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Quantifying Energy Risk Exposure Using SAS®: Analyzing the Impact of the Weather and the Economy during Volatile Times

David Hamilton, ODEC
Craig Carothers, SAS Canada
Kathy Schaan, SAS US

ABSTRACT

In today's times of frequent global economic fluctuations and highly volatile weather conditions, managing risk within an energy company is an ongoing challenge. An electric generation and transmission cooperative, ODEC is a power provider to its 12 members systems.

This presentation will show how Old Dominion Electric Cooperative (ODEC) uses SAS solutions to arm its management and executive team with the needed intelligence to effectively manage its margin – as well as its risk. It addresses the key challenges faced by ODEC and its members, and how ODEC leveraged the SAS Enterprise Intelligence Platform to meet these challenges and to:

- Forecast both demand and energy in a granular model that reflects its members' characteristics
- Utilize this model for short-term, mid-term and long-term forecasts
- Achieve results within an acceptable confidence interval for managing ODEC's energy purchases
- Employ "what-if" scenarios to determine how economic and weather-related factors affect the forecasted results.

INTRODUCTION

Energy and utility companies operate in a unique climate of risk, uncertainty, and volatility – a climate where the challenges are intensifying daily. These organizations work relentlessly to improve overall profitability by doing the following:

- Focusing on business excellence
- Driving costs out of the business
- Managing risk and avoiding excessive leveraging

Across all sectors of the energy and utility industries, companies must make reliable decisions amid hundreds or even thousands of variables. At the same time, they must balance two corporate objectives that are often distinct: operational excellence and customer satisfaction. These companies must accurately predict energy demand, purchase energy needed when the demand exceeds capacity, account for fluctuating weather and economic indicators, and plan for building additional operational assets, such as new power generation facilities, as energy demand grows over time – all in an environment sharpened by soaring energy costs. They must also improve profitability by controlling supply costs and enhancing operational efficiency. Even small improvements can have a significant impact on overall profitability. For example, accounting for the overall economics, a 1% improvement in either revenue forecasting or risk management can translate into an increase in overall profitability worth millions of dollars.

This paper will disclose key forecasting processes and solution capabilities which enables ODEC to:

- Forecast both demand and energy in a granular model that reflects its member's characteristics
- Model for short-term, mid-term and long-term forecasts

- Achieve results within an acceptable confidence interval for managing ODEC's energy purchases and revenue projections

- Employ "what-if" scenarios to determine how economic and weather-related factors affect the forecasted results, and how these factors quantify ODEC's and its members' risk

OLD DOMINION ELECTRIC COOPERATIVE FORECAST SYSTEM

History: ODEC is a Generation and Distribution Cooperative with 11 members that serve some 400,000 customers in Virginia, Maryland & Delaware.

Objective: To plan, develop and implement a comprehensive "state of the business" daily peak and energy forecast platform that provides senior management with the information needed to manage revenues, risks and long range goals.

Scope: ODEC has developed a member (bottom-up), regional, and system forecast model platform using SAS *Forecasting, Strategy Assessment and Management Framework.* The framework enables the staff to focus on a front (data development) to back (final forecast with confidence intervals and scenario planning) complete lifecycle process.

Model Development: ODEC with the help and support of SAS consultants developed specialized daily energy and peak models that fully explain daily causation of energy and peak variation and volatility. These ARIMA-Regression models use advanced variable identification and combinations which greatly aid in model coefficient stability and long range accuracy. Independent variable combinations of weather, economics, and calendar binaries provide the model with efficient correlated time series to predict the dependent variables of interest. ODEC has now developed specific model forms which are imported into the process to be used with any new model forecast which is needed. ODEC adopted a modified ARIMA-Regression approach to control for serial autocorrelation which is normally present in load/energy weather times series problems. ODEC has successfully developed the capability to accurately forecast each member, region, state and the total system and is continuing to refine the process to quickly change forecast assumptions to output scenarios for financial and system planning.

Scenario Capability Vital Need: ODEC developed some initial stress test scenario data streams which fluctuates weather and economics to provide sensitivity bounds to real world potential outcomes. This capability allows the staff to recognize and quantify variation and volatility extremes which can be hedged by financial or physical operations.

