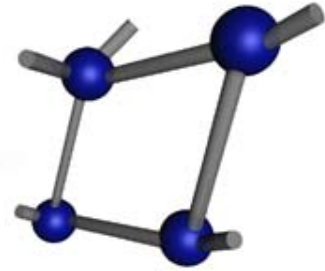


Energy Auctions Chilean Experience: process and lessons



Sebastian Mocarquer
Hugh Rudnick

Overview



- Chilean system description
- Contract scheme before auction mechanism
- The need for energy auctions
- Regulatory reforms
- Design and implementation of energy auctions mechanism
- Results and conclusions

System description

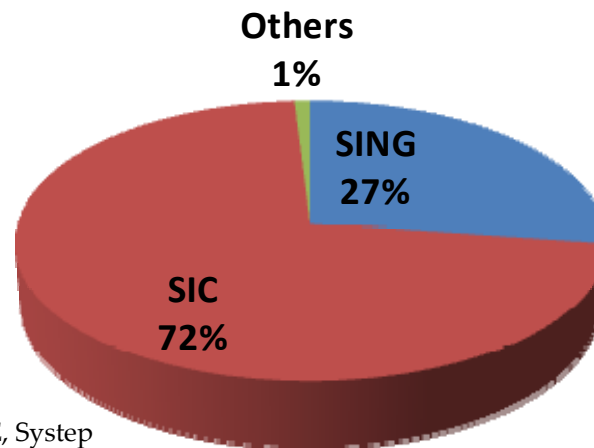
➤ Norte Grande Interconnected System (SING)

- ❑ 90% mining and industry
- ❑ 99.6% thermal generation

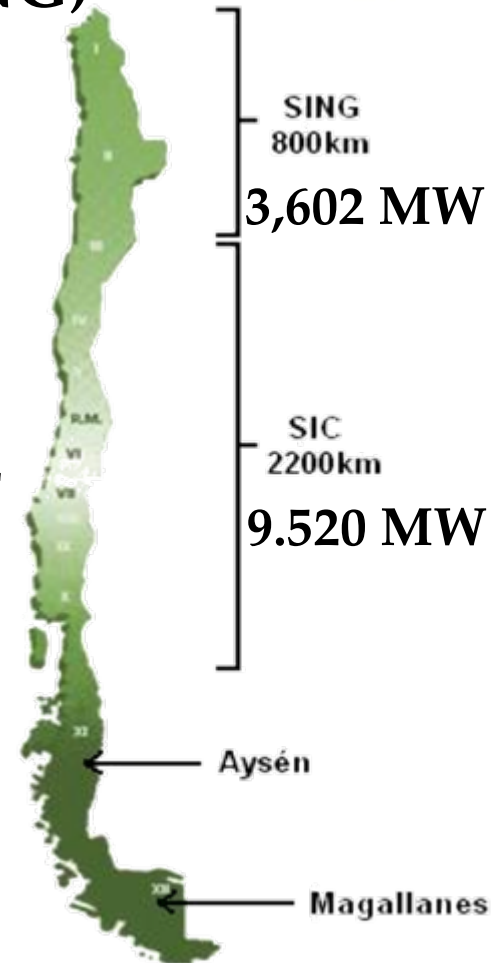
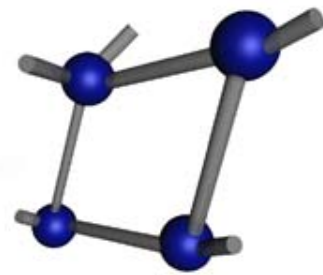
➤ Central Interconnected System (SIC)

- ❑ 60% residential
- ❑ 90% of total population
- ❑ 55% hydraulic, 44% thermal, 1% other

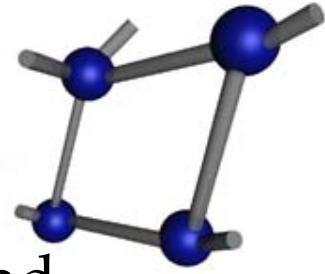
**Installed
Capacity**



Source: CNE, Systeop

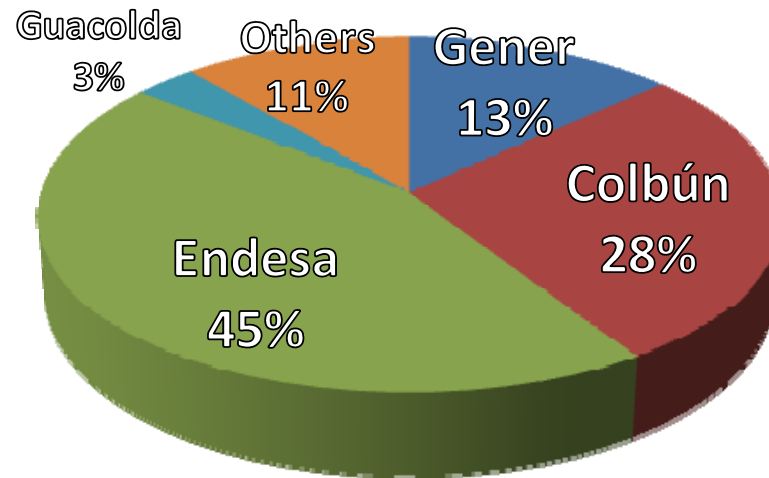


Market description



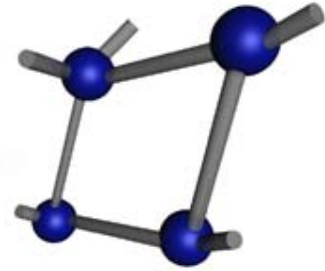
- High (though uncertain) growing rates of demand
- Mainly hydraulic generation
- High dependence on foreign primary energy sources
- Generation market is competitive, but dominated by four companies

