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Abstract

Capacity mechanisms have been controversial in theory as well as practice. Lessons from experience with different capacity mechanisms led to the development of the reliability options. This mechanism promises two advantages over other types of capacity mechanisms. Firstly, it ensures the availability of capacity contracted via the capacity mechanism during scarcity. Secondly, the reliability option mechanism limits any energy market distortion due to its implementation and provides the consumer a hedge from high prices. We assess the ability of reliability options in delivering the two promises by analysing the reliability option designs in Italy and Ireland. We find that they deliver on the first promise but only partly on the second.

Keywords

Adequacy policy; capacity mechanisms; reliability options.

1. Introduction*

Capacity mechanisms in their different forms have been controversial in theory as well as practice. Over time, lessons from the experience with different types of capacity mechanisms led to the development of the reliability option. A reliability option is a call option for generation capacity that acts as price insurance. It can also be defined as a one-way contract for differences (Oren, 2005; Vazquez et al., 2002).

The concept of reliability option was first introduced by Pérez-Arriaga, (1999). A further detailed description of reliability option design was presented by Vazquez et al., (2002). Reliability Options have also been discussed by Bidwell, (2005); Oren, (2005, 2003). Finally, a decentralised reliability option design has been discussed by Woodhouse, (2016). However, in practice, the application of and experience with using reliability options have been limited in comparison to other types of capacity mechanisms.

According to the early developers of reliability options, this capacity mechanism promises two advantages over other types of capacity mechanisms. Firstly, it ensures the availability of the capacity contracted via the capacity mechanism at the time of scarcity and provides the consumer a hedge from high prices. Secondly, a reliability option limits any energy market distortion due to its implementation. In this paper, we assess the ability of reliability options in delivering these two promises by analysing the reliability option designs in Italy and Ireland. Both capacity mechanism designs have received EU state aid approval. We find that they deliver on the first promise but only partially on the second.

This paper is structured as follows. Section 0 discusses the ability of reliability option design to ensure that that capacity is available during scarcity. Section 0 provides insights into the possibility of market distortion arising from implementing reliability options. Section 0 summarises the key conclusions.

The content on Ireland and Italy presented in this research is based on the following documents: Ireland: EirGrid, (2018a, 2018b, 2016); European Commission, (2017); SEM, (2017a, 2017b, 2016a, 2016b, 2015). Italy: ARERA, (2018); European Commission, (2018b); Mastropietro et al., (2018); Termini, (2014); Terna, (2018a, 2018b, 2015).

2. Ensuring availability during scarcity

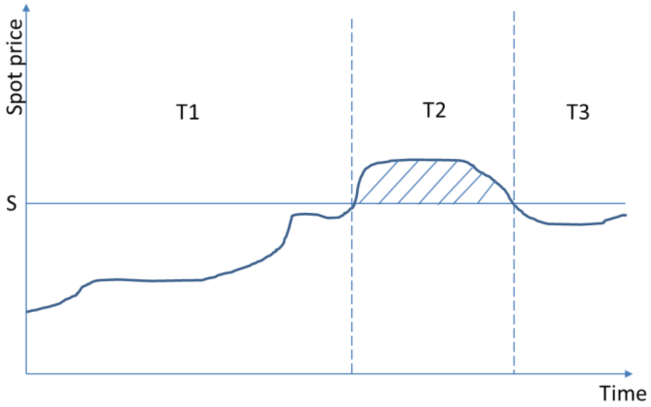
The first advantage of a reliability option mechanism is that it ensures the availability of supply during scarcity. The reliability option mechanism is based on the concept of a call options contract. A call option for a particular commodity gives the buyer of this contract the right to buy the said commodity at a predefined price. Thus a reliability option can be defined as a call option for generation capacity (Oren, 2005; Vazquez et al., 2002).

The buyer of these reliability options is the system operator on behalf of the consumers, while the sellers are generation companies. A centralised auction-based approach is proposed in the literature to set the price for these option contracts (called as reliability premium). In return for the reliability premium, the buyer of the option contract gains the right to buy equivalent electricity on the wholesale market at the predefined ‘strike price’. When the prices in the spot market exceed a pre-agreed strike price, the seller of the option returns to the option holder the difference between the spot price and the strike price. If the spot price remains below the strike price, the seller of the contract receives the spot

* The authors would like to thank experts that provided their views during the Florence School of Regulation Policy Advisory Council in November 2018. We would like to especially thank Barry Hussey and Thomas Quinn from CRU, Massimo Ricci from ARERA and Matti Supponen from the European Commission for their insights.

price. Figure 1 illustrates this process. During time T1 and T3, generators receive spot prices, while during T2; the generators must return the difference between the spot price and strike price to the option holder.

Figure 1: Illustration of interaction between the strike price and the spot price



The design of the mechanism inherently penalises option sellers (generators) that remain unavailable during a period when the spot price is above the strike price. In such a scenario, the generator not only loses the income from the spot market (at the strike price level) but also has to pay the difference between the spot price and the strike price. This ensures availability of the capacity committed during the period of scarcity. Moreover, this also mitigates any possible market power abuse from withholding.

Furthermore, the regulator to ensure availability of the capacity during scarcity can apply additional safeguards. Firstly, a regulator may apply an additional penalty for non-compliance. Secondly, a physical capacity guarantee for all options sold is made part of the contractual obligation. However, it can be argued that this physical nature of the contract forms an integral part of the reliability option concept to ensure supply adequacy as proposed by Pérez-Arriaga, (1999); Vazquez et al., (2002) and Oren, (2005).

