S2S4E DECISION SUPPORT TOOL: THE NEW FORECASTING TOOL FOR THE ENERGY INDUSTRY

The S2S4E project has developed a forecasting tool tailored to the energy industry, the S2S4E Decision Support Tool, which shows subseasonal and seasonal forecasts for renewable energy production and electricity demand.

The S2S4E Decision Support Tool is a climate service that features scientifically based climate information intended to enhance users' knowledge of the weather conditions expected over the coming weeks and months so that they can use this knowledge in their decision-making. The tool is developed by the S2S4E Climate Services for Clean Energy project, which is funded by the EU's research and innovation programme Horizon 2020 and coordinated by the Barcelona Supercomputing Center. The 12 partners in the project come from seven different countries in Europe, and together they have been working to make subseasonal and seasonal forecasts more useful to the energy sector.

Global forecasts for essential climate variables and energy indicators

The S2S4E Decision Support Tool is available at s2s4e.eu/dst. It shows global forecasts for essential climate variables and energy indicators such as temperature, near-surface precipitation, solar radiation, wind speed, wind and solar power capacity factors, snow coverage, and inflows to hydropower plants. The forecasts that are fed into the tool come from the European Centre for Medium-Range Weather Forecasts (ECMWF), one of the world's six leading weather agencies. In addition to seeing the latest forecasts, users of the tool can opt to get more information on forecasts for the specific locations they are interested in and to see past forecasts.

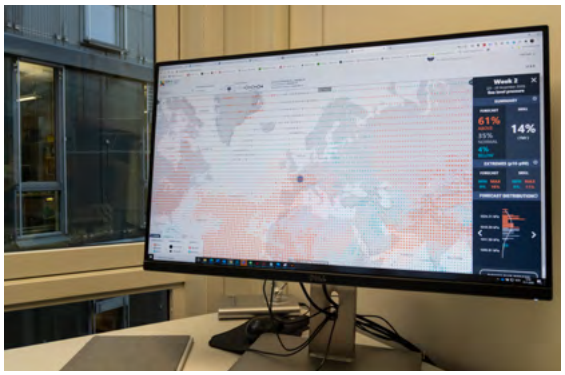
Responsive design allows you to access the tool on the go.

Shows forecasts for up to three months ahead and how these compare with the norm

The forecasts in the tool are inherently probabilistic. This means that rather than seeking to predict specific weather events – for example that a windstorm will take place on a particular date – the forecasts provide intelligence about the overall nature of the weather conditions which are likely to occur over the following weeks and months.

The subseasonal forecasts focus on week-to-week changes in weather conditions and show the outlook for the next four weeks. Meanwhile, the seasonal forecasts focus on month-to-month changes and present predictions for the next three months. The forecasts are carefully calibrated to historic observational data and are compared with many years of previous forecasts to provide information on the potential for anomalous weather conditions.

Users of the tool can thus easily see how the forecasts for each location and lead times compare with the seasonal norm or if, for example, they are expected to be markedly wetter, drier, hotter or colder than normal. Specialist users can opt to see the full probability distribution of the forecasts, which gives important information about their uncertainty.



The desktop view.
How most users will encounter the S2S4E Decision Support Tool.

Try the tool at
www.s2s4e.eu/dst

USE OF SUBSEASONAL AND SEASONAL FORECASTS CAN POTENTIALLY LEAD TO MORE SUCCESSFUL ENERGY TRADING

When subseasonal and seasonal forecasts show skill and prove accurate, they can potentially help increase the earnings of the energy companies using them, as research by the S2S4E project shows.

Subseasonal and seasonal forecasting is still at an early stage, but scientists working to improve these forecasts have made substantial progress over the past decade. Such forecasts are now able to predict the evolution of some large-scale extreme weather events several weeks in advance, and to show whether the upcoming season is likely to be drier or wetter, or hotter or colder, than normal.

Weather conditions are a key factor in the formation of wholesale electricity prices, as both renewable power production and electricity demand are weather-dependent. Predicting the weather thus plays a key role in electricity price forecasting.

