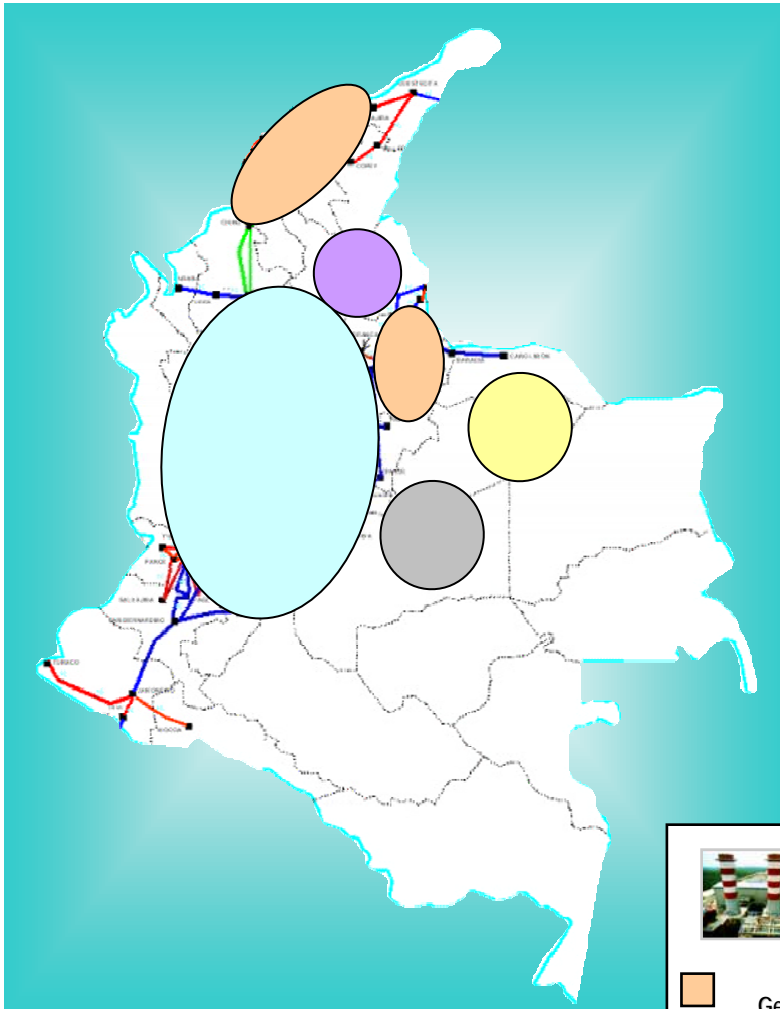


The first Chilean auction: results

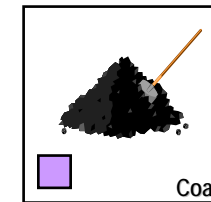
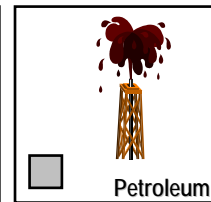
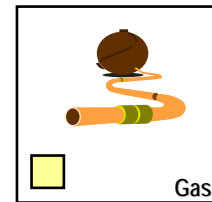
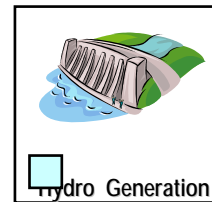
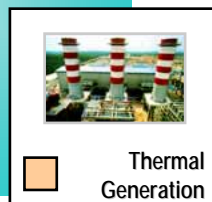
- 90% of auctioned demand coverage
- average energy price: 53 US\$/MWh



Colombia

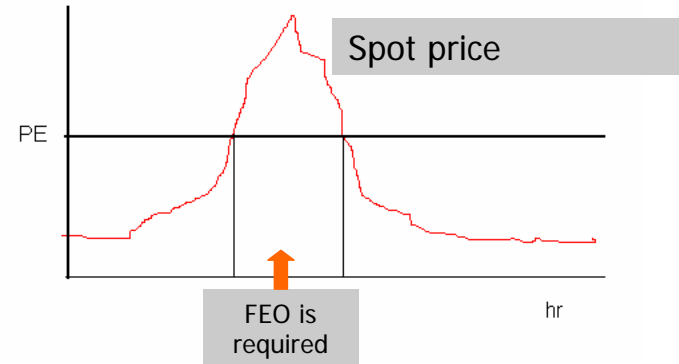


- Installed capacity: 13,300 MW (66% hydro)
- Peak demand: 8,700 MW
- Energy demand: 44 TWh
- Demand growth: 4% per year