In general, the reliability option designs implemented in practice follow the framework proposed in the literature. Both Italy and Ireland use a centralised auction mechanism for trading reliability options and setting the 'option premium'. Both market designs include a requirement for a guaranteed physical cover for the option. However, the two designs diverge in the context of a penalty for non-compliance.

In Ireland, non-compliance penalties are not applied, on the grounds that the built-in penalties (payback obligation) discussed above are sufficient. In Italy, two types of non-compliance penalties have been included in the market design, namely temporary non-fulfilment and definitive non-fulfilment.

Thus, qualitatively it appears that both designs have a sufficient level of robustness necessary to mitigate the concerns regarding the availability of contracted capacity during a period of scarcity and provide the consumer a hedge from high prices.

3. Limiting market distortions

The second advantage claimed of the reliability options mechanism over other types of capacity mechanisms is that it limits any distortion to the energy market that may occur due to its implementation as compared to other types of capacity mechanism. Capacity mechanism designs such as capacity payments and capacity obligation require defining an artificial product (i.e. capacity) which can distort the energy-only market. As Oren, (2005) explains: *"Generators receiving capacity payments can be more aggressive in pricing the energy they produce. This in turn may suppress energy prices, making it impossible for generators to recover their capacity costs from inframarginal profits on energy, thus perpetuating the need for the capacity revenues."*

In principle, reliability options do not have these distortions, because it is a risk-sharing mechanism. The buyer is insured against high prices as well as the availability of generation. In return, the seller of this option earns a reliability premium based on its opportunity cost that should factor in any loss of revenue during the period of energy market prices above the strike price. The energy market itself continues to function 'business as usual', and any capacity that is uncontracted in the reliability option auction but clears the market would receive the market-clearing price. Moreover, the price formation of the reliability premium itself is transparent due to the use of an auction mechanism. The only regulatory intervention envisaged is setting of the strike price and determination of demand curve for the auction.

However, on analysing the Irish and Italian design, in practice, while designing reliability options, regulators have intervened in several elements. The first design element is the inclusion of differentiation based on technology type of the generation. Reduction factors are applied on capacity (with a physical guarantee) that can be bid into the reliability options auction. Current reduction factor ranges for some key technologies are as follows: Italy: Thermal: 80%, Hydro 40-60%, Solar 5-10% and wind 10-15%. In Ireland: Gas turbine: 85.3 – 92%, Hydro generation 74.5-86.4%, Solar 10.8% and wind 8.9%. Thus for example in Ireland, the maximum capacity that a wind farm with 100 MW installed capacity could bid under these rules is 8.9 MW. Reduction factors can aid in estimating more accurately the generation capability of different power plants and reflects a power plant's actual ability to contribute to the security of supply. However, there is a risk that inaccurate setting of de-rating factors can provide an advantage to specific technologies as compared to others thus distorting the level playing field. Inclusion of de-rating factors also partially takes away the decision of 'how much capacity to bid?' from the generator.

The second design element is the variation of reliability option contract lengths based on whether the power plant already exists or is under construction. In Italy, an existing power plant that clears the market would receive a one-year contract while new capacity can receive contracts for up to 15 years. In Ireland, currently, new capacity that clears the market gets contracts for ten years, while an existing unit that clears the auction receives a contract for only one year. While such differentiation can reduce revenue uncertainty for under construction and refurbished power plants to a different extent, the same advantage is not extended for existing generators that in both cases get one-year contracts. Thus, a new generator will have greater revenue certainty as compared to an existing generator. An approach used to reduce uncertainty for existing generators is the use of a sloping demand curve.

The third example is the inclusion of price caps in the reliability option auction. Both Irish and Italian design envisage price caps. Price caps have been historically used in markets as a safeguard to mitigate risks arising from abuse of market power (Joskow and Tirole, 2007). However, inefficiently set price caps would not reflect the true premium price and thus influence the revenue of the generators. Consequently, the generator's bidding strategies on the energy market would be adapted, which may distort the energy market price

Furthermore, two other design elements implemented in Ireland, but not Italy exist, which can lead to distortion. First is the obligation for generators above 10MW to participate in the capacity mechanism. Consequently, all generators clearing the auction would receive a payment for the options sold while the un-cleared capacity could continue to participate on the energy-only market. Such a step would enable greater liquidity in the reliability options auction, but at the same time, the mechanism is not voluntary anymore, which was one of the key features of this mechanism. .Second is the inclusion of a stop-loss limit to protect generation companies during a prolonged period of prices above the strike price. Such risks are valued more accurately through the reliability option auction rather than via a regulatory intervention, as generators will internalise it into their bids.

All the above administratively set parameters are well intended and serve a purpose. Nevertheless, the devil is the details; if these parameters are not set properly, they can create distortions. It is outside the scope of this study to judge to what extent these parameters will distort the market. Only time and experience will answer this question.

4. Conclusions

In this research, we discuss the reliability option design in theory and practice from two perspectives: Firstly, the ability of reliability options to ensure that the contracted capacity is available during the scarcity period. Secondly, regulatory interventions in reliability option design and their possible impacts.

Qualitatively, it appears that both assessed designs (Ireland and Italy) have a sufficient level of robustness necessary to mitigate the concerns regarding the availability of contracted capacity during a period of scarcity and provide consumers a hedge against high prices.

However, the detailed implementation of reliability options requires several parameters to be set by the regulatory authorities. If not set properly, these well-intended parameters can create distortions. Although more promising than other types of capacity mechanisms, reliability options still entail design complexities and regulatory risk.

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