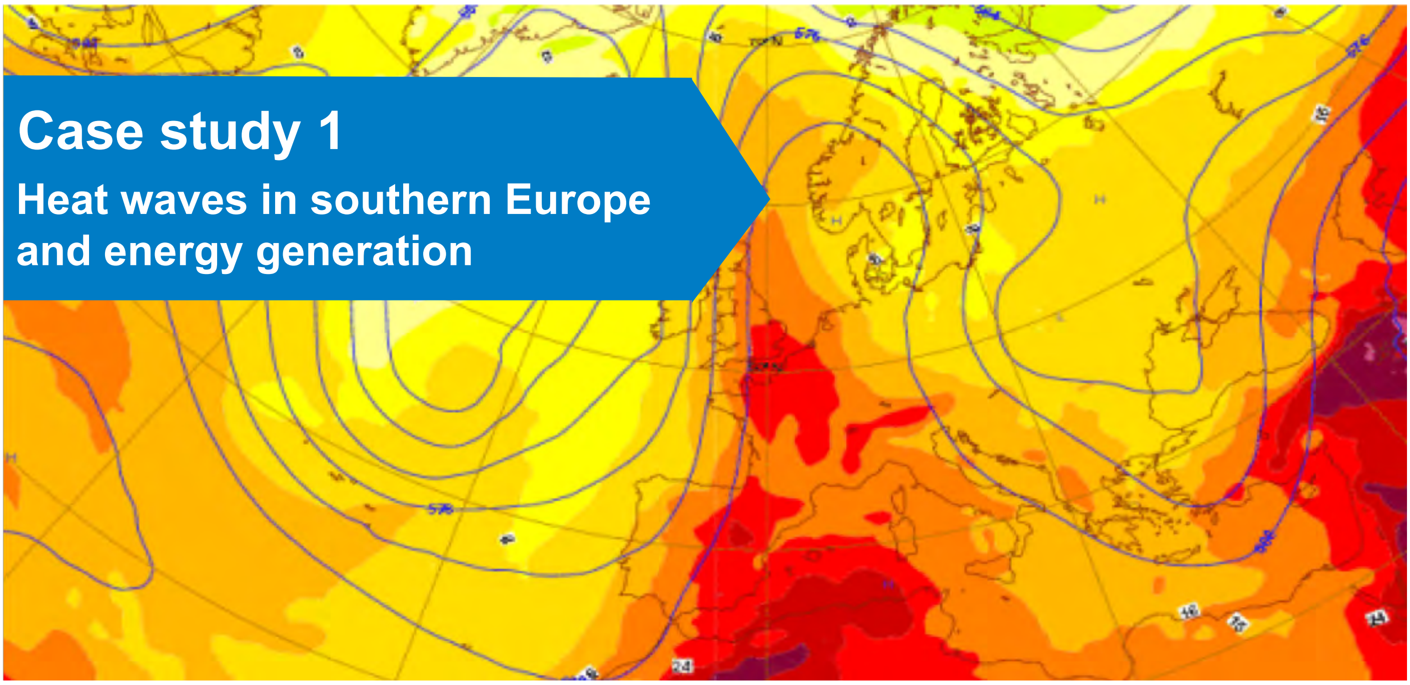

Case study 1

Heat waves in southern Europe and energy generation

Focus: Heat waves in southern Europe and the implications for energy generation and demand

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 partner is utility company, ENEL, and the research partners are ENEA and EURAC.

Boosting decision making

- The main objective of this case study is to illustrate the benefits of designing adequate decision support products for the identification of extreme summer heat waves, which have a major impact on the power system.
- How can ENEL effectively manage the risks associated with extreme climatic events?

The seasonal forecasting context

- This case study focuses on seasonal forecasts of surface temperature. It explores the skill in predicting extreme summer weather such as occurred in Italy in July 2015.

Sectoral challenges and opportunities

- Electricity price dynamics associated with air conditioning demand spikes (net of total renewable production).
- Power price management and hedging of generation portfolio – when to hedge the power production?
- How are market and asset portfolio decisions affected by the (un)availability of water for thermal electricity plant cooling?
- Accommodating enhanced demand model uncertainty due to extreme events.

