Arming the customer with Smart Technologies, Information, and Price Signals – the new (or déjà vu?) way to meet our energy resource needs.

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Recent events have once again put energy efficiency on the map; energy security issues highlighted since September 11, 2001 were followed by the 2003 Midwest blackout and concern with infrastructure reliability; since then economic growth worldwide has caused rapidly rising prices for all energy, and looming shortfalls to our electric generation, transmission, and distribution systems. Now, with recognition of global warming and its relationship to our energy use patterns, we have a *perfect storm* that must be addressed.

The electric utility industry increasingly recognizes the vital role of technologies that increase the efficiency of how its customers use energy in "creating" up to half of the new energy supply needed over the next 20 years, with the lowest resource cost, in a manner that has inherently less risk, less lead time, and yet more environmentally benign than any other resource, even renewable resources such as solar or wind.

Energy efficiency is not the same as energy conservation, which is generally equated with sacrifice. Efficiency means investment in technologies that produce more benefits for us (comfort, light, hot water, travel, industrial output, etc.) with less energy consumption.

The immediate opportunities to increase energy efficiency in a home are often large. New compact fluorescent lights and fixtures produce beautiful light with 75% less electricity. New refrigerators can use 65% less electricity than those that are 15 years old. Although air conditioners are now 35% more efficient than 10 years ago, with a little more copper on the coils they get 30% more efficiency, as some new models on the market already do. Further, the typical home central air system can save 10% to 20% (even new homes) by simply repairing leaky ducts and incorrect refrigerant levels. Air-conditioning tune-ups alone can replace the need for 25 new nuclear-sized power plants. High-efficiency motors, windows and washing machines continue to be developed that save a third or more.

Also, we're learning that Internet-enabled communications with customers, thermostats and other control devices can dramatically reduce the peak demand for electricity in our offices and industries, as well as in our homes. Intelligent cycling of air conditioners, water heaters and even refrigerator defrost cycles can work around utility system peaks without any compromise in comfort or performance. The vision of a smarter power grid, coupled to smarter appliances as directed by smarter customers is proving to offer at least a 20% decrease in peak demand, but to do this we need new metering systems to measure the benefits as well as government support for time-based rates and demand response initiatives.

Is this new or déjà vu?

A policy consensus to promote energy efficiency developed in the 1980s following the shortages and price run-ups of the prior 10 years. National appliance standards promoted appliance efficiency in refrigerators, freezers, air conditioners, water heaters, showerheads and lighting products. CAFE automobile standards and the first round of utility-funded efficiency programs reached their peak impact in the early 1990s.

As a result, by 1995, we spent 35% less money on energy (about $60 billion/year) as compared with the historical trend. That 35% reduction meant 35% less air and water emissions from fuel combustion, and significantly less capital expenditure on generating plants. This slowdown in energy

growth allowed energy supplies to grow faster than demand, which in combination with other structural and world factors, allowed real energy prices to drop to approximately the level of 1972. This helped support a sustained period of rapid economic growth during the 1990s. In the years since 1995, however, the US *dropped the ball* on efficiency. We stopped setting new standards on automobiles and appliances; we reduced utility efficiency programs, and as a result we re-coupled energy growth and economic growth.

Technology's new role: Web communications, advanced meters and time-based pricing, and appliance controls

This time around, we have technology that has made the once human-intensive job of promoting efficiency easier. With web tools, energy companies are transforming their commodity customers into energy management partners. At very low cost-per-customer, this assistance helps individual homes and businesses make cost-effective decisions on new equipment and services that add to their comfort, light, and process efficiency while lowering their associated total costs.

Beyond energy savings, a key objective of utility technology is to control peak demand requirements. With less than 50% average utilization of the existing infrastructure of power plants, transmission, and distribution systems, there is a great opportunity to reduce the cost of new system load growth by adjusting the pattern of electric usage. An efficient power grid requires that customers control AC and other electric loads sensibly, based on accurate information and pricing signals. However today, most home and small business electric consumers have neither. Consider this example of the problem:

Hot summer, weekday afternoon – the dog days bring critical peak electric demands on our electric system. Many power generating facilities have been built only to serve these specific days. On wholesale power markets, where many utilities buy power, electricity demand exceeds supply and prices increase to ten-fold or more from the average.

Many households are willing to help, and want to save money too. But, they don't know what to do. Part of the problem, if central air conditioned, is that they've heard the incorrect conventional wisdom: *don't touch the thermostat all summer long*. As a result, homes often run full-out during utility peaks*, even when no one is home.* And as the population grows, the economy grows, and our uses of electricity including central A/C grow in market share, the critical peak electric demand problem grows with it.

In fact, most homes have oversized units, and the thermostat can be controlled, and still recover adequately before dinner, saving energy overall and especially on these peak periods. Further, if the epidemic of leaky ductwork and incorrect refrigerant levels (even on new systems) were repaired, there would be less demand on the system and even more ability to adjust temperatures.

Even in homes that are occupied during weekday afternoons there are often opportunities to reduce or postpone electric uses: many homes run lights, dishwashers, wash loads, and pool pumps, as if electricity costs the same as at other times. After all, for the customer, it does. But, in fact it costs us all an order of magnitude more, and we all share in the expense.