**Installed capacity
by company
in SIC**

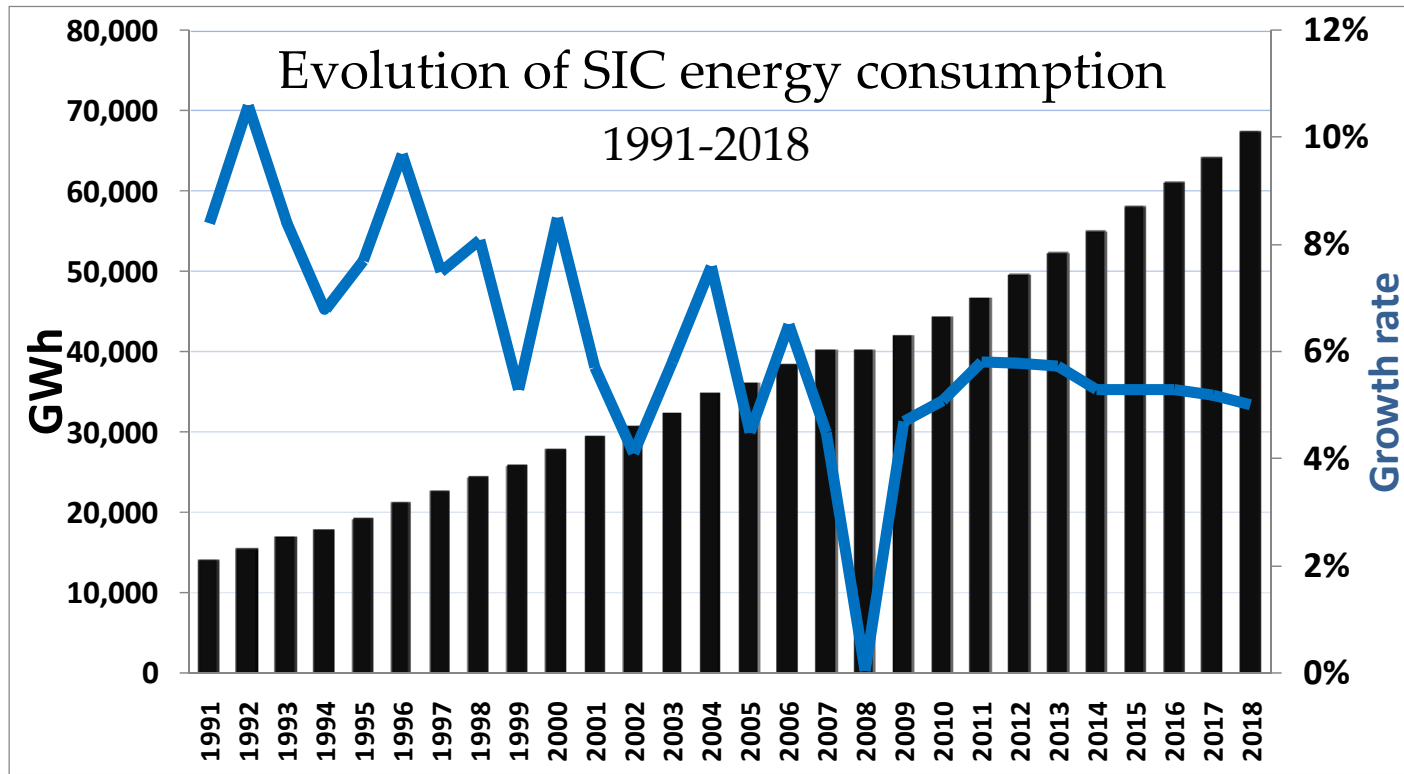


Source: CDEC-SIC, SysteP

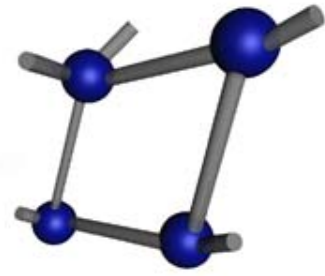
Demand evolution



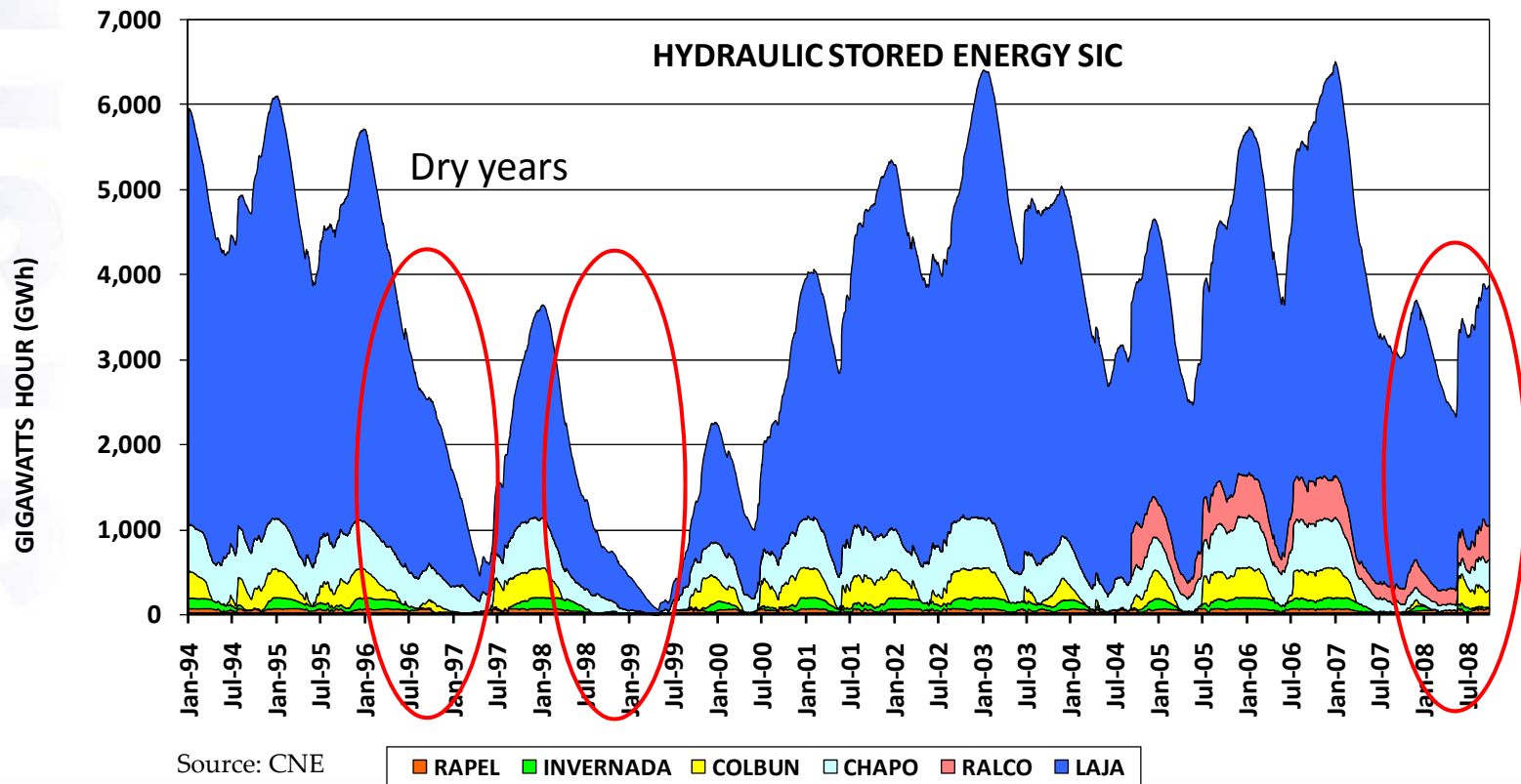
- Energy growth 4% to 6% per year
- As in developing countries, high correlation between energy growth and GDP growth



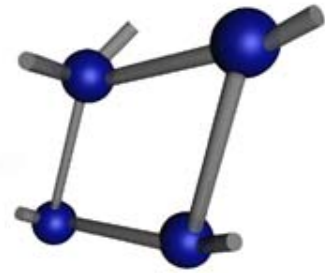
Hydrology



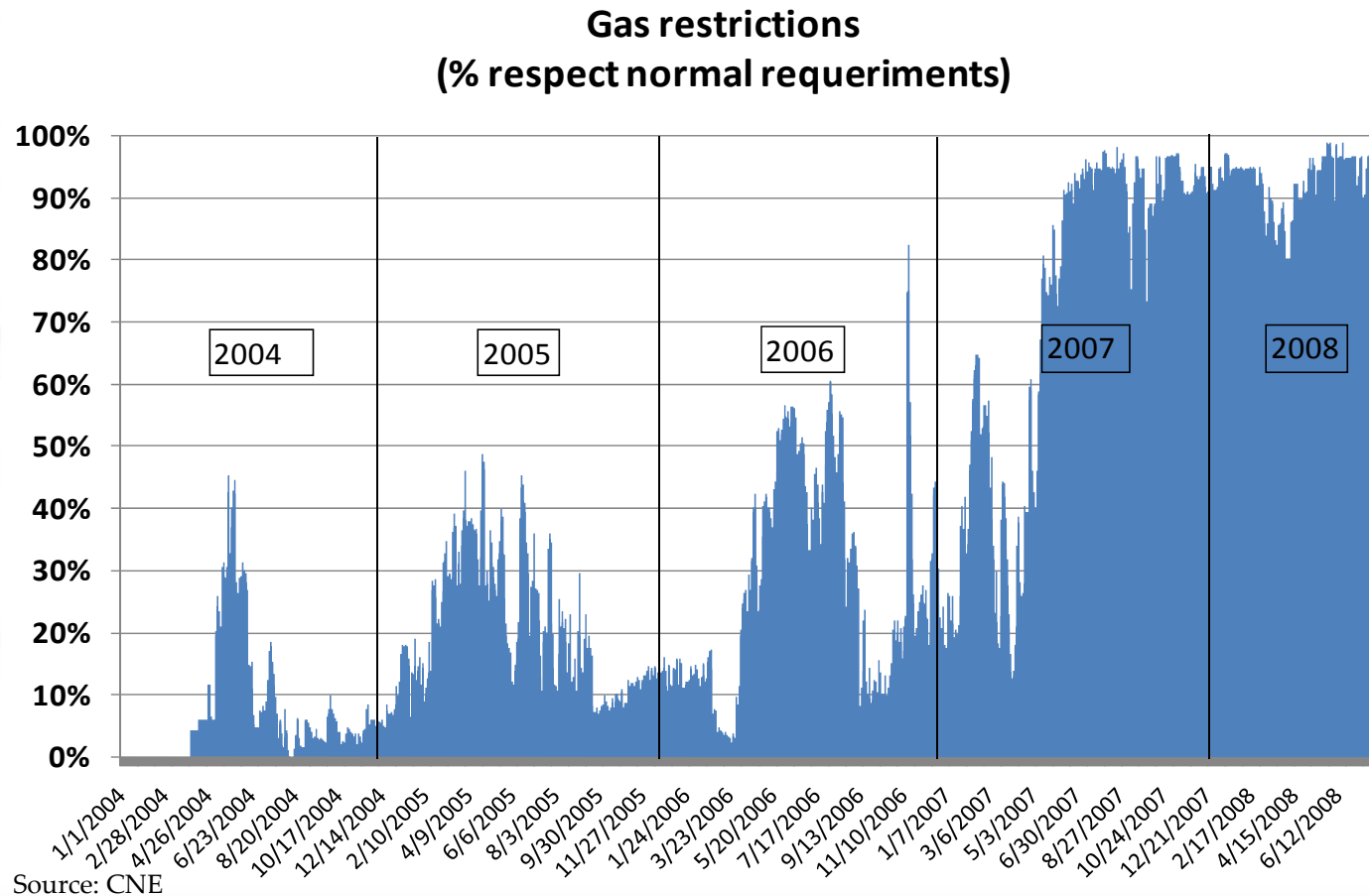
- SIC system generation highly depends of hydrology
- Prolonged droughts can drive to supply crisis



