DEREGULATION AND RESTRUCTURING OF THE ELECTRIC POWER SECTOR IN LATINAMERICA

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Structure of the presentation

- Latinamerican power sector
- Power market reform
- Market design - generation, transmission, distribution
- Successes
- Problems and challenges
LATINAMERICA
a region in transition

* Growing tendency to open economies and democratic governments
* End of the debt crisis
* Economic reforms - market economies encourage economic growth
* Geopolitics reasons increase worldwide interest in the region
* Regional commercial agreements (MERCOSUR, NAFTA) creating new conditions for economic development

Pioneering regulatory changes in the electrical sector
GDP vs. electricity demand

KWh per capita

GDP per capita (US$)

Growth in electricity demand

Growth in electricity production versus growth in GDP, 1990-97

MarketLine, 1998
ELECTRICITY INFRASTRUCTURE in Latinamerica

Replacement cost of the existent infrastructure
-approx. US$500000 millions
(approx. installed capacity 166 GW)

New investment needs in the next 10 years
-approx. US$28000 millions a year during first decade of the next century

ELECTRICAL SECTOR- historical development in Latinamerica

Initial private developments - insufficiencies

Government action (Endesa, Electroperú, Ende, Eletrobras, ISA, Edelca, CFE)

Limited private participation

Diverse regulatory arrangements
ELECTRICAL SECTOR- main problems in Latinamerica

Management problems
Infrastructure deterioration
Growth of electric energy demand without efficient use
Inefficiency in production & use
High levels of losses
Financial & economic crisis
Tariffs problems and cross subsidies
Overstaffing
Environmental restrictions

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Drivers of deregulation and privatization

- indicated problems
- not necessarily search for price reductions
- political reasons - open market ideology
- fiscal deficit and need to sell State assets

International “trend”
- World Bank initiatives
- not technological changes

ECONOMIC - TECHNICAL BASES FOR DEREGULATION

A global energy strategy to achieve maximum social wealth

- Establish economic efficiency conditions in the energy sector
- Develop lowest cost energy resources
- Achieve adequate security and availability of energy supply
- Efficiency in the use of different energy resources

COMPETITIVE MARKET

- Subsidiary role of the government
- State does not act if there are private third parties that do it
- At most, regulate monopolies and do indicative planning

PRIVATIZATION
Change of Paradigm - Unbundling

COMPETITIVE MARKET MODEL

GRIDCO  POOLCO  FUELCO  FUELCO
GENER.  PLANTCO  PLANTCO  GENER.
SELLCO  SELLCO  SELLCO

TRAN.
BROKECO  BROKECO
DISTR.  BUYCO  BUYCO
LINECO  LINECO
RETAILCO  RETAILCO
CUST.  CUST.
### ELECTRICITY MARKET REFORMS

- **Electric power system**
- **Electric market**
- **Customer**
- **Client**
- Protection of the public company providing electricity service at a given cost
- Competition among firms that offer a product (a commodity) at resultant prices

### Change of Paradigm

<table>
<thead>
<tr>
<th>Present</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertically integrated areas</td>
<td>Unbundling: Generation, Transport, Distribution</td>
</tr>
<tr>
<td>Costs</td>
<td>Price</td>
</tr>
<tr>
<td>Cost - Minimization</td>
<td>Profit - Maximization</td>
</tr>
<tr>
<td>Clear mathematical solution</td>
<td>Many business strategies</td>
</tr>
<tr>
<td>Coverage of the costs</td>
<td>Market price, result of competition</td>
</tr>
<tr>
<td>Monopoly</td>
<td>Competition</td>
</tr>
<tr>
<td>Uniform product</td>
<td>Many products</td>
</tr>
<tr>
<td>Average Prices</td>
<td>Flexible prices, online offers</td>
</tr>
<tr>
<td>Subsidies</td>
<td>No Subsidies</td>
</tr>
<tr>
<td>Obligation to serve</td>
<td>Unserved energy if it is economical</td>
</tr>
</tbody>
</table>

Change of Paradigm
ELECTRICITY MARKET REFORMS

*wholesale market deregulation (unregulated prices for large consumers)