Specific scenarios that require attention are:

Cold Winter – Heating Degree Days (HDD's) up 10%

Hot Winter – Cooling Degree Days (CDD's) up 10%

Pessimistic Economy – Economic factors down by 50%

Optimistic Economy – Economic factors up by 2%

FORECASTING FUTURE ENERGY AND SERVICE REQUIREMENTS

Without reliable demand intelligence, overall energy needs must be serviced by supply options that add millions of dollars to energy rates each year. So, in addition to all of the other benefits, a strong demand-intelligence solution provides the volumetric impact scenarios that a company needs in order to analyze how to meet future energy and service requirements efficiently, reliably, and at the lowest reasonable cost.

- Without this Intelligence it is not impossible to assess corrective actions to reduce overall business risk, specifically:
    - Will margin expectations be met? Level of certainty?
    - What are future cost exposures? Are forecasts isolating these exposures?
    - How cash flow is impacted based on various weather scenarios?
    - Are existing contingencies (if any) sufficient to offset business risks?

The Impact of these factors on the overall cost of service can exceed 25 million dollars in any given quarter.

- Without this intelligence it is not Impossible to assess corrective actions to reduce overall regulatory risk, specifically:
- Are variations in normalized forecasting results increasing uncertainty?
    - Rate Making Purposes and On-Going Reporting Requirements?
- Is existing intelligence sufficient to reduce risk of regulatory disallowances?
    - Validate prudent decision making
    - Impact these facts can exceed 10 million dollars in any given regulatory decision.
- Are the underpinning forecasts increasing shareholder risks?
    - Do they truly reflect weather risk? True cost of service? Changes in customer behavior?
- Are ratepayers adequately informed of magnitude of risk?
    - Consumers must have a sense of magnitude of risk to assess appropriate hedging strategy

Facts Are

- 66% of avg. daily send-out impacted by variations in weather
- Weather conditions from one year to the next can vary by over 25%
- For any given temperature condition, demand can vary over 50% from one day to the next, even with the temperature remaining constant
- Multiple forecasting techniques exist to forecast weather but it's uncommon that one forecasting process will consistently outperform all others
- Energy prices are not uniform even when demand is the same

