



Case study 5

Strong El Niños and energy mix planning

Focus: Strong El Niños in a South America context and energy mix planning

Boosting decision making

- The main objective of this case study is to illustrate the benefits of designing adequate decision-support products to predict the expected amount of flow of the hydro resources.
- As a complementary study, the case study will estimate how an optimum mix of hydro, wind and solar technologies can be achieved in Colombia. This could help to overcome the negative effects of events such as strong El Niños when relying on a single energy source.

The seasonal forecasting context

- This case study focuses on demonstrating the impact of using seasonal forecast rainfall information for big utilities with a large proportion of hydro power in their portfolio.

Sectoral challenges and opportunities

- To plan the future hydro resources during El Niño-La Niña events.
- To buy fossil fuels options in advance at lower prices to compensate for low hydro generation.
- To design a future energy mix adapted to the local climate variability and based on renewable sources.

El Niño and La Niña phenomena

El Niño (La Niña) is a phenomenon in the equatorial Pacific Ocean that can be characterized by a five consecutive 3-month running mean of sea surface temperature anomalies in the Niño 3.4 region (Figure 1) that is above (below) the threshold of $+0.5^{\circ}\text{C}$ (-0.5°C). This standard measure is known as the Oceanic Niño Index (ONI).

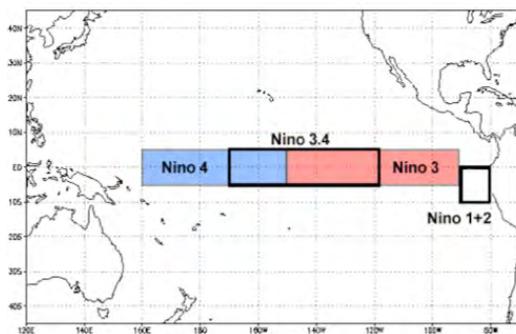


Figure 1: The Niño 3.4 region of the Pacific Ocean



Figure 2: The regions of Colombia

The El Niño phenomenon effects in Colombia are strongest in the north of the Pacific region (west of the country), parts of the Andean region (center) and the Caribbean region (north) (Figure 2), drastically decreasing the levels of rainfall accompanied by an increase in temperature, affecting the agricultural and electricity sectors, among others.

The 2015-2016 El Niño event

In this case study the focus will be on the severe drought in 2015-2016, which, in March 2016, led to an emergency plan requesting the Colombian population to reduce daily electricity consumption by 5-10% in order to avoid a complete blackout.

During 2015 and 2016, the Colombian electricity system faced one of the longest and most intense dry seasons ever registered, putting pressure on and testing the Colombian energy regulation framework.

With such critical hydrological conditions, the average share of thermoelectric generation went from 49 GWh/day (28% of total energy) in the first half of 2015, to 88 GWh/day (48%) in Q1/2016, and later it exceeded 100 GWh/day. Given the low levels of the reservoirs reached by early March 2016, XM (Colombian TSO and Wholesale Electricity Market Operator) recommended a program of energy cuts for at least six weeks in order to save 5% of the daily demand.

Climate event

El Niño and La Niña:
The El Niño-Southern
Oscillation (ENSO) cycle

Severe drought between
2015-2016 in Colombia the
result of a strong El Niño
event

Sector impact

Scarcity of water resources
in a market with a high
dependency on hydro-
power increases the prices
and the risk of a blackout

Industrial and research partners

The SECLI-FIRM project aims to demonstrate how improving and using long-term seasonal climate forecasts can add practical and economic value to decision-making processes and outcomes, in the energy and water sectors. To maximise success, each of the nine SECLI-FIRM case studies is co-designed by industrial and research partners. For this case study the industrial partners are Emgesa, part of the ENEL group, Celsia and AES Chivor – all big utilities with important assets in Colombia. The main research partner is AWS Truepower, a UL Company who brings expert knowledge in the use of meteorological information for the renewable energy industry. The University of East Anglia (UEA) is also a research partner.

