

Case Study

Climate change and Resilience Enel LATAM



Speaker:

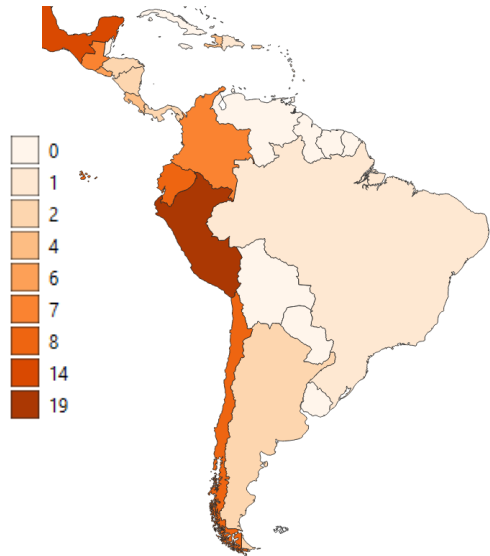
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Resilience Events in Latam 2000-2023

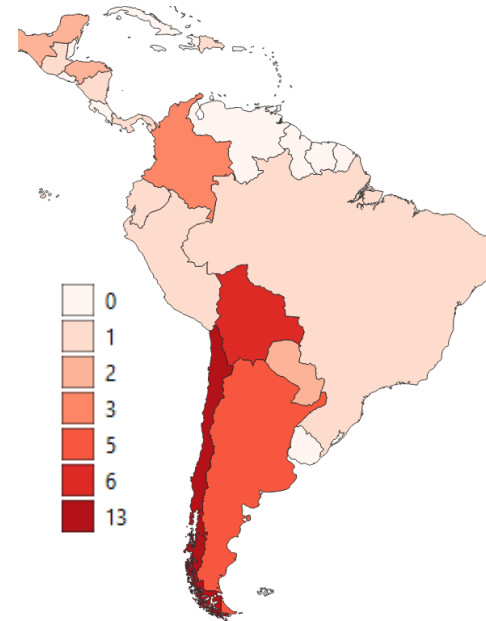
Earthquake



Storm

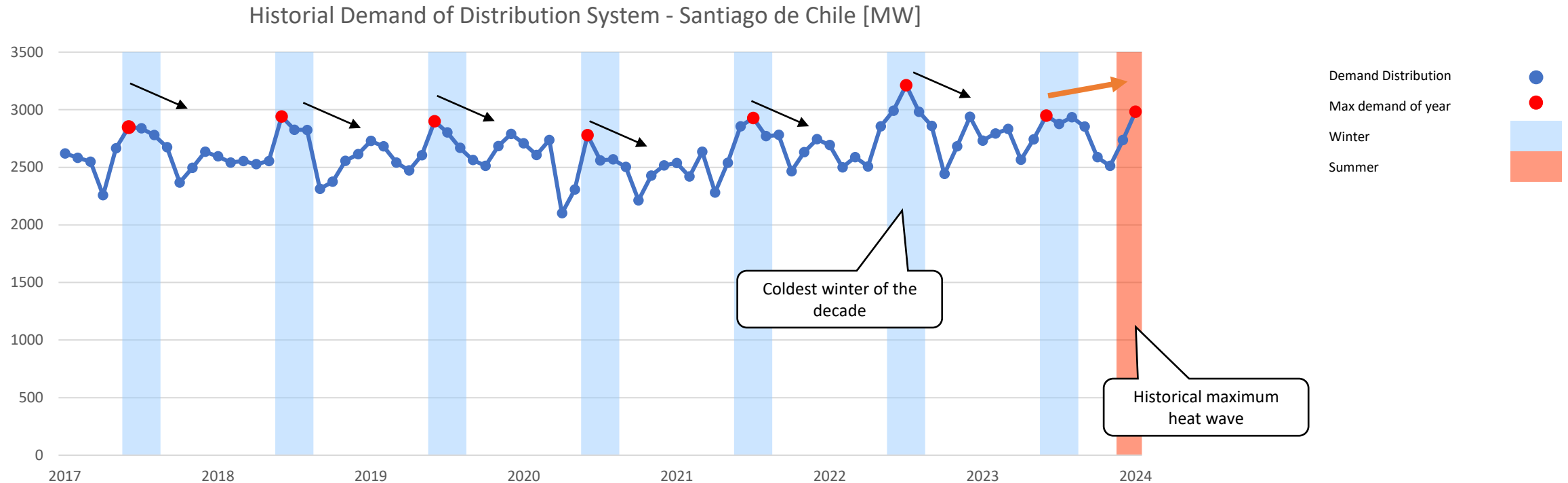


Wildfire



- Power grid designs are based on historical weather events.
- Due to the effects of climate change, atypical weather events are occurring around the world
- Given people's current and future dependence on electricity, more resilient networks are needed
- At Enel we separate reliability analyzes from resilience analyzes

