Lessons Learned, or Are They?

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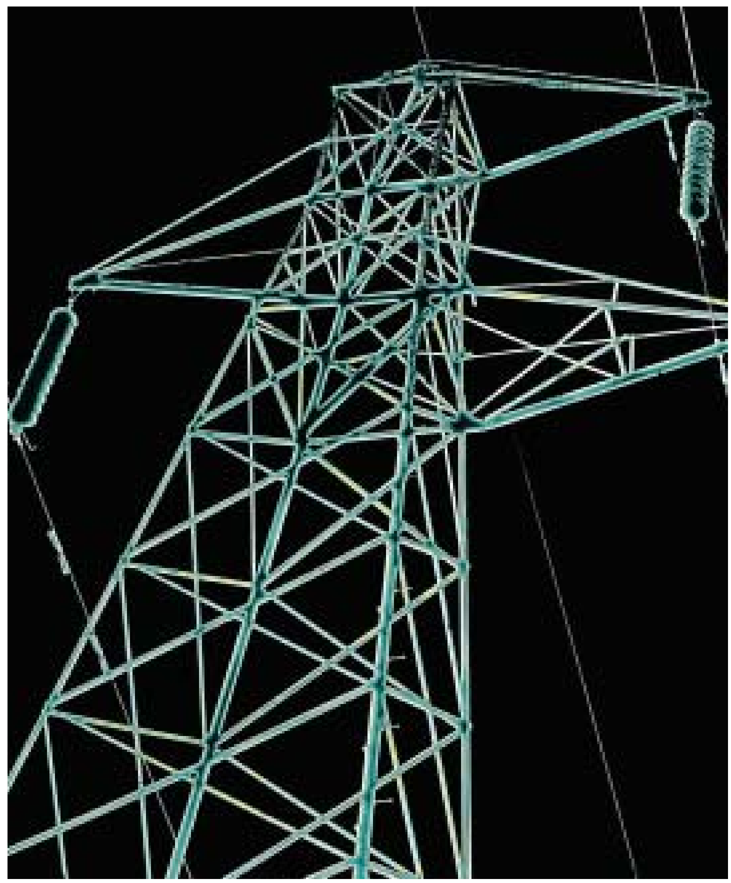

Somebody said that history would have been different if we had learned from it. In the history of electricity, we are in a period of rapid change. The pace of change is fast – in fact, so fast that in many cases there is little or no history to learn from. Consequently, some mistakes are made. It is acceptable as long as we learn quickly from them and adapt to change. In any case, we must not repeat the same mistakes.

The deregulation of the electric industry has taken many different shapes and routes. The California energy crisis in 2000 and 2001 not only left the state and its citizens with a two-digit billion dollar bill, but left most people inside and outside California with a bad taste for deregulation. The taste is so bad, in fact, that it overpowers the much better taste of successful deregulation in Texas, the UK, New Zealand and Scandinavia.

The California deregulation model of 1996 was like designing a nuclear reactor without control and safety systems. The combination of inadequate generation supply, high dependency on the import of power, transmission and distribution (T&D) bottlenecks, a wholesale market without long-term contracts (only a daily spot-market) and utilities obligated to serve their customers at fixed prices reached a critical reaction and resulted in a meltdown. Thanks to a mild summer in 2001, negotiations of long-term but very expensive contracts and, eventually, permission for the utilities to radically raise the prices to the consumers, stability was restored. So what can we learn?

To repeat what has already been communicated by most Monday-morning quarterbacks: In order to make the wholesale market work, there must be enough capacity on the supply side – the generation. However, that's not enough. There must also be enough capacity in the T&D system. One may even argue that in many areas, like California, Chicago and New York, T&D may be a bigger constraint than generation capacity.

In terms of T&D, the lesson still to be learned is that without an incentive to invest, no one will invest. If everyone should have access to the grid at the same cost as the one owning the grid (FERC order 888), then at least for most of the vertically integrated utilities, there is little or no incentive to invest. To change the situation, stimulating more investments in the T&D infrastructure, regulated utilities (or "wirecos") as well as new entrants such as "independent transmission providers" must be allowed to make a return on their investments and to introduce new concepts such as "transmission toll roads."