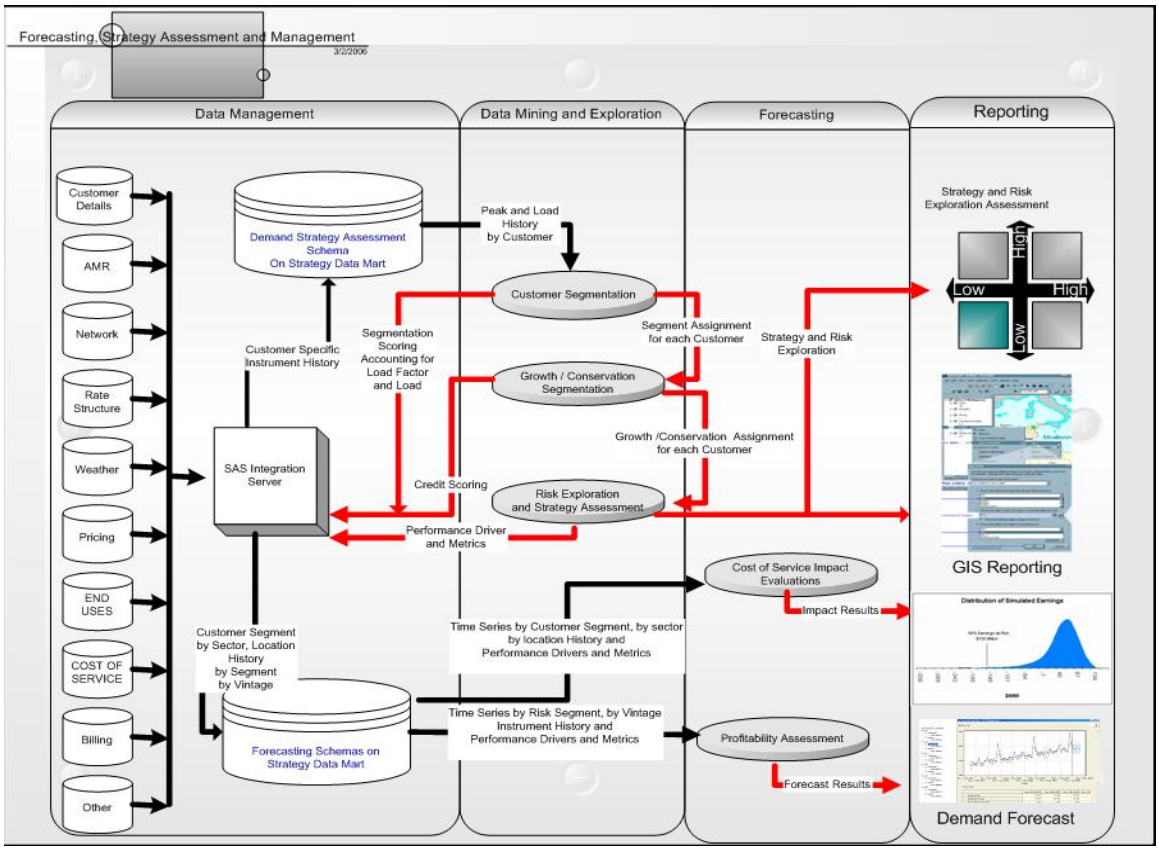

Figure 1. The Forecasting, Strategy Assessment and Management Framework

We're only a few weeks into 2009 and there are no signs that the volatility, uncertainty and economic challenges of the last year are easing. Energy companies are engaged in a daily battle to understand both current and likely future performance. The *Forecasting, Strategy Assessment and Management Framework* (Figure 1) provides the means to assess the impacts of varying economic conditions, weather, and green investment, quantify the risk, and define like future performance.

The Forecasting, Strategy Assessment and Management Framework address companies needs for short term, mid-term and long term planning such as Integrated Resource Planning (IRP) Forecasting, It enables energy companies to evaluate the full range of possibilities (including multiple and varying scenarios which includes expectations related to weather conditions, economic conditions, energy conservation and efficiency programs) and provide adequate and reliable service at the lowest possible cost.

IRP encompasses traditional generation, transmission capability planning, and supply planning. It considers both demand-side and supply options to ensure that adequate capacity exists to meet increases in demand. The result of IRP is a plan that most economically maximizes efficiency and customer satisfaction. Such planning is fundamental to the North American strategy for reducing billions of dollars of incremental energy costs yearly. Accurate forecasts isolate the timing and the magnitude of future conservation opportunities that will reduce the need to use existing transportation and distribution infrastructures. Conservation enables states and provinces to reduce annual energy requirements by tens of millions of dollars and reduce the capital investment that is needed to create, transport, and distribute energy.

Changes in future energy demands are not uniform across customers. Changes in demand vary significantly, driven by several attributes:

- revenue class
- the age of the home
- whether the customer is a new construction customer or conversion customer
- what type of end users are downstream of the billing meter
- efficiency of the equipment that is used

Each unique combination of these attributes defines a unique customer segment. Members of a unique customer segment have a common rate-of-change in demand.

Forecasting at the customer-segment level produces the most accurate forecast. The Forecasting, Strategy Assessment and Management solution provides a consistent, integrated framework that joins all crucial aspects of controlling, preparing, completing, analyzing, and publishing energy forecasts. While maintaining a common framework, the solution provides the capability to utilize differing forecast techniques to produce short-, mid-, and long-term forecasts. The forecast engine for each forecast period can contain multiple, independent forecast models which allow a robust forecasting environment to exist to minimize expected forecast error.

For example, using this approach, the Forecasting, Strategy Assessment and Management Framework establishes which model or combinations of models will provide the most accurate forecast for a “Monday projected to be partly cloudy and windy” versus a “Friday predicted to be sunny and hot condition with temperature of 92 degrees and humidity of 76%” under Pessimistic Economy conditions.

