The Texas Blackouts and the Problems of Electricity Market Design

By Georg Rilinger

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Even in an ideal electricity market, reliability is an elusive and precarious byproduct of companies' search for profits. Since market designers are rarely in a position to enforce this ideal, electricity markets tend to produce poorly maintained infrastructures that collapse as soon as there is trouble on the horizon.

At the peak of the arctic storm that plunged Texans into darkness this past February, 48.6 percent of generators in the state were forced offline. The Electric Reliability Council of Texas (ERCOT) later reported 1,797 separate outage events and revealed that the system had been only minutes from complete collapse. As the humanitarian effects of the disaster become visible, experts have begun to debate whether there is something fundamentally wrong with Texas' reliance on electricity markets.

Some economists argue that the markets were not the problem. Rather, the storm was so severe that it exceeded the tolerances the system was designed for. The blackouts would have happened under any institutional framework, according to this view.

Others point out that the storm may have been extreme, but that it was not unprecedented: After a similar event in 2011, the Federal Energy Regulatory Commission (FERC) determined that Texas' system was ill-prepared for extreme weather and recommended that the state winterize its generation fleet. As we now know, power producers largely failed to implement these recommendations.

In addition, Texas also had the lowest level of operating reserves in the US: in 2019 they were at 7.8 percent, well below the reference value for reliable operation. Despite a decade of warnings, Texas was poorly prepared for the storm. Those who blame Texas' electricity markets often point to the corrosive effects of unfettered competition: in a deregulated market, utilities try to enlist customers who want to buy the cheapest energy. To maximize profits, companies will therefore cut costs wherever they can. This leads to poorly maintained infrastructures that collapse as soon as there is trouble on the horizon.

This argument begins with a correct observation. Power producers did not have incentives to maintain their generators. But it is too easy to blame 'the logic of free markets.' Electricity markets are neither free nor deregulated in any meaningful sense. To the contrary, they are carefully designed structures. Market designers write software and rules, build interfaces and monitoring regimes to ensure that the trading process produces results that are in line with the goals of the system operator—the entity in charge of balancing the complex interplay of generators that produce the flow of electricity on the grid.

If companies do not have incentives to build enough generators or pay maintenance costs, this is not simply a problem of how markets work. It is a problem of market design, a problem of *planning*. And indeed, this problem has persisted for a long time. It plagued California's first electricity markets during the Western Energy Crisis of 2000/2001 just as much as it mars Texas electricity markets today.

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So, the real question is: why is it so difficult for designers to build markets that incentivize companies to build and maintain generation capacity at the required level of reliability?

While the specific reasons will differ from case to case, history teaches us two very general lessons. First, even an ideal market would make reliability a precarious achievement. This has to do with the physical characteristics of electricity. For the most part, electricity cannot be stored efficiently. Most of it is therefore produced the moment before it is consumed. To ensure that there is always enough to go around, the capacity must be built up to the point where it can serve the highest level of demand in the system. Since the system is at peak for only a few hours during the year, these generators are idle for most of the time.

In an ideal market, prices would spike to extremes during the few hours and thus compensate the companies for these investments. Specifically, the price would jump to the value of lost load, i.e. the maximum amount consumers would pay to avoid outages. The same is true for the costs that generators incur for maintaining generators for extreme and rare weather events.

It is obviously very risky to tie the reliability of electricity systems to such an ideal. Even assuming ideal conditions, the long-term reliability of the system would depend on the calculations of a few companies that need to gamble on conditions that obtain for only a few hours each year. The companies must bet that the system will need their resources during the hours of peak demand and that prices will be high enough to make the investment worthwhile. Due to the long lead-times to construct new capacity, this is often hard to predict. For example, if too many others also build up generation, the company's investment might not pay off.

Historically, the electricity industry has experienced boom-and-bust cycles. The closer the existing capacity is to peak demand levels, the more dangerous the gamble. Another problem is that even ideal electricity markets produce powerful incentives *not* to invest. In moments of scarcity, companies may be able to charge higher prices for output from older generators. Why invest if existing generators can already profit from scarcity pricing?

