

ENGINEERING RATES FOR NEW ENERGY ECONOMIES

- SMUD and GridX Charting New Path for Rate Design Methodology

Summary

Sacramento Municipal Utility District (SMUD), a leading municipal utility with close to 600,000 meters based in Sacramento, California, recently engaged GridX, Inc., a provider of Big Data Billing and Billing Analytics solutions, to help evaluate the revenue and cost impacts of new time-of-use rate designs. The collaboration resulted in a completely new method of utility rate design – Rate Engineering. The Rate Engineering approach uses financial simulation of revenue and cost by calculating shadow bills for every single customer without relying on the traditional sampling and estimation approach. Using precise financial simulation to calculate the impacts of these rates, the new approach eliminates the sampling error and results in more precise rate designs, which can help the utility better achieve policy and business objectives. In the process, the whole population bill impact analyses have resulted in a wealth of data that enables SMUD to better target and engage its customers as it rolls out new rate structures and ultimately designs rates to maximize customer adoption.

SMUD RESIDENTIAL RATE RESTRUCTURING

With the growth of solar and other distributed resources, SMUD is aligning charges with the true cost of serving customers by rolling out Time-of-Use (TOU) rates over the next two years. In preparation for this significant rate reform, SMUD wants to ensure the right rate designs are in place. At the same time, the Customer Retail Strategy (CRS) team needs better insights into the impacts of new rates on customers' bills in order to develop effective marketing and customer engagement strategies before rolling them out.

LIMITATIONS OF THE TRADITIONAL RATE DESIGN APPROACH

Due to software-tools constraints, traditional rate design methodology relies heavily on the sampling approach. This method samples a small customer sub-population, develops rates based on the consumption behaviors of the "representative" customer population, and extrapolates the rate designs to the whole customer population. Depending on the sample size and the sampling strategies used, this sampling approach may miss some of the critical sub-populations and introduce sampling errors.

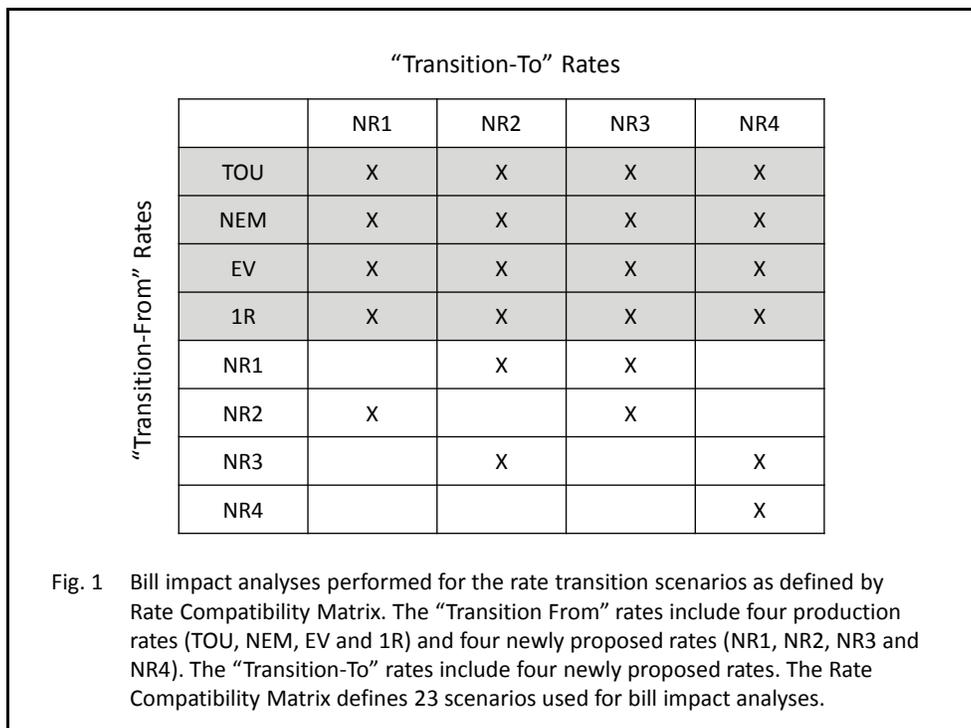
THE BIG DATA APPROACH TO RATE DESIGNS

To overcome the shortcomings of the traditional sampling-based rate design approach, SMUD and GridX have developed the industry’s first big data approach to rate designs. The new approach, known as Rate Engineering, combines SMUD’s internal rate design expertise and GridX Big Data Billing Analytics to develop more precise rate designs, which will help SMUD achieve its policy and business objectives and at the same time provide a more comprehensive view of how new rate designs impact SMUD revenues, customer classes, and even individual customers.