*competition at generation level with centralized generation dispatch

*short term marginal cost based schemes

ELECTRICITY MARKET REFORMS

*regulation in transmission and distribution

*transmission open access regulation, base for competition, global allocation of network costs, special pricing given economies of scale

*competition by comparison in distribution (yard stick competition, price cap)
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CHARACTERISTICS OF GENERATION

- diverse generation resources
  - technological restrictions for electricity storage
  - stochastic hydroelectric resources
  - there are no scale economies
CHARACTERISTICS OF GENERATION

Average costs of generation alternatives

<table>
<thead>
<tr>
<th>Generation technology</th>
<th>$US$/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro storage plant</td>
<td>1.87</td>
</tr>
<tr>
<td>Run of river hydro</td>
<td>2.01</td>
</tr>
<tr>
<td>Combined cycle gas</td>
<td>2.08</td>
</tr>
<tr>
<td>Steam coal</td>
<td>3.60</td>
</tr>
<tr>
<td>Diesel turbine</td>
<td>6.71</td>
</tr>
</tbody>
</table>
- COMPETITION AS THE DRIVING FORCE
- reduce entry barriers - free entrance to the sector
- hydroelectric projects - concession for water use
- open access to the transmission system
- no obligation to serve (market action)
- obligation to coordinate

Price system (Chile, Argentina, Perú, Bolivia)

- spot prices for exchanges at wholesale market (MgC)
- regulated prices for small final consumers (proj. MgC)
- unregulated prices for large consumers
PRICING MICROECONOMIC PRINCIPLES

Under optimum conditions

Income obtained from selling all energy at the short term marginal cost, plus income obtained from selling capacity at the development cost of peaking units, are equal to the cost of capital plus total generation operation costs.

ELECTRICITY MARKET

Electric products

Energy
Capacity

Reactive power
Frequency regulation
Spinning reserve
Cold reserve
Organizational Framework for Competition

System Structures for Deregulated Markets

Bilateral Model
- Supplier
- Transport
- Customer
- Coordination

Bilateral Model + ISO
- Supplier
- Transport
- Customer
- ISO

Pool Model
- Supplier
- Transport
- Customer
- Pool / ISO

Poolco model
- Generation
  - Supply
  - Demand
- Market 
  - Market price
  - Invoicing
  - Planning
  - Network control
- Transmission
  - Transmission tariffs
- Distribution companies
  - Demand
  - Sale
  - Market prices
- Ancillary services markets
Market agents

Generators -> Dispatch operation -> Distributors

Local governments

Large users

Environmental bodies

Small users

Antitrust bodies

Government

Regulator

ARGENTINA WHOLESALE ELECTRICAL MARKET (MEM)

INDEPENDENT POWER PRODUCERS

NATIONAL GOVERNMENT'S GENERATORS

BINATIONAL GENERATORS

INTERNATIONAL INTERCONNECTIONS (Exports)

MEM

DISTRIBUTORS

LARGE CONSUMERS

INTERNATIONAL INTERCONNECTIONS (Imports)

SUPPLY (sellers) -> TRANSPORTATION -> DEMAND (buyers)
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CHARACTERISTICS OF TRANSMISSION

- Economies of interconnected systems
- Base for competition
- Need to remunerate large investments
- Significant economies of scale (lines, transformers)

TRANSMISSION

*economies of scale*

US$/MVA/km

Transmission lines in Chile
**LINE OF THINKING**

- significant economies of scale
  - natural monopoly
    - need for regulation
      - need for open access = base for competition
        - regulation of tariff

**OPEN ACCESS AS CENTRAL CONCEPT**

- required concession for transmission systems
- open access when available capacity
- single transmission company

Two part price scheme
(Argentina, Chile, Perú, Bolivia)
  - marginal loss income
  - additional toll (peaje)
SPATIAL NODAL PRICES

Generation costs, losses, restrictions, non supply cost

Area of influence- toll paid per use of system
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develops in geographical compartments
economies of scope and density
duplication of costs with network superposition
large number of small users with large elasticity

development of geographic monopolies (franchised monopolies)

need for regulation

opportunities for network standardization and incentives for cost reduction

**CHARACTERISTICS OF DISTRIBUTION**

<table>
<thead>
<tr>
<th>Area 1A</th>
<th>Area 1S</th>
<th>Area 2</th>
<th>Area 3</th>
<th>Area 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>[$/KW]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>2000</td>
<td>4000</td>
<td>6000</td>
<td>8000</td>
</tr>
<tr>
<td>10000</td>
<td>12000</td>
<td>14000</td>
<td></td>
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</tr>
</tbody>
</table>

