A Survey of Capacity Mechanisms: Lessons for the Swedish Electricity Market

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Many countries around the world have introduced capacity mechanisms to support the wholesale electricity market. Producers are then remunerated for providing a contracted amount of capacity over a given period. A main purpose of capacity mechanisms is to ensure resource adequacy, i.e. that there will be sufficient resources available to serve electricity demand under all but the most extreme conditions. In this paper, we survey the literature on capacity mechanisms. We compare market-wide mechanisms, known as *capacity markets*, to *strategic reserves*, where capacity payments are paid to a limited number of generation units.

Capacity payments to each generation unit are based on its available capacity, or *firm capacity*. Estimating firm capacity is straightforward for thermal production, which has a high and predictable availability. It is much harder to accurately estimate availability for intermittent production, such as solar and wind power. This task is also considerably more difficult for demand response and for energy-limited production, such as hydro power.

A related issue is the possibility for owners to influence the availability of a unit by its location, design, maintenance, and preparations for extreme weather conditions. Experience from the U.S. has shown that the latter is crucial, as capacity tends to fail when the weather is extremely warm or extremely cold. A challenge for capacity markets is to provide the right economic incentives to ensure that the contracted capacity is indeed available in crisis situations.

A fundamental problem of capacity markets is that the buyer procures nearly all available capacity and that the supply of capacity is limited in the short run. Many capacity markets in the U.S. have therefore struggled with excessive capacity prices because of imperfect competition. An advantage of capacity markets is that all market participants face a lower risk when all units receive fixed capacity payments. Another is that capacity markets, especially volume-based, prevent investment cycles.

Strategic reserves have the advantage that only a small part of the existing capacity is procured, which improves competition. Firm capacity must be estimated also for units in the strategic reserve, but those plants are few and often thermal. We conclude that a strategic reserve is a more suitable capacity mechanism than a capacity market for electricity systems dominated by hydro power and intermittent renewables, which is the case for instance in Sweden. The paper goes through the Swedish reserve in detail, and makes suggestions for improvement of the reserve.

A general conclusion is that all capacity mechanisms introduce market distortions. To minimize those distortions, price caps should be as high as is politically acceptable. In the future, one would expect consumers to react more to prices. Price-responsive consumers would reduce the need for price caps and capacity mechanisms.

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