IssuesLetter

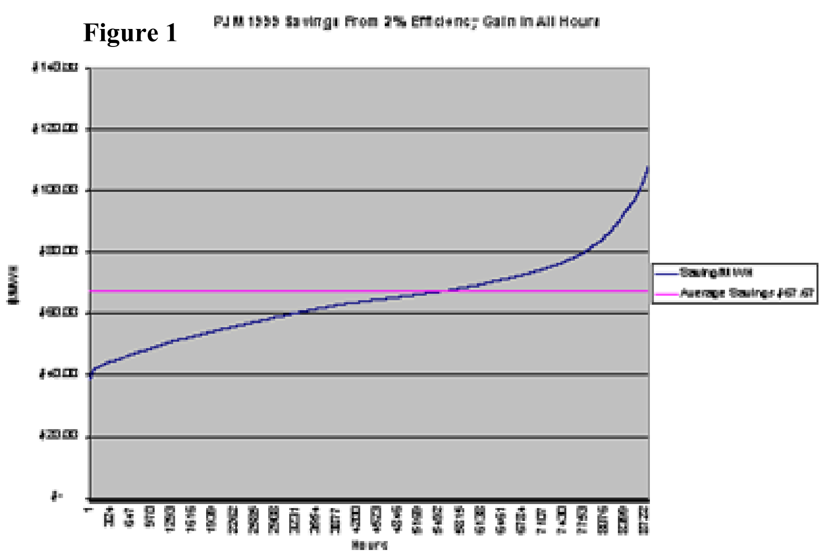
Using A Demand Response to Stabilize Electric Markets

Electric power markets in the United States today face three related and potentially fatal problems: price spikes, loss of reliability, and market power. The cheapest and fastest way to solve these problems and lossen the grip of market power is to build demand reduction opportunities into wholesale and retail markets. Viable competitive markets depend on the interaction of demand and supply. Unfortunately in current markets, the demand side is essentially missing.

Utility managers understand that load management can improve ***reliability*** at low cost, by reducing peak demands on the power system. However, in today's power markets the ***economic*** benefits of reducing load are magnified.

Investments in energy efficiency and load management are not only cost effective to consumers using the technologies, they also lower the wholesale market prices paid by all consumers. In competitive wholesale markets where all power plants receive the market clearing price for each hour of operation (which is how all four spot markets associated with regional ISOs now operate), the ability to reduce peak demand reduces the power costs paid to every unit running at the time of the peak. This market-wide cost reduction greatly exceeds the savings previously achieved by demand reduction. In fully regulated wholesale markets, the only cost savings from reducing demand were savings related to use of marginal units to meet the peak. Now the benefit of demand reduction has jumped from the value of avoiding a marginal unit to a system-wide multiple of that value.

Figure 1



For example, in the PJM market (see Figure 1), the value of load reduction was as high as $114 per MWh and averaged $67.67 per MWh (6.7 cents/kwh) across all hours. Enormous amounts of energy efficiency and load management are available at far less than $67.67 per MW.

Achieving a strong demand response to prices in the wholesale and retail markets requires work by both state and federal regulators. It is up to federal regulators to insure that demand responses are fully reflected in the wholesale markets. State regulators need to incorporate demand response in retail markets.

RAP's Issuesletter *FERC 2000 and RTOs* (May 2000) described how the absence of a demand curve in electricity markets vested unprecedented market and price power in the unopposed, supply curve. This Issuesletter explores the problems created by the lack of a demand response and presents policy options for state and federal regulators to create the needed demand opportunities, both in the short and long term.

All policy recommendations flow from one main point:

Every effort should be made to expose the value of demand response in the wholesale and retail markets to as many participants as possible.