**distribution costs**

- CDAT
- CDBT
Regulatory concepts
- monopolistic franchised activity
- distribution as public service
- concession required to use public and private spaces
- only concessionaries distribute (legal monopoly)
- obligation to serve (only ones in electricity path)
- quality of service regulated

Price system
- regulated distribution prices
- “pseudo competition” based on benchmark regulation
  (model company or price cap)

Alternative Pricing Schemes

- **COST-OF-SERVICE REGULATION** (rate or return or cost plus)
  – prices track costs
  – no profit incentives for efficient cost reduction

- **INCENTIVE or BENCHMARK REGULATION**
  *Regulation by efficiency level* (price cap; decreasing prices)
  *Competition by comparison or relative performance evaluation* (yard stick competition)
INCREASING DEREGULATION

“LARGE” DEREGULATED CONSUMERS

CHILE         2000 kW
PERU          1000 kW
ARGENTINA     100 kW
               0 kW (2000)

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PERU - ELECTRICITY COVERAGE

National

Edelnor - Lima

ENDESA productivity increase:
production (GWh) versus number of employees in Chile
CHILE- PRODUCTIVITY INCREASES AT DISTRIBUTION COMPANY CHILECTRA

Average time for emergency service

Losses (technical and non technical)

Chilectra (Santiago)  Edesur (Buenos Aires)  Edelnor (Lima)
Non served energy January 88 - Dec 95 (GWh) - Argentina

WHOLESALE ARGENTINE MARKET
AVERAGE MONTHLY PRICE
Node price and marginal cost
Cerro Navia - Alto Jahuel 220 KV

Node price and marginal cost
Crucero (SING)
INVESTMENT IN THE CHILEAN CENTRAL SYSTEM

FOREIGN INVESTMENT: CASE OF ENDESA CHILE

1. Acquisition of 24.01% of the power station Costanera
   US$ 46.00 millions  1992  Argentina

2. Acquisition of 5.61% of the electric distribution firm EDELSUR
   US$ 56.21 millions  1992  Argentina

3. Acquisition of 37.29% of the Hydroelectric Chocón
   US$ 165.30 millions  1993  Argentina

4. Investment in the power station Buenos Aires owned by Costanera
   US$ 91.00 millions  1995  Argentina

5. Acquisition of 25.8% of the electric generation firm EDEGEL
   US$ 204.50 millions  1995  Perú

6. Acquisition of 74.75% of Hydroelectric Betania
   US$ 301.00 millions  1996  Colombia
**Investment abroad**

**ENERGY GENERATION OF ENDESA**
(Millions of kWh)

(*): Include “filiales” and “coligadas” that Endesa operates.
Rate of Return (Profits/Capital Stock)

Economic integration in South America leading to energy integration

- natural gas exchanges
- electricity exchanges

MERCOSUR market
12 million km²
200 million people
Future Gasoduct Network in South America

Revista CIER, año V, N°17, setiembre 1996

CHILEAN - ARGENTINEAN EXAMPLES

The Gasoduct Electric War 1996-99

The Gasoducts War 1994-97
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<tr>
<td><strong>Generation</strong></td>
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<tr>
<td>- pool governance problems</td>
</tr>
<tr>
<td>- spot price calculations</td>
</tr>
<tr>
<td>- capacity price calculation</td>
</tr>
<tr>
<td>- reliability control</td>
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<tr>
<td>- market power</td>
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<tr>
<td><strong>Transmission</strong></td>
</tr>
<tr>
<td>- problems with allocation of open access payments</td>
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<tr>
<td>- lack of expansion signals</td>
</tr>
<tr>
<td>- congestion</td>
</tr>
<tr>
<td><strong>Distribution</strong></td>
</tr>
<tr>
<td>- conflicts with tariff calculations</td>
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<tr>
<td>- quality of service</td>
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<tr>
<td>- penalties for not complying</td>
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Worldwide Deregulation Processes

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