Having information about how hot, cold, wet, dry, or windy the upcoming weeks and months are expected to be can be critical for estimating how high or low electricity demand is likely to be and how much electricity is likely to be generated by wind turbines, solar panels, and hydropower plants.

Very little wind or solar power is generated when the wind does not blow or the sun does not shine, and hydropower production drops in periods with little rain and low snow-melting. Electricity demand, meanwhile, increases both when it gets so cold that people start turning on their electric heaters to stay warm and when it gets so hot that they turn on their air conditioners to cool down.

When subseasonal and seasonal forecasts are skilful and accurate, they can help energy companies improve their trading strategy by giving them early information about the weather conditions that are likely to occur over the coming weeks and months. This in turn can lead to better economic outcomes for the companies using these forecasts.

For more detailed information, please see Deliverable 2.2 by the S2S4E project.

SUBSEASONAL AND SEASONAL FORECASTS CAN HELP ENERGY COMPANIES IMPROVE THEIR RISK MANAGEMENT AND PRODUCTION PLANNING

Subseasonal and seasonal forecasts can help energy companies become aware of weather-related risks at an earlier stage and enable them to better prepare for them. They can also help them decide when to perform maintenance on their power plants.

The sooner power producers get information on how weather conditions are likely to evolve over the coming weeks and months, the more time they have to prepare for them and to protect their power plants from potential hazards. If operators of wind and solar power plants know in advance that weather conditions will soon turn very wintry, they can, for example, organise snow removal to minimise the risk of the snow reducing power production and ensure unhindered access to their power plants.

Similarly, if hydropower operators know that heavy rain is expected in a couple of weeks or next month, and that it could lead to a risk of flooding, they can reduce the filling levels in their reservoirs to make room for all the water to come.

Seasonal forecasts can help companies identify risk of cooling water problems

Conventional power plants are often located near rivers and lakes to ensure that they have access to plenty of water to cool down the steam produced during the electricity generation process. During a heatwave, however, the water used for this purpose may get too hot, and the power plant may have to shut down or reduce its electricity production significantly. Electricity demand tends to be high during heatwaves because people use their air-conditioning systems to cool down. Lower supply of power from conventional sources during heatwaves can therefore lead to a risk of blackouts.

Subseasonal and seasonal forecasts can predict when such events may occur and help energy producers prepare for them. Such forecasts can thus contribute to increasing the security of supply during prolonged periods of unusually hot weather.

Can help plant operators plan maintenance on their power plants

Subseasonal and seasonal forecasts can also help operators of both renewable and conventional power plants decide when is the best time to plan maintenance outages.

Power plants usually need to be shut down to undergo maintenance, which will lead to a decline in electricity production. This means that maintenance outages should ideally occur when both power demand and electricity prices are expected to be low.

Subseasonal and seasonal forecasts can help power producers identify when such situations are likely to occur. These forecasts can therefore help them avoid situations where maintenance outages might pose a risk to the security of supply and lead to a sharp reduction in income due to lower electricity sales during periods with high power prices.

CASE STUDIES OF UNUSUAL SITUATIONS IN THE POWER MARKET

Case studies by the S2S4E project of specific, unusual situations in the power market in several European countries show that subseasonal and seasonal forecasts could often have brought added value to companies' decision-making.

