ELECTRICITY MARKETS IN LATIN AMERICA: COSTS, PRICES AND QUALITY OF SERVICE

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IEEE-IEEE
London, UK, April 5, 2000
Structure of the presentation

- Latinamerican power sector
- Power market reform
- Market design - generation, transmission, distribution
- Successes
- Problems and challenges

LATINAMERICA
a region in transition and growth

* Open economies and democratic governments
* End of the debt crisis
* Economic reforms with market economies encouraging economic growth
* Geopolitics reasons increase worldwide interest in the region - the place for investment
* Increasing regional commercial exchanges are creating new conditions for economic development
The American Electricity Market

CANADA & UNITED STATES
- Market of 765000 MW
- 1-2% annual growth
  = 7650 - 15300 MW a year

LATINAMERICA
- Market of 190000 MW
- 5% annual growth
  = 9500 MW a year

Growth in electricity demand

1990-97

Growth in GDP

Argentina: 2% 4% 6% 8% 10% 12%
Bolivia: 0% 1% 2% 3% 4% 5%
Brazil: 2% 4% 6%
Chile: 14%
Peru: 6% 8% 10%
Southamerica: installed capacity per technology (1997)

- Hydro: 71.8%
- Thermal: 23.2%
- Nuclear: 1.2%
- Others: 3.8%

Total Capacity: 141.451 MW

Source: Cier 1998

Electricity generation by type, 1997

- Brazil
- Mexico
- Colombia
- Chile
- Argentina
- Peru

Load factor

Generation (TWh)

MarketLine, 1998
Areas of interest for future power investment
(MarketLine, 1998)

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ELECTRICAL SECTOR - historical development in Latinamerica

Initial private developments

Government action - vertically integrated utilities (Endesa, Electroperú, Ende, Eletrobras, ISA, Edelca, CFE)

Limited private participation

ELECTRICAL SECTOR main problems in Latinamerica

Financial & economic crisis
Tariffs problems and cross subsidies

Management problems
Infrastructure deterioration
High levels of losses

Overstaffing
Drivers of deregulation and privatization

- sustain investment with high demand growth
- price reductions (not necessarily)
- political reasons - open market ideology
- fiscal deficit - need to sell State assets

International “trend”
- World Bank initiatives

-not technological changes
- minimum quality levels

Pioneering regulatory changes in the electrical sector
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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

*incentive based regulation in distribution (yard stick competition, price cap)

Change of paradigm

Vertically integrated company
- public service company
- obligation to serve
- protection and rates
Change of paradigm

Generation
- competition
- no public service
- no obligation to serve
- no protection

Change of paradigm

Distribution
- franchised monopoly
- obligation to serve

Transmission
- open access obligation
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Investment in the Chilean Central System

Source: CNE Chile
PERU- ELECTRICITY COVERAGE

National

Edelnor- Lima

WHOLESALE ARGENTINE MARKET
AVERAGE MONTHLY PRICE
Energy losses in distribution systems in Perú (1990-1999)

ENDESA productivity increase: production (GWh) versus number of employees in Chile
Clients per Worker

<table>
<thead>
<tr>
<th>Year</th>
<th>1.994</th>
<th>1.995</th>
<th>1.996</th>
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<td>795</td>
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GWh per Worker

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<th>Year</th>
<th>1.994</th>
<th>1.995</th>
<th>1.996</th>
<th>1.997</th>
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</thead>
<tbody>
<tr>
<td>Value</td>
<td>2.3</td>
<td>2.5</td>
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PRODUCTIVITY INCREASES AT DISTRIBUTION COMPANY EDELNOR- PERU

CHILE- PRODUCTIVITY INCREASES AT DISTRIBUTION COMPANY CHILECTRA

Average time for emergency service

<table>
<thead>
<tr>
<th></th>
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<td>Hrs.</td>
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<td>4.0</td>
<td>3.0</td>
<td>2.0</td>
<td>1.0</td>
<td>1.0</td>
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Growing electric interconnections

Growing gas interconnections
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PROBLEMS AND CHALLENGES IN MARKET DESIGN

- independent operator (Chile)
- transmission open access (Argentina, Bolivia, Colombia, Chile, Perú)
- distribution pricing (Bolivia, Chile, Perú)
- blackout crisis (Argentina, Chile)
- regional energy market

GOVERNANCE OF THE POOL

Generation

- problems with pool governance
- spot price calculations
- capacity payments
- reliability control
GOVERNANCE OF THE POOL

Assumptions

-a central dispatch is needed for competing generators
-governance better achieved by agreement among all participants
(with perfect competition, prices will be marginal costs

-central dispatch needed to clear the wholesale market
(Adam Smith role)

Market design
-central dispatch as a single system irrespective of ownership
-marginal cost based dispatch (traditional pool)
-large generators form a club that acts as an independent operator
-agreements to be achieved unanimously, otherwise regulator intervenes

