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Forward reliability markets: Less risk, less market power, more efficiency

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Abstract

A forward reliability market is presented. The market coordinates new entry through the forward procurement of reliability options—physical capacity bundled with a financial option to supply energy above a strike price. The market assures adequate generating resources and prices capacity from the bids of competitive new entry in an annual auction. Efficient performance incentives are maintained from a load-following obligation to supply energy above the strike price. The capacity payment fully hedges load from high spot prices, and reduces supplier risk as well. Market power is reduced in the spot market, since suppliers enter the spot market with a nearly balanced position in times of scarcity. Market power in the reliability market is addressed by not allowing existing supply to impact the capacity price. The approach, which has been adopted in New England and Colombia, is readily adapted to either a thermal system or a hydro system.

Keywords: Capacity market; Forward reliability market; ICAP; Adequacy; Reliability; Firm-energy market

1. Understanding the generation adequacy problem

The reliability of a power system depends on how it is operated in the short term (security) and medium term (firmness), but if there is not enough generating capacity, it will not be possible to serve all load and achieve security and firmness.[2] In this way, adequate generation is the most fundamental reliability issue, and it is also the one most distant from the spot market because it is the most long-term aspect of reliability. This paper focuses only on the long-term issue of generation adequacy. However, the importance of the prescribed reliability-options approach to adequacy is that it facilitates the solution to the three worst problems of contemporary electricity markets: investment risk, market power and inefficient pricing.[3]

Contrary to conventional wisdom, the level of generation adequacy is not much of a problem for two reasons. First, marginal generating capacity is relatively inexpensive when compared with other costs of delivered energy. Second, as with most optima, the derivative of net benefit with respect to capacity is zero at the optimal capacity level. For example, an extra 10% of capacity increases capacity costs by much less than 10% because peaking capacity is by far the cheapest kind of capacity, and adding peak capacity does not increase fuel costs, transmission costs or administrative costs. As a consequence, increasing total capacity by 10% will cost consumers only, perhaps, 2% extra. But there is some benefit to the resulting extra reliability. So the loss of net benefit is less than 2%. A good regulatory approach is unlikely to overshoot by more than 10% on average, and the best

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[2] For a more complete explanation of reliability see the paper in this issue by Batlle and Pérez-Arriaga.

[3] These problems are actually solved by the capacity-market/reliability option design, provided that the rest of the market design is reasonable and the market does not have structural problems such as high supplier concentration.

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market-based approach will not be perfect. Hence, the net benefit of improved adequacy from any market-based approach is necessarily quite small—likely less than 1% of total retail cost. The true cost of the adequacy problem has been the distortion of market designs by misguided attempts to solve it. These designs cause risks, inefficiencies and regulatory responses that are far more costly than any likely mistake in the provision of adequacy. Of course the adequacy problem needs a solution, but that solution should not exacerbate already difficult aspects of electricity markets.

The misconception most responsible for the current state of affairs is the notion that a cleverly designed ‘‘energy-only’’ market can induce optimal adequacy, or something close to it, even while the market has insufficient demand elasticity. Interestingly, when the notion of reliability markets was first developing back in the late 1990s, the importance of adequate demand response in an ‘‘energy-only’’ market was fully recognized.

> In this approach there is no price cap that limits the market price. It is assumed that the elasticity of demand to prices is enough to prevent any occurrences of market's failure to supply because of lack of generation adequacy.
>
> Pérez-Arriaga (1999)

Unfortunately, when the idea of reliability options spread to the US, these assumptions were sometimes replaced with the idea that options priced only on the basis of their financial cost would solve the reliability problem in spite of a lack of sufficient demand elasticity.

In an ideal market, with sufficient demand elasticity, the market always clears. This means there can be no adequacy problem because involuntary load shedding occurs only when the market fails to clear and demand exceeds supply. In a market that always clears, energy prices do not and cannot determine the level of reliability for, with respect to adequacy, the market is automatically 100% reliable. Instead, energy prices do what every economics text says they do, they determine the efficient (not reliable) level of capacity. Any less capacity would cause expensive *voluntary* load reductions, and any more capacity would mean that too much had been spent on capacity. The crucial point is that no energy-only market, even with ideal demand elasticity, can solve the adequacy problem. No energy market, on its own, can ever answer the question: ‘‘What level of capacity provides optimal reliability?’’ That would be the same as a market discovering a positive and optimal amount of time that it should fail to clear. No economic theory claims any market can do this.

Of course if reliability is sold as a product, so that the customer can pay more to gain reliability, the market can answer the reliability question. But that is not an energy-only market, and it requires technology that is not yet in place. At present, you cannot buy more reliability than your neighbor, because you are on the same physical circuit and neighbors will always be blacked out together.

Rather than attempting a reliability market, it may be better to install real-time meters and use real-time pricing to increase elasticity to the point where the market becomes perfectly reliable with regard to adequacy. In principle this can be achieved with prices well below the Value of Lost Load (VoLL). As long as price stays below that level, such a market will be more efficient than an inelastic market with even a perfectly optimal level of adequacy. Even so, one should not hope for dramatic efficiency gains because peaking capacity is cheap relative to the total cost of power.

As just noted, those who believe an energy market can solve the adequacy problem have simply misunderstood the economic theory of optimal investment. In a competitive market, optimal investment has nothing to do with reliability. To understand why it sometimes appears as if there is a connection, a more detailed look at energy markets is helpful.

Energy markets fall into one of two categories: Case 1, they always clear and have no adequacy problem; or Case 2, they can fail to clear and do have an adequacy problem. To classify a market correctly it is necessary to consider how it would perform without market power or regulation.

Case 1 occurs when there is enough demand elasticity so that the supply and demand curves always intersect as they do in any normal market. With the market clearing at all times, there will be a long-run capacity equilibrium, but it will not be efficient if the price sometimes exceeds the VoLL. VoLL varies with time, but at any given time it is the average price that all consumers in the blackout region would pay to avoid the blackout.[4] Suppose this value is \$2000/MWh. It is quite possible for the demand curve to be downward sloping at \$50,000/MWh or any other value. In this case the market could clear at \$50,000 even though VoLL was only \$2000. Paying \$50,000 for power that is only worth \$2000 is clearly inefficient, and because it pays suppliers too much, it causes excess entry, and the capacity level will end up inefficiently high. Economics does not predict, as many imagine, that simply because a market clears, it is efficient. Efficiency depends on all consumers expressing their demand in the market. Next consider the sub-case in which there is just enough demand elasticity to keep spot prices in Case 1 below VoLL, both risk and market power are almost certain to reach problematic levels. Under such conditions, the regulated, reliability market described in this paper is still almost certain to outperform an unregulated energy-only market. Only when a market's demand side is functioning quite normally and spot prices stay well below VoLL, is a pure energy market at all likely to outperform a good capacity market, and even then, better investor coordination may favor the capacity market.

Case 2, in which reliability is not guaranteed to be 100%, is the case considered in this paper. In most markets, few observers are willing to guarantee that involuntary load shedding is out of the question if the market is left to its own devices. Even so, some markets appear to be reliable on their own. Does this mean competitive energy prices are coming close to

[4] Although VoLL is not measurable, that does not mean it does not exist or does not matter. Although inter-temporal preference make VoLL difficult to define in real-world situations, the above analysis is rigorous in simplified models, and in complex models the inefficiencies would be no less. The complexities of the real world are extremely unlikely to produce an efficient outcome in situations where simple models predict inefficiency.