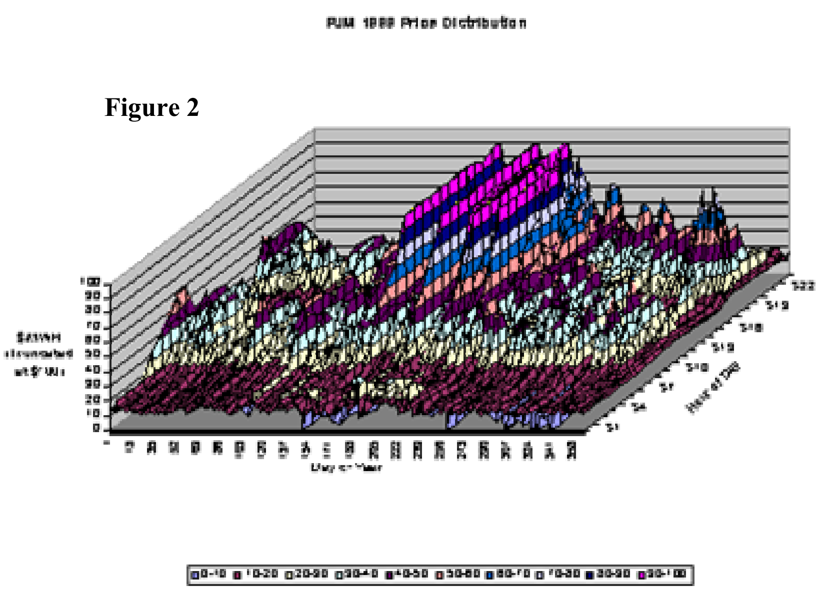
It is becoming clear that a demand response has enormous value to all customers. However, the structure of the markets hides the value from those who could profit from providing a demand response. Regulators need to structure the market and market rules so customers, retail sellers, distribution utilities and current and potential vendors of demand response have an opportunity to realize the market value of their demand reduction services.

Problems in Today's Electricity Markets

Electric power markets are expected to solve three related problems: price spikes, loss of reliability and market power.

Figure 2 visually illustrates the distribution of price spike events in the PJM market in 1999. This type of price volatility has been a common occurrence in every wholesale market in the last two years.

Figure 2



Reliability problems have been caused by shortages of generating capacity as well as by transmission and distribution constraints. However, a shortage of capacity can just as easily be interpreted as a *surplus of load*. The cause of reliability "close calls" may vary but, they have one common theme: For a relatively short number of hours, loads are too high.

The third and perhaps the most intractable problem is market power. While FERC continues to try to deal with vertical market power issues, little effort aims at reducing horizontal market power. Every day brings more evidence that market power is a very thorny problem.

For example, the forced outage rate of power plants in New England has almost tripled since deregulation of the generating sector. This high outage rate is inconsistent with the expectation that deregulation of generation would make plants more efficient and reliable as competitors seek to maximize profits from the operation of their power plants. Instead the evidence suggests that generators in New England may have been engaged in strategic bidding practices as withholding modest amounts of total capacity can dramatically increase profit levels.

Proving that generators are ***illegally exercising*** market power is a difficult and time consuming. The easiest and fastest way to reduce market power is to add more competitors. At the moment, demand side competitors are forced to sit, unseen on the sidelines because market rules do not permit them to play. Nothing will help the market more (or more quickly) than unleashing demand-side competitors and letting them freely participate in the market.

Conventional Solutions: Wires and Turbines

The most common response to the problems of thin generation margins is a call for increased investment in, and expedited siting of, power plants and transmission lines. However, the problems of price spikes, market power and reliability cannot be cured simply by adding turbines and wires. Even if such an outcome were possible, it certainly would not be the nation's least-cost solution. Finding ways to allow demand response and energy efficiency to participate in the wholesale and retail marketplace is a far less costly, faster and cleaner option.

Demand Response: Really Letting the Market Work

Energy efficiency is a proven, low-cost resource. During the period 1985 to 1995 more than 500 US utilities developed DSM programs, successfully delivering more than 29,000 MW of savings nationwide, at an average cost of between 2 and 3 cents a kwh. In 1997, the Department of Energy's "Five Lab Study" (*Scenarios of U.S. Carbon Reductions, 1997*) concluded that DSM potential could offset 15 percent of peak load within three years. Utilities in a current New Jersey docket have asserted that DSM savings could be as much as 30 percent of total load. In summer of 2000, ACEEE completed a study that found over 100,000 MW available by the year 2010 from just three programs: residential air conditioning upgrades and repairs; commercial heating, ventilating and air conditioning (HVAC) equipment and tune-ups; and commercial lighting design and upgrades.

