

# CAPACITY MARKETS: A FILLIP FOR INDIA'S POWER SECTOR

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## Introduction

Securing investment and delivering reliable power supply to consumers at a reasonable price has always been a central objective of power market design. Markets across the world have adopted various approaches to this challenge to ensure access to round-the-clock power supply at competitive rates in a reliable manner. In a competitive wholesale power Energy Only Market prices are the primary driver of both short-term and long-term decisions by the market participants. However, the energy markets alone seem inadequate in attracting investments in generating capacities to ensure affordable and reliable power supply to consumers. To ensure the right level of resource adequacy, generators need additional revenue stream to maintain system reliability.

The Capacity Markets meet the above requirements alongside the existing Energy Only Markets. This market provides an additional source of revenues through the sale of capacity and this market works with a mandate of long-term and medium-term resource adequacy requirements. Primarily, capacity markets help achieve long-term security of power supply and ensure an additional revenue stream to generators besides the revenues from Energy Only Markets.

## Background

In the short-term, electricity is sold and purchased in MWh i.e., in terms of energy, is known as an Energy Only Market (EOM). To build capacity to generate power, the producer makes investments, and the fixed cost of such investments is known as Capacity Charge, which is calculated on an annual/monthly basis. An additional cost is incurred, including fuel, when the energy is produced, which is referred to as Incremental Cost or Marginal Cost. In the traditional EOM the producer is compensated for the capacity by implicit means i.e., by margins over the incremental cost of energy in the Over-the-Counter contracts or bilateral contracts as well as in the spot market. Even if OTC contracts is in terms of MW capacity, the final pay-out is as per energy delivered. Generators, when despatched, gets fully compensated for energy charges but remain under-compensated for capacity/fixed charges, during low demand periods and periods of high RE scenario, in energy markets. This discourages new capacity additions in competitive markets, particularly when renewable prices are sliding down exponentially, while fossil-fuel based and nuclear costs are going up. Thus 'capacity market' is suggested to create a market for capacity, which is necessary for investments in generation capacity, grid operation and security.

With the increase in renewable penetration and stringent targets to achieve climate goals, it even becomes more important to have a certain capacity in place to ensure grid security and provide round-the-clock power to all. As more intermittent renewable generation comes on stream, the Capacity Market will provide back-up generators and demand-side responders to help balance the network at times of stress.

Creation of Capacity Markets relies on creating a generation resource adequacy requirement, which is the ability of the system to meet any level of power demand, including peak demand, at all times. Resource Adequacy requirements can be of a short, medium, or long-term nature. Long-term Resource Adequacy is part of a grid planning process that ensures the system operators have the resources available to balance supply and demand considering demand growth, system uncertainties like unexpected generator outages, fluctuating load and changes in weather, which are becoming increasingly important factors. Estimating resources needed to meet the demand growth, uncertainties are the need of the hour.

In the context of regulated utilities, the Resource Adequacy process sets the planning reserve margin used to signal the need for a new generation and guides procurement decisions. In some restructured markets, the planning reserve margin is often the justification for capacity markets. In other markets, the planning reserve margin is advisory and, along with scarcity price signals and expectations in the spot market, resource decisions of market participants or the requirement on loads to procure long-term contracts are undertaken.

Electricity capacity markets work in tandem with electricity energy markets to ensure that investors build adequate generation capacity, in line with consumer preferences for reliability. With increased variability and uncertainty due to penetration of renewables, the significance of Resource Adequacy becomes even more relevant.

## Global Benchmarks

Currently, the following variation of capacity mechanisms prevail in matured markets:

- **Capacity Obligation** – A decentralised scheme where obligations are imposed on Load Serving Entities (Discoms) and large consumers to contract a certain level of capacity-based on self-evaluation of demand for the future. Obligation can be met using ownership of plant or contracting capacity with generators or by buying tradeable capacity certificates.
- **Capacity Auction** – Centralised scheme where the total required capacity is set well in advance for several years and procured through auction by an independent body. The price is set by forward auction.
- **Reliability Auction** – Contracted capacity providers are required to pay the difference between the market price and pre-set reference price. The plants participating in the capacity market auctions receive, in addition to the fixed annual premium, the remuneration deriving from the sale of energy in the markets, up to at a maximum price imposed 'strike price' and 'premium' as defined in the competitive auction held by the Transmission System Operator to assign the contracts.
- **Strategic Reserve** – Where a certain capacity is set aside to ensure supply in exceptional circumstances, which can be signaled by prices in the Energy Market reaching above a certain threshold. This is operated by system operators to keep the system safe and secure during stress and contingency.