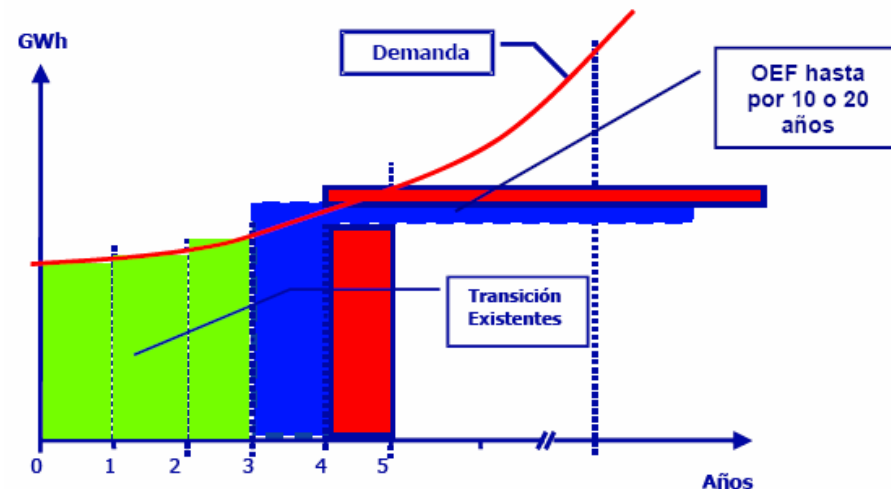


Colombia: auctions for firm energy options

- Auctions of long-term firm energy contracts **to be carried** out in 2007-2008 for delivery in 2010-2011
 - Constant (premium) + energy payment
- Commitment period: 20 years for new generators, auctioned 3 years before



PLANTA O UNIDAD DE GENERACIÓN	DEFINICIÓN	PERIODO DE VIGENCIA DE LA OEF
Nueva	Al momento de ejecutarse la subasta no se ha iniciado la construcción del mismo	Entre 1 y 20 años
Especial	Al momento de ejecutarse la subasta, la planta o unidad de generación se encuentra en proceso de construcción o instalación	Entre 1 y 10 años
Existente	En operación comercial al momento de ejecutarse la subasta	1 año



Conclusions

- The second wave of market reforms in South America is focused on instruments to ensure sufficient capacity and investment to serve reliably its growing economy
- The use of auctions to contract energy is a positive move, as it promotes transparency, reduce risks for investors and increases competition
 - Contracting in advance facilitates project financing
 - Auction design is important to avoid market power and to stimulate the participation of new investors
- Auctions have been attracting a large and quite diversified candidate supply (hydro, gas, coal, sugarcane biomass, international interconnections, oil), which is a positive sign
 - the use of energy call options helped to increase competition

Some References

- Website:
 - <http://www.ccee.org.br> (Brazilian auctions)
 - <http://www.licitacion.cl> (Chilean auctions)
 - <http://www.creg.gov.co> (Colombian auctions)
 - <http://www.ing.puc.cl/power> (info on Latin American deregulation)
- References:
 - [Ensuring Resource Adequacy with Auctions of Options and Forward Contracts](#); L.A. Barroso, H. Rudnick, R. Moreno, B. Bezerra - IEEE PES General Meeting 2007, Tampa, USA.
 - [The Challenge Of Conciliating Energy Development & Environmental Constraints In South America](#); L.A. Barroso; H. Rudnick, S. Mocárquer, T. Castro - IEEE Power and Energy Magazine, Vol 4, July-Aug 2006.
 - [Contract auctions to assure supply adequacy in an uncertain energy environment](#), H. Rudnick; S. Mocarquer, IEEE General Meeting 2006, Montreal, Canada
 - [Auctions of Contracts and Energy Call Options to Ensure Supply Adequacy in the Second Stage of the Brazilian Power Sector Reform](#); L.A. Barroso, B. Bezerra, A. Guimarães, J. Rosenblatt, M.V. Pereira - IEEE PES General Meeting 2006, Montreal, Canada.
 - [Energy Call Options Auctions for Generation Adequacy in Brazil](#); B. Bezerra, L.A. Barroso, S. Granville, A. Guimarães, A. Street, M.V. Pereira - IEEE PES General Meeting 2006, Montreal, Canada
 - [South American reform lessons - twenty years of restructuring and reform in Argentina, Brazil, and Chile](#); H. Rudnick; L.A. Barroso; C. Skerk; A. Blanco - IEEE Power and Energy Magazine, Vol 3, July-Aug 2005.

Thank you!

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