The industry context

In Colombia, the deregulation of the electricity sector started in 1994, and the spot market initiated operations in July 1995. This deregulation process has faced some particular challenges in Colombia. The Colombian electricity system has an important penetration of traditional renewable energy technologies. In terms of installed capacity, 64% is hydro-generation, and nearly 80% of its energy consumption is covered by hydro resources.

The business process

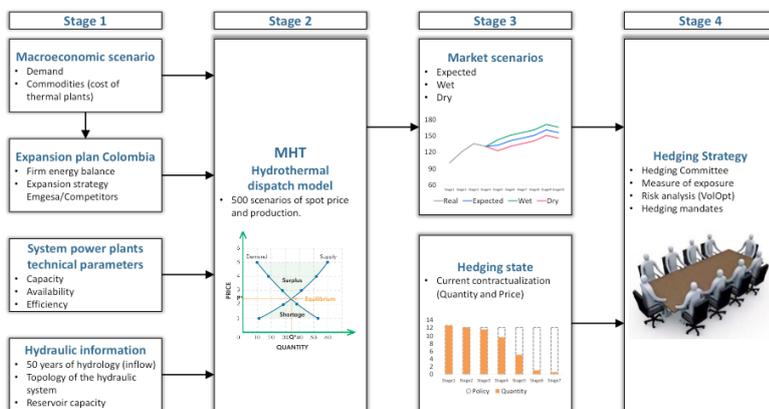


Figure 3: Flowchart for Emgesa business process

Figure 3 shows the general framework of the decision process to manage the business within Emgesa. A control group and a test group will be established (see Figure 4 overleaf). In terms of climate conditions, the control group will only be able to access widely known climatological conditions (currently the most common approach) while the test group will also be given current tailored seasonal climate forecasts.

Co-designers

Emgesa – ENEL
Celsia
AES
AWS Truepower – UL
UEA

Industry context

The energy sector in Colombia relies mostly on renewable energy technologies

Business process

Data gathering (market and meteo)
Simulations of the power market
Hedging committee

Value assessment of seasonal forecasting

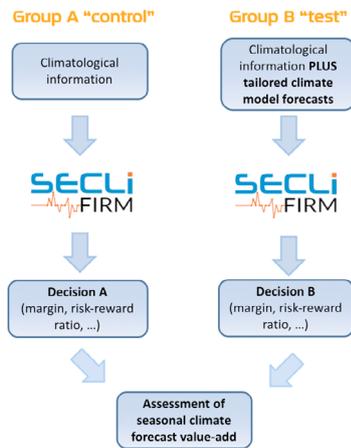
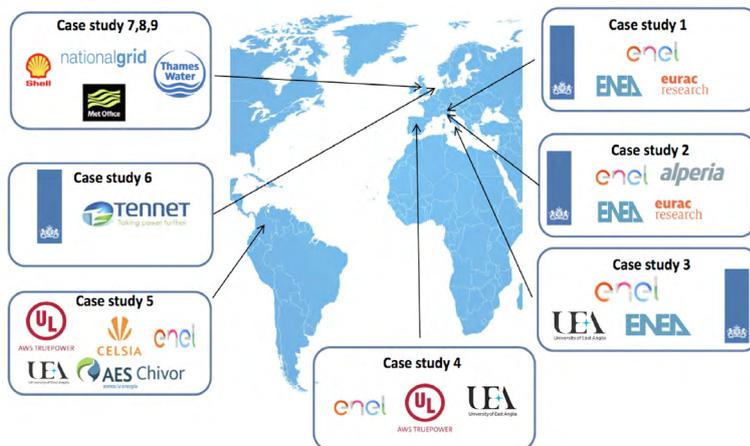


Figure 4: Flowchart for the evaluation process

The nine SECLI-FIRM case studies



The Added Value of Seasonal Climate Forecasting for Integrated Risk Management (SECLI-FIRM)

For more information visit:

www.secli-firm.eu

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Value assessment

How will the value of seasonal forecasting be assessed?

Find out more

For more about this and other SECLI-FIRM case studies, visit www.secli-firm.eu

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