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Weather conditions and the power system

Figure 1 (left) shows the average temperatures recorded in Italy during July and August 2015 compared with the 15-year average. Temperatures in July were ~ 5 °C above these climatological values. Figure 1 (right) shows the effects of the weather extreme on power demand. In July 2015, it reached a value of ~ 32 TWh, above the maximum over the last five years. It is interesting to compare the July situation with respect to August when more 'normal' weather predominated.

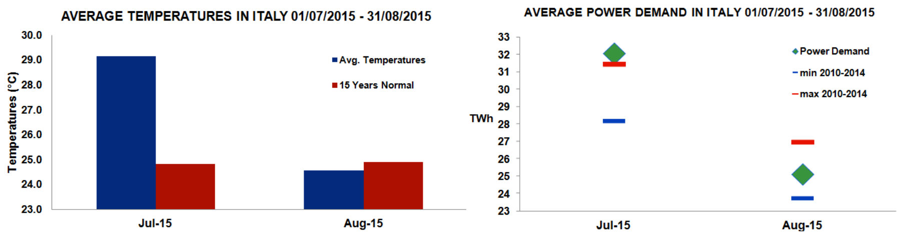

Figure 1: Jul/Aug temperatures and correlating power demand

Better strategy management

Assume an energy producer decided to sell 1 TWh (Figure 2) for the Q3/2015 product at a power price level consistent with market prices in May, within the range 45-55 €/MWh. If temperature forecasts correctly identifying the enhanced heat wave risk had been available, the producer could have taken the decision to keep its long position until the delivery period, selling its own production later at about 60 €/MWh (a differential of +10 €/MWh, or 20%).

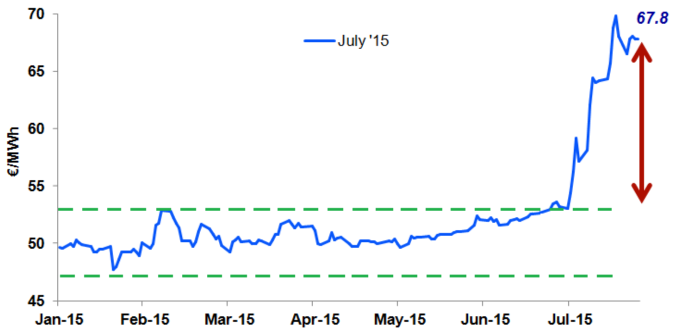

Figure 2: Italian spot power prices in July

The industry context

In Italy there is an open market system for power, where price is determined by the balance between offer and demand. The Italian power market is divided into six geographical zones that, in some situations, behave as insulated systems. In terms of the power market, electricity price correlates positively with demand and negatively with renewable production because, in the bidding curve, renewable power plants are offered at zero price. Therefore, a measure of tightness could be defined as the demand net of renewable production.

Climate event

Extreme heat wave
in southern Europe
July 2015

Sector impact

Increase in power prices
associated with spike
in summer

Management strategy

Using seasonal climate
data to forecast energy
demand linked to weather
conditions

Industry context

Utility
Power generation

The business process

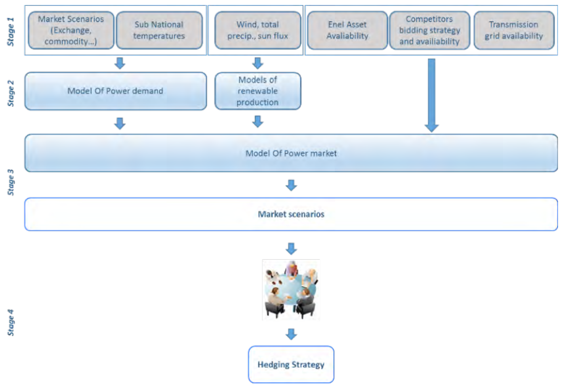

Figure 3: Flowchart for ENEL business process

Figure 3 shows the general framework of the decision process to manage the business within ENEL. A control group and test group have been established. 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.