These considerations show that the margin of error for electricity market design is very thin. Market participants must act reliably on the basis of risky calculations. To ensure that they do, market designers would have to exercise quite a bit of control over the institutions of the market. The actors would need to face the correct incentives, have the correct information about the system and each other, and act rationally; further, the designers have to eliminate the exercise of market power and ensure prices that will sustain necessary investments. Electricity market design is thus an ambitious project of social engineering that operates against a thin margin of error.

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History's second lesson is that designers are almost never in a position to enforce the demanding requirements of their ideal. The most intuitive example is consumers' low tolerance for high electricity prices. Most people do not view electricity as a financial commodity. They view it as a basic service that should always be available at low cost. As outrage over electricity bills of over $17,000 in Texas shows, high prices can end political careers. Regulators and politicians therefore tend to curb prices before the market can remunerate generators' investments. Regardless, what the mechanism requires and what designers may want, a market that produces astronomic prices for an essential service during desperate times is not acceptable or enforceable.

In light of such resistances, market designers tend to fall back on two strategies to fix the resulting market imperfections. This is where things become difficult. First, designers can set rules and mandate desirable behavior. For example, if the markets do not sustain the incentives to invest in winterization, regulators might simply mandate such measures. However, to the extent that such rules run up against profits, companies will lobby against them. This is what happened during the creation of California's electricity markets, when power marketers blocked rules that would have corrected flawed incentive structures. Ostensibly, it is also what happened to the FERC's findings after the 2011 events in Texas. Even if administrative rules had been put into place, the market would have incentivized actors to elude compliance. The reliability of the system then hinges on enforcement actions by chronically underfunded regulators.

For this reason, market designers usually prefer to create additional market mechanisms. The idea is to re-align companies' interests with reliability requirements. For example, Texas chose to adopt an operating reserve demand curve, which augments the energy market to reflect the cost of investments in marginal capacity. Another approach is separate markets for the construction of new capacity. In each case, designers translate technical reliability requirements into new products or markets. This creates custom-tailored incentives for companies to meet the requirements of the system.

Unfortunately, these solutions tend to suffer from the same problems that made them necessary in the first place. The development of new market rules is a deeply political activity. Ideal market mechanisms do not simply serve as blueprints that experts then implement. Rather, they offer a common language that stakeholders, experts, and politicians use to articulate their interests in public negotiations. The resulting compromises rarely reflect the logic of the ideal markets that prompted the design effort. Instead, they tend to express the interests of powerful incumbents and prior institutional constraints. Just as the market structure of the first California markets represented the interests of independent power producers, so did the auction rules for European capacity markets depress incentives for investment in renewable energy to the benefit of large players. The solutions to market imperfections thus tend to produce new imperfections, leading to an eternal cycle of regulation and re-regulation.

This produces yet another barrier to success. Market design takes place in organizations. People in a bureaucratic division of labor operate, manage, and monitor the markets as well as their relation to the electricity system. As the number of interlocking markets for different products, rules, and exceptions increases, it becomes more and more difficult to understand what incentives market actors face at any point in the system. During the California energy crisis in the early 2000s, the system operator iteratively adjusted the rules of different markets in response to games that power marketers developed. This shifted incentives in other parts of the system and created new opportunities for manipulative behavior. At some point, the complexity of the market process overwhelmed the ability of designers to create a consistent set of rules that generates the desired behavior.

Even in an ideal electricity market, reliability is an elusive and precarious byproduct of companies' search for profits. Market designers pursue this ideal in less-than-ideal conditions. Market design is a highly political activity that takes place in bureaucratic processes and is open to stakeholder influence. As such, it is usually pushed off course. Attempts to resolve the resulting imperfections are bound by the same problems that made these attempts necessary in the first place. Considering all this, the answer to the reliability crisis of electricity systems might be fewer, rather than more, market mechanisms.