CASE STUDY 2

DRY WINTERS IN NORTHERN ITALY AND ENERGY GENERATION

Focus: A mild, dry winter 2015/16 due to a persistent, high-pressure system over the Mediterranean basin and southern France - the impacts on 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 partners are utility companies, ENEL and Alperia, 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 to identify winter conditions in the Alps and Apennines that impact on the power system.
- How can ENEL and Alperia effectively manage the risks associated with extreme climatic events?

The seasonal forecasting context

- This case study focuses on seasonal forecasts of precipitation and hydrological balance.
- Seasonal forecasts of precipitation and snow pack will be used to forecast hydroelectric production and the amount of potential energy stored by snow and ice.

Sectoral challenges and opportunities

- Power price management and hedging of generation portfolio – when to hedge the power production?
- Prediction of gas price movements in a context of low hydroelectric power production and changing
- demand net of total renewables.
- Optimising efficiency in hydropower production management (Alperia).

Grant Agreement n. 776868

www.secli-firm.eu

Weather conditions and the power system

Due to a prolonged drought with an extremely dry fall and mild temperatures, the end of 2015 and the beginning of 2016 were characterized on one hand by a low level of power and gas demand and on the other hand by a deficit in hydro supply production (Figure 1). During the first three months of 2016 the actual hydroelectric production (red line) was almost half of the energy produced during the same period of 2015 (red ellipse). It was even lower than the minimum of the 5-year range. There was a similar situation in the period of October to December 2016 (green circle).

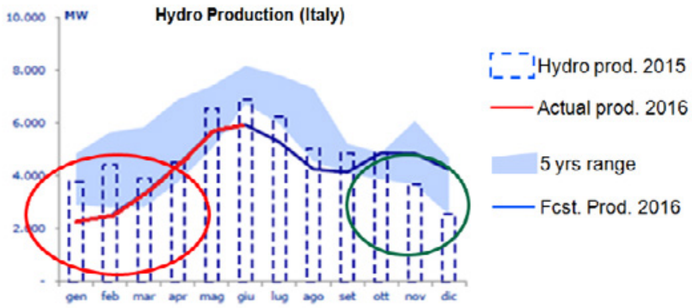

Figure 1: Italian hydro production

The combined effect of low demand (Figure 2) and hydro deficit led to an increasing Italian spark spread level. The spark spread level is the difference between power prices and gas prices. In other words the revenue of a power generator minus the costs linked to the power energy produced.

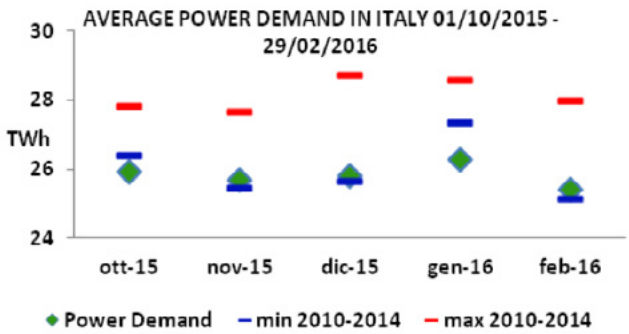

Figure 2: Monthly power demand in Italy from Oct - Feb 2016

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

Mild and dry winter 2015/2016 in the Alps and Apennines

Sector impact

Gas price movements in the context of low demand and hydroelectric production

Industry context

Utility
Power generation

The business process

In the broad context of the business process within ENEL (Figure 3), Alperia, which produces renewable energy, cannot interfere directly with the market scenario. It can only try to sell the energy at the most advantageous price.

In the control and test groups established by ENEL, 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.