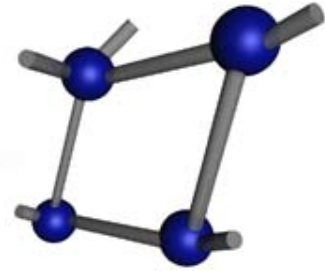
Gas restrictions



- Uncertainty of natural gas supply from Argentina

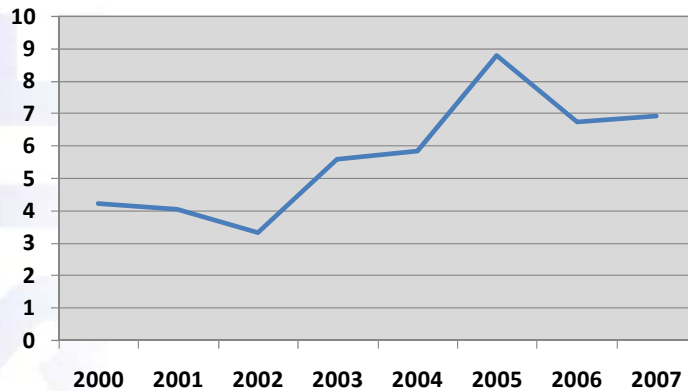


Fuel Prices



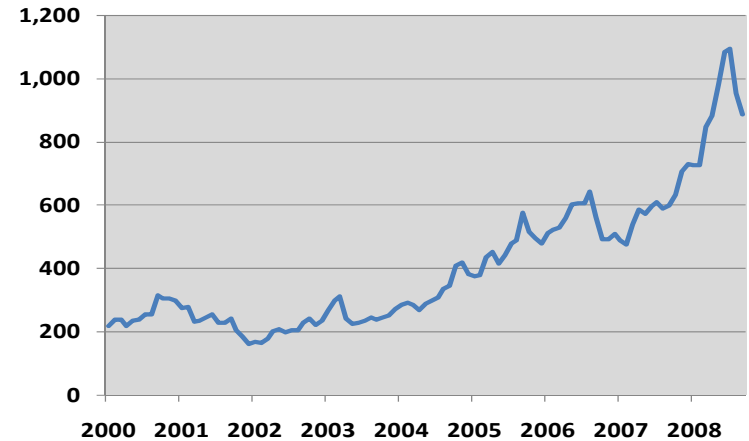
➤ Rising cost of alternative energy sources

Gas Natural (US\$/MM BTU)



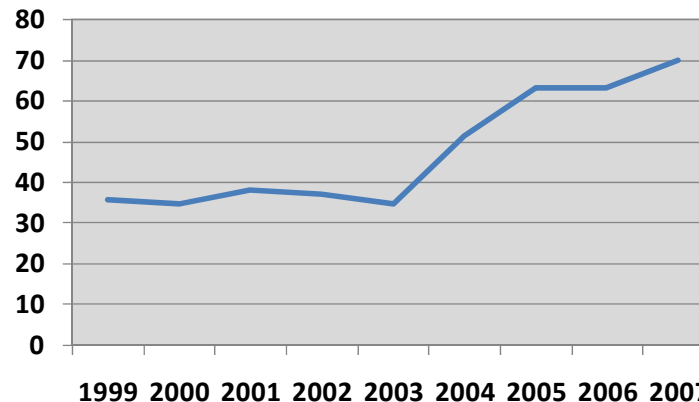
Source: Henry Hub prices, BP Statistical Review of World Energy

Diesel (US\$/m3)



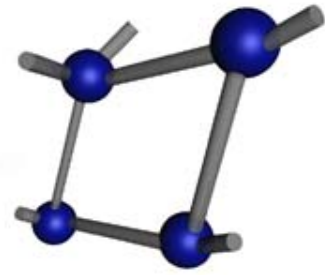
Source: CNE

Coal (US\$/ton)

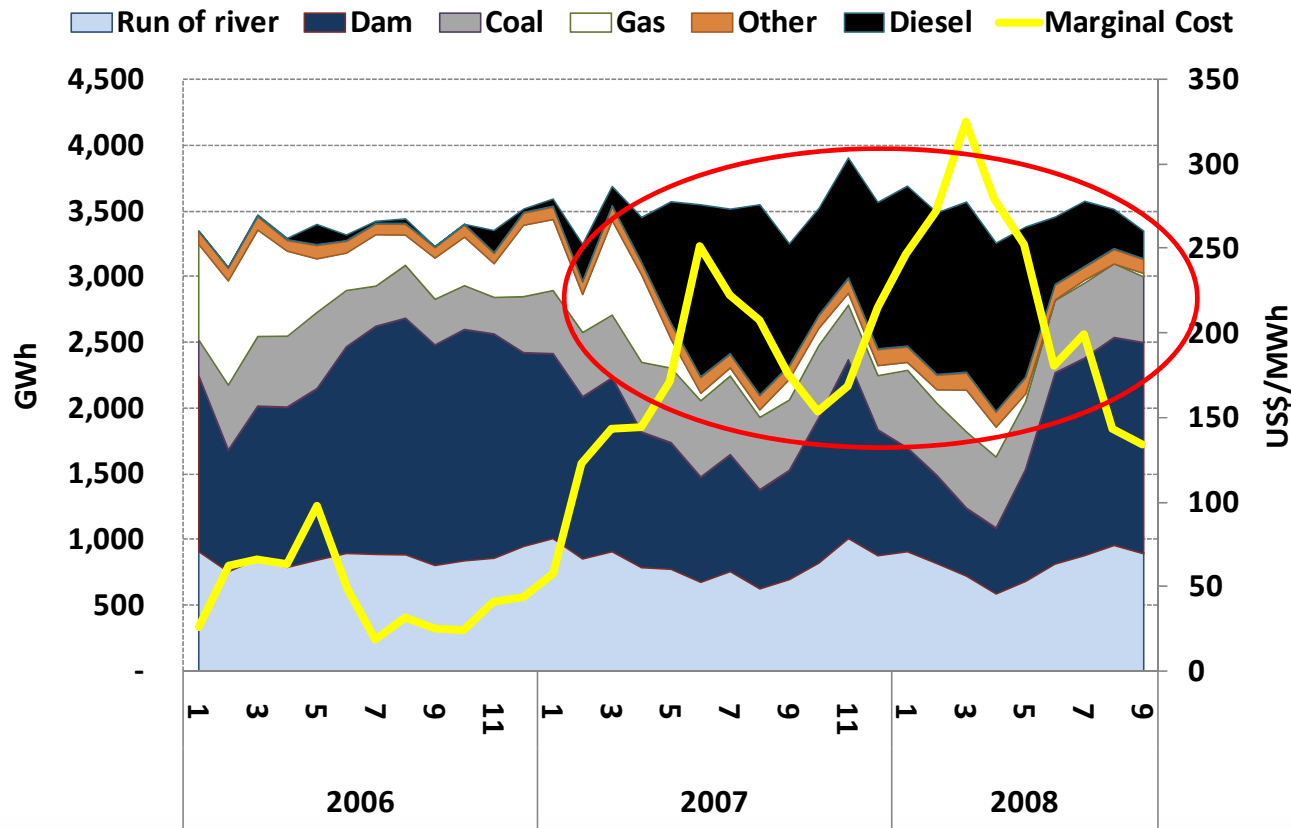


Source: Japan steam coal prices, , BP Statistical Review of World Energy

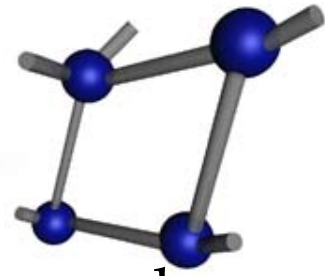
Generation portfolio



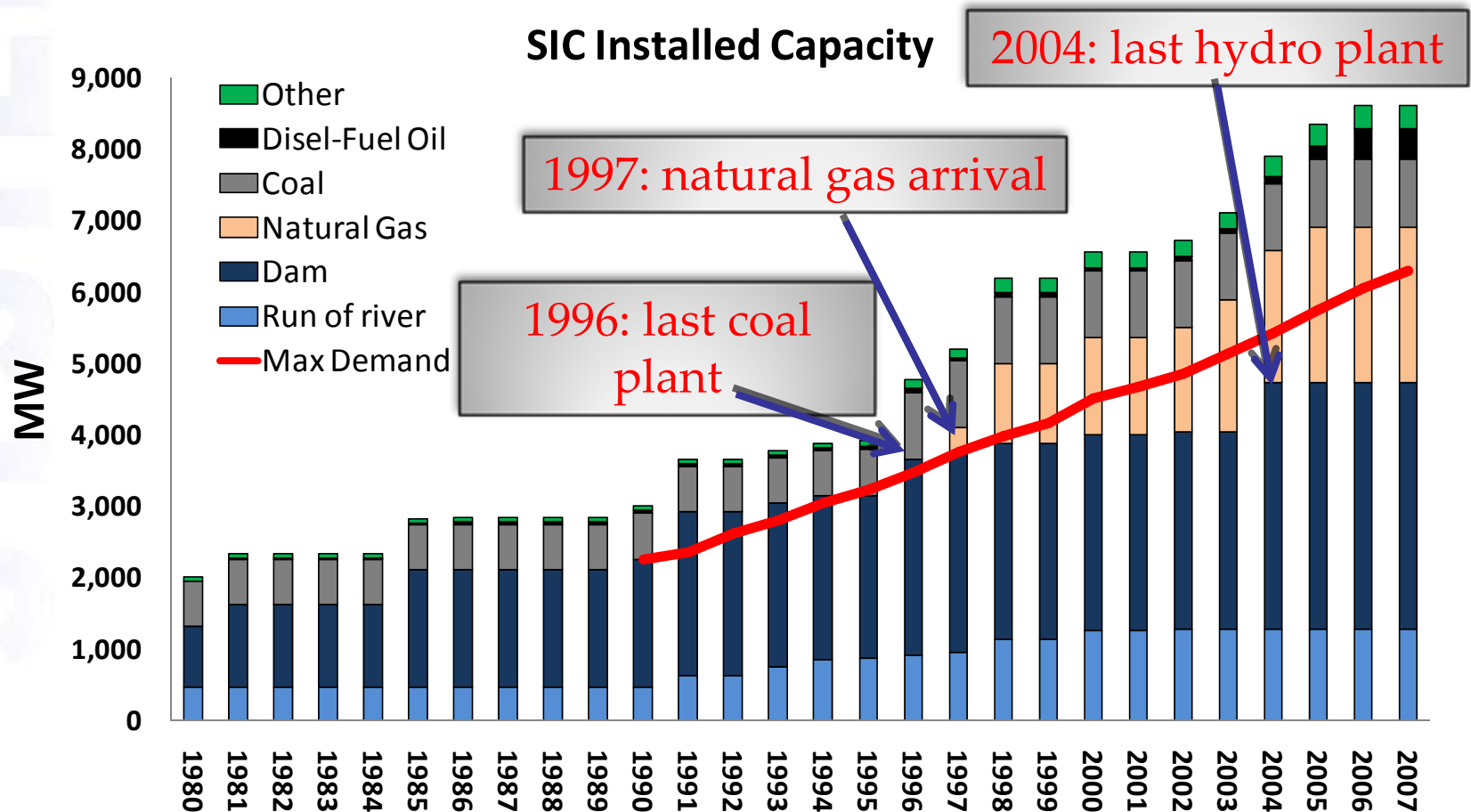
- Diesel replaced Natural Gas
- Inclusion of expensive units whose implementation is fast