Another potential given would be that prices for the grid should be more differentiated to better reflect the cost and the value of using the grid. By and large, the electric grid is the only transportation system in which distance is not reflected in the price. Technical challenges to accurately measure the flow of electricity exist, but as expressed in FERC order 2000, the distance should matter.

Remote power generation as well as remote consumption should pay for their dedicated extensions of the grid. By the same rationale, distributed generation (DG), where power is produced at the site of consumption, should pay less for the grid. A lesson to be learned from the UK is that small and clean DG does not have to pay for the transmission component of the T&D.

Distributed generation can help utilities to optimize the grid. Instead of responding to increased demand by boosting the grid – for instance, adding more wires and cables, or adding and changing transformers – a more optimal solution may be to use the existing grid infrastructure, but supplement it with more DG. The electric utilities are in the best position to do this optimization. Consequently, it makes strong sense that utilities have a right to use DG at least up to a certain size – perhaps 2 MW, which is the average size of a feeder.

A major negative lesson learned from the California deregulation was the model of "atomization," which is a strict unbundling of the vertically integrated electric utility. Thus, the regulated utilities, the "wirecos," were not allowed to have any generation, not even a 2 kW photovoltaic system! Not surprisingly, the strongest advocates for this fundamental unbundling were the large energy-trading companies, who saw the opportunities in more transactions. The more atomized the structure, the more transactions and the more money to be made on the transactions!

The most successful California utilities in the middle of the energy crisis were the municipal utilities, like LADWP and SMUD, that remained vertically integrated. As municipal utilities, they were not part of the deregulation, which basically covered only the investor-owned utilities. Thus, these municipal utilities, with their generation assets intact, could not only provide their customers reliable power, but also provide power at lower cost relative to other California utilities and, further, in the case of LADWP, become a national leader in green-power initiatives.

Learning from history, it is worthwhile to remember that the dominant push for deregulation of the electric industry in the U.S. was not a consumer-driven movement. It was driven by General Motors and other large industries. They saw it as crucial to their global competitive situation that the cost for electricity was reduced in high-cost areas

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where they had factories. That's understandable. Lessons learned from deciding the location of green-field, energy-intense industries is that access to reliable and inexpensive power has been and will be a most important factor. Nevertheless, deregulation or not, most large industries tend to have enough bargaining power to negotiate attractive power arrangements.

Industrial customers consume roughly one-third of all power. Residential and commercial customers consume about one-third each. Compared to the industrial customers, residential and commercial customers have a more challenging situation. By definition, they are less movable, and individually, they have much less bargaining power. The starting point must be to rethink what these end-users of power really want. As consumers, we want reliable, affordable and clean power. We prefer to have somebody provide the energy service, and we want choices.

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Reactions to Price

The single most important lesson learned from California is that customers do react to price. It was the California consumers facing a doubling in electricity rates that cut down on demand and consumption. Price contributed more than any other factor to restoring the balance of supply and demand.

Other examples that customers react to price can be learned from Japan. Commercial customers pay 6 cents per kilowatt hour during the night, while during the daytime they can pay more than 30 cents per kilowatt hour. As intended, this rate structure has triggered great creativity. For example, buying cheap night power to generate ice can be used to support the air-conditioning during the day, thereby reducing the total cost of energy. This price delta between daytime and nighttime power has also triggered substantially greater use of distributed generation, in particular for small cogeneration.

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The high differentiation between nighttime and daytime power is probably why distributed generation in Japan during the last four years has grown 18 percent per year versus 2 percent for centralized power plants. Distributed generation helps reduce the consumption of expensive daytime power.

For green power, we have learned that in the United States, 5 to 10 percent of the customers are prepared to pay a premium of up to 10 percent.

We can also expect that customers will respond to different prices for different levels of power quality and reliability. Customers focused on the lowest possible energy costs do buy low-cost, interruptible power. Residential customers have responded favorably to demand-side programs. Several models have been tested, but bottom-line customers do respond to price signals and economic incentives.


Installation of PowerLight photovoltaic panels atop a Los Angeles corporate building.

The electric system is unique in that, by and large, the power has to be generated the very moment it is consumed. So far, there is no economical way for large-scale storage of electricity. One might say that electricity is truly a real-time commodity. To make a perfect market of electricity, supply-and-demand response to price would eventually need to occur in real time. Such a vision of real-time prices may still be far out, but it is worth striving for.