## Capacity Remuneration Mechanism

**Capacity Payment**- Fixed price is paid to the generator for capacity made available at times of system stress. The amount is determined by the independent body.

The various models followed in some countries are provided for reference.

Market	Mechanism
Eastern USA (MISO, PJM ISO-NE, NYISO), UK, Colombia & Brazil	Capacity Auction
Australia/TEXAS (ERCOT) & France	Capacity Obligation
Spain, Greece, Italy, Ireland, Chile & Argentina	Capacity Payment

### UK CAPACITY MARKET: A CASE STUDY

In the United Kingdom, the capacity market was introduced in 2014 as part of a wider programme of reform known as Electricity Market Reform designed to decarbonise the UK's electricity supply, while keeping the lights on and costs affordable. It is a voluntary market. The amount of capacity that is needed is decided by the Secretary of State for energy and climate change, following a recommendation from the National Grid.

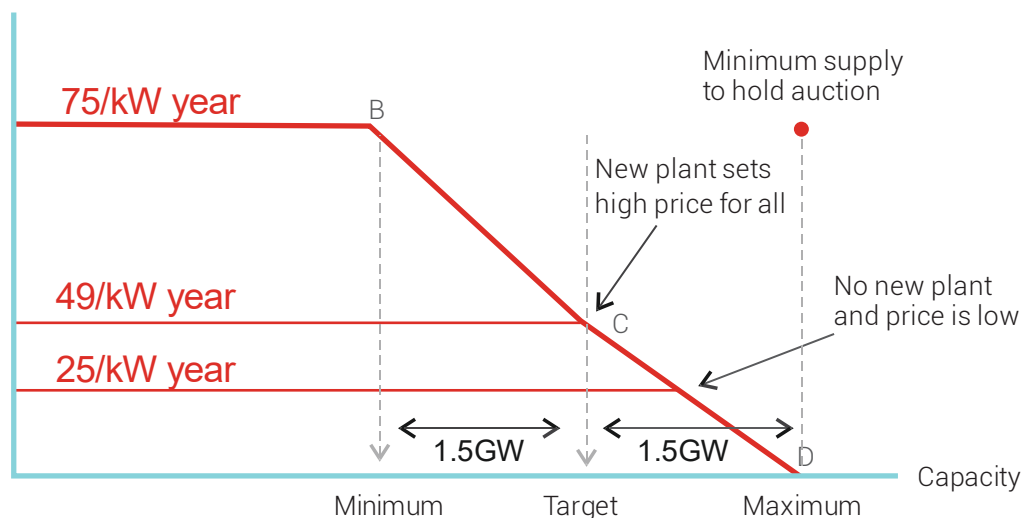
The National Grid assesses the capacity required, following the Reliability Standard of 3 hours loss of load expectation per capacity year. This means that we would expect on average three hours per year in which supply is insufficient to meet electricity demand, forcing the system operator to enact involuntary load shedding – leading to voltage reduction 'brownouts' and possibly customer disconnection 'blackouts'.

The Government picks a target of how much capacity to contract, which will be based on underlying calculations about the reliability standards for the UK electricity market.

This target level is bought, if the price is equal to Net CONE (Cost of New Entry) - an administrative estimate for the level of capacity payment needed to incentivise new build. This sets the price at which the Government is willing to buy the target volume of capacity. There will be a target range of  $\pm 1.5$  GW for the four year-ahead auctions (which may differ for the one-year ahead auction).

The slope of the demand curve will be negative i.e. more will be contracted at a lower price, and less will be contracted at a higher price.

The demand curve for the capacity auction will be a line passing through each of the following points, as shown in the figure below:



Source: Electricity Market Reform Capacity Market - Impact Assessment 2013 & 2014  
DECC (Department of Energy & Climate Change)

- I. Price cap of £/KW at a capacity of 0 GW (Point A)
- II. For the four-year ahead auction, the price cap (£75/kW) at a capacity of 1.5 GW less than target level (B)
- III. Net cost of new entry (Net CONE) at the target level of capacity (C)
- IV. For the four-year ahead auction, £0/kW at a capacity 1.5GW more than the target level (D)

## Capacity Auction

The National Grid runs the capacity market auction. It is a competitive process to award Capacity Market Agreements to try and meet the target capacity for the relevant delivery year. There is a pre-qualification stage around four months ahead of the auction, which confirms the eligibility and bidding status of all potential capacity. Capacity Market Units (CMUs) that have been pre-qualified and if necessary, have confirmed enter the auction.

