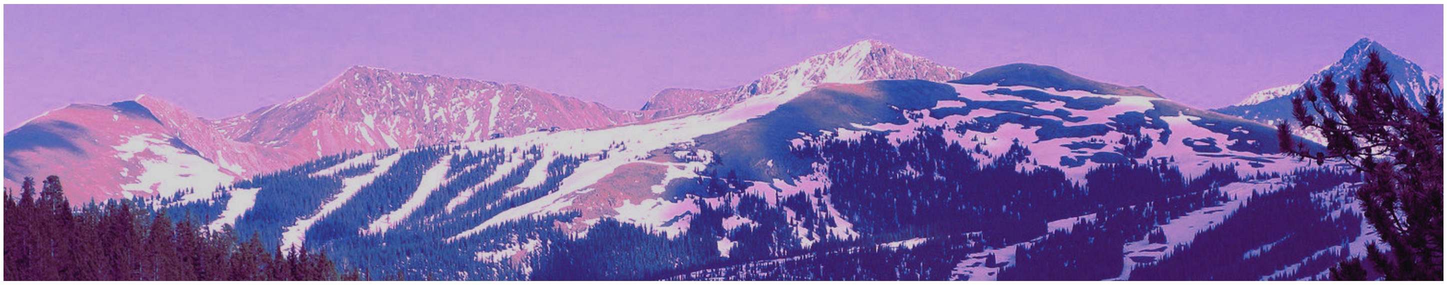
NET DEMAND SIMULATION
CASE STUDY

This case study presents the underlying motivation and representative insights from an electric cooperative net demand planning exercise that utilized a long-term (15-year) correlated climate simulation and machine learning-based energy resource modeling. The approach described here overcomes several challenges related to net demand planning and resource adequacy analysis, namely– 1) the creation of a large sample of properly jointly distributed weather, 2) the incorporation of climate change trends, 3) the creation of a typical hourly net demand path, and 4) the creation (and curation) of extreme–but realistic–weather and energy scenarios across a utility footprint.



Holy Cross Energy’s Need for Net Demand Simulation

Holy Cross Energy (HCE) is a member-owned electric cooperative that serves more than 40,000 customers in the Western Colorado counties of Eagle, Pitkin, Garfield, Mesa, and Gunnison. HCE has a goal of providing 100% renewable energy supply to its customers by 2030.

Accordingly, HCE is actively adding renewable energy resources such as utility-scale solar and wind to its energy portfolio. As a result, HCE is managing an increasingly variable energy position that combines residential demand, commercial demand (including ski resorts), solar generation, and wind generation (see Figure 1).

Furthermore, the greatest portfolio risk for HCE, as an electric cooperative, is no longer anticipating and managing *peak* demand–but rather anticipating and managing *net* demand (demand minus renewables). Net demand poses a risk at both high levels (when HCE must be confident it can procure enough firm supply to cover its customer obligations) and low levels (e.g., when renewable generation exceeds demand and HCE may be forced to sell excess power at a loss).

To quantify its net demand risks, Holy Cross Energy needs a way of simulating many possible hourly net demand outcomes over a long-term planning period–accounting for all the factors that drive both short-term and long-term net demand: weather variability, climate change, structural demand growth, electrification, and the addition of new renewable energy supply.