GridX Big Data Billing Analytics is the industry’s first big data billing technology specifically designed to perform revenue and cost analyses related to new rate designs. It allows business users to quickly develop new rates without having to write software codes or scripts, apply them to smart-meter data, and perform a wide variety of “what if” revenue and cost analyses for the whole customer population. With a 100% sampling, the Rate Engineering approach is able to capture the insights of not only “representative” customers, but of every customer individually, thereby enabling the development of more precise rate designs.

SMUD’S WHOLE POPULATION BILL IMPACT ANALYSIS PROJECT

SMUD’s Whole Population Bill Impact Analysis Project consists of two parts: (1) calibration of GridX Big Data Billing Analytics against SMUD’s SAP billing system to ensure the accuracy of the analysis results, and (2) use of GridX Big Data Billing Analytics to evaluate the bill impacts for all of SMUD residential customers.



As a part of the former, GridX modeled SMUD's 4 production rates, 8 riders and 12 taxes and fees; ingested all 550,000 residential customers' meter data for the test year; calculated approximately 6.6 million bills; and reconciled them against SMUD's SAP billing system. The whole population calibration process resulted in 99.7% of its bills being within 1% error with respect to SMUD's SAP billing system.

To evaluate bill impacts due to the new rates, GridX modeled four additional newly proposed rate designs. Each analysis scenario is defined by a "Transition-From" rate (e.g., the production TOU rate in Figure 1) and a "Transition-To" rate (e.g., proposed new rate NR1). The scope of the Whole Population Bill Impact Analysis Project consists of 23 such transition scenarios. Each scenario involves the calculation of customers' bills for the test year under two sets of rates. These bills were then aggregated into revenue for the test-year for SMUD and cost for the test-year for SMUD's customers.

