Resilience in South America
Brazil and Colombia experience

03/2016
El Niño is an abnormal weather pattern caused by the warming of the Pacific Ocean near the Equator, off the coast of South America.

It reaches its highest point at the end of the year (December) but its effects are felt throughout the northern hemisphere spring (March-May) and can last up to 12 months.

High temperatures, low rainfall with drought and abundant rainfall associated with floods.

The current “El Niño” intensity is considered the worst in recorded history (1982-83 y 1998-99).
Installed capacity

Installed capacity 16,5 GW (7%)

Installed capacity 141 GW (61%)

Installed capacity ≈ 230 GW

03/2016 Source: ANEEL – ONS – CCEE-UPME-XM
Electric sector situation

MW-month Reservoirs  Max.:287.046 MW

Source: ANEEL – ONS – CCEE-UPME-XM
The Electricity Generation System Resilience

- Thermal generation dispatch to avoid using hydro reservoirs.
- Maximum energy spot price. High financial exposure on Gx and Dx. Government intervention to support the industry (financially: loans for 8 billions US$).
- The situation began to return to normal because of increase in rain intensity
- The same situation occurred in 2001: 20% electric rationing. The cost was 1,5% GDP
- Thermal generation dispatch to avoid using hydro reservoirs.
- Burning hydro plant: 560MW and fault thermal plant: 230 MW. 11% of firm energy
- 07-03 energy saving measures aimed at consumers.
- Resigned Minister of Mines and Energy
- 5% saving energy to avoid rationing. Estimated cost of 1% GDP.
- The same situation occurred in 1992: 3% rationing. The cost was to 2-2,5% GDP

The energy sector has greater robustness to extreme hydro stress
Current Regulation: Auctions

Generators can sell at auction their energy firm

- Distributors must contract 100% of its demand
- Differentiated technologies auction
- Long-term contracts (20-30) years for new plants depending on the technology
- Price in Reais (R$) with IPCA indexation
- Descending Clock auctions (Hybrid)

- No obligation energy contract (Distributors and Free Customers)
- Auctions are not differentiated by technology
- Validity period of the obligations 20 years for new plants
- US dollar price
- Descending Clock auctions (Hybrid)

Long-term decreases the financial risk for the investor

Long-term increase the risk of exposure to extreme events

Can sell more energy=marketer

It can be traded with Distributors, Free Customers and Spot Market. Free conditions and prices

In auction get the CxC

Total Energy

Energy sold in auction

Remaining Energy

Firm Energy

Spot market

Total Energy

Energy sold in auction

Remaining Energy

Firm Energy

03/2016
Residential customer price Including Taxes
Consumption 200kWh-month

US$/MWh
October 2015

- Taxes
- Commissions, grants, canon, subsidies and other
- Distribution and Marketing (D&M)
- Generation, Transmission

03/2016 Exchange rate real average October 2015

260

185

175

173

168

142

140

143

144

205

Enel<br>Latam

Promedio

Enel<br>Italia

Enel Servizio Elettrico<br>Italia

NEEP<br>España

EEC<br>Cundinamarca

Chilectra<br>Santiago

Codensa<br>Bogotá

Edesur<br>Buenos Aires

Edelnor<br>Lima

Ceará

Rio de Janeiro

Ampla

Coelce
Issues to review…

- This is an opportunity to adapt the rules to provide more resilience to the system
- To the estimated energy firm can be assigned a reserve level Resilient

Expansion Planning

- In Brazil there are auctions security reserve supply
- In Colombia, Creg adds a % to the growth reported by agents.

System has to face n-2 situation
The Transport and Distribution sector should also be designed to withstand peak loads related to extreme events. Investments in smart grids and smart metering are a tool to mitigate.

Tx and Dx Asset remuneration using DORC. Safety in investment remuneration. Destructive damage is not paid.

Useful life assets from 20-30 years, equivalent to depreciation time.

Decouple the depreciation from capital remuneration: accelerated depreciation in areas of risk assets.

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\text{Regulatory Asset Base (RAB net)} \times \text{Regulated Rate (RT_{rbl})} + \% \text{ Depreciation} \times \frac{\text{RAB}_{\text{gross}}}{\text{RAB}_{\text{net}}} = \text{Wacc and regulated rate r.b.t (Distribution)}
\]
Issues to review...

• Renewable energy is the best option to increase the resilience of generation systems

• Renewable energy have predictable costs, faster operational startup, gives flexibility to the system and produce no emissions.
Thank you