The framework also supplies a versatile infrastructure that accommodates additional data inputs, facilitates the addition, change or removal of forecasting algorithms, and creates an environment that supports analysis for the development of new models to allow for changes in customer or market behavior. At the same it time significantly improves forecast accuracy by providing utility companies with the following benefits:

- Forecasting demand at the customer-segment level, which produces the most accurate forecast
- Enabling weather measures to be tailored to segment and to account for variations across billing cycles

- Incorporating independent drivers (such as weather, baseload profiles, energy prices, and economic indicators) and isolating the impact of change at the segment level.

Not only does the SAS solution improve the accuracy of forecasts, it also enables you to distill segment forecasts down to the ZIP-code level, helping you isolate the following information:

- Where incremental infrastructure is necessary to support the higher demand.
- Which communities must be targeted for your Integrated Resource Planning (IRP) /Demand-side Management (DSM) programs
- How much load must be conserved to eliminate the need for incremental infrastructure? This information maximizes the value of your IRP/DSM efforts because the program is targeted to communities that truly need it.

Past DSM efforts failed to achieve the expected benefits because the IRP/DSM program was not targeted to communities that truly need it, nor was it targeted to individuals who truly have an opportunity to conserve with minimum investment.

SOLUTION

The solution provides consistent methodology to manage uncertainty associated with a changing forecasting environment and a framework to assist in the optimization of forecasting accuracy by incorporating existing business knowledge.

The solution will allow an organization to easily:

- Add additional data sources
- Change forecast models
- Modify business and validation rules
- Change KPI's
- Add new reports

The solution provides these abilities through a robust modular architecture that is completely open - enabling developers to modify existing capability and add new functionality as required. In addition to providing a stable production forecasting environment, the solution also contains a development environment where users can make changes and conduct testing. Using the solution, organization will have the ability to control the future development of their load forecasting process by changing or modifying their forecasting models to meet business, industry and customer requirements.

