Electricity Futures: A Basis In Fact

Free market economists and other people with a correct outlook on life have long noted the parallels between economics and ecology. Nature's penalty for failure is extinction: sort of like corporate downsizing without continuation of medical benefits. Biological systems are full of interesting parables, including the successes of the parasitic wasps who ensure their survival by laying their eggs in plump and stodgy caterpillars in a struggle evocative of the duel between currency speculators and central banks.

The ongoing moves to deregulate the electric utility industry are creating a parallel situation in economics. For years, this industry lived in the economic fantasyland of cost-plus pricing; investments had to be justified in front of state public utility commissions, but not in the jungle of the free market. New generating stations, once built, were rewarded with tariffs designed to protect returns. Utilities had monopoly pricing power in their service areas, and industrial customers who wanted cheaper electricity had to resort to building cogeneration facilities or relocating to other service areas.

The results were predictable: the utility industry, shielded from competition, overinvested in generating capacity and underinvested in energy management services. Even worse, since prices were set by regulatory lawyers, no one -- including self-described "consumer advocates" -- had any real notion of what the market price of electricity should have been.

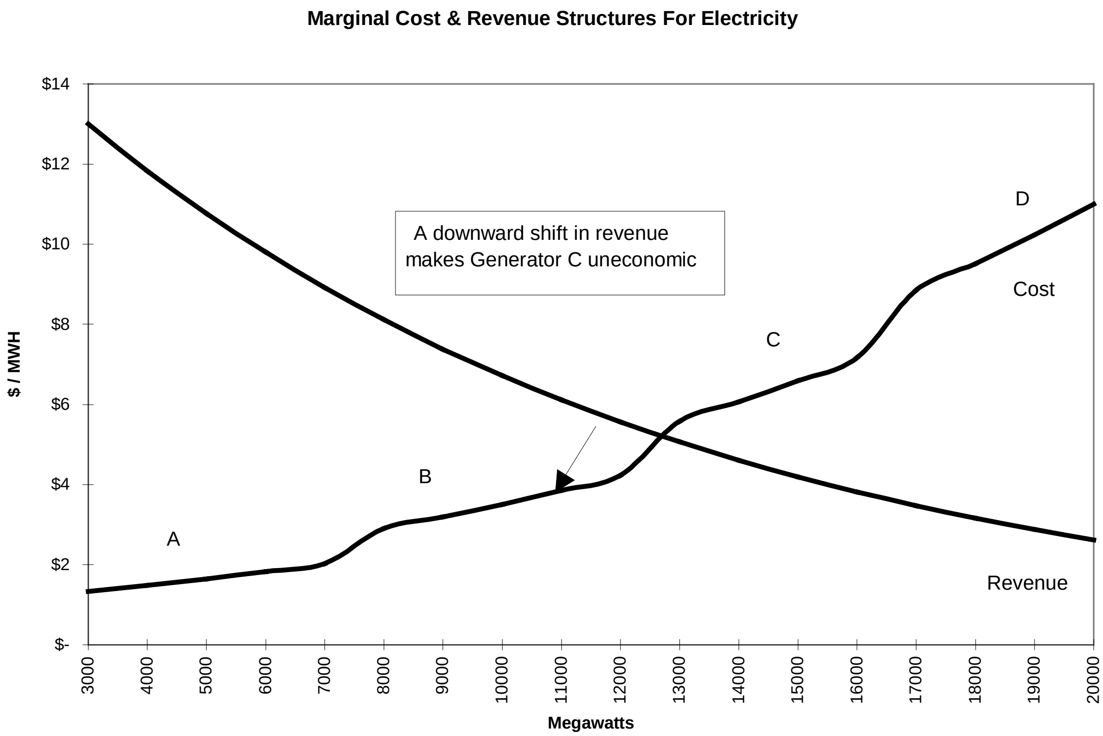
Lower.

Per Microeconomics 101, each utility can maximize profits by expanding production to the point where marginal revenue, the price received for the last megawatt, falls to the marginal cost of generation, the cost of producing the last megawatt. This marginal cost of generation, in turn, will depend upon the costs of fuel and capital, and upon the efficiency of the last generator brought into production. Because each new station brought on has a higher cost structure for its initial megawatt than the previous unit's last megawatt, the marginal cost curve ascends in a sawtooth, rather than a smooth, fashion. This pattern is especially true when there are hydroelectric and nuclear plants involved: hydroelectric dams receive their energy as a gift of nature, and nuclear plants run at near-constant levels.