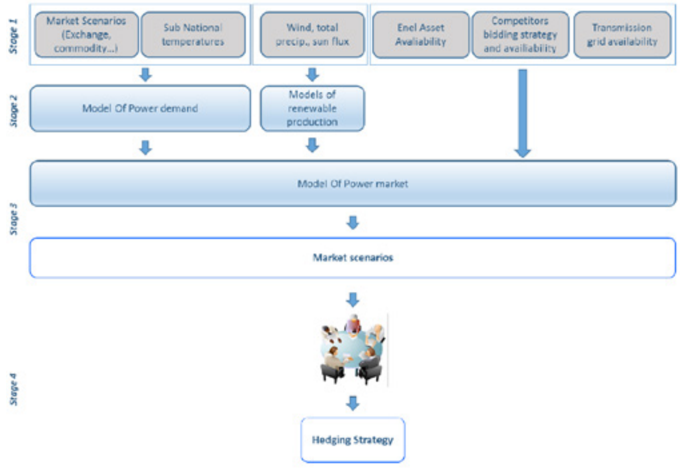

Figure 3: Flowchart for business process

Decision trees

The decision tree here represents the strategic decision making process and has the aim to evaluate the impact of seasonal climate forecasting models. The valuation is based on the comparison of results obtained by using three sets of input data: climatology, SECLI-FIRM forecasts and actual data, that represents the target.

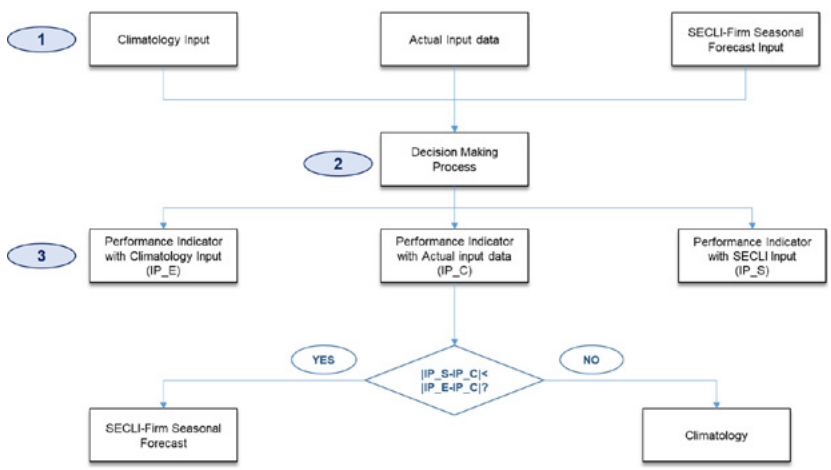

Figure 4: Enel Decision Making Tree: Performance Indicator Comparison

Business process

Data gathering (market and meteo)

Simulations of the power market

Hedging committee

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.

Case Study Highlights

The low hydropower production occurring November 2015- January 2016 was analyzed in two different periods: Q4-15 and Q1-16. The first period (Figure 1) was characterized by low precipitation and mild temperatures over Alps and Apennines, while in the second there was an increase in rainfall especially in the month of March.

The ECMWF forecast system (SEAS5) and the combination of four models (ECMWF, Meteo France, Met Office and DWD) were compared with ERA5 climatology and actual value. The study was performed at different initialization months before the target period: One month before (M-1), three months before (M-3), and five months before (M-5) for both solutions in the two Alpine and Apennine areas. The input of decision-making tree consists in two forecasts solutions (MME and ECMWF -Single Model), one for actual measure, one for climatology. In fact, the weather forecasts have been compared with a base case scenario (computed using climatology as input) and a “perfect forecast” scenario (using the real value as input of the decision-making tree). In order to evaluate the added value of seasonal forecasts inside Enel’s economic assessment a Performance Indicator was defined and calculated for each initialization and each solution. In detail: Performance Indicator from seasonal forecasts (IPs), from Climatology (IPe), from Actual values (IPc). In this way, when the difference between IPs and IPc is less than the difference IPe-IPc the forecast is considered to have added value’ (Figure 4).

