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EXECUTIVE SUMMARY

How AI is Powering Accurate, Scalable Load and Generation Forecasting

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KEY TAKEAWAYS

- A range of challenges can impact the accuracy of energy forecasts.
- The multivariable complexity of the energy transition is upending conventional forecasting models.
- The shifting energy landscape is driving improved forecasting for planning and operations.
- Cloud-based AI and deep learning tools can help utilities improve energy forecasting.

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How AI is Powering Accurate, Scalable Load and Generation Forecasting

OVERVIEW

As regional power market supply and demand continue to evolve, energy planners for utilities have little choice but to grapple with new ways forward. Pulling together data on the many moving parts of energy management, including renewables, DERs, various regulations, and consumer demands is extremely important, but can be challenging. In addition, quality data are critical to determining the best path forward, and the volume of data that must be analyzed to ensure forecast accuracy creates another challenge to effective analysis.

Advancements in technology, including cloud-based SaaS tools and AI-driven applications, can help utilities overcome these challenges. SAS delivers forecasting capabilities in the cloud, providing utilities with accurate, reliable load and renewable forecasts from anywhere. SAS uses all data to maximize investments in smart meters and advanced metering infrastructure, and helps operators do more—and more effectively—with existing planning and forecasting resources.

CONTEXT

The presenters discussed challenges to energy forecasting and described how AI-powered tools available in the cloud can help improve forecast accuracy.

KEY TAKEAWAYS

A range of challenges can impact the accuracy of energy forecasts.

In the current energy landscape, utilities are facing increasingly difficult challenges when developing forecasts. These include both supply and demand challenges.

Supply Challenges	Demand Challenges
– **Unplanned generation outages** require real-time reaction and rapid adjustment. – **Extreme events,** such as weather, are occurring with increasing frequency. – **Holidays** differ between regions, such as school vacations. – **Economic and power market conditions exist**, from imports and exports that are subject to commodity exchange rates, to market conditions such as congestion. – **Data quality:** Accurate modeling depends on clean, high-quality, and visible data. – **Lack of skillsets** exist within the utility sector, especially data scientist and AI expertise. Internal upskilling and third-party technology providers can fill some gaps.	– **Accurate solar forecast and cloud coverage** can vary widely depending on equipment tilt, panel type, sun intensity, and other conditions. – **Accurate wind forecasts** are similarly subject to difficult-to-predict factors. – **Hydro forecasts**—especially in regions with extensive hydro units—must account for variable environmental conditions. – **Consumer energy consumption behavior** is changing. – The proliferation of **electric vehicles** requires the ability to increase load in certain areas and provide flexibility to the grid in others. – There is intermittence due to lack of visibility into **renewables and behind-the-meter DERs**.

Figure 1: Energy forecasting challenges

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> "A new generation of consumers [makes] more environmentally conscious decisions . . . around demand-side management, energy efficiency, green energy programs—all of those have to be in consideration when you're looking at energy forecasts."
>
> *John Villali, Research Director, IDC*

The multivariable complexity of the energy transition is upending conventional forecasting models.

Although the majority of energy supply currently comes from fossil fuels, decarbonization will eventually impact the traditional energy forecast, as energy generation shifts to greener and cleaner sources. As the renewable energy supply stack grows, models will need to evolve to handle increased complexity.

Advanced models should be capable of considering both complex regulatory requirements—which often vary by jurisdiction and market mechanisms—and other factors such as carbon pricing, or the ability to forecast and dispatch non-utility-owned DERs in the wholesale market (under FERC 2222). Models that account for these conditions and their impact on energy availability will result in more accurate forecasts.

The shifting energy landscape is driving improved forecasting for planning and operations.

Some states have set ambitious goals that will require infrastructure investments. For example, both California and New York have programs focused on increasing the number of zero-emission vehicles (ZEVs), spurring rapid EV penetration.