Many of the demand-side options can be implemented in the short term with very little investment. Active load management operated just a few hours of the year could significantly lower peak loads, peak load price spikes and a surprisingly large fraction of overall, annual power costs.

The Value of Demand Response is Hidden

While it is clear that the demand side has significant value, it is also clear that newly-emerging power markets have been organized in ways that hide its value. Neither consumers, retail sellers, distribution utilities, nor new and potentially innovative vendors of demand response are in a position to capture the value of this cost-effective option.

Customers do not see the demand response value

The theory of market advocates was deceptively simple: Competitive wholesale markets would reveal the true cost of electricity every hour of the year. Customers would see these transparent prices and would respond by increasing or decreasing consumption. In practice, very few customers have the metering needed to take advantage of real-time prices. Even those with real-time metering continue to choose fixed price options over variable prices. *Indeed, one of the great ironies of retail choice is that many retail customers may never choose to buy electricity other than on a flat per kwh basis simply because they prefer fixed prices.*

With monopoly distribution companies, customers could be required to pay time-of-use prices and many large customers -- even large use residential customers -- faced this obligation. With retail access, these customers have a choice, and they tend to choose fixed prices and thus will not ever see time-differentiated prices. Further, the volatility in many wholesale markets is causing even more customers to choose fixed prices.

Retail sellers do not see the value

Another basic premise of electric restructuring was that retail sellers or their load serving entities (LSEs) would be exposed to real-time, wholesale prices so they would have an incentive to manage load. For example, it was thought that LSEs would encourage consumers to shift load to off-peak periods by offering off-peak customers a lower price. To know whether LSEs have an incentive to do this requires knowing how LSEs are billed for electricity they buy for their customers.

For large customers, with real-time or hourly metering, the incentive is present, and the LSE essentially sees real-time, wholesale prices. So even if the customer has elected fixed retail prices, its LSE is responsible for wholesale prices based on the customer's hourly loads.

But, to make retail choice available to customers without real-time meters (which includes all small customers), retailers are billed for service based on average load profiles of the customers they serve. This means, for example, all residential customers in Boston Edison's service territory are assumed to have the same load profile. If two customers both use 500 kwh per month, their LSE will be billed the same cost for wholesale service for each customer. However the customers may use electricity quite differently. One may concentrate most usage on-peak and the other largely off-peak. Because the billing system charges the LSE based on average load profiles, the LSE sees no benefit from shifting the customer from on-peak to off-peak.

The result of using average load profiles, which has been approved by state and federal regulators, is that the obvious and measurable value of shifting a customer from on-peak to off-peak has been hidden from both the customer and the LSE.

Vendors don't see value either

Another theory was that efficient electricity markets would spawn a host of new and innovative services. Smart houses and appliances would be equipped with microchips that would automatically manage customers' energy service needs. Constant, two-way communication through the internet, cell phones or radio signals would feed price information to the house or business, and the chips would manage appliance use based on consumer preferences. Vendors of these services would include companies like Honeywell, Johnson Controls, AT&T, AOL and General Electric.

In reality, while these services are all technologically possible, they are not being provided because wholesale and retail markets have not been designed to expose the value of these services to the vendors (or consumers or LSEs). There is also no opportunity for vendors to sell load control services directly to ISOs or power exchanges. Without a way to realize the value of these products and services, it is unlikely that vendors will build and deploy these technologies.

What Needs to Be Done? **Incorporate Demand Bidding in Wholesale Markets**!

What needs to be done to expose the value of demand reduction to customers, LSEs and other vendors? First, demand bidding should become a requirement in wholesale markets. Demand bidding, by exposing the value of load reductions to customers, LSEs and other vendors will produce a lower market clearing price that benefits all consumers. Figure 3 illustrates this concept, using our familiar demand and supply curves.