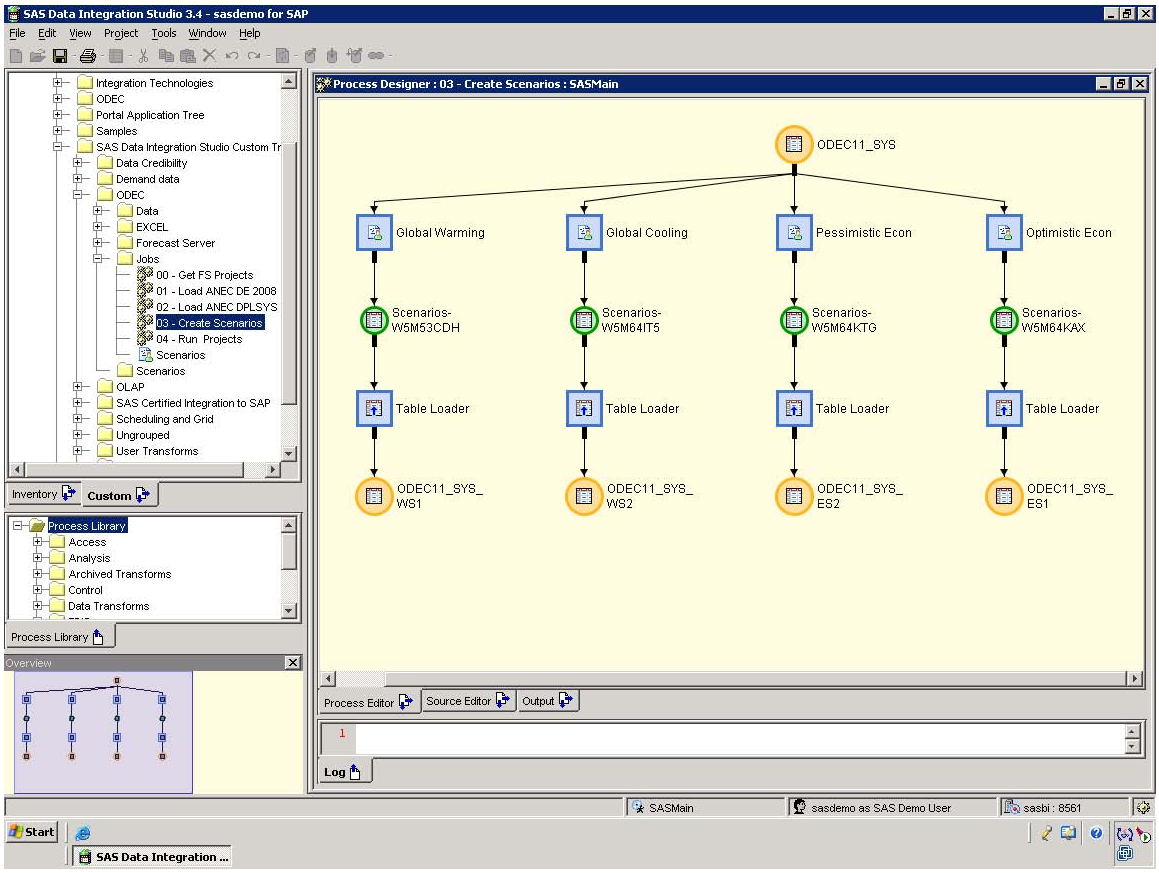

Figure 2. SAS Data Integration Studio automates the creation and management of scenarios.

Using the *Forecasting, Strategy Assessment and Management Framework* provides an integrated set of tools to define, manage, and analyze the effects that weather and economic fluctuations will have on the business. In the area of data management, SAS Data Integration Studio is a central point for accessing and cleansing weather and economic data sources, creating SAS data sets for analysis, defining scenario definitions, and driving the creation of automated forecasts for each scenario. In Figure 2, scenarios includes definitions for global warming, global cooling, a pessimistic economy, and an optimistic economy are shown. Management of updates or recalculations for any scenario can be scheduled for off-peak hours. New scenarios can be quickly added to the process flow. In Figure 3, the parameters that affect the global cooling scenario can be changed on the fly, providing a valuable “what if” model that can be easily fed to other financial or systems planning applications.

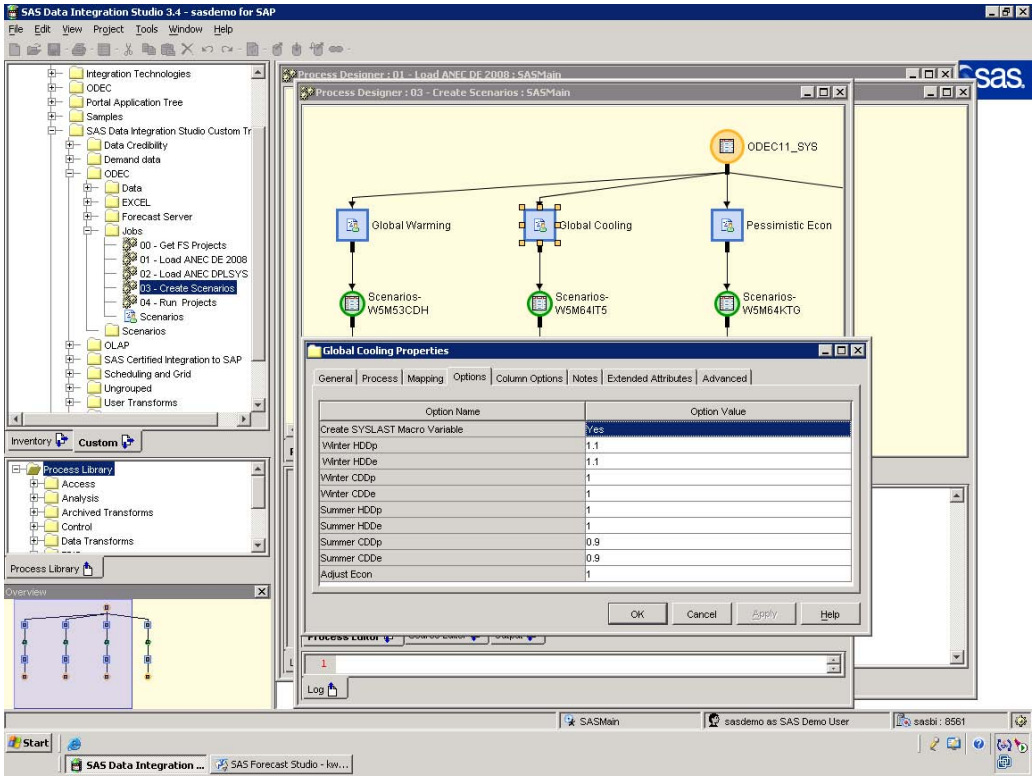

Figure 3. SAS Data Integration Studio provides the ability to quickly model and re-forecast multiple scenarios by simply inputting different economic or economic factors