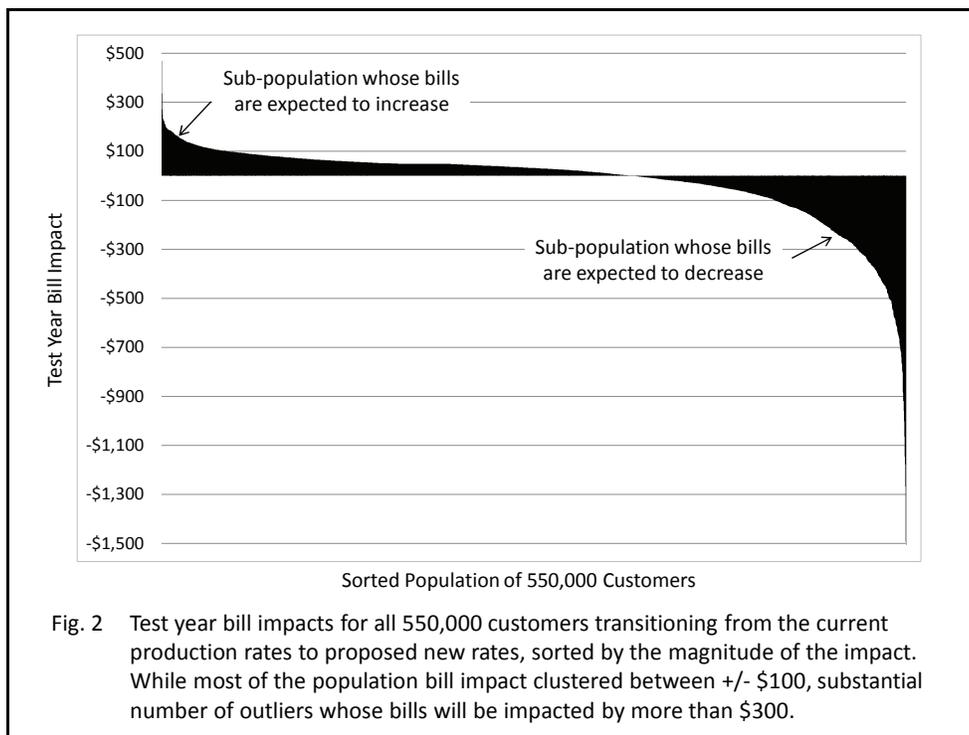
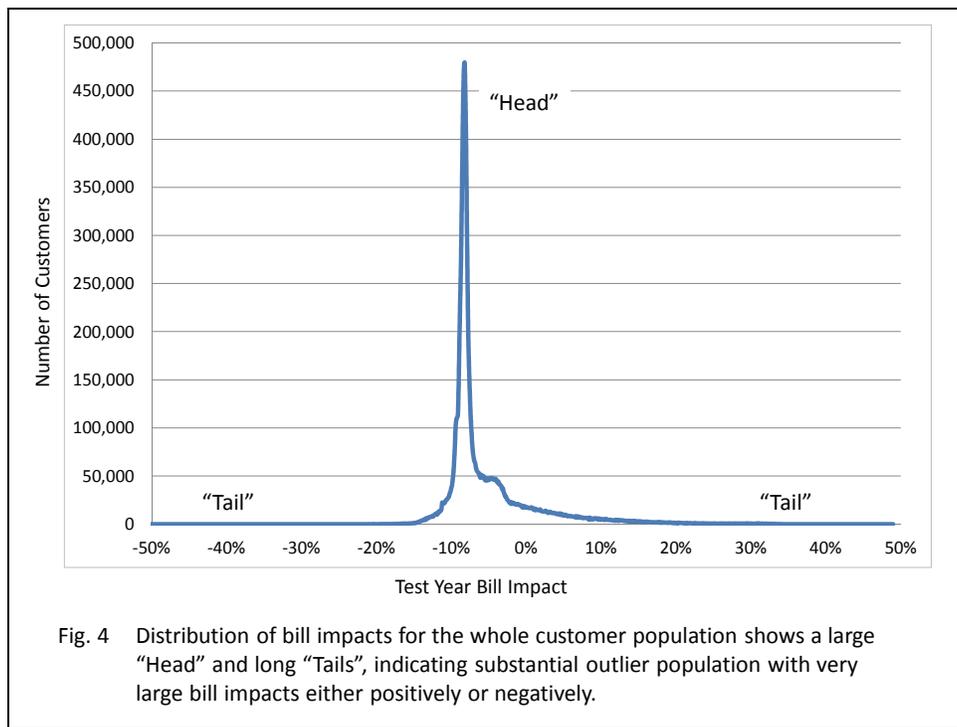
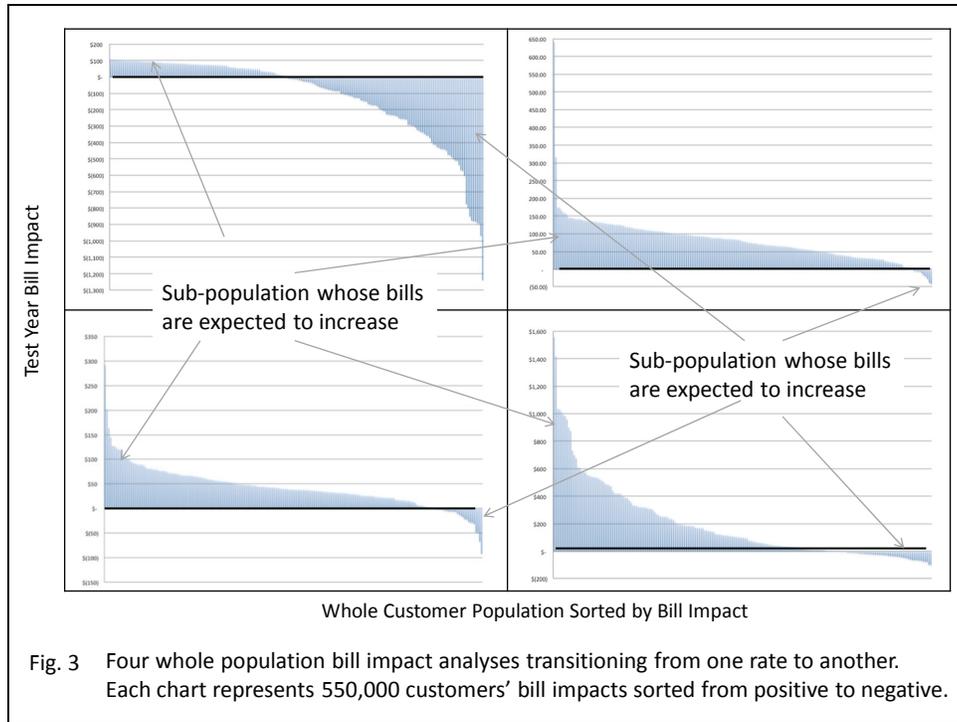


Figure 2 illustrates a typical whole population bill impact analysis, sorted by descending order from positive to negative. The positive bill impacts indicate the customers whose bills are expected to increase by the new rate, whereas the negative bill impacts indicate expected bill decreases.