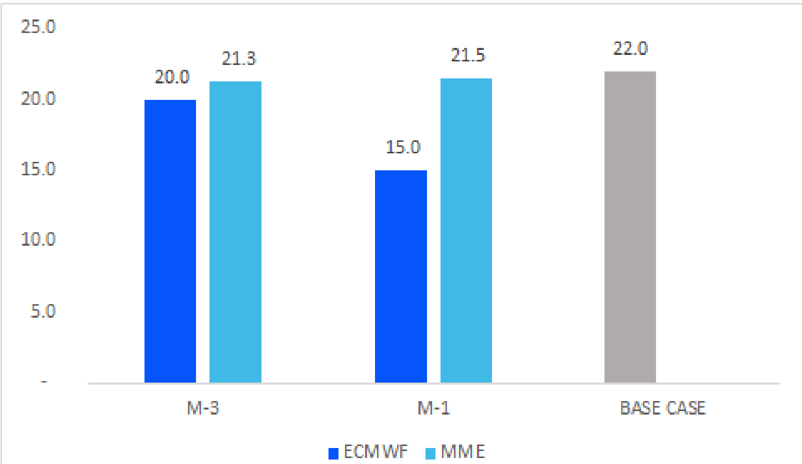

Figure 5: Example of Indicator performance comparison in Q4-2015 of CS2.

Case Study Highlights

- Comparison among ERA5, ECMWF (single model) and MME forecasts
- Error analysis for MME
- Application of single model and seasonal forecasts to internal econometric models
- Estimation of the added value from the decision of tree with the new SECLI-FIRM weather input

The Future

The SECLI-FIRM Project was a great opportunity to investigate a recent technology given by the seasonal forecast. This enabled us to learn scientific and technical skills for using these tools and about the reanalysis database. The profitable interaction with the SECLI-FIRM project Work Package 2: Optimisation of climate prediction performance' allowed us to acquire an awareness about the topic of medium-term weather forecasting, including the caveats related to a technology that is still a research frontier. Nowadays, seasonal models provide different scenarios of forecasts that do not give unique information. Therefore, the technique to translate these different forecasts into a deterministic value tends to produce average results that may not reflect the magnitude of large signals observed in the case of extreme events. For this reason, the evaluation of an extreme event may be subject to errors. In this case study, this behavior was observed for both Single and Multi-Model solutions.

In conclusion, although the seasonal models to the present day do not offer performances that are able to perfectly reproduce the extreme events, the use of these models by Enel should be considered as a stepping stone.

The Climate Service Teal Tool was customized to Enel's needs (referring to D1.1 and D1.3) and it will be fed by the ERA5 dataset, for historical analyses, with the seasonal forecasts (ECMWF and NMME) and with the operational short term forecasts. However, Enel will remain committed to following the technological and scientific evolution of seasonal models in order to use them as a tool for improving operational skills.

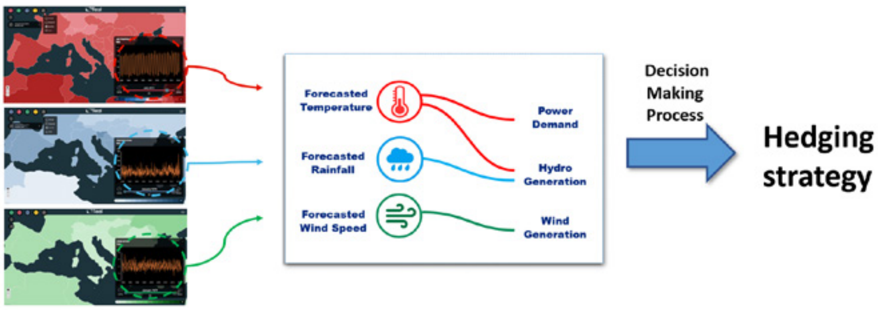

Figure 6: Example of the use of Teal Tool weather forecasts in Enel's decision-making process.

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

For more information visit:

www.secli-firm.eu or contact us at:**info@secli-firm.eu**

The Future

Implementation of Seasonal forecast within the Teal Tool.

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

Related Materials
Watch the Case Study 2 video
https://youtu.be/rOBjx0t-1VRo

Grant Agreement n. 776868