There are two capacity auctions:

- **T-4:** this is the main auction; it buys most of the capacity needed for delivery in four years. In this auction, new build generators can secure 15-year agreements.
- **T-1:** these are top-up auctions just ahead of each delivery year to fill in any gaps. The T-1 auction is also designed to reserve some capacity for demand side response.

## Price Discovery Mechanism

The auction is 'pay as clear'. This means that all participants will receive the clearing price set by the marginal bidder. It will follow a descending clock format, in which the price offered is gradually reduced until the minimum price is reached, at which the supply of capacity offered by bidders is equal to the volume of capacity required. Descending clock auction requires the auctioneer to announce a high price at the beginning of the auction, and providers indicating that they are willing to supply capacity at that price, and then repeated rounds at lower prices until the auction discovers the lowest price at which demand equals supply.

## Eligibility

Capacity Market participation is open to a wide range of assets – new and existing generators (except CFD), including on-site generators such as combined heat and power engines and heat pumps, demand side response and energy storage. Plants bid for capacity based on their de-rated capacity (calculated by National Grid based on a published methodology) rather than their 'nameplate' capacity.

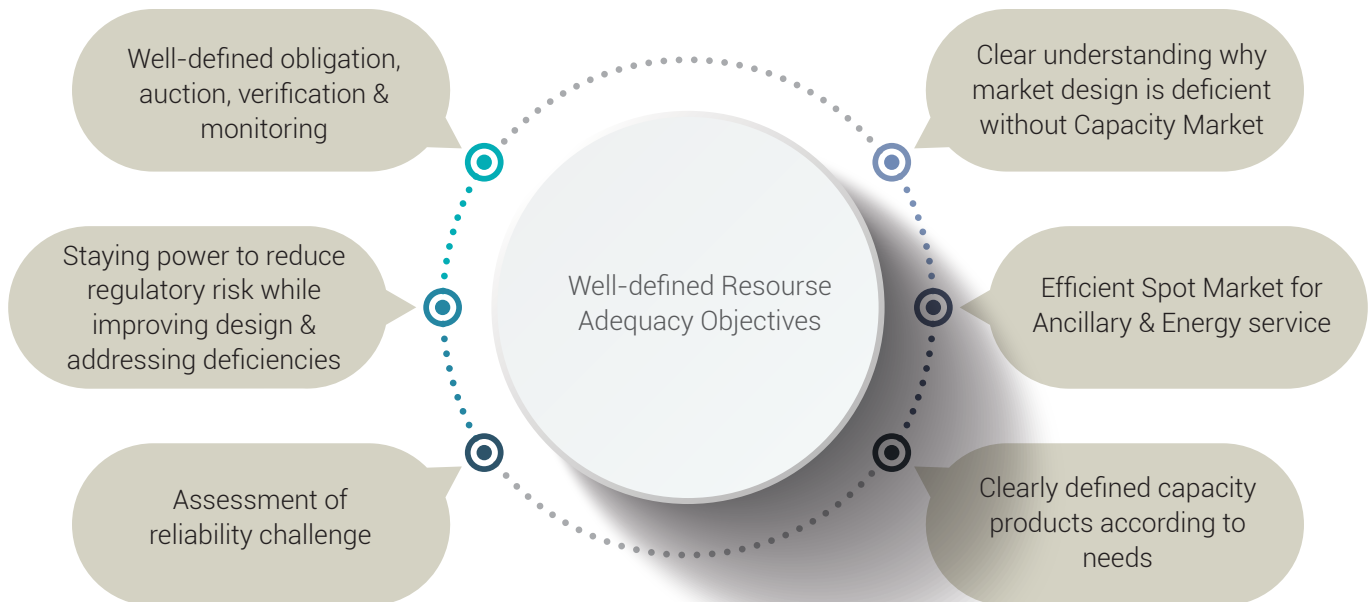
## Award of Contract

Providers who are successful in the auction(s) are awarded a Capacity Agreement, which confirms their Capacity Market Obligation and their payments.

- Existing plants are entitled to bid for one year capacity agreements unless they require major refurbishment, in which case they may be eligible to access a capacity agreement with a term of up to three years.
- New entrants have access to a longer-term agreement for a term they nominate, up to a maximum limit. Currently, that maximum limit has been proposed at 15 years, although the Government is consulting on whether longer-term contracts are required to encourage new investment.
- Demand side response only offers one-year contracts.