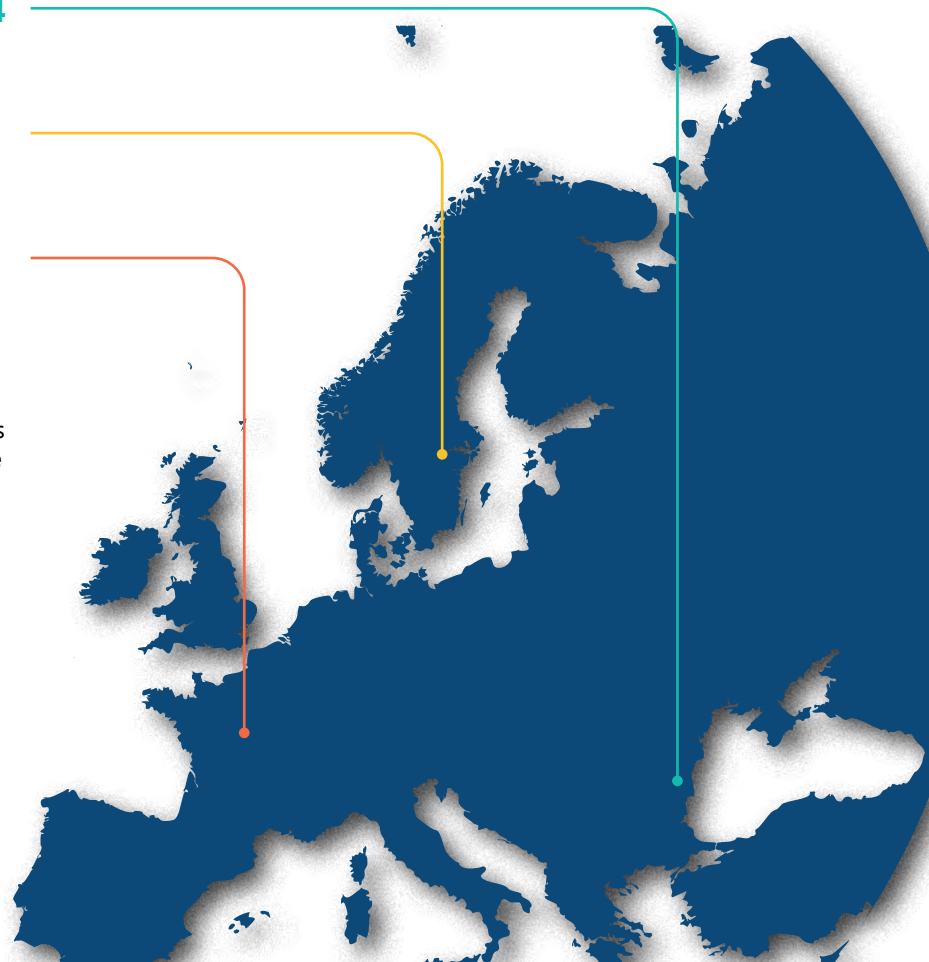
Interviews conducted as part of the S2S4E project have revealed that energy companies tend to be risk averse when it comes to using subseasonal and seasonal forecasts. They are often more concerned about making a decisional error due to a poor forecast than about potential gains they can make from using a good forecast. As part of the S2S4E project, several case studies have been conducted for situations in the energy market that the energy companies involved in the project remember due to unseasonal weather conditions.

These case studies show that subseasonal and seasonal forecasts would in some cases have been able to offer strong indications of unusual events well in advance of them occurring. They could therefore have brought added value to the trading and risk management activities of the companies using them and thereby helped them increase earnings and limit losses.

ROMANIA, WINTER, 2014

SWEDEN, SUMMER, 2015

FRANCE, JANUARY, 2017



For more information about the forecasts produced for the case studies, please see Deliverable D4.1 by the S2S4E project.

The analyses of the economic gains of using these forecasts for the case study events can be found in D.2.2.

FRANCE, JANUARY, 2017

A prolonged cold spell caused a jump in power demand, as most French households rely on electricity for heating. At the same time, wind power production was low and some of the country's nuclear power plants were offline for maintenance.

The combination of expectations of high demand and tight supply led to soaring prices in the forward market, with the contract for 16–22 January, the week with the highest expected electricity demand, rising to **EUR 170/MWh** in the preceding week. As the spot settlement later showed, this contract was markedly overvalued, with the French spot price for this week out-turning much lower and averaging **EUR 89.61/MWh**.

Spot prices settled lower because the weather forecasts available at the time – and consequently the market – had overestimated how cold it would be. The subseasonal forecasts produced for the week of 16–22 January by the S2S4E project showed already three weeks in advance that temperatures in France would likely be around freezing that week.