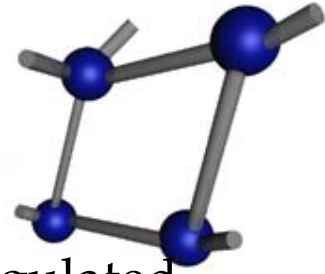
Generation Investment



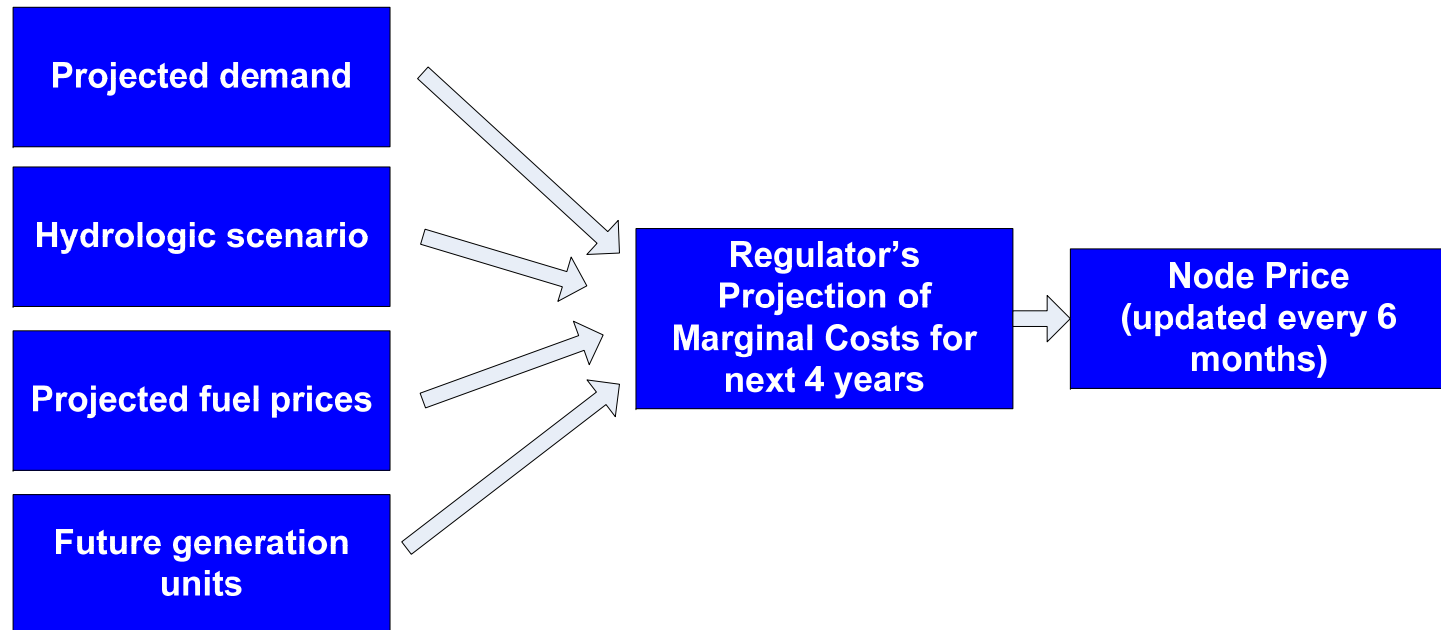
- Investment rate and demand growth were unbalanced



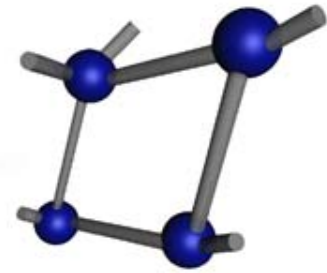
Contract scheme before auctions



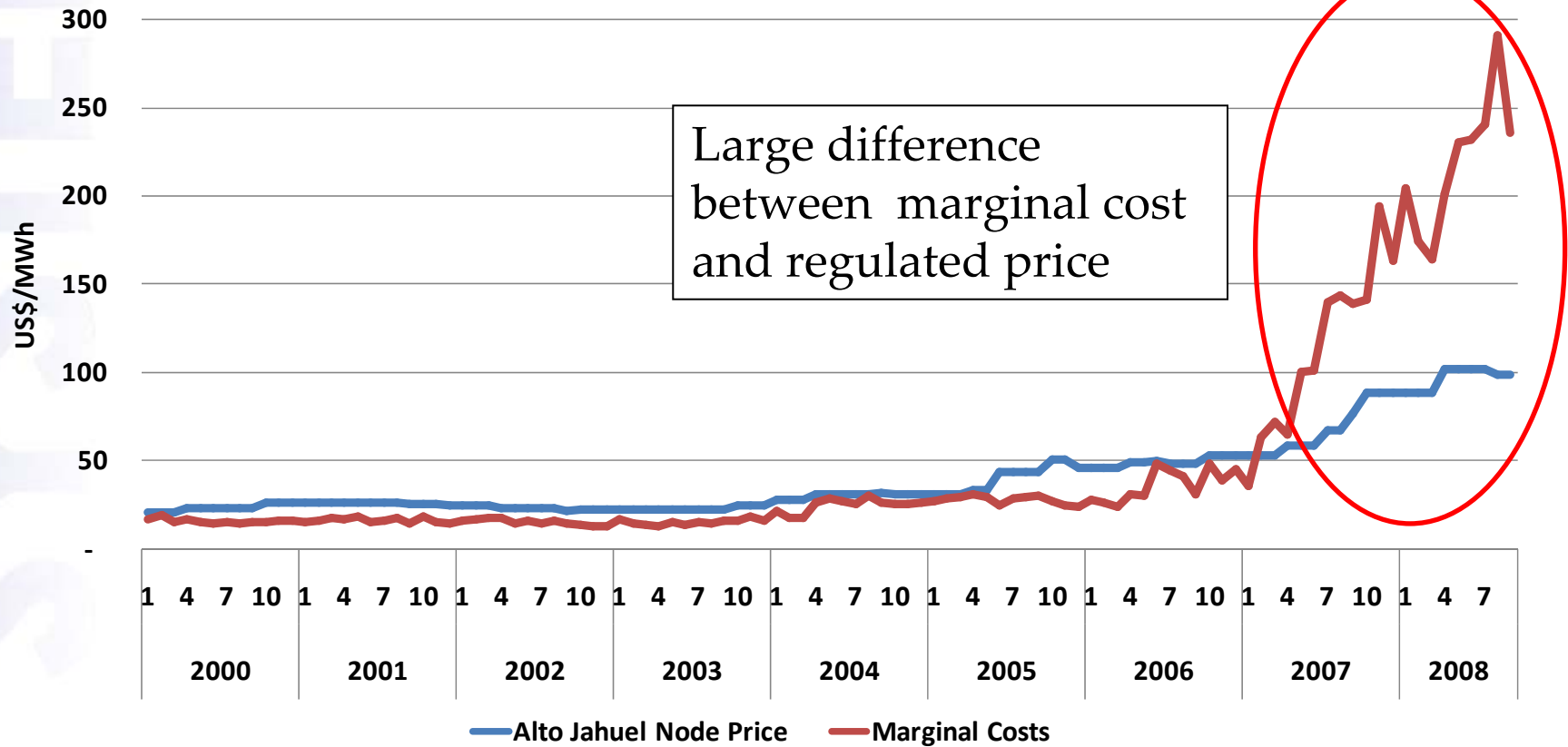
- Supply for regulated costumers was contracted at fixed regulated price (Node price)
- Node price: Regulator's projection of future marginal cost, updated every 6 months
- Unstable long-term price signal