The unprecedented EV growth rate is changing how utilities develop resource plans, moving away from more traditional 15-year plans for power plant and transmission distribution line buildouts to much more condensed timelines. To handle the rapid growth, significant investment in infrastructure must be made much earlier, requiring improved forecasting capabilities.

> "In many cases, distribution transformers are already running at full load during peak hours. . . . One study shows that at 25% EV penetration there will be a 30% increase in load. In California, the penetration level of EVs in 2030 will be more than 50% . . . two to three times the growth rate we are used to seeing."
>
> *Arnie de Castro, PhD, Product Manager, SAS*

Transitions such as high EV adoption are driving significant operational changes, as well. EV fast chargers require high kilowattage, driving massive increase in demand on the distribution system, and the corresponding change to the shape of the at-home consumption profile is pronounced. Traditional pricing models, such as time-of-use, may have to be modified or replaced altogether.

When considering operational changes due to renewables, the US is currently slated to achieve 80% generation from renewables by 2030, with solar and wind together accounting for an estimated 40% to 62%. (Currently, solar and wind generation currently account for 7% and 4%, respectively, of electricity generation.)

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Advanced forecast models incorporate data from improved sensor technology, satellite imagery, and enhanced weather prediction models. Addressing accuracy at each stage of the process can greatly improve forecasting, but any analysis must be applied to a clean dataset to achieve reliable, useful forecasts. In the case of weather-related data, using as many weather stations as possible, applying historical trends, and leveraging math to remediate errors contribute to a higher quality data set.

> "Wind and solar are hard to predict. The output tends to be more uncertain, so we have to account for those uncertainties . . . the forecasting process needs to be enhanced to address today's challenges."
>
> *Tao Hong, PhD, Duke Energy Distinguished Professor, UNC-Charlotte*

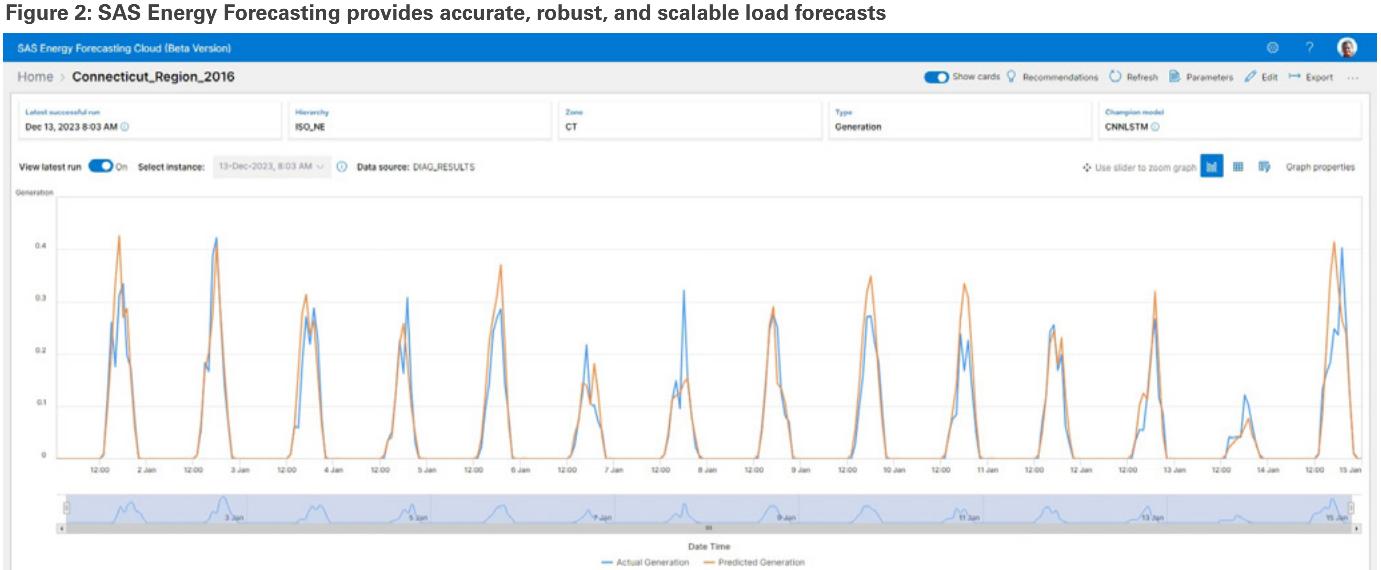
Considering the rapid growth of demand, a significant increase in renewables, and an exponentially growing volume of data required to make better predictions, using AI-driven models in operations, trading, and integrated resource planning can provide benefits to power and utility companies and produce a significant ROI.