They would also have provided more accurate temperature estimates than the weather forecasts did in the preceding week. The subseasonal forecasts could thus have helped traders realise that the contract in the forward market was overvalued and that it would be better to buy power in the spot market. The subseasonal forecasts could also have helped traders decide when to buy the power they needed for the week of 16–22 January in the forward market.

There, the price for that week had reached its lowest level about two weeks earlier, at **EUR 63/MWh**. The subseasonal forecasts indicated already then that the weather in the week of 16–22 January would be colder than normal. If traders had purchased the electricity they needed for that week then, they could have saved 29% compared with buying it in the spot market.

Download case study fact sheet.

SWEDEN, SUMMER, 2015

Electricity prices plunged to record lows in late July due to very high hydropower generation, following an unseasonably rainy and cold summer. The cold weather had led to snow melting occurring slower and later than expected, and when the snow finally started to melt, the water inflows became extreme.

This caused very high unregulated hydropower production and forced many hydropower operators to reduce the filling levels in their reservoirs by spilling water to reduce the risk of flooding, without using it to generate electricity.

At the same time, wind levels were also strong, causing high wind power generation. Both the unseasonably wet weather and the amount of snow left in the Swedish mountains had been underestimated by most of the forecasts that were available at the time. However, as the case study by the S2S4E project showed, seasonal forecasts could have informed hydropower producers already three months in advance that both precipitation levels and inflows to hydropower reservoirs were likely to be higher than normal.

If they had used seasonal forecasts in their decision-making, they could have reduced the economic losses they suffered due to the weak prices by increasing their power production earlier that summer, when prices were higher. This would also have enabled them to reduce the filing levels in their reservoirs to make room for all the water that was to come.

Download case study fact sheet.

ROMANIA, WINTER, 2014

During a prolonged period of unusually wintry conditions in January and February, some of the wind turbines in the country froze and, consequently, stopped. Snow-covered roads made it difficult for wind farm operators to inspect their turbines, so it took a while before they realised what had happened.

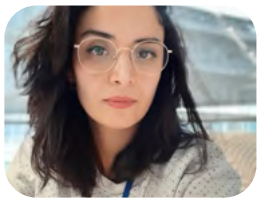
The drop in wind power output led to the operators suffering losses both because of lower electricity sales and because they had to pay penalties to the transmission system operator for failing to deliver as much power as promised. The S2S4E project has produced a subseasonal forecast for one of the three weeks the cold snap lasted to see if that week's wintry conditions could have been foreseen.

This forecast could not have given the wind farm operators early information about the wintry conditions that were to come, indicating how challenging it can be to produce accurate and reliable subseasonal forecasts, and that more research is needed to improve their quality.

However, if the subseasonal forecast had been accurate – and if it had been available before the event – it could have helped the wind farm operators to better prepare for this situation by, for example, improving their trading strategy and organising snow removal to ensure unhindered access to their wind farms. The cost of snow removal would likely have been much lower than the losses they incurred due to the sudden and unexpected drop in wind power generation.

Download case study fact sheet.

QUOTES BY THE ENERGY PARTNERS INVOLVED IN THE PROJECT



Hiba Omrani,
research engineer at French utility EDF.

"At EDF, we joined the S2S4E project consortium particularly because of our need for monthly and seasonal forecasts. Since the launch of the S2S4E Decision Support Tool, we have used the tool regularly."

Michael Christoph,
weather analyst at German utility EnBW.

"We at EnBW decided to take part in the S2S4E project to be at the forefront of new developments in energy meteorology. Meteorologists at EnBW use the S2S4E Decision Support Tool on a weekly basis, on the days when the forecasts in the tool are updated."

Daniel Cabezon Martinez,
head of meteorological models and special tasks at Spanish utility EDP Renewables.

"EDP Renewables decided to join the S2S4E project because we wanted to learn more about subseasonal and seasonal forecasts. It is very useful that the S2S4E Decision Support Tool so clearly shows both the forecast skill and the probability thresholds for the forecasts!"

This fact sheet summarises insights from the S2S4E white report. Please read the S2S4E white report for more information about the S2S4E project and its research on subseasonal and seasonal forecasts, and how the energy industry can benefit from increasing its use of such forecasts.

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