Several market reforms are needed to expose the value of demand reductions to different current and future market participants

Step 1. Move to multi-settlements systems

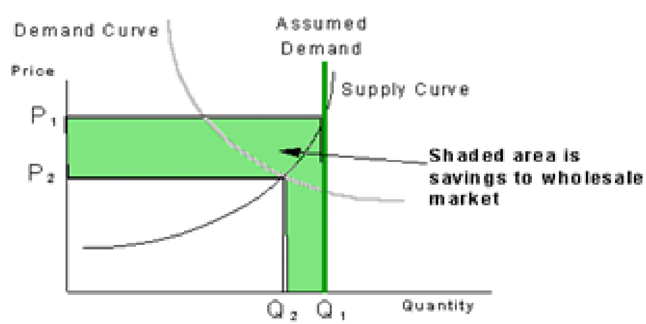


Figure 3: Role of demand services in reducing load and prices for all customers.

At least two reforms are needed to expose the value to LSEs. The first is to move from single settlement systems to "two-settlement" or "multi-settlement" systems. The key attributes of such systems are 1) bids are taken for loads from LSEs, demand reductions from LSEs and others, and supply from generators, 2) accepted bids become firm financial commitments to buy and sell, 3) the market is cleared ahead -- typically a day ahead -- of the real-time spot market. (This is not a theoretical proposal. A two-settlement system is being implemented in the PJM region and is in the planning stage in the New England ISO).

The multi-settlement system achieves several things. First, it directly reflects the willingness of LSEs to buy electricity at different prices. Second, it creates firm commitments to buy stated amounts of power at stated prices. This gives buyers the right to forgo their entitlement to power by selling power back to the real-time market. (Selling already-purchased power back into the market is a wholesale transaction subject to FERC jurisdiction.) This system addresses the concern that payments for load reduction might just be buying back "phantom load." Finally a multi-settlement system exposes the value of demand reductions to a wide array of participants.

The multi-settlements system may also be extended to large customers who decide to sign up for a given amount of load in the day-ahead market. If the prices in the real-time market are higher than expected, the customers may decide to reduce demand and sell their entitlement back to the market.

Northwest Aluminum Companies Provide a Demand Response

A vivid example of consumers selling back power has appeared recently in the Pacific Northwest as part of the ongoing drama of the California electricity crises. The Bonneville Power Administration entered into power sale contracts with aluminum companies. The aluminum companies were required to buy specified amounts of power at agreed-upon prices. When spot power prices in the California market shot up, the aluminum companies found it more profitable to curtail production and resell the power they were entitled to at current market prices - prices which are tenfold higher than their contract prices. While some have raised concerns about the wisdom of Bonneville's actions, the contract and sell back is a good example of demand response. New York Times 12/29/00

<u>Step 2. Amend load profile policies</u>

Adopting a multi-settlements system does not change the problems caused by the use of average load profiles. Dealing with the problems created by load profiles requires action by state and federal regulators. One solution is to require real-time meters for all customers. This is neither cost-effective nor realistic. The simplest way to address the problem may be to require the use of multiple load profiles. In the residential class, for example, we know that two most readily controllable loads are water heating and air conditioning. At a minimum, regulators should require creation of alternative load profiles for customers who have either or both of these potentially cost-effective, load management tools. With alternative load profiles in place, LSEs and others would have an incentive to not only search out customers with these load management opportunities but to actively invest in equipment necessary to move customers from one load profile to another.

<u>Step 3. Make demand reduction and dispatchable load an ancillary service, purchased directly by the ISO</u>

The multi-settlements system exposes the value of demand reductions to LSEs, but it does not provide an easy or low-risk way for vendors such as Honeywell, Johnson Controls, AOL or others to see the value of services they offer. The ISO should establish a class of qualifying demand-side practices and technologies that can demonstrate the ability to deliver quantifiable and reliable load reductions. The ISO would buy these services through competitive bids in the same fashion it now buys other competitive, ancillary services. The cost of these services would also be recovered in the same manner the ISO recovers the cost of other ancillary services. The guiding principle for buying demand reductions would be to buy all that lowered load enough to cause the market price for everybody to drop.