Energy prices

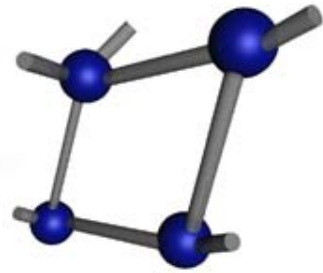


Node Price vs Marginal Costs

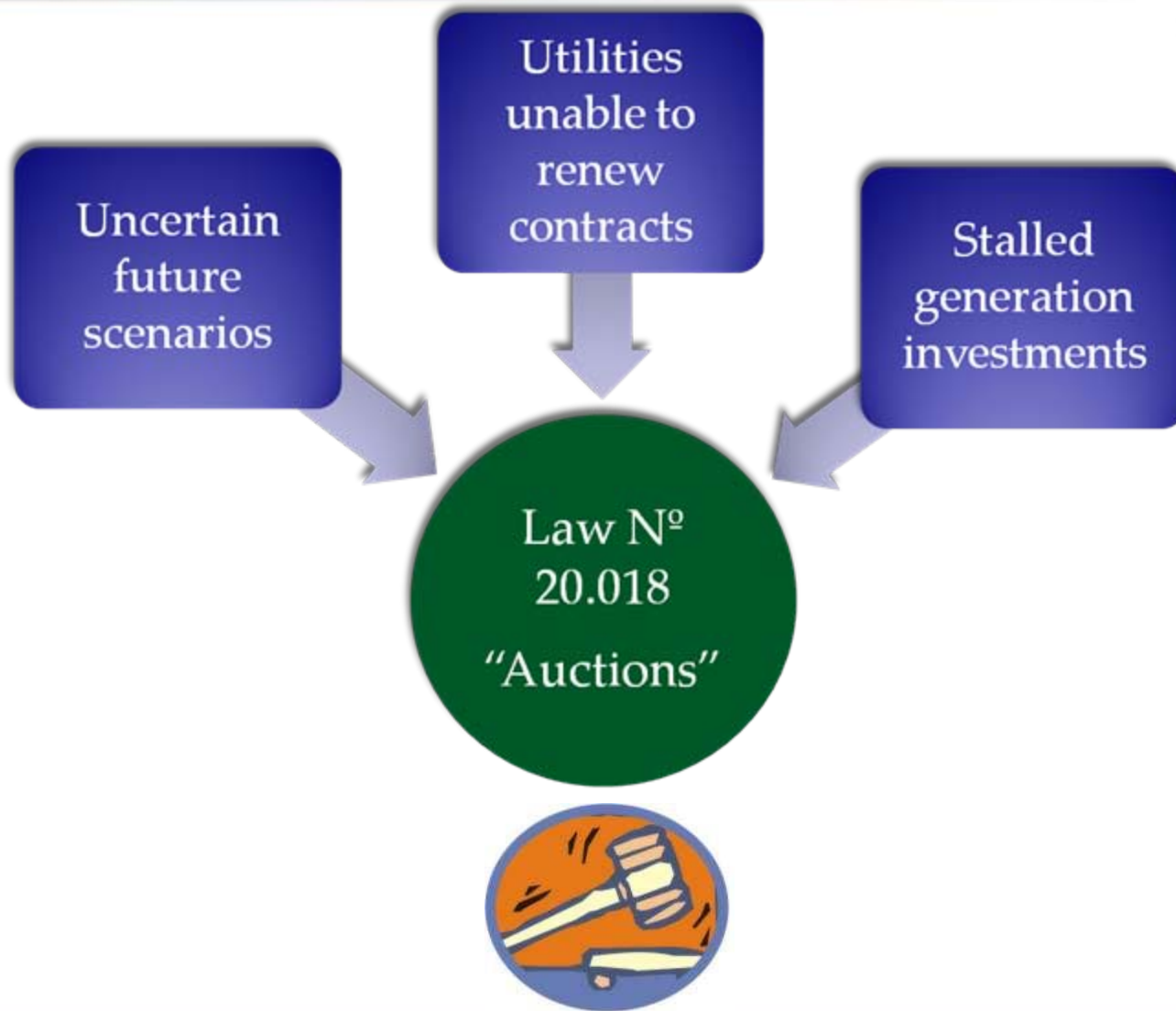
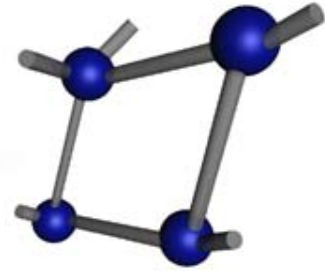


Source: CNE 2008

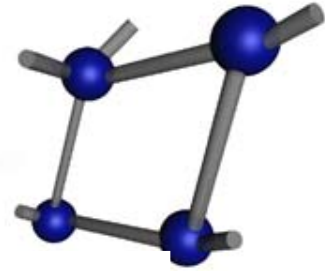
Drivers for reforms



Regulatory Reform

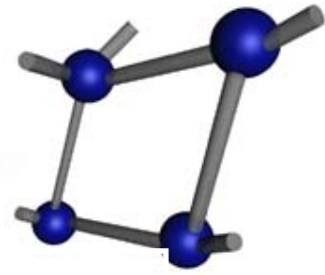


Auction mechanism



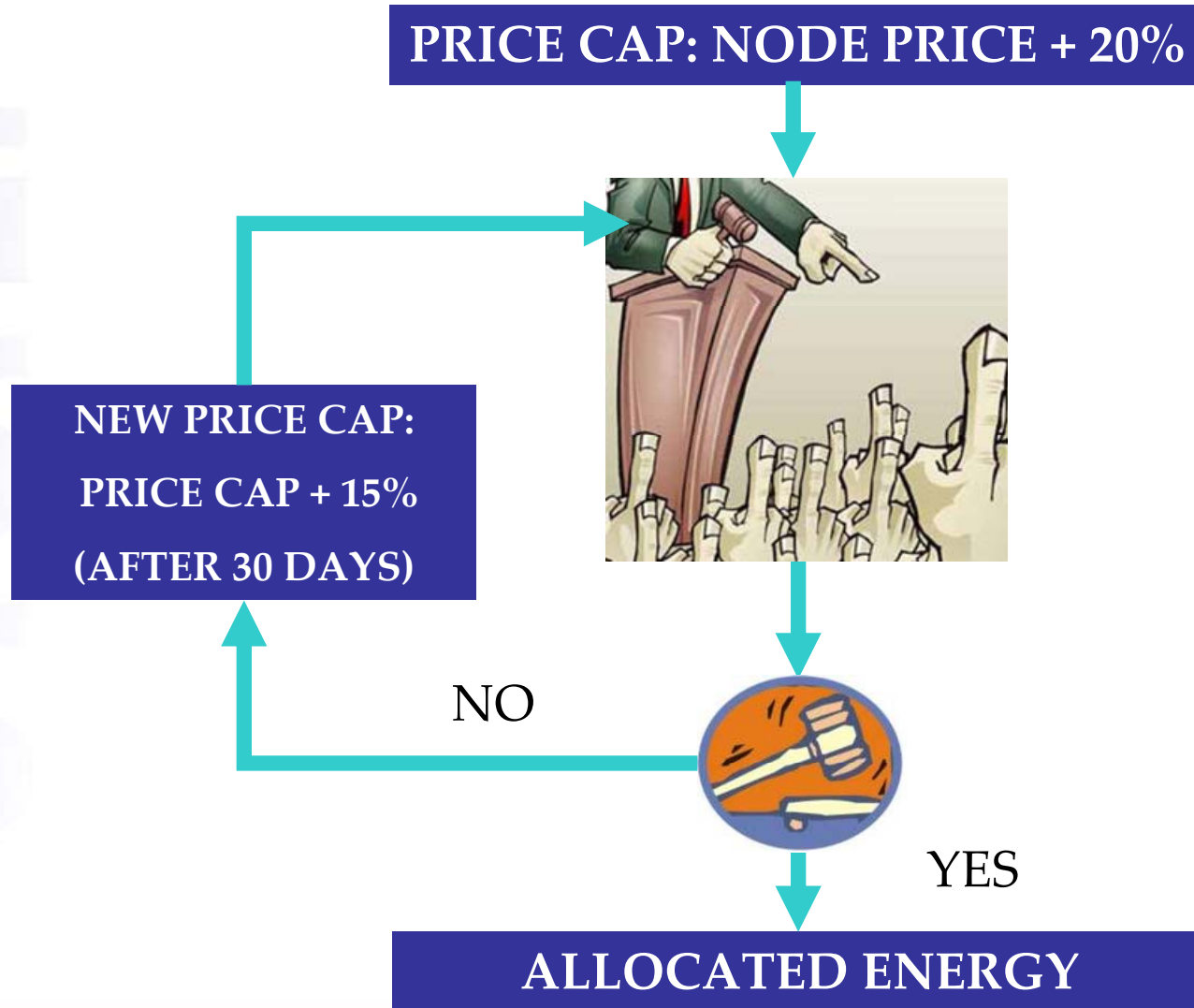
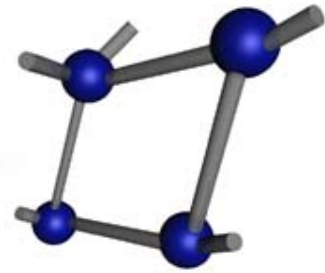
- Law N° 20.018 allows Distribution Utilities to contract their energy requirements by means of competitive auctions (price defined by auctions)
 - ❑ Replaces volatile spot prices as market signal for expansion
 - ❑ Long-term signal prices based on real cost expectation from generation companies
 - ❑ New generation capacity is backed with long-term supply contracts, reducing risk.

