INCREASING BACKUP GENERATION CAPACITY AND SYSTEM RELIABILITY BY SELLING ELECTRICITY DURING PERIODS OF PEAK DEMAND

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Overview

Meeting electricity demand during the 200 hours of greatest use each year is costly and challenging, especially in transmission constrained urban centers. At the same time as load is growing, investment in new generation and transmission capacity is lagging. Measures such as installed capacity markets (ICAP) have been established to ensure adequate system reserves for grid stability and encourage new capacity. At the same time, customers are demanding higher reliability of system and have installed large amounts of backup and emergency generators. With power outages on the order of 2 – 3 hours per year, these geneators represent a significant amount of underutilized capacity (1). Allowing installed backup and emergency generators to sell electricity for profit during peak demand and participate in the installed capacity (ICAP) market could lower the price of electricity and increase the reliability for all customers, not just the owners. The additional revenue could also provide an incentive for more customers to buy backup generators, adding still more reliability to the system. There are, however, barriers to this strategy specifically retrofitting the interconnections to allow the generators to operate in parallel with the grid and adding environmental controls so as to not severely harm human health (2).

In the New York Independent Systm Operator (NYISO) market, the generators participate in an emergency demand response and a special case reserves program. Recently, the NYISO has announced its intent to move these generators into the regular markets. Here, we evaluate the economic potential of using backup generator for meeting peak electricity demand and ICAP requirements in the New York City – Long Island (NYC-LONGLI) region in New York (NY) State. Specifically, our objectives are as follows:

1. To examine the available profits for backup generators selling during periods of peak electricity demand and participating in the capacity markets, and investigate how these profits influence the quantity of backup generators capacity;

2. To explore the system effects (simultaneity problem) of how profits will change with the additional backup generators; and,

3. To evaluate the system (social) benefits, specifically in reduced capacity market payments and improve reliability, and to what extent inducements are justified for this strategy.

Methods

To evaluate these effects, first, we calculate the implicit value of unserved electricity as revealed by the investment in backup generator. Second, we evaluate the profit that would be earned by a backup generator available during the 200 peak hours each year, using the NYC and LONGLI zonal prices in 2005 and in 2006 as a case study. The profits from real electricity are calculated as the zonal prices minus the marginal cost of the generator. The profits from the ICAP market are equal to the clearing price minus the opportunity cost of being ready to operate. We then subtract the available profits from the costs of ownership (fixed costs) to estimate the 'reduced' implicit value of reliability, or the adjusted reservation price for purchasing a generator. We then estimate the increase in backup capacity assuming a range of elasticities of reliability. Finally, we address the effect of having all backup generators, rather than a single one, provide electricity and capacity to the market.

Results

We find that the implicit value of unserved electricity is much greater than the estimates in literature, since owners of backup generator reveal themselves to value electricity during lost service at approximately 26$/kWh or 85.9 $/kW – year. A single backup generator selling during the top 200 hours in NYC or LONGLI and participating in the summer and winter ICAP markets could generate sufficient revenue to lower its costs by approximately 80% with most of the profits from the ICAP market. If additional backup generators could earn this revenue, we estimate that this would result in adding 400 MW of backup generator capacity in NYC and 115 MW in Long Island. However, as additional backup generators bid into the electricity and ICAP markets, they reduce the market clearing price for electricity as well as for capacity. If all of backup generation were bid into the market, we estimate that the market clearing price would equal the generation cost of these backup units, generating no revenue beyond variable cost. Similarly, the price in the capacity market would fall to zero. While making all the backup generators available during peak hours would not generate much additional revenue for the owners of the generators, it would save electricity customers a great deal of money, especially in the capacity market, as well as increase system reliability. We estimate a savings of $66 million and $75 million in electricity payments in NYC and LONGLI, respectively, and $1 billion and $500 million in the ICAP market in NYC and LONGLI, respectively.

Conclusions

Even if people are not willing to pay more for increased reliability, they are less likely to accept significant reductions in reliability without substantial cost savings. One option is to employ idle generation capacity such as installed backup generators. In this paper, we show that allowing backup generators to operate in electricity and installed capacity markets results in substantial savings. A single generator would be motivated by the available profits in the electricity and capacity markets. If all available generators participated, however, the backup generators would become the marginal unit. As a result, we recommend incentives to encourage the generators to operate, especially with regard to retrofitting the interconnections and installing emission controls.

References

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