Sunairio's Full Portfolio Modeling Capability

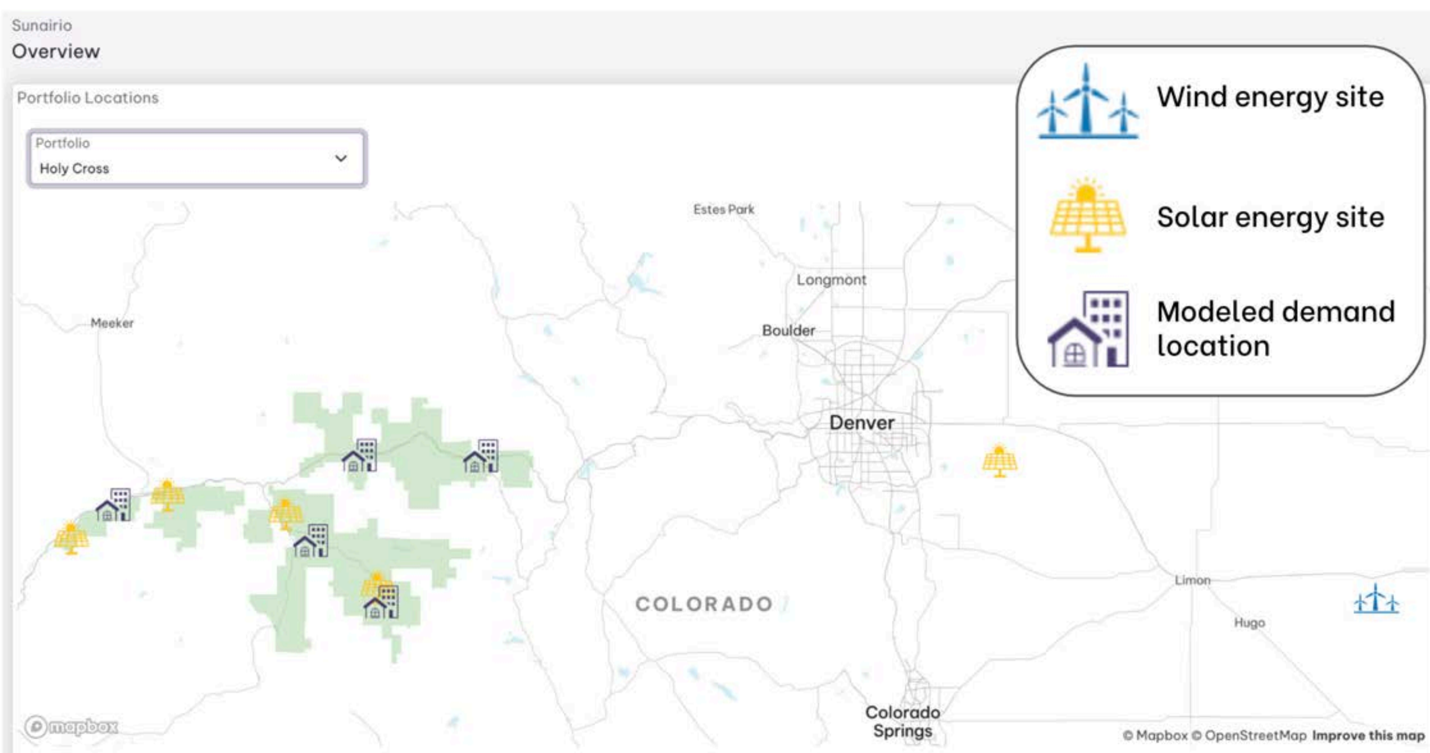


Figure 1. Holy Cross Energy demand footprint (green) and Sunairio-modeled full portfolio of demand locations, wind energy sites, and solar energy sites.

Analytics Challenges

The fundamental challenge with simulating hourly net demand outcomes over a utility/cooperative planning period is the need to generate correlated hourly outcomes of load and renewables at appropriate likelihoods. Typically, this first requires generating a properly correlated set of future hourly weather outcomes at many population centers, solar energy asset locations, and wind energy asset locations.

Yet traditional climate modeling methods cannot efficiently generate these large, forward-looking data sets. Instead, it is common practice to use historical weather as an analogue for future weather risk–a difficult task due to the challenge of obtaining large amounts of high-quality, localized historical weather data at wind and solar sites.

In fact, electric utilities often rely on a very limited number of historical weather years for wind and solar modeling, or even just one synthetic year: the developer's pre-construction 8760/Typical Meteorological Year (TMY). The years in this limited set are treated as "profiles" that can be mixed and matched with longer historical series of temperature data, which are more easily obtained from airport weather stations. In other words, a limited number of years of hourly solar capacity factors and wind capacity factors are extended over a longer historical hourly temperature data set.

This approach thus suffers from at least three major problems: 1) the lack of a large sample of wind and solar data from which to measure extreme events and variability risks, 2) a dubious statistical method for extending the wind and solar data to create a larger demand-wind-solar sample, and 3) the lack of any consideration of climate change impacts.

Sunairio's Solution for Holy Cross Energy Net Demand

The Sunairio platform offers a new approach to net demand simulation that is built on several layers of proprietary technology: hyperlocal historical climate data, climate change-aware stochastic climate simulation, and machine learning-based energy prediction models.

The Sunairio platform enabled Holy Cross to simulate thousands of hourly outcomes of correlated, localized, climate change-aware weather and energy across its footprint (and specifically at its solar and wind sites) for the next 15 years.

By subtracting solar generation and wind generation from hourly demand in each correlated simulation outcome, HCE obtained a large sample of forward-looking hourly net demand simulations over the entire range of its planning period.

In addition, Sunairio curated several weather and energy simulations for Holy Cross to use in its planning process: a "typical" net demand path (and associated weather and energy paths) constructed using a process similar to the construction of a TMY, as well as several extreme paths that were selected based on the magnitude and duration of particular weather risks of interest to HCE.

Results

Time series plots of the "typical" net demand path–along with the underlying demand, solar, and wind paths are shown in Figure 2 for a week in July 2025. Note the difference between the relatively regular demand pattern and the highly volatile wind and solar resources. More importantly, observe that the highest net demand hour is *not* the peak demand hour. While the highest raw demand hour occurs on July 26th, the variability and correlations between wind, solar, and temperature act to create a higher net demand peak on July 24.