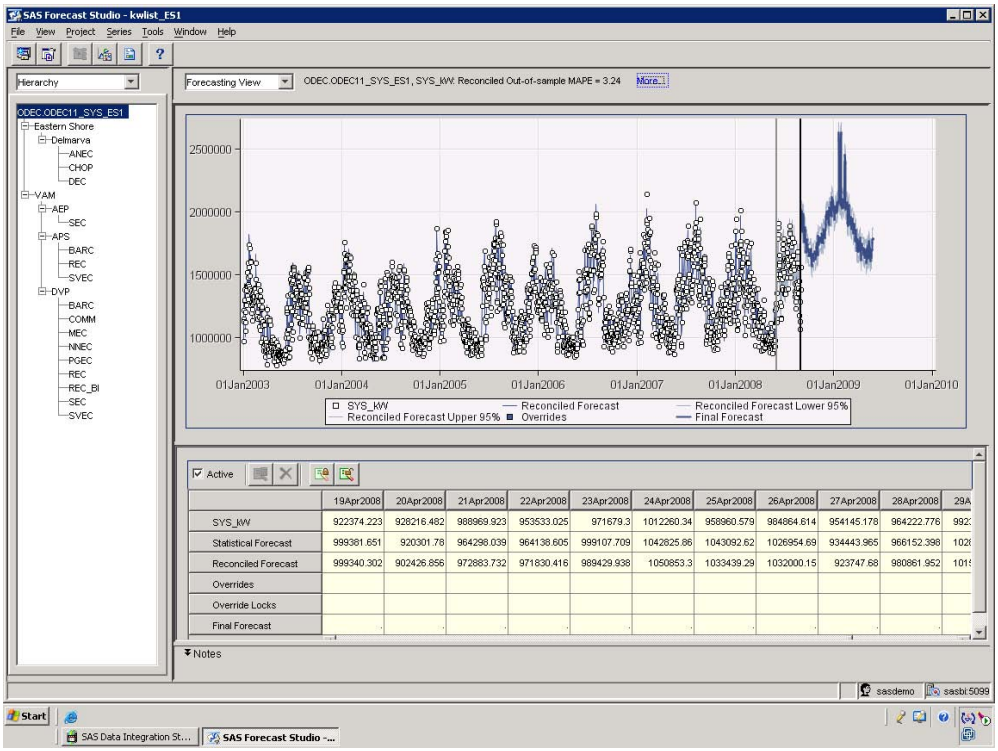

Figure 4. SAS Forecast Studio displays the results of forecasts generated automatically for each scenario

The next component of the SAS Forecasting, Strategy Assessment and Management Framework that is vital to modeling different scenarios is Forecasting. The results of a top-level forecast generated by the SAS Data Integration Studio for the optimistic economy scenario showing projected demand in a short-term forecast, is graphically displayed in Figure 4 within the SAS Forecast Studio. Forecasts are readily available down to the customer-segment level, visible by selecting customer name from the hierarchy drill-down on the left. This ability provides decision makers with rapid response to demand data at a customer level, for example, without requesting that another forecast be generated.

SAS provides dissemination of these analytical results to key decision makers across the organization within the Reporting portion of the Forecasting, Strategy Assessment and Management Framework. Ad-hoc reports, data visualizations, explorations, dashboards, key performance indicators, publication channels, and portals are available to display results and allow decision makers to perform further comparisons across multiple scenarios. For example, comparing the forecasted demand, by month and by member, for both pessimistic and optimistic economy scenarios, is a valuable tool for strategy assessments. Examples are shown in Figures 5 and 6.