In the evolution toward more real-time prices, already differentiated prices (for example, based on time of day) combined with smart demand (for example, automated decisions regarding demand, energy storage and other means of energy conservation) will go a long way. Technology progress in smart appliances, two-way meters and Web-based information solutions are very encouraging. For the residential customer, affordable technology that can receive and automatically respond to real-time prices may ultimately have a better return on investment than any residential generation or storage device.

A dominant majority of customers worldwide prefer to have their utility or energy service provider (ESP) offer them the energy service. Utilities should be allowed to expand their services to the customers. We can learn from Europe that customers do appreciate an integrated service of power and comfort (hot water and/or cooling).

An increasing number of industrial, commercial and some residential customers invest in their own backup power and/or higher levels of power quality. In fact, billion of dollars are invested annually in all degrees of backup power. Customers do this because they perceive that they have to. If their utility or ESP could offer backup as part of their service, that would most likely be preferred. We can learn from North Carolina and Wisconsin, for example, that many commercial and industrial customers do not mind paying their utility a premium for a higher level of power reliability and quality.

Allowing utilities and ESPs to bundle services of "bulk power" from the centralized power plants with on-site solutions for different levels of power quality and reliability, with different levels of green power and with heating and cooling services will increase customer choice. There should be no restriction for a utility to install DG on any side of the meter.

To increase transparency and customer choice, there should not be any penalties for customers or third-party ESPs to connect DG to the grid, provided it meets air-quality requirements as well as the technical interconnection requirements, including safety. Today, penalties in the shape of "stand-by charges" or "exit fees" can pull the rug on the economics for deploying DG. It should make no difference if a customer reduces his or her consumption by turning off lights or installing energy-efficient fluorescent lights or other energy-saving devices, or by using on-site generation or energy storage.

On the contrary, we can learn from Japan that leveling the playing field between energy savings and on-site generation can trigger innovative energy storage solutions as well as energy-efficient combined heat and power DG solutions for peak shaving. Leveling the playing field can come about by eliminating penalties and differentiating prices between nighttime and daytime power.

One more lesson learned from the last 10 years is that governments can stimulate new energy technologies by focused incentives rather than regulations. From Europe we can learn that tax incentives and other subsidies for sustainable energies such as wind power have helped such technologies to reach critical mass, sliding down on the cost curve and becoming competitive on their own merits. In the same way, we can learn from Japan that incentives for residential photovoltaic have helped that technology as well to slide down the cost curve.

Today, with increased attention to global warming and CO_2 reduction, we can learn, for example, from Germany that programs of tax incentives and other subsidies are stimulating more use of combined heat and power, which is the quickest way to much-increased energy efficiency when using fossil fuels.

In summary, an aggregated lesson learned is that deregulation in the shape of a fundamental unbundling of the vertically integrated utilities is not the way to meet customer demand for reliable, affordable and clean power. Far more efficient is to encourage more price transparency and to allow customers more choice by combining grid power with such options as energy conservation and on-site generation. ■

Example of a 200+ kilowatt array of Capstone MicroTurbine driven Sumitomo-Meiden combined heat and power systems atop a hospital in Oita, Japan.

Dr. Åke Almgren is president and CEO of Capstone Turbine Corporation, a newly public American company focused exclusively on the commercialization of microturbine power generation technology. Founded in 1988, Capstone is the world's premier developer, designer and assembler of microturbine systems for on-site power production and for use in hybrid electric vehicles. Since Capstone introduced its third-generation microturbine, the Model 330, in December 1998, more than 2 million documented hours of operating time at customer sites have been accumulated.

Prior to Capstone, Dr. Almgren spent an accomplished 26-year career at ASEA Brown Boveri (ABB) Limited, a worldwide power solutions company. While there, he served as president of various divisions, managed the operation of 36 plants in 28 countries, and led turnkey projects in the U.S., Canada, Brazil and India. Before relocating to the U.S. in 1991, Dr. Almgren was president of Autoliv, based in Stockholm, Sweden. Under his leadership, the automotive restraint company established a North American presence and expanded into the development of airbags.

Dr. Almgren holds a Ph.D. in engineering from Sweden's Linköpings Tekniska Hogskola and a master's degree in mechanical engineering from Sweden's Royal Institute of Technology.

He is an early advocate of distributed generation and believes microturbines and other emerging technologies will increasingly supplement more conventional technologies for generating and distributing electric power.