Marginal revenues are determined by demand for electricity in the market relative to the available supply. Demand for electricity is somewhat a function of population and economic activity, but is dominated by time-of-day and day-of-week, (which economists can now predict with 95% reliability) and by weather, especially summertime air conditioning demands.

Now let's return to the biological reference up above. Each utility will seek to maximize its profit, which will mean expanding production over all of its generating capacity, at ever-higher marginal costs. Since they can only sell most of this incremental production in other service areas, and since their product is wholly undifferentiated, they will have to compete on the basis of price. This will lower the production levels at which marginal revenue will be maximized and reduce the probability that higher-cost generating stations and utilities will be able to survive.

This is illustrated in the graph "Marginal Economics." A utility system with four generators, with Generator 'A' being the cheapest and therefore first unit brought into production, is faced with station 'D' being uneconomic for normal, non-emergency use. Station 'C' is barely economic. If the marginal revenue curve is pushed down (arrow), then station 'C' -- and possibly the whole system -- becomes uneconomic as well.



The Role Of Futures

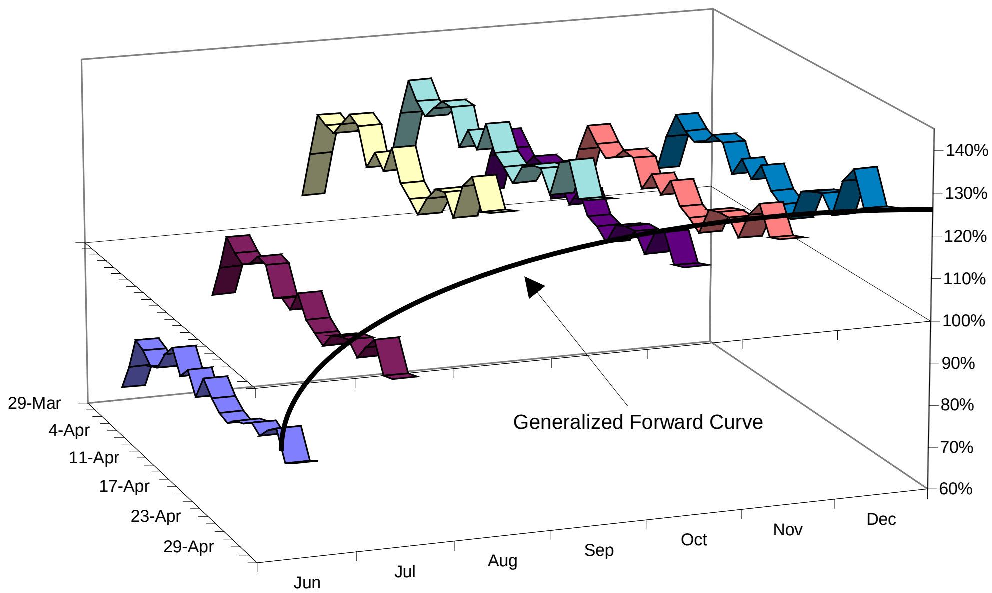
This type of struggle is easy to understand, but rather inelegant; the winner exposes himself to bloody combat in all instances and anti-trust lawsuits if too successful. This is where the parasitic wasps have beaten the game: they avoid fair fights and use others' resources to further their own ends. Utilities can use electricity futures to adopt a similar strategy.

Electricity is one of the "new" classes of commodities that is not storable in the classic sense. We can, to some extent, store electricity by pumping water uphill or charging battery banks, but the current itself is a disappearing asset. Nor can electricity be "squeezed," at least not by the same person twice. What is storable, however, is a claim on another utility's future production capacity.

The forward curve of the new NYMEX California-Oregon border (C.O.B.) futures over their first month, depicted in the graph below, shows a generalized contango structure, with the distant months trading at an increasing premium to the cash market price. The curve has two extremely important deviations, however. The first is that the prompt month, June, is trading at a substantial discount to cash more befitting to a commodity in backwardation. This discount reflects price competition at the margin, as discussed above. The second important deviation is the excess premium for August and September, the hot and dry months in the Pacific Coast markets.

Implicit in the shape of the forward curve is a price forecast -- and two marvelous opportunities. First, a utility can sell a volume of electricity forward into this curve in an amount sufficient to protect the economics of its own generating stations. This will drive down the marginal price for other utilities and make them either reduce their own output or compete on the basis of lower prices for themselves. At some point, their price for marginal output will fall to the point where the first utility can buy power more cheaply from their non-forward selling competitors than it can produce from its own higher-cost generators. Score one for the wasps.