Market reality
-competition on cost of supply (efficiencies increased, new technologies introduced- CCGT) and on commercial actions (contract portfolios)
-club scheme operates well for over 10 years (outside criticism by parties that are not able to participate)
- as competition increases and prices decrease, unanimous agreements become the exception (disagreements on determination of spot price, dispatch models, transmission modeling, operation security strategies)
- governing difficulties
- regulator essentially directing the actions of the pool, with no interest to do so
- reliability endangered by disagreements

**Divergences within the pool**
**(CDEC-SIC)**

![Diagram showing the number of divergences per year from 1986 to 1997.](image-url)
TRANSMISSION PRICING

Transmission
- problems with open access tariffs
- lack of expansion signals
- congestion

Assumptions
- agents that cause transmission expansion must pay for use
- generators and consumers- differences among countries

Market design
- transmission payments based on natural economic use of lines, no relation with commercial use and contracts
- natural use measured as incremental use under economic dispatch
- peak capacity use or energy use
Market reality

- weak definition of natural use
- disputes on how to measure natural use
- incremental measure dependent on marginal bus location

- no clear definition on handling of network restrictions and economic decoupling of areas of the system
DISTRIBUTION PRICING

Distribution

- conflicts in tariff calculations
- quality of service

Assumptions

-economies of scope give place to monopolistic activity
- geographic franchised activity subject to regulation
- strategic objective for pricing is to avoid welfare losses from monopoly pricing, provide signal for economic efficiency (investment and operation), with symmetry of risk and opportunities for regulated firm

- obligation to serve (only one in electricity chain)
- competition by comparison (benchmarking) reduces asymmetry of information about the firm’s costs
Market design

-prices based on cost comparison against an efficient model firm
-value added cost of distribution based on hypothetical model distribution firms
-standardized costs, optimally sized firms and optimal business management
-typical standardized distribution areas
-independent studies by consultant requested by regulator and firms
-preliminary prices determined and coherency check for revenue of the whole distribution industry

Total monthly cost for area 2 (Chile, 1988)

Average value 10,2 US$/kW/month
Market reality (Chile, 1996)

- Complete study bases issued by regulator for 39 distribution companies, 5 typical distribution areas
- Differences in criteria between regulator and firms
- Unclear definition on treatment of unregulated consumers, economies of scope, stand-alone firm or shared-costs firm, criteria for optimal installation expansion, technological updating, useful life for installations
- Extended legal battles

Differences among value added costs as determined by regulator and companies

<table>
<thead>
<tr>
<th>Distribution density</th>
<th>% de variación</th>
<th>1988</th>
<th>1992</th>
<th>1996</th>
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<tr>
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<td>High</td>
<td>64</td>
<td>44</td>
<td>118</td>
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<tr>
<td></td>
<td>Average</td>
<td>21</td>
<td>73</td>
<td>123</td>
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<tr>
<td></td>
<td>Low</td>
<td>60</td>
<td>60</td>
<td>-17</td>
</tr>
<tr>
<td>Low voltage distribution</td>
<td>High</td>
<td>53</td>
<td>40</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>37</td>
<td>64</td>
<td>137</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>62</td>
<td>49</td>
<td>10</td>
</tr>
</tbody>
</table>
BLACKOUT CRISIS

Generation

-ununsupplied energy

Regulator intervention for adequacy

*capacity payments

*regulated tariffs for small consumers
Hugh Rudnick, IEE-IEEE Lecture, London, April 5, 2000

**System operator and security**

*freedom to compete?*

*mandatory poolco approach*

**Penalties**

**Chile**

*drought 1998-99*

*combined cycle failure*

*rotating blackouts*
Chile

* no lack of investment
* decoupled price signals
* contracts do not oblige generators to serve
* weak coordination pool
* low “unsupplied” energy cost
* law changed to impose obligation to serve
Argentina

*substation failure
*extended blackout

Argentina

*no lack of investment
*lack of coordination
*low “unsupplied” energy cost
*penalties imposed
REGIONAL ENERGY MARKET DEVELOPMENT

Commercial/market agreements
Gas interconnections
Electricity interconnections

Geographic distribution of consumer loads and energy resources

Endesa 1999
Integration among markets

- price equilibrium among markets
- natural gas grows in importance - large gas companies join the electricity market
- minimum size of companies changes - expansion to other markets and new economies of scale
- decisions of gas and electricity expansion projects are linked
Technology impact: combined cycle plants

-new plants replacing coal plants

-combined cycle defining long run marginal cost (substantially lower than the historic one)

-combined cycle competing with transmission and changing investment patterns

Restructuring of the world electricity market

-arrival to Latinamerica of main world energy (gas and electricity) players looking for regional portfolios

-increase of competition versus increase of vertical and horizontal integration

-prices initially on a downward trend

-regional expansion of transmission

-need for regional common regulatory arrangements