Auction mechanism

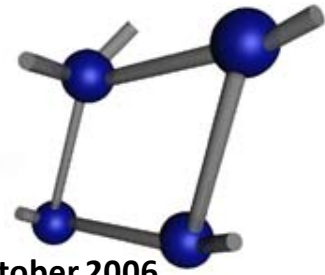


- Open and competitive bidding process
 - ☐ First price sealed bid auction
 - ☐ 100% of demand must be contracted all the time
 - ☐ Contracts for 15 year period
 - ☐ Contracts for base and variable energy supply
 - ☐ Demand is divided in blocks to allow partial supply offers
 - ☐ Utilities may group to allocate larger demand blocks
 - ☐ Indexation formulas are established by generators

Auction mechanism



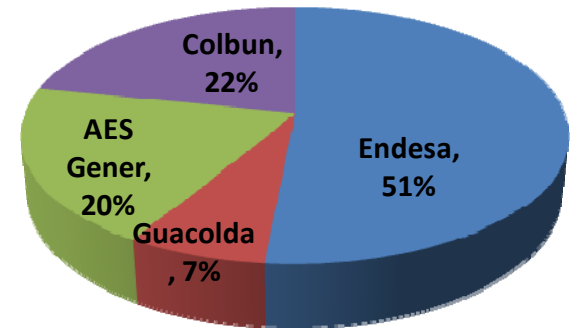
Auction Process



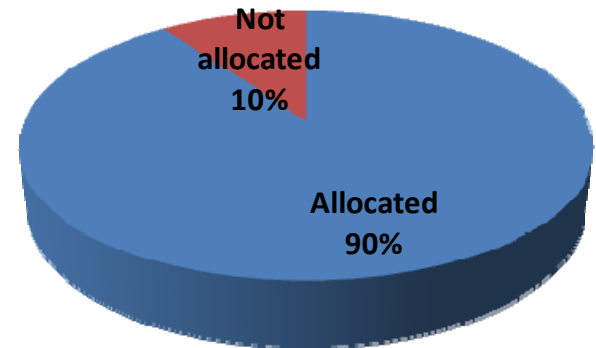
Auction 1, October 2006

| | |
|------------------------|---------------|
| Total energy: | 14,170 GWh |
| Allocated energy: | 12,766 GWh |
| Price cap: | 61.7 US\$/MWh |
| Mean allocation price: | 52.8 US\$/MWh |

First Auction October 2006
by Generators



Auction 1



Energy Not-allocated : 1,404 GWh

Source: CNE Oct 2008

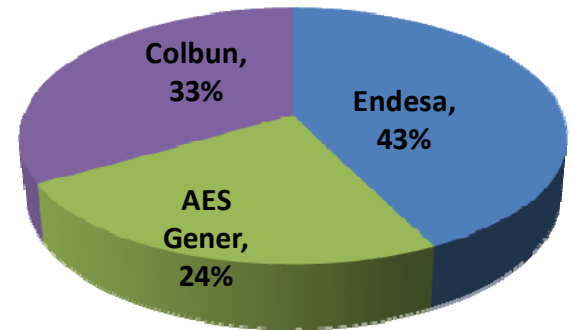
Auction Process



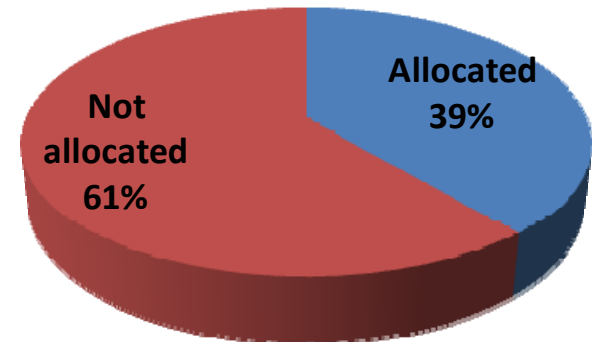
Second Auction October 2007
by Generators

Auction 2, October 2007

| | |
|------------------------|---------------|
| Total energy: | 14,732 GWh |
| Allocated Energy: | 5,700 GWh |
| Price cap: | 62.7 US\$/MWh |
| Mean allocation price: | 61.2 US\$/MWh |



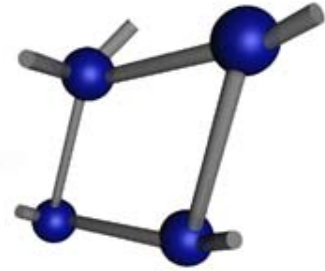
Auction 2



**Total Energy Not-allocated:
9,032 GWh**

Source: CNE Oct 2008

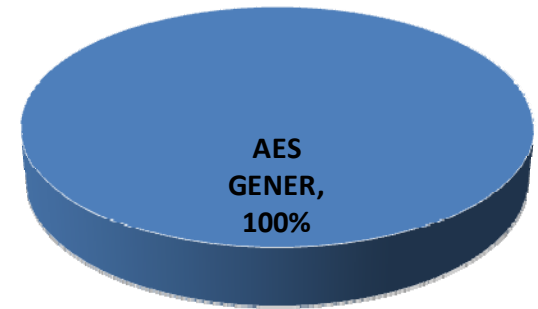
Auction Process



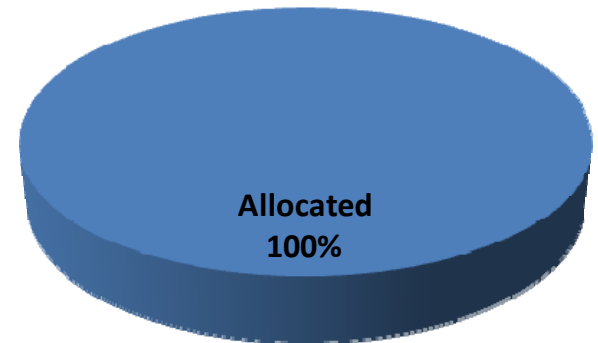
Auction 2.2, Second bidding, March 2008

Second Auction, second bidding
March 2008
by Generators

| | |
|------------------------|----------------|
| Total energy: | 1,800 GWh |
| Allocated energy: | 1,800 GWh |
| Price cap: | 71.06 US\$/MWh |
| Mean allocation price: | 65.5 US\$/MWh |



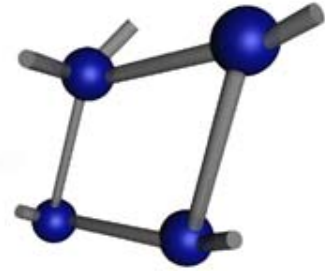
Auction 2.2



**Total Energy Not-allocated:
7,232 GWh**

Source: CNE Oct 2008

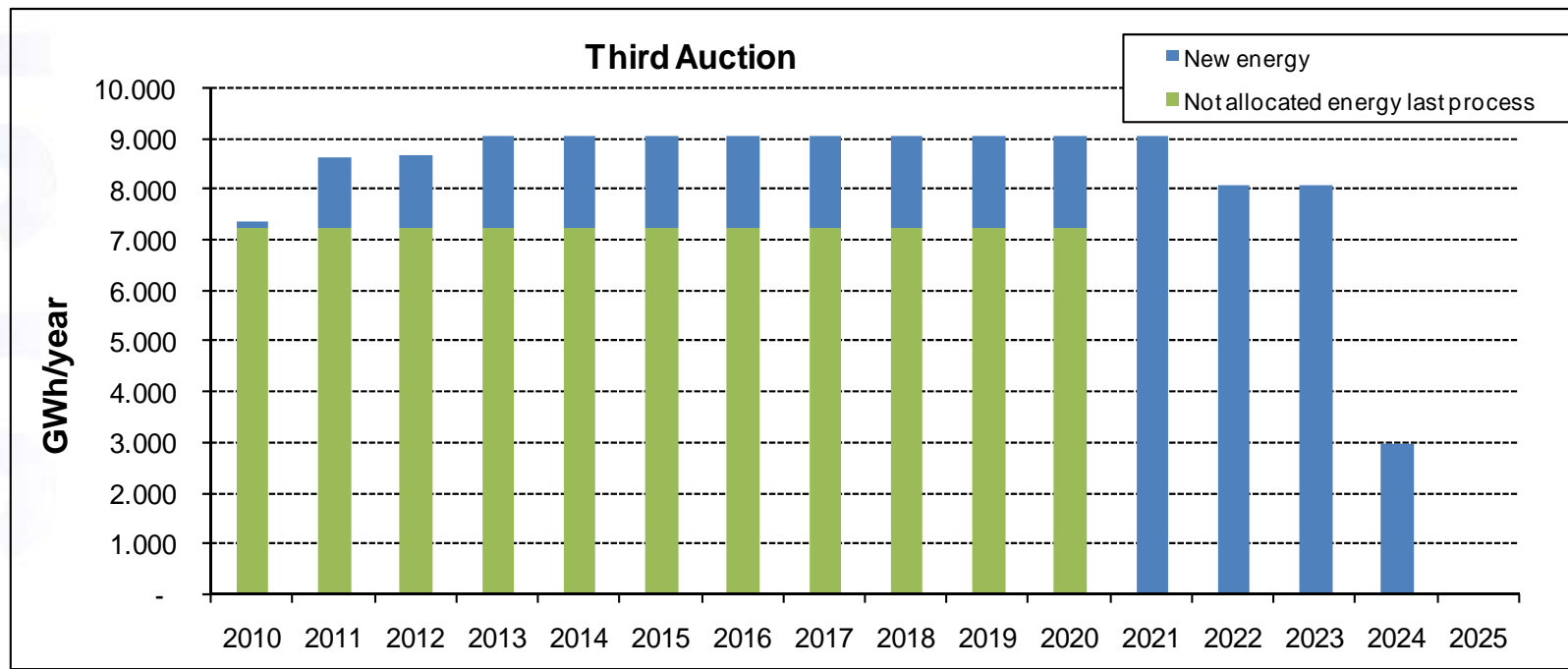
Auction Process



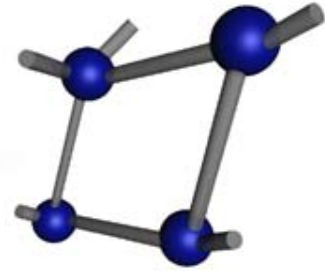
Auction 3: delayed until december 2008 !

