# *FIRM SUPPLY OF DEMAND RESOURCES AND CRM COST ALLOCATION*

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## Overview

Capacity Remuneration Mechanisms (CRMs) are introduced in liberalised power sectors to reinforce the short-term energy market signal through a long-term contract and attract the investments needed to guarantee said resource adequacy. Before the 2022 energy crisis, CRMs were already deemed a regulatory mainstay for the European energy transition. Now, with the call for improved long-term contracting, CRMs have also been mentioned by several experts as a possible solution out of the crisis (Meeus et al., 2022). Once considered as a way to subsidise fossil-fuel-driven generation, capacity mechanisms have demonstrated their essential role in fostering the development of new business models, as demand response.

The cost of a CRM is usually socialised among electricity consumers or allocated through simplistic methodologies, through charges applied over a large amount of high-demand hours. This dilutes the efficient signal that these charges could convey to end-users. In Brito-Pereira et al. (2022), we demonstrated that the firm supply of resources willing to participate in a CRM should be proportional to their expected contribution to the reliability target set by the regulator. Symmetrically, we believe that consumers should cover CRM costs according to their expected contribution to the scarcity conditions in the system. The same methodology could also be used to define the firm supply of demand resources, measured as the ability of consumers to reduce their load during the expected scarcity conditions. This firm supply could be used to promote an efficient participation of demand response in CRMs, as we analysed also in Rodilla et al. (2023).

## Methods

To assess the CRM cost allocation and firm supply determination for different demand profiles, we use a convolution simulation (NERC, 2018 and NREL, 2021), which has been commonly applied to study power system reliabiltiy. This method represents the Load-Duration Curve, intended here as the probability that the electricity demand in the system is greater than or equal to a specific value, and then determines, through a probabilistic approach, how generation assets are expected to satisfy this demand. In this assessment, the merit order of the power plants and their Equivalent Forced Outage Rates (EFOR) are modelled. A graphical representation of this method can be observed in Figure 1.

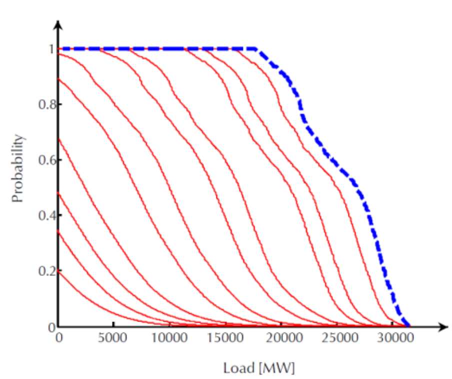


*Figure 1: Load-Duration Curve and how different generation resources are dispatched to cover demand*

This analysis will study the contribution of each demand profile to the appearance or worsening of scarcity conditions in the system and, therefore, determine their obligations in terms of allocation of CRM costs. Different demand reduction profiles will also be studied to determine their firm capacity according to scarcity conditions in the system. These assessments are carried out by calculating the Expected Energy Non Served, or EENS, a continuous reliability metric whose properties we studied in Brito-Pereira et al. (2022). Although simulations based on convolution present limitations for adequacy assessments, such as a lack of sequential representation and operational constraints, this stylised representation is consistent with these analyses based on a statistical representation of non-planned outages and expected production.

## Results

The results of such an assessment will show the intricate relationship between the reliability metric, the firm capacity recognised to demand resources and the efficient cost-allocation strategy, as represented graphically in Figure 2.

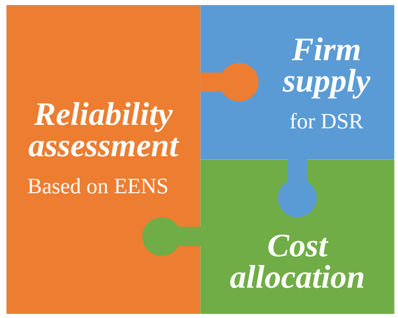


*Figure 2: Graphical representation of links between reliability metrics, firm capacity and cost allocation*

Results will show how different demand profiles contribute to scarcity conditions in the power system. The expected outcomes are that demand profiles that concentrate their consumption in periods when the risk of power shortage is larger (e.g., due to high demand or net demand, if intermittent renewables are considered) contribute more to the potential scarcity conditions, while demand profiles that concentrate their consumption in periods when the risk of power shortage is smaller contribute less. Consequently, the former will have to bear a larger share of the CRM costs, while the latter will still have to cover part of the CRM costs, since there will be a non-zero probability of scarcity conditions while they are consuming. The same is true for the firm supply of demand resources. Consumers able to reduce their demand during periods when it is more likely to have scarcity conditions in the system will be assigned a larger firm supply than the rest of end-users.

## Conclusions

According to first principles, electricity consumers must cover the CRM costs according to their expected contribution to scarcity conditions in the system, i.e., depending on their demand in periods of high scarcity risk. The other side of the coin is that demand resources must be assigned a firm supply proportional to their ability to reduce their load exactly during the same periods. With a simplified methodology, this analysis will show how to determine an efficient cost allocation strategy for CRM costs and a consistent definition of the firm supply of demand resources willing to actively participate in the capacity mechanism.

## References


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