Effects of climate change on temperature and electricity demand



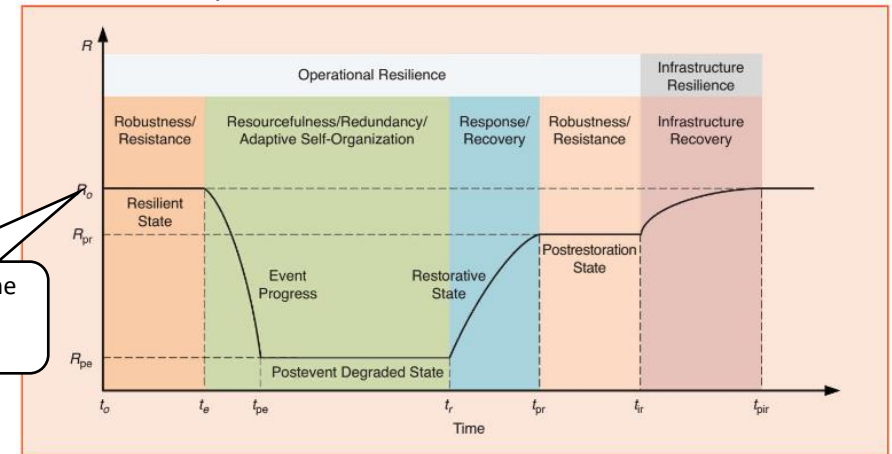
- Historically, the maximum demands of the distribution network has been in winter in Chile.
- The effect of climate change has tended to move the peak distribution demand, from winter to summer, associated always with extreme temperature (heatwaves)
- This is generating some failures in the underground network due to overload.

Resilience – 4R Strategy

The **Enel 4R Strategy** is based in four step: Risk Prevention, Readiness, Recovery and Response



Conceptual resilience curve associated to an event

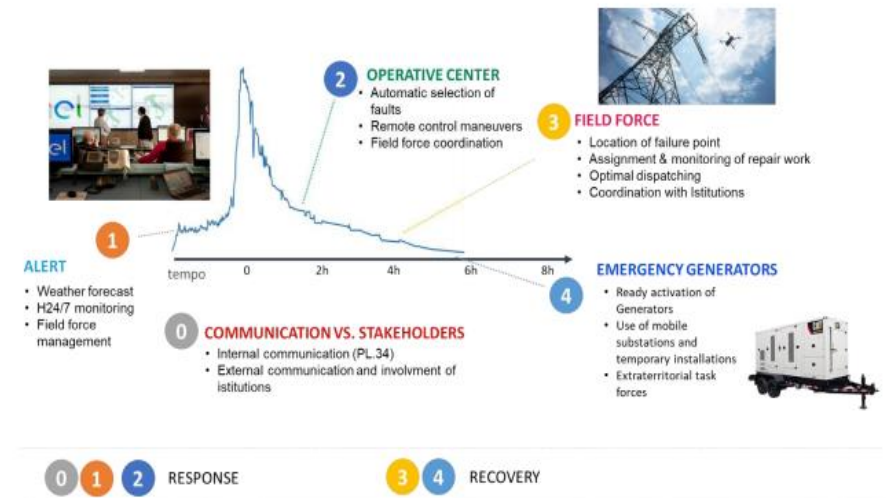


Resilience state of the electrical system before the event

Source: Panteli, M., & Mancarella, P. (2015). A Stronger, Bigger or Smarter Grid? Conceptualizing the Resilience of Future Power Infrastructure. *IEEE Power and Energy Magazine*, (May), 1-16.

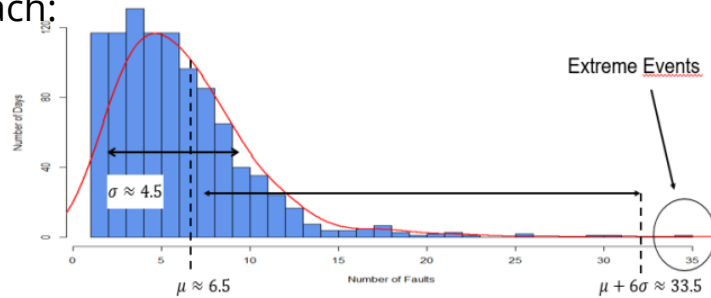
- **The 4R Strategy** response to each of stages of a resilience event
- In the image below on the right, is possible to see the deployment of different operational activities that allow addressing a resilience event
- It should be noted that in aggregate terms we can speak of two stages of a resilience event in **operational and infrastructure terms**.