Estimated price cap : 125,2 US\$/MWh

Supply begins: 2010



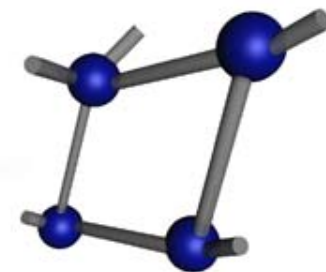
Ex-post evaluation



➤ Was auction mechanism successful in Chile?

- ☐ Did energy price reach equilibrium?
- ☐ Was all energy allocated?
- ☐ Did generation investment grow?
- ☐ Did new competitors enter the market?

Effect on energy price



➤ Bidding prices

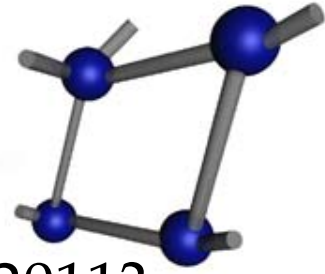
| Auction date | GenCo | Bid price (US\$/MWh) | Indexed bid price sept 08 (US\$/MWh) | Supply begins | Average price sept 08 (US\$/MWh) |
|-------------------|-----------|----------------------|--------------------------------------|---------------|----------------------------------|
| Auction 1 2006 | Endesa | 50.8 | 71.6 | 2010 | 94.2 |
| | AES Gener | 56.4 | 130.1 | | |
| | Colbun | 53.9 | 111.6 | | |
| | Guacolda | 55.1 | 99.8 | | |
| Auction 2 2007 | Endesa | 61.0 | 69.3 | 2011 | 65.9 |
| | Colbun | 58.2 | 60.3 | | |
| Auction 2.2 | AES Gener | 65.8 | 67.5 | | |

➤ Large price gap between 2010 and 2011 energy blocks

**Average Indexed price
Sept 2008 (US\$/MWh)**

| Supply 2010 | Supply 2011 | Δ |
|----------------|----------------|------------|
| 94.2 | 65.9 | 30% |

Effect on energy price



➤ What causes price difference between 2010 and 2011?

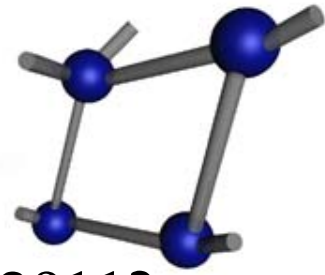
❑ Indexation Formulas

| Indexation | | | | | Supply begins |
|------------|------|------|-----|--------|---------------|
| GenCo | CPI | Coal | LNG | Diesel | |
| AES Gener | 31% | 69% | 0% | 0% | 2010 |
| Colbún | 30% | 45% | 0% | 25% | |
| Endesa | 70% | 15% | 15% | 0% | |
| Guacolda | 60% | 40% | 0% | 0% | |
| AES Gener | 100% | 0% | 0% | 0% | 2011 |
| Colbún | 100% | 0% | 0% | 0% | |
| Endesa | 70% | 0% | 30% | 0% | |

| Average Indexation parameters | | | | |
|-------------------------------|-----|------|-----|--------|
| Supply begins | CPI | Coal | LNG | Diesel |
| 2010 | 52% | 34% | 8% | 6% |
| 2011 | 87% | 0% | 13% | 0% |

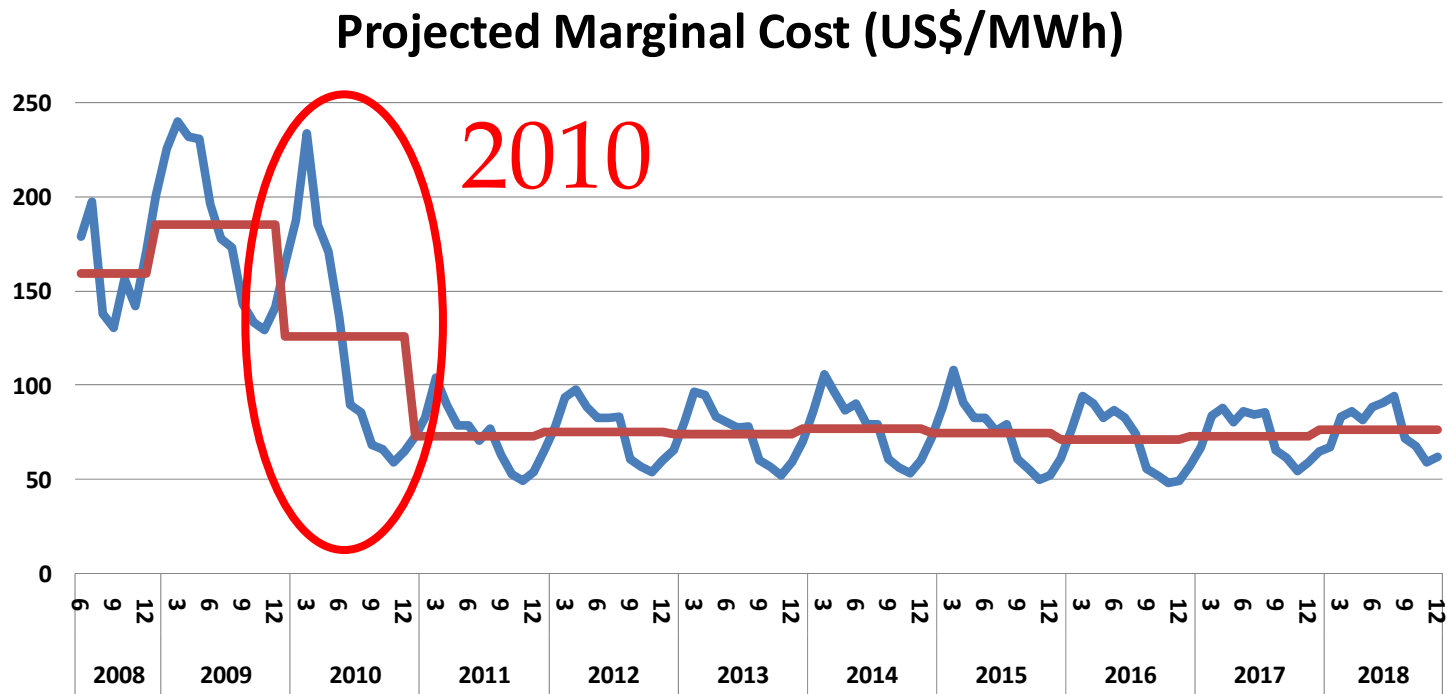
➤ Coal indexation leads to higher future prices

Effect on energy price



➤ What causes price difference between 2010 and 2011?

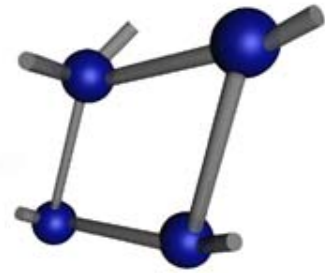
- ❑ Additional risk for supply contracts starting on 2010