The shaded area indicates the revenue impact for the test year transitioning from the "Transition-From" rate to the "Transition-To" rate. As this example bill impact analysis indicates, the new rate design is expected to result in a net decrease in revenue, as the shaded area representing the negative bill impact is greater than the shaded area representing the positive bill impact.

The whole population bill impact study also indicates diverse bill impact distributions based on different rate designs (see Figure 3). Depending on different rate structures, parameters and prices, the bill impacts for the customers can vary dramatically. Conversely, by adjusting these rate design parameters, the Rate Engineering approach allows rate designers to optimize for the desired bill and revenue impact distributions.



BILL IMPACT DISTRIBUTION UNDERSCORES THE CASE FOR NEW RATE DESIGN APPROACH

Figure 4 shows a typical distribution of bill impacts for the project's whole population. As it illustrates, in addition to a very distinct "head," there are two very long "tails," which is known as "Long Tail Distribution." Long tail distribution indicates a substantial number of population outliers and underscores the case for 100% sampling and a Rate Engineering approach.

Anecdotal evidence from SMUD's previous rounds of rate designs seems to support the existence of population outliers and confirms the shortcomings of the traditional sampling-based approach.

COLLABORATION WITH INTERNAL RATE DESIGN TEAM

The Rate Engineering approach does not replace the traditional rate design process and function, but rather complements them. As a part of the Whole Population Bill Impact Analysis Project, SMUD's internal rate design team had developed four proposed rate designs based on SMUD's policy, financial, and business goals. The Rate Engineering approach allows SMUD to evaluate the impacts of the proposed rate designs on every single customer with the focus of maximizing the adoption of these rates in the marketplace.

BENEFITS OF THE RATE ENGINEERING APPROACH

More Precise Rate Designs – Through calibration against the billing systems and evaluation of bill impacts for the whole customer population, the Rate Engineering approach results in more precise rate designs. The massive amount of computation power made available by big data technology enables rate designers to simulate the bill impacts for a large number of design proposals, then choose the design with not only the right average rate, but also the right distribution of bill impacts among various rate classes.

More Comprehensive Analyses – By evaluating the bill impacts for the whole customer population, the Rate Engineering approach enables SMUD to understand the impact of new rates on every single customer every month before submitting them for approvals. The fine-granularity, bill impact analyses allow SMUD to investigate the "tails," those sub-populations whose bills are substantially impacted either positively or negatively.

Analyses Available to More Stakeholders – Given the importance of bill impact analyses on new rates, organizations outside of the rate design team have a lot of interest in the analysis results. Traditionally, the rate design team receives a large number of data requests from such departments as Marketing, Finance, Load Research, etc. Very often, these data requests require rate design teams to perform custom analyses. As such, the rate design team spends a significant amount of time serving these data requests. The availability of comprehensive fine-

granularity, bill impact analyses frees the rate design team from these data requests and provides other stakeholders with self-serve options.

BETTER INSIGHTS FOR MARKETING NEW RATES

In addition to more precise and effective rate designs, another key benefit of the Rate Engineering approach is “Design for Adoption.” The customer-by-customer, month-by-month analysis of their energy costs under the new rates enables SMUD to target customers with personalized messages and recommendations depending on whether customer bills are positively or negatively impacted. SMUD can target the negatively impacted, i.e., those whose bills are expected to decrease, with recruitment mailings to gain early adoption and to create word of mouth. Alternatively, SMUD can target the positively impacted, i.e., those whose bills are expected to increase, with specific program or consumption-behavior change recommendations, such as energy efficiency, demand response, and load shifting, to mitigate the expected cost increase.

The personalized bill impact analyses also give SMUD’s Call Center the opportunity to better engage customers calling for advice about choosing new rates. SMUD can also more thoroughly prepare its call-center reps to answer questions more quickly and accurately, yielding O&M savings and an improved customer experience, a SMUD rate reform goal.

SUMMARY

Through the use of the industry’s first revenue grade Big Data Billing Analytics, SMUD and GridX have demonstrated the advantages of whole population bill impact analyses and, in the process, developed a new approach to developing rate designs. The Rate Engineering approach analyzes personalized bill impacts of new rates on a customer-by-customer basis for the whole population and develops more precise rate designs to effectively achieve the policy, financial, and business goals. The large-scale, detailed bill impact analyses also make a big data set available to SMUD from which it can derive insights to develop more effective marketing and customer engagement strategies.