Cloud-based AI and deep learning tools can help utilities improve energy forecasting.

To mitigate the many challenges of the rapidly evolving energy landscape, utilities must look to more advanced tools that leverage AI to improve forecast accuracy. Cloud applications allow utilities to take advantage of advancements in computing power, deep learning models, complex algorithms for model selection, intelligent automation, and integration of the forecasting process with monitoring and control systems for rapid response and optimization.

Using deep learning allows models to handle much larger volumes of data, provide important variables and feature selection capabilities, and identify patterns that are too complex for humans to discern. In addition, because it is more difficult to manipulate machine learning methods than traditional methods, machine learning often produces more accurate, less biased results than human-driven approaches.

Figure 2: SAS Energy Forecasting provides accurate, robust, and scalable load forecasts



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> "To bring in all this data requires a scalable platform that can create models and forecasts at a granular level."
>
> *Jennifer Whaley, Principal Systems Engineer, SAS*

Not only does cloud enable management of the vast amount of data required to run effective AI and neural networks, but it also provides access from anywhere, at any time, to detailed analysis and forecasts. While cost can still be a concern for utilities, the longer-term TCO benefit can be significant, especially when considering the continued evolution of forecasting capabilities that will be required as the energy landscape shifts to greener and cleaner solutions. Because of this, investments in cloud-enabled AI-powered forecasting tools are only expected to grow in the power and utilities sectors.

ADDITIONAL INFORMATION

To learn more about:

- **SAS**, visit sas.com
- **IDC**, visit idc.com

BIOGRAPHIES

Arnie de Castro, PhD
Product Manager, SAS

Arnie de Castro is a Product Manager for industry products at SAS. He has more than 35 years' experience in electric utility operations and resource management. Prior to his work at SAS, de Castro managed the development of enterprise market analytics software applications widely used in industry for optimal power system planning and operations, electrical price forecasting and energy transaction risk analysis.

John Villali
Research Director, IDC

John Villali is a Research Director for IDC Energy Insights, primarily responsible for thought leadership in utility digital transformation. He joined the IDC Energy Insights group with an impressive background in the power and natural gas markets. Villali's expansive experience within the energy industry includes providing superior market insight and having firsthand experience with the needs and desires of energy industry customers. Villali works out of the IDC offices in Framingham, MA. He is a regular contributor to the IDC Community energy blog.

Tao Hong, PhD
Duke Energy Distinguished Professor, UNC-Charlotte

Tao Hong is a Professor of systems engineering and engineering management (SEEM) and an Associate Professor of the Energy Production Infrastructure Center (EPIC) at the University of North Carolina at Charlotte. He has applied various statistical and optimization techniques to the development of algorithms and tools for utility applications of analytics, such as energy forecasting, power system planning, renewable integration, reliability planning and risk management. Hong provides consulting and education services to hundreds of organizations in all sectors of the utility industry.

Jennifer Whaley
Principal Systems Engineer, SAS

Jennifer Whaley's experience includes industry and consulting in the electric utility sector, with a focus on generation planning, load forecasting, environmental policy impacts and economic analyses. She is an IEEE Senior Member and patent holder. She enjoys collaborating with customers and colleagues to solve business problems using advanced analytics—particularly emerging topics about load forecasting and the challenges of incorporating distributed energy resources on the grid and improving renewable forecasts for the energy needs of the future.