Operational example of resource management in a resilience event



Resilience – Methodology

The first step is based in historical data, is choose the resilience event with statistical approach:



Secondly, it is important to calculate the network resilience index. based on the degrees of vulnerability, frequency and times of the interruption.

$$I_r = \frac{1}{\sum_{i=1}^N V_i} \quad V_i = \frac{F_i \cdot \bar{D}_i}{8760} \cdot 1000$$

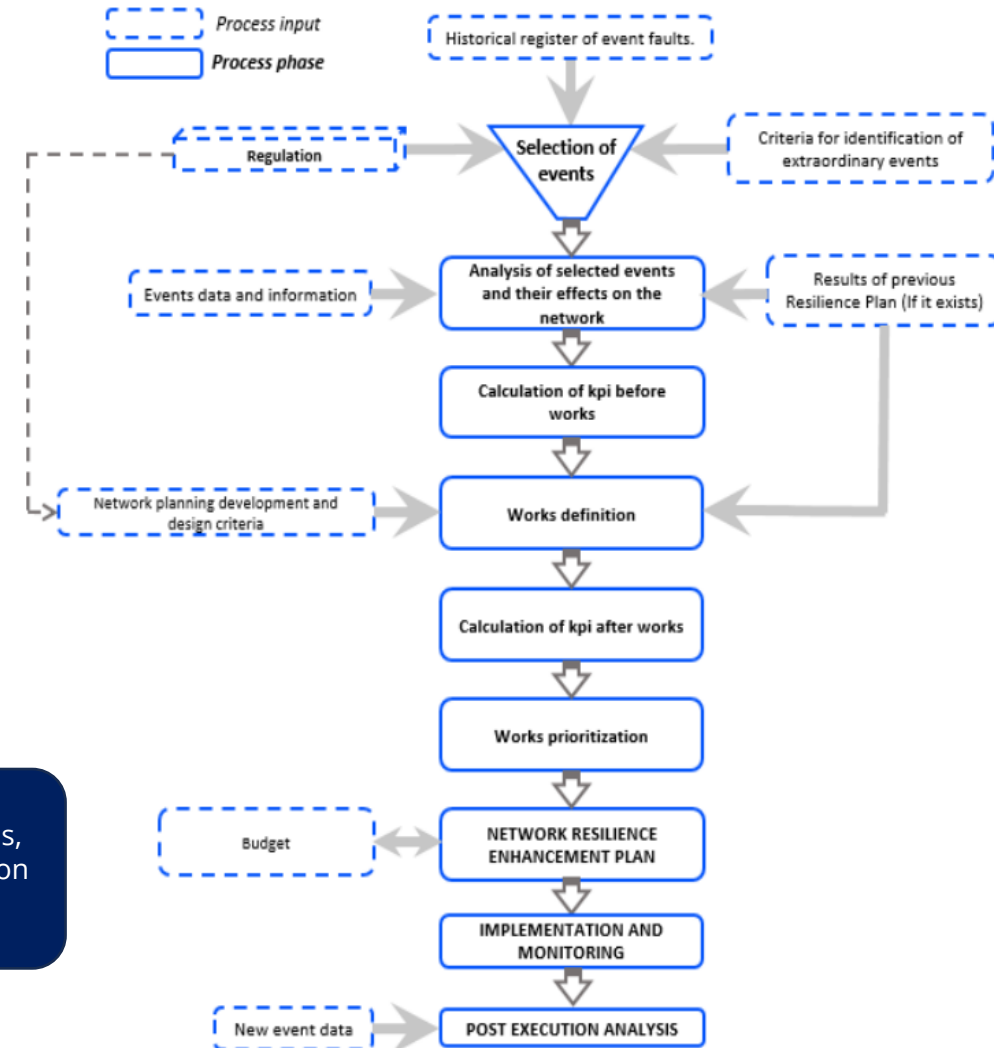
For example, in a snow event the definition of works could be:

Table 1: Technical Solutions for Snow Events

Event	Technical Solutions
Snow	<ul style="list-style-type: none"> - Installation of anti-icing devices - Reinforcement or replacement of poles - Replacement of obsolete conductors - Replacement of bare aerial conductors with insulated conductors - Alternative line paths - Conversion of aerial lines to underground lines - Connection with other lines - Trees trimming

And finally, to conclude with the methodology...

"Post-event analysis aims to evaluate network performance against expectations, identifying overlooked areas for intervention and assessing the effectiveness of implemented measures



Resilience in Distribution Grid

- Use of Microgrid, Distributed Energy Resources (DER) and Storage.
- A regulatory framework considering investments for resilience.
- Pricing signal during peak demand. Demand response. (Use of Smart Meter)
- Use of efficient electric appliance technologies, thermal isolation, etc.