The potential capacity Market participants can bid for contracts in auctions held four years ahead of the delivery date. During the delivery year, capacity providers will receive monthly payments for their agreed obligation at the auction clearing price.

## Price Discovery Mechanism



The most appropriate market-based design for resource adequacy depends on policy objectives and risk tolerance.

## Assessment of Capacity Market in India

Currently, our short-term market is purely an energy only market and in mid- and long-term markets, investment in building the capacity is recovered through fixed charge, which is recoverable at the normative level of PLF and there are incentives for higher PLF. However, in mid- and long-term contracts, the buyer is bound to consume energy from the contracted capacities. This creates a huge liability on the buyer, to pay a high fixed charge over a 25-year PPA period and sometimes consume out-of-merit energy. With an increase in renewable generation and its large-scale penetration, the power producers have been finding it difficult to sustain as the PLFs fall and there is no incentive available for them to set up new capacities and operate the existing ones. In view of the intermittent nature of renewable energy, these stable capacities are essential for maintaining grid stability and need be incentivised and retained as reserves.

The lack of peaking capacity calls for the establishment of Capacity Markets.

The Capacity Markets seem suitable in India for a variety of reasons:

- A transparent national market for new generation capacity is created, and this capacity can sell its energy in the Exchange/OTC separately.
- Capacity Markets provide a mechanism for maximum development of power system by allowing markets to choose the least cost mix of generation, transmission and energy efficiency resources.

A few broad necessary activities are desirable for the development of Capacity Markets in India including the following:

- Forecasting peak demand of the country and Discom-wise/State-wise contributions say over the next five-to-ten-year horizon.
- Imposing binding Capacity Adequacy Requirement on the States/Discoms through regulations.
- Capacity market units need to be defined. The generation technologies are not similar in their contribution towards peak demand. For example, coal-based plants with an average availability of 85%, whereas hydro with 40% and RE sources like wind and solar with 20%. Therefore, new capacities of different technologies are assigned different weightages. The peak load requirement can be met with many combinations of capacity technologies. Therefore, we use capacity market units in place of capacity for resource adequacy requirements.
- Provision of strict penalties for non-compliance of capacity adequacy requirements by states/Discoms
- Laying eligible requirements regarding newly constructed power plants that would participate in capacity markets.

While designing a Capacity Market it is important to understand that the mechanism is not intended to provide additional revenue for the participating resources. Rather, they are designed to provide a more predictable and stable stream of payment for the capacity and separate capacity from energy. The capacity auctions can be run based on the target mix of resources and net demand forecast for the targeted year. All resources will bid in the auction with preference given to more flexible resources followed by the next and so on. These capacity auctions can be run on National level, if the available capacity is not sufficient to suffice the anticipated demand in the country. This can be linked with the reliability measures to ensure grid security. Alternatively, Discoms of the deficient state will be required to determine the Capacity Adequacy requirement for their respective state and capacity obligation enforced on them by the state commission to procure the targeted capacity by running an auction. The state Discoms who don't meet their reliability obligations are penalised.

In India, 4-year lead time maybe chosen between the capacity auction and the year electricity is to be delivered. This allows relatively accurate forecasting of the capacity required. This implies for Capacity Auction Markets wherein capacities could be procured 1-5 years in advance via competitive auctions. This model is followed in the US and UK, and it has been successful in attracting the capacity needed to maintain system reliability in an economically efficient manner. These markets have been successful in facilitating new demand-side resources, with ratepayers and society reaping the economic and environmental benefits.

## Conclusion

The Power Exchanges have played a very critical role in transforming the overall power market in India. It is felt that Capacity Market will help ensure the creation of capacities by keeping long-term demand profile at the country level. Once capacities are created at the national level, energy markets through the Exchange will help allocate resources on merit basis for each time block of 15-minutes. Implementing reserve requirements on a multi-year forward basis offers improved reliability and also encourages the participation of new generators to meet the forward resource needs of the distribution companies. The new generation capacity addition through Capacity Markets auctions will improve liquidity in the market and encourage new technology to integrate into the grid. Further, with increasing energy demand and ambitious renewable energy targets, it has become imperative to deepen the electricity market and encourage new capacity addition through Capacity Markets auctions, thus enhancing grid stability, and achieving reliable, round-the-clock uninterrupted and competitive power supply to the consumers.



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