As an analogy to clarify the benefits of pricing signals, consider the economics of food in an alternative world - where supermarkets don't have cash registers, but instead charge by weighing shopping carts as they leave the store. The price per pound of food is used, instead of the price of individual purchases, to charge supermarket customers. In this world, a price of a can of caviar is the same as a can of tuna of the same weight, even though it costs the store fifty times more. Customers without accurate price signals fill up their shopping carts inefficiently. As a result, *everyone pays more.*

Just as with cash registers, electric meters that measure time-dependent use, and rates that send time-differentiated price signals are a key ingredient in making our electric system more efficient, and more secure in meeting electric demands during critical peak periods.

Interval metering and critical peak rates: Will Customers Respond?

To provide electricity pricing signals, new interval meter technologies that measure electric use during critical peak periods are being evaluated in many areas including New England, being tested in many areas including California, and rolled out in others including parts of Washington, Wisconsin, Pennsylvania.

With interval meters, time-differentiated rates can be supported, where customers are charged by time of day. Critical peak rates, for example, charge their highest rate for a few hours on a handful of days per year when loads are highest. Two compelling arguments favor these rates. First, fairness: customer charges more accurately represent the cost of electric service. Second, savings: these rates encourage load shifts, making electricity production more efficient, and less expensive, for everyone.

A key question is, will electric customers understand these rates and manage their use in response to them? If customers are forever unable or unwilling to choose, comprehend, and respond to these rates, then perhaps the incremental costs of interval meters, though dropping sharply, aren't warranted, although the fairness argument would still favor Interval meters if customers didn't respond.

However, experiences from utility energy management programs suggest the opposite: customers are able and want the opportunity to manage their energy costs. A recent statewide pricing pilot in California over 90% understood time-based prices and felt they should be offered. Statewide, customers on the pilot reduced their peak demand by about 15%. Another indicator of interest: Over 20% of a utility's customers call their utility each year with a bill-related inquiry on average 2.5 times each, according to EPRI Solutions.

How can households respond? Since the typical utility peak period is during hot summer midweek afternoons, homes are often more flexible in their ability to shift than businesses, during this time. Demand response opportunities in an individual home may seem small, as compared with the opportunity for control systems in industry and offices, but these small loads add up:

- Home central air conditioning systems in the many homes where everyone is at work or school can cut their contribution to utility peak by adjusting the clock thermostat intelligently. Thermostats that are adjustable over the Internet have become available at low cost, creating many new web-based options.

- Electric water heat can easily be shifted to off-peak. This could become more ubiquitous in the future using Internet communications and intelligence built into the water heater.

- Refrigerator defrost cycles occur randomly; in the future they will have built-in intelligence to respond to price.

- Laundry, dishwashers, pool pumps can often be shifted by consumers who understand that prices vary by time-of-day, season, and weather conditions.

- Even on hot summer afternoons, it is not uncommon for the ubiquitous recessed ceiling lighting, with 75-100 watts each, to be running in kitchens and family rooms in homes where families are home. In response to price signals, these can be turned off, or replaced with improving compact fluorescent replacement recessed fixtures.

Helping Customers Respond to Critical Peak Rates

One approach is to support customers by installing controls on thermostats, water heaters, pool pumps, and other equipment controlled by the utility. Companies such as Florida Power and Light have shown great success with these load control programs. Recently, several companies including Kansas City Power and Light, and Southern California Edison, have offered customers a thermostat that can be controlled by the utility to increase temperatures during the "critical peak" period. These programs have generally been acceptable to customers and cost-effective for the utility.

A recent focus on utility meter and bill analytic tools that power simple, effective communications for average customers, show that information can be effectively delivered at low cost over the Web, by the contact center, and on the bill. Several companies have rebuilt their Web customer service and call center systems to focus on meeting key customer needs to understand and manage their energy bills. Many of these companies have 10-15% of their entire customer base using these online tools each year. Supported by advanced modeling, the bill analyses provide the customer with actionable information including benchmarks and personalized bill-reducing strategies.

A general survey of residential and commercial customers throughout conducted as part of the California statewide pricing pilot indicated that at least 70 percent of residential customers and 81 percent of commercial customers would benefit from additional information Over 50% of residential customers were interested in a customized energy analysis by the utility to help them manage their costs. Respondents indicated that information should be customized and very specific to individual rooms, appliances or equipment that the customer has. A *pie chart* showing the breakdown of electricity use in the customer's home or business is also reported by the survey respondents to be very valuable to customers.

Ultimately, utility web tools may ubiquitously help set appliance controls automatically based on web price signals. In the not-distant future, many appliance manufacturers will be selling Internet addressable appliances. In response to web-posted pricing or critical peak signals, these appliances will support intelligent cycling of air conditioners, water heaters and even refrigerator defrost cycles to work around utility system peaks without any compromise in comfort or performance.

CONCLUSION

Efficiency as a technology has a potential impact over the next 10 years that is larger, cheaper, safer, quicker, and cleaner than any other alternative. Advanced electric meters, along with information delivered via networks to customers and control devices, will provide home and business electric consumers with what they need to respond to price signals, saving money at home while making the electric system more efficient and secure. By bringing these new technological advances to all sectors of energy users, the nation can protect its supply of power, improve its economy, and protect the environment.

Harvey Michaels is CEO and co-founder of Nexus Energy Software, which provides energy utilities with meter data management and bill analysis tools for utility websites and call centers, currently in use at over 75 utility companies. Previously, he was President of XENERGY, Inc.