Progress update

To study the July 2015 heat wave event, seasonal forecast by ECMWF system 5 model initialized respectively one (M-1), three (M-3) and six (M-6) months before the event, have been compared with ERA5 July climatologies in order to evaluate the added value given by the use of seasonal forecast instead of historical climatologies. The added value has been quantified by comparing these results with the actual ERA5 raw values, as shown in Figure 4.

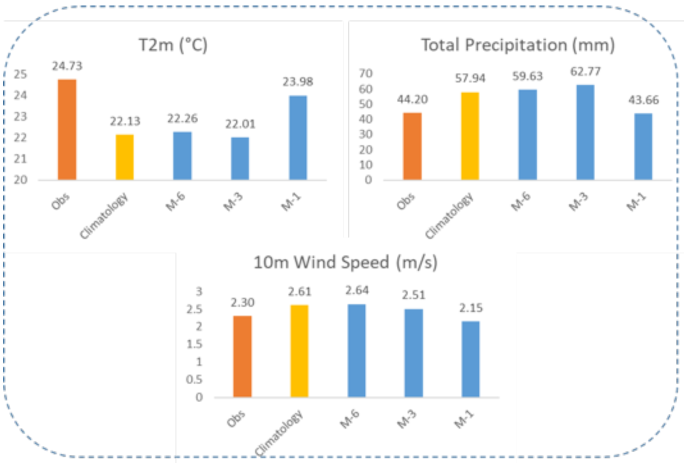

Figure 4: Italian monthly averages of (upper left) 2m temperature, (upper right) total precipitation and (bottom) 10m wind speed for ERA5 raw values ("Obs", orange), ERA5 Climatology (yellow), ECMWF system 5 calibrated seasonal forecast (blue) initialized one (M-1), three (M-3) and six (M-6) months before the event month on July 2015.

Business process

Data gathering (market and meteo)

Simulations of the power market

Hedging committee

Decision trees

To evaluate the impact of seasonal climate forecasting models on the decision-making process, the following steps shall be implemented (Figure 5):

1. Define three input data based on the same information set except for weather variables. The input data set used shall be:
   I. Climatology input for a given delivery period
   II. Seasonal forecasts developed within SECLi-FIRM
   III. Reanalysis ERA 5 (as Actual Weather Data)
2. Perform the decision-making tree three times based on input data of point 1.
3. Compute the associated Performance Indicator.

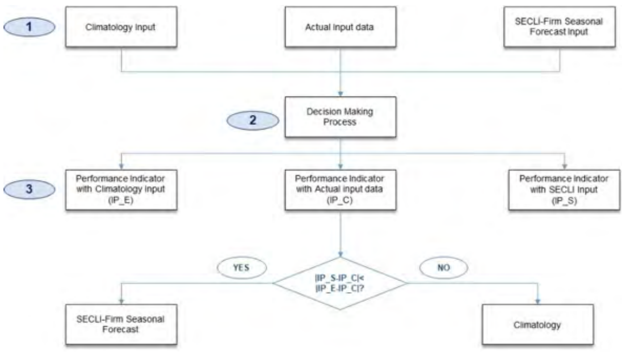

Figure 5: Enel Decision Making Tree: Performance Indicator Comparison

Next steps

- Extend the error analysis to multi-model seasonal forecast combination.
- Deterministic application of seasonal forecast to internal econometric models.
- Probabilistic application of seasonal multi-model forecast to internal econometric models.
- Estimate the added value from the decision tree with the new SECLI-FIRM weather input.

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

For more information visit:
www.secli-firm.eu

or contact the SECLI-FIRM team at:
info@secli-firm.eu

Decision trees

Evaluating the impact of seasonal forecasting models

Let us denote with IP_E, IP_S and IP_C performance indicators linked to climatology, SECLI-FIRM seasonal forecast and Actual Weather Data, respectively.

The impact of the seasonal climate forecasting model has added value to the decision tree if $[IP_S-IP_C]<[IP_E-IP_C]$.

Indeed, seasonal forecasts add value, even when the decision taken is as similar as possible to the one that would be taken knowing the exact weather variables actually measured at delivery.

Find out more

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

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