Correlated Energy Resources and Resulting Net Demand (Typical)

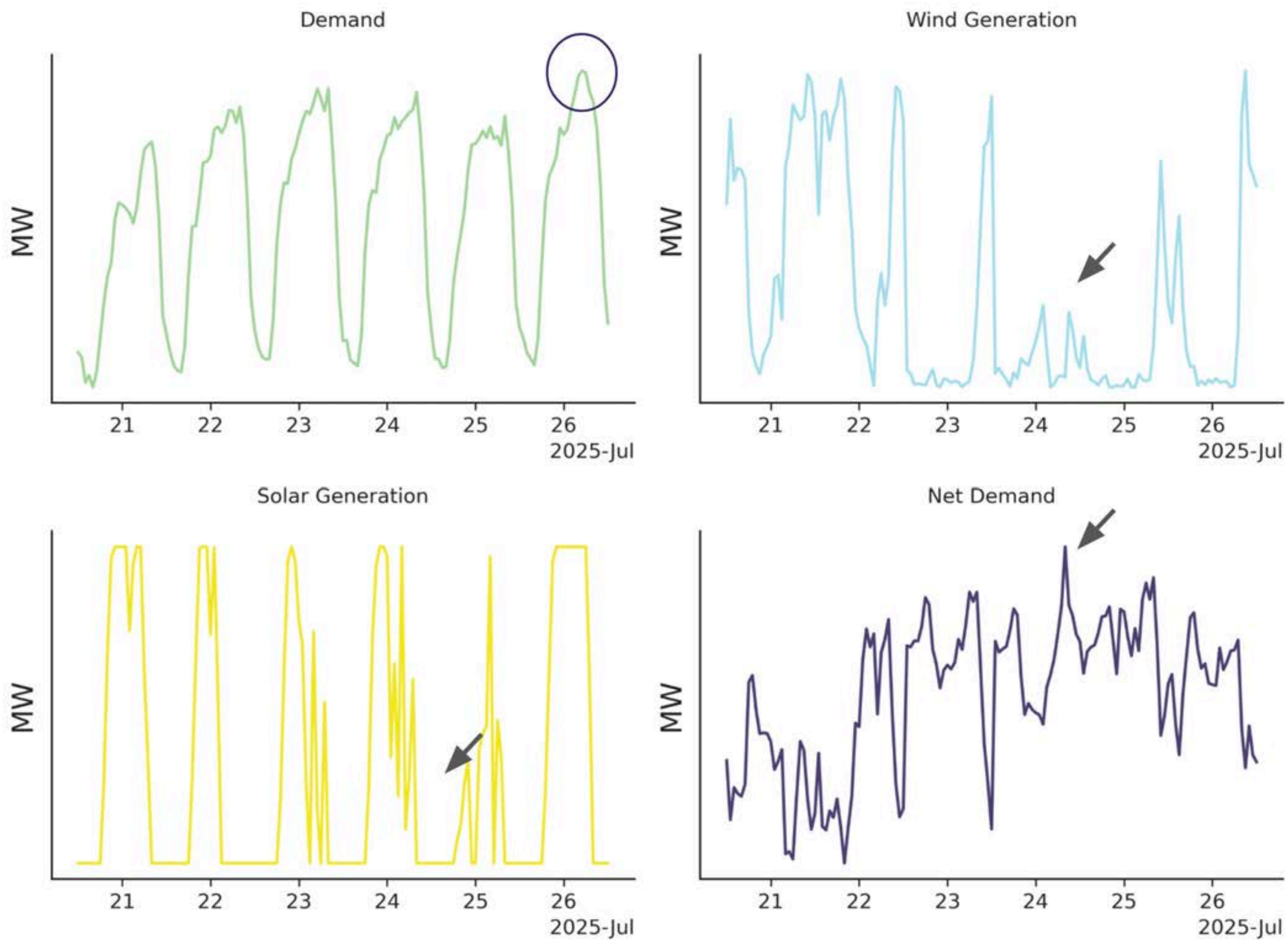


Figure 2. Correlated demand, wind generation, solar generation, and resulting net demand for a typical weather path week in July 2025. Note that the highest raw demand hour occurs on July 26 (circle) but the highest net demand hour happens two days earlier due to the concurrence of high temperature, low wind speeds, and lack of solar (arrows).

This doesn't guarantee that the 24th will feature the highest net demand hour in July 2025–but it does provide HCE with a realistic *baseline* for diurnal, daily, and seasonal variability - a crucial but often overlooked factor in planning decisions. Moreover, this interaction reflects the everyday, real-life challenge HCE faces in managing supply and demand risks on behalf of its members.

Note that *extreme* weather paths that present tail risks to HCE's portfolio were also selected for planning purposes based on HCE criteria and statistical processing.

Conclusion

As utilities and electric cooperatives replace dispatchable generation with intermittent renewable energy, the need to plan for *net* demand becomes much more important than planning for *peak* demand alone. This case study demonstrates the Sunairio platform’s scalable solution for net demand planning via comprehensive, climate-change aware correlated weather and energy resource simulations.