INFORMATION AGGREGATION IN ELECTRIC POWER: HOW TO ACHIEVE MORE SECURITY, HIGHER EFFICIENCY AND LOWER CAPITAL COST

Vernon L. Smith

Interdisciplinary Center for Economic Science

George Mason University
The California Energy Crisis Stemmed from a Market Design that Failed to Provide for the Aggregation of Relevant Demand Information

I. What is the Design Problem?

To design efficient, flexible, power delivery systems for adjustment to dynamic load variation that reduces the disruptive cost impact of unscheduled outage events—generator failures, line, transformer and connector faults.
II. How is the Design Problem Related to Information Aggregation?

1. Electric power spot markets aggregate real time price signals—WTA—from the supply side only; WTP demand signals are almost entirely metered and aggregated monthly.
   - This is because all demand is “must serve:” There is little implementation of the technological capability of prioritizing and selectively interrupting loads below the substation (a relic of 1930s technology).

2. Also, there is no aggregation of WTP price signals for security, i.e., no ‘Call market’ (limit prices) for incentive interruption of the consumer’s lowest priority uses of power.

Rather, all outages are treated as a Call only on supply side security reserves of

- Transmission—load lines to a fraction of thermal capacity using n-1, and n-2 security analysis.
- Generation—maintain a Call on 15% spinning and quick-start excess capacity.
III. What are the Limitations of Current Practice?

The current system is conditioned by incentives induced by 95 years of state regulation under a “must serve” load mandate at a time invariable price. The resulting management system is

1. **Energy inefficient**—the unintended effect of fixed per unit time retail prices is to subsidize peak consumption (where cost exceeds revenue) by taxing off-peak consumption (where revenue exceeds cost).

   - When the subsidy exceeds the tax, the local utility loses money until the imbalance goes away; if the imbalance does not go away, then the utility applies to the state regulatory commission for an increase in the fixed price.

2. **Investment inefficient**—the regulated price is set to induce capacity expansion to levels required to serve peak fixed-price demand. Capacity is **idle** at all other times.

3. **Insecure**—with the inevitable occurrence of a confluence of scarcity events, as in CA, “must serve” is impossible, and the only alternative is to shed load, substation by substation, blacking out elevators, computers, porch lights and toasters, all of which have been afforded equal priority.
4. **Monolithic**: Why does not competition bring new switching, metering and monitoring to the end user?

- Your local utility has a franchised monopoly of the wires, and is not well motivated to permit access to the wires by alternative energy providers.
- Remember Ma Bell? Telephone sales, repair and connection service were tied to telephone accounts.

5. Higher **environmental** impact.

6. Extreme **vulnerability** to a terrorist attack on critical points in the grid requiring a large-scale shutdown of substations rather than a selective shutdown, starting with the lowest priority uses of power.
IV. What is New in our Approach and What is the Evidence that it Would Work?

1. Market experiments using WTP price signals that incentivize selective interruption of 16% of peak demand demonstrate that:

   - Prices are lowered.
   - Price change volatility is dramatically lowered
   - Generator market power is controlled.

2. This is why it will be productive to extend the market design to include demand side reserves for security. Suppose X% of demand is on selective standby interruption. What level of forced outages—generation, transmission—can be sustained on a network without involuntary load shedding? What will be the impact on network prices and allocations?

1. **Interruption** (strategically exercising Call options for reduced on peak consumption) disciplines prices, lowers energy cost by shifting load from peak to off-peak users.

2. **Interruptible capacity** (holding Call options for selective emergency load shedding) substitutes for the higher capital cost of reserve generation and transmission capacity, increasing home security.

   • This is the ultimate free lunch: actions that lower cost increase security.

3. Reduced impact on environment from reduced emissions and generation/transmission capacity.

   • Another free lunch.