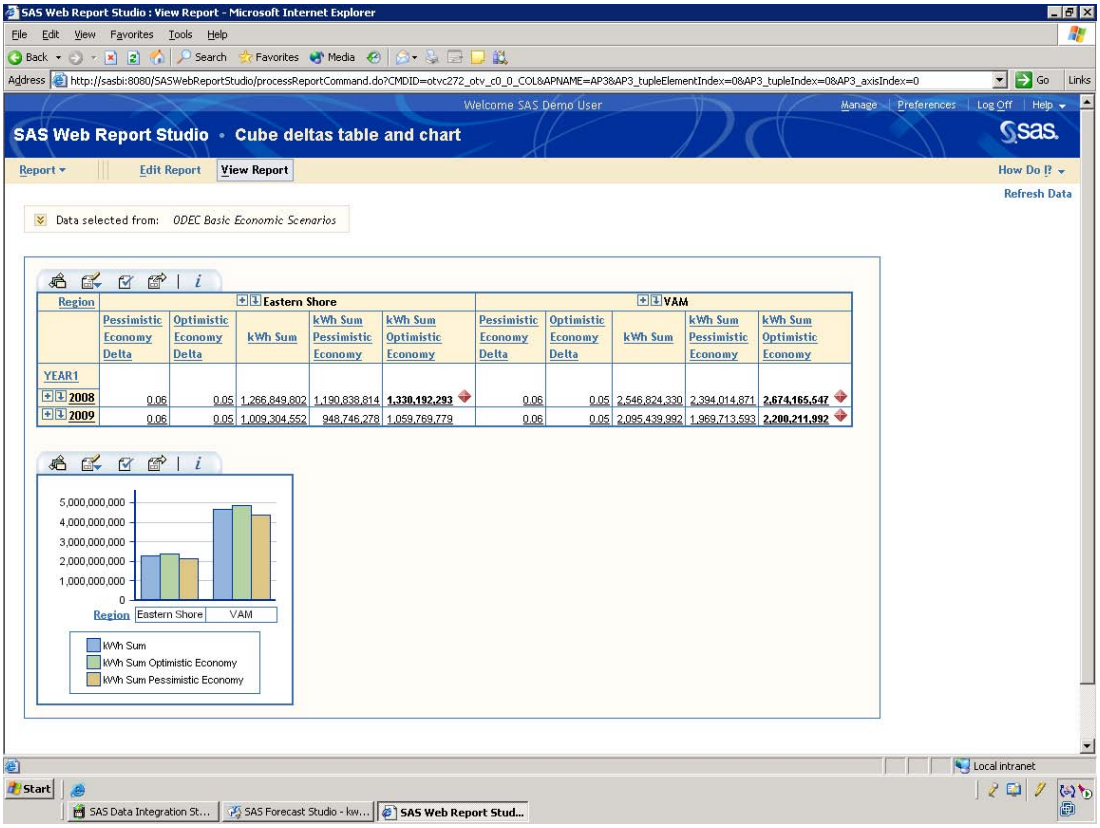

Figure 5. SAS Web Report Studio provides reports that make ad-hoc exploration by time and region easy for those looking to quickly compare results across multiple forecasted scenarios.