NYMEX C.O.B. Electricity As Percentage of Spot



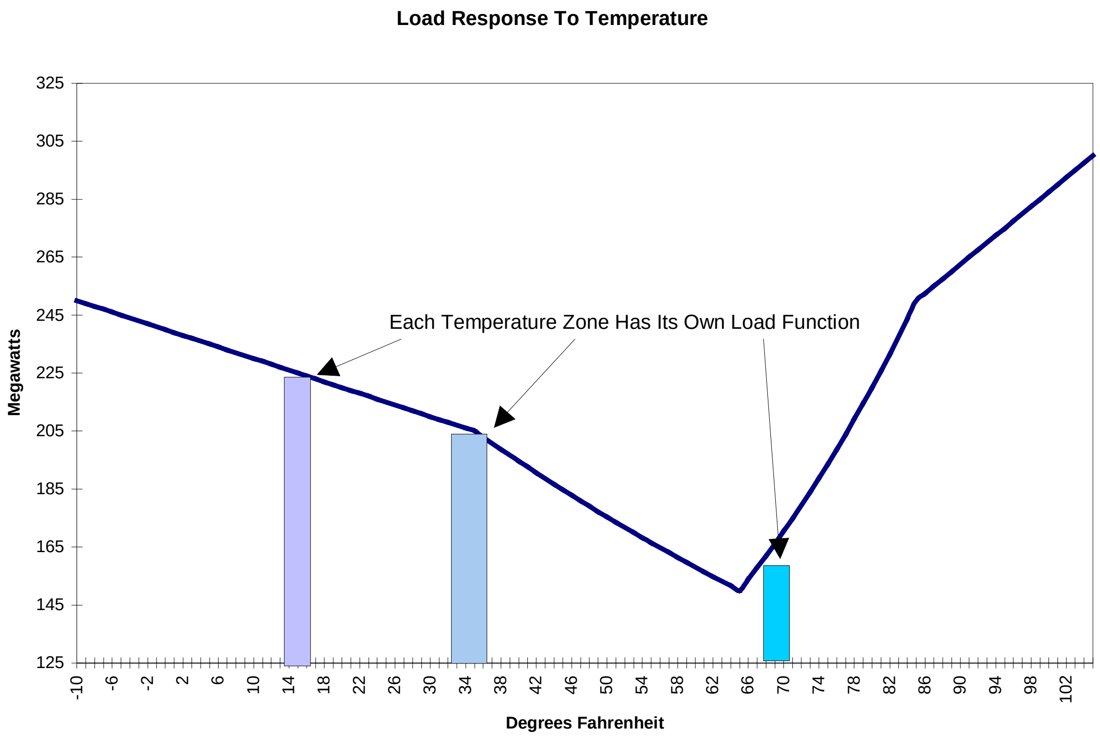
The second opportunity is even better: since the forward curve is distorted from pure carry by price forecasts, and since price is largely a function of demand, rewards will flow to whomever has the best load forecasting tool. Consider the Total Energy System Load Analysis (TESLA) system produced by the Springfield, VA, company of the same name. While utility forecasters in the U.S. are pleased with 3% load forecasting errors, and the intermonth spreads shown above are over 10%, the TESLA, Inc., experience at London Electricity has been for accuracy approaching 1%.

The TESLA model incorporates, in addition to the time-of-day and day-of-week data referenced above, an extensive weather linkage module and sensitivities to short-term economic factors. The model is especially sensitive at critical peak and turning points because of its use of Very Large Linearized System (VLLS) regression techniques, discussed below.

The core forecasting equation structure is:

Load = f(Clock, Calendar, Weather) * g(Economic, Demographic)

It is easy to say that “only” the weather is significantly variable in this construct, but this would be like saying that “only” volatility makes option trading challenging. Since the relationship between load and weather is highly complex and is in turn a function of clock/calendar and drifts over the years with economic and demographic variables, simple forecasting procedures do not work. VLLS cuts through this knot by splitting the multivariate load-temperature relationship into a large number of small ranges, each of which can then be modeled against the other determining variables. This is how people solved curve measuring problems before Newton simplified things with calculus. Conceptually, this can be seen in the graph “Making It Linear.” Once a large set of linear relationships is developed, they can be estimate jointly using a technique called principal components analysis.



A utility trader armed with a weather forecast would be in position to trade the expectations of the electricity forward curve. More importantly, that trader would be able to lay claim to the productive resources of other utilities when demand is forecast to be high, and to sell excess capacity when demand is forecast to be low.

Survival of the fittest is a lot more fun with a few bucks in your pocket.