This type of ancillary service market means that customers may choose to buy fixed price energy from its LSE and enter into an agreement with another energy service provider (ESCO) who would pay for the right to control one or more loads. Also, appliance manufacturers could build control intelligence and communications into water heaters, refrigerators, freezers and air conditioners. Manufactures could sell their appliances to consumers at reduced prices with the expressed understanding that the appliance would be subject to a certain amount of control by the appliance distributor or manufacturer. The appliance manufacturer can then bid its "dispatchable load" back into the demand control ancillary service market.

Step 4. Establish standard protocols for load controls

ISOs across the country have invested hundreds of millions of dollars in hardware and software to manage a wholesale market for generation. Regulators should require ISOs to establish common protocols and invest in the hardware and software that communicate directly with vendors of demand-side energy. The market should be designed to allow any LSE, appliance manufacture, ESCO or telecommunications firm to sell demand response directly to the market. Any demand-side seller should be able to connect through radio signals, internet or other communications devices and register with the ISO. This provides the engine for a business plan as well as the opportunity to substantially suppress price spikes.

Step 5. Explore options to encourage investment in long-term energy efficiency

Most of the demand response options described in this paper are load management options, not energy efficiency options. Using the example of an air conditioner shows how these two options differ. Load-management will move the time an existing, inefficient air conditioner off peak. Energy efficiency replaces the air conditioner with one that uses less electricity. Both options may have the same effect during the peak periods; the energy efficiency option has demand reduction value over many more hours.

The high value of demand reduction is not limited to a few peak hours. Studies performed on the California and PJM markets show that the value of load reduction during all hours of the year reduces the market price of power by many times the cost of the load reductions. In PJM in the year 2000, a five percent reduction in load would have produced lower wholesale power costs of an average value of 25 cents per kwh during summer afternoons and 3.5 - 6 per cents per kwh in the off-peak and winter periods. (This is calculated as the reduction in wholesale price multiplied by the energy bought in the wholesale market divided by the amount of load reduction.) In a similar study done in California for the period June 1998 through May 1999 (before the current continuous high spot prices), the savings per average kwh reduction across all hours was 7.51 cents. Again, with a great untapped reservoir of demand reduction available at less than 4 cents per kwh, customers and policy makers alike are simply missing the boat. Worse, they are paying unconscionably high prices to sit on the dock.

Wholesale markets can be designed to capture the large consumer savings attached to greater use of energy efficiency. The market should be required to invest in energy efficiency that pays for itself. For example, an investment in energy efficiency funded through a wires -- or uplift -- charge equivalent to 5 mills per kwh will reduce average wholesale prices by 10 mills. This is a large and direct net benefit to all electricity users delivered in the form of lower wholesale prices. It does not even take into account the attendant value of reduced air pollution.

Wire Charges for Energy Efficiency Investments

Here are the questions policy makers need to think about when designing an energy efficiency wires charge:

- How might a self-funded wires charge work?
- Who would collect the funds?
- Who would decide how the funds are invested?
- How would the benefits of the investment be evaluated and monitored?

Conclusion

Regulators need to structure markets and market rules so customers, retail sellers, distribution utilities, and current and potential vendors of demand response have an opportunity to realize the value of the demand response services. If markets hide or obscure the value of demand reduction, as is the case today, then demand response and the many benefits it brings will not materialize. Electricity simply costs too much for public policy to thoughtlessly throw millions of 25 cent kwhs away!

Studies referenced:

Mid-Atlantic States Cost Curve Analysis (Marcus 2000)

The Public Value of Load Reductions in the California Market (Ferguson 1999)

Five Lab Study - Scenarios of U.S. Carbon Reductions (Department of Energy 1997)

Retail-Load Participation in Competitive Wholesale Electricity Markets (Hirst 2000)

The Regulatory Assistance Project

177 Water Street
Gardiner, Maine 04345-2149
Tel (207) 582-1135
Fax (207) 582-1176

50 State Street
Montpelier, Vermont 05602
Tel (802) 223-8199
Fax (802) 223-8172