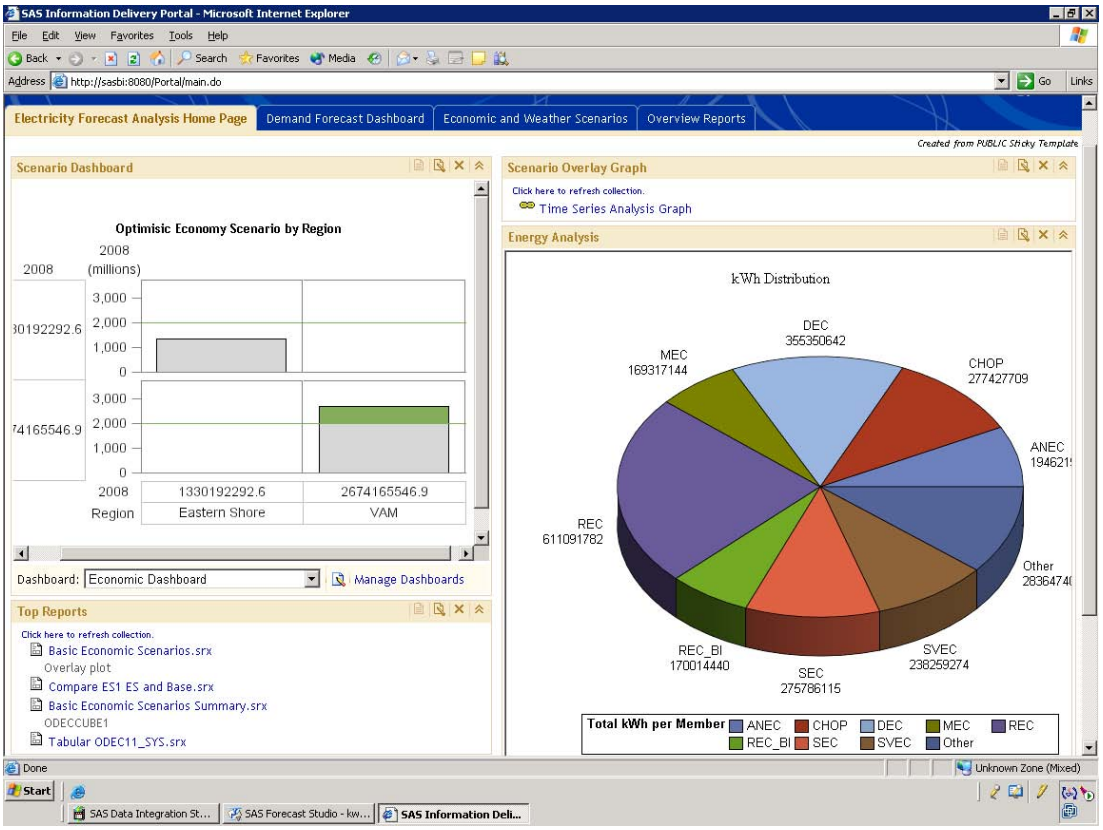

Figure 6. SAS Information Delivery Portal collects business-focused visualizations, dashboards, and data explorations in a central location for authorized users.

CONCLUSION

The power of this solution is its ability to enable organizations to reach evidence-based decisions and confidently:

- Solve complex business problems.
- Manage for performance to achieve measurable business objectives.
- Drive sustainable growth through innovation.
- Anticipate and manage change.

With SAS' unsurpassed track record—spanning more than three decades—as the foremost provider of analytics, with this solution new doors are now open, new opportunities can be capitalized on, even in this period of uncertainty.

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the authors at:

Name: David Hamilton
Enterprise: Old Dominion Electric Cooperative
Work Phone: 804-968-4017
E-mail: DHamilton@odec.com

Name: Craig Carothers
Enterprise: SAS Canada

Work Phone: (416) 307-4603
E-mail: Craig.Carothers@sas.com

Name: Kathy Schaan
Enterprise: SAS US
Work Phone: (904) 230-8638
E-mail: Kathy.Schaan@sas.com

Author Biographies

Name: David E. Hamilton
Company: Old Dominion Electric Cooperative, Glen Allen, VA
Position: Senior Forecast Analyst
Phone: 804-968-4017

David is a senior forecast analyst for ODEC. He has been involved with load research, load analysis & modeling, load forecasting, and customer load simulation for some 24 years. He has worked for TXU Energy, Southern Company Services in Atlanta, GA; Wisconsin Energy in Milwaukee, WI; East Kentucky Power Cooperative in Winchester, KY; and West Texas Utilities Co in Abilene, TX. David has an MBA in Finance from Hardin Simmons University in Abilene, TX.

Name: Craig Carothers
Company: SAS, Toronto, CA
Position: Principal Demand Intelligence
Phone: (416) 307-4603

Craig has 20 years of diversified experience developing and leveraging Forecasting and CRM solution to optimize performance in energy sector. These solutions are used to grow revenue, assess risk, promote customer loyalty, navigate operations, and optimize investments. His skill sets includes: Short term; Mid-term; Long term Forecasting; Market Surveillance, Budgeting; Distribution planning; Rate Design; DSM program design and Impact Evaluation.

Name: Kathy Schaan
Company: SAS, Jacksonville, FL
Position: Systems Engineer
Phone: (904) 230-8638

Kathy has 15 years of experience using software and analytics tools to help solve business problems. She is a member of the SAS North American Utilities team and currently helps SAS utility customers define and deliver business value from their SAS investments.