Source: Syste

— Alto Jahuel 220 — Annual Averages

Effect on energy price

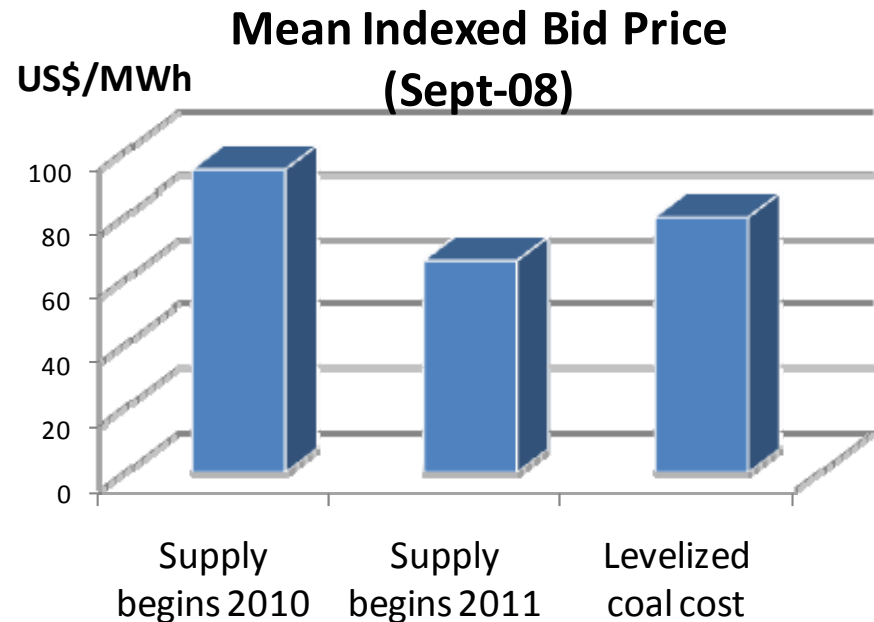


- Auction prices according to market expectations, specially after 2011

Levelized cost of a coal generation unit

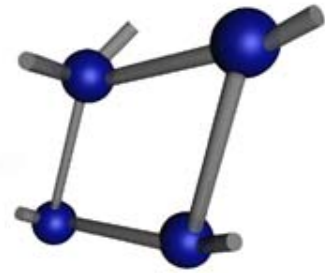
| Costs for Coal Unit 350 MW | | |
|----------------------------|-----------------|----------------|
| Capacity | MW | 350 |
| Own consumption | % | 6% |
| Real capacity | MW | 329 |
| Investment cost | US\$/kW | 2,000 |
| Connection investment | miles US\$ | 7,000 |
| Port Investment | miles US\$ | 20,000 |
| Total investment | miles US\$ | 727,000 |
| Plant factor | % | 85% |
| Coal cost | US\$/ton | 100 |
| NCVC | US\$/MWh | 4 |
| Levelized cost | US\$/MWh | 79.7 |

Source: Systep

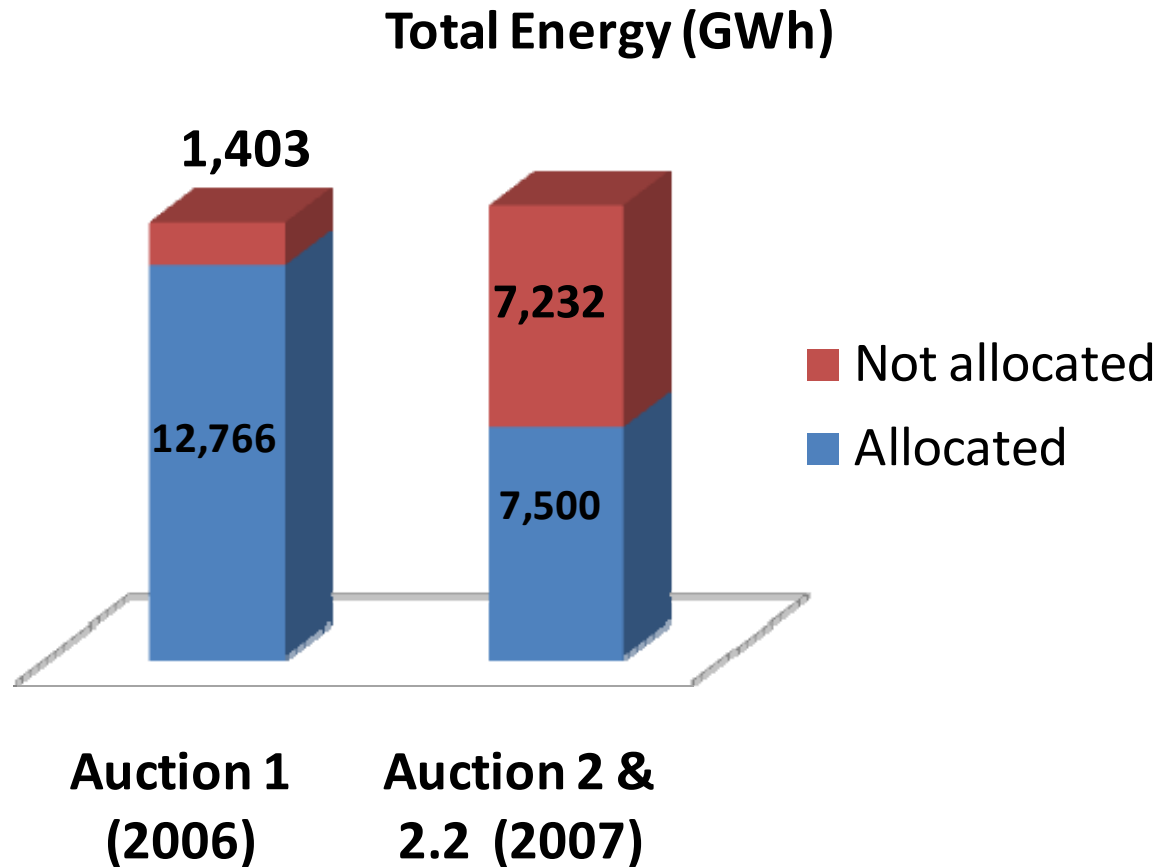


Source: CNE

Allocated energy

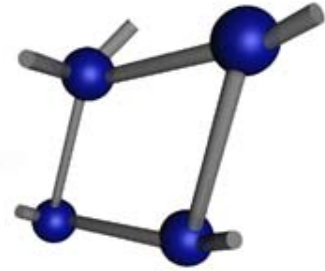


- Auctions allocated 70% of energy up to date



Source: CNE Oct 2008

New investments

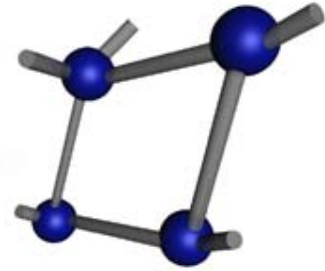


- SIC capacity will expand 6,757 MW (71%) next ten years
- Only one unit (342 MW) is directly backed by auctions

| Year | MW | | | |
|-------|-------|-----|--------|-------|
| | Coal | Gas | Diesel | Hydro |
| 2008 | - | - | 373 | - |
| 2009 | 139 | 240 | 232 | 155 |
| 2010 | 924 | - | - | 172 |
| 2011 | 482 | - | - | 327 |
| 2012 | 445 | - | - | 553 |
| 2013 | - | - | - | 705 |
| 2014 | 250 | - | - | 660 |
| 2015 | - | - | - | - |
| 2016 | 300 | - | - | 500 |
| 2017 | 300 | - | - | - |
| TOTAL | 2.840 | 240 | 605 | 3.072 |

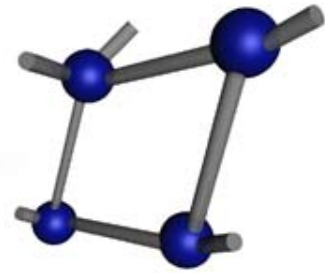
Source: CNE, Node price report Apr 2008

New competitors



- No new competitors entered the market during this process
- However, price stability resulting from auction process may be attractive for new investors in future biddings
- Timing shall be revised to avoid entry barriers

Auction implementation



➤ Auction 1 (2006)

- ☐ Bidding process lasted only a few months
- ☐ Time barrier for new investors to prepare proposals

➤ Auction 2 (2007)

- ☐ Supply contract scheduling was tight and rigid
- ☐ Lead time for new coal units exceeds lead time to begin supply
- ☐ Time barrier for new investments

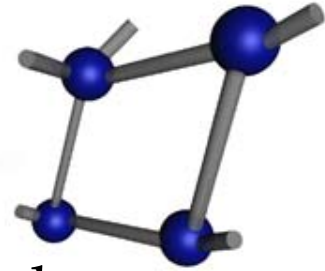


Conclusions



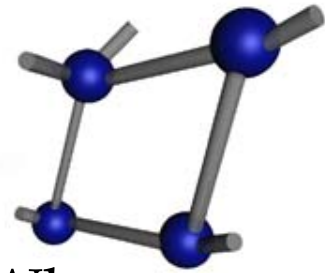
- Auction mechanism in a regulated market provides a stable signal for long-term prices, enabling generation investments
 - ❑ Chile faced the supply crisis using competitive market tools
 - ❑ Resulting investments overcomes the disequilibrium of supply and demand
- Pending challenges
 - ❑ Large energy blocks remains unallocated (7 TWh)
 - ❑ Price cap has increased significantly
 - ❑ Indexation formulas did not increase prices uniformly

Speed over Precision

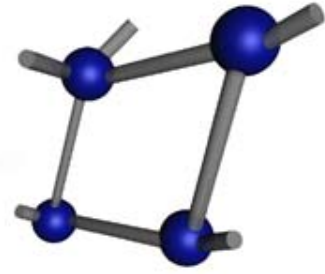


- Energy blocks starting by 2010 were not allocated
 - ❑ Generators foresee an additional and unbounded risk for 2010
 - ❑ Chile will be in a transition period to equilibrium beyond 2010
 - ❑ No new generation units available to supply those blocks
 - ❑ It is a **risk issue** rather than a price issue
- Free criteria to define indexation formulas makes difficult the comparison of different offers
 - ❑ Low bids might result in higher future prices, depending on indexation
 - ❑ How do we evaluate the real cost of bids?

What's next?



- Current auction's cap price reached 125 US\$/MWh
 - ❑ A long-term cost higher than system development cost can seriously endanger competitiveness and impair consumers
- Solution alternatives
 - ❑ Modifications in auction design, specifically on timing to allow new participants and generations units to supply demand
 - ❑ Extend current mechanism for supply without contract to overcome the critical transition period
- Administrative solution from Regulatory Authority is required



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