BALANCING RESOURCE OPTIONS: AN ALTERNATIVE CAPACITY MECHANISM

4 November 2011

SUMMARY

Decarbonisation targets will have a profound effect on our electricity markets, requiring the patterns of demand and the generation mix of the future to be radically different from that of today. The transition to a decarbonised economy presents significant challenges for electricity markets in terms of delivering low carbon generation, maintaining security of supply and ensuring economic efficiency.

As the resource mix across Europe shifts increasingly to variable and (relatively) unpredictable renewable generation and, in some countries, lower flexibility nuclear generation, the responsiveness of the residual fraction of the market will take on greater importance. There will continue to be a requirement to maintain adequate available capacity (MW of reliable supply or reliable demand reduction capable of operating during a given period of time), but the ebb and flow of available low-carbon capacity will create a greater need for a range of capacity with flexibility and reserve capabilities within this residual fraction of system resources. It will be essential that the value of different types of capacity is correctly recognised in future electricity markets.

The mechanism introduced here provides a solution to the difficulties associated with traditional means of securing adequate balancing resources though capacity payments or obligations. It proposes expanding the market-based principles of an energy-only market by creating a clearly defined framework in which trading of options is both incentivised and facilitated.

The commercial rationale for the envisaged option contracts comes through their interaction with imbalance pricing arrangements. Current market rules often lead to damped imbalance prices that fail to feed appropriate price signals into short term traded markets. Furthermore, parties typically face imbalance charges when they have a contractual shortfall or surplus, even if they have flexible capacity at their disposal at, or after, Gate Closure which could be used to resolve this imbalance. As a result, they do not have the potential to hedge directly any exposure to the energy imbalance price. This acts as a barrier to the development of reserve options.

Our suggested mechanism removes this barrier by enabling a ‘balancing resource option’ contract holder to mitigate their exposure to energy imbalance. Options could be exercised prior to Gate Closure if the holder becomes aware of a shortfall or surplus, or held to mitigate imbalance penalties arising from unexpected events closer to real-time. Such options could conceptually be extended to virtually any volumes and traded over multiple timeframes – from day-ahead to many years into the future – which, in turn, would allow the investors in new resources to reduce uncertainty over project returns and pass on a share of market risk to those who would ultimately benefit from the new resources.

Our balancing resource option mechanism is presented as a straw man for further development. We recognise (and discuss in this paper) that several aspects require more detailed thought and that there may be implementation issues which need resolution.

THE CHALLENGES OF DECARBONISATION

Decarbonisation targets will have a profound effect on our electricity markets, requiring the patterns of demand and generation mix of the future to be radically different from that of today. The transition to a decarbonised economy presents significant challenges for electricity markets:

- **Delivering low carbon generation:** Significant investment in low carbon generation capacity is required in order to deliver a decarbonised electricity system. Existing markets have a successful track record for supporting investment in conventional, fossil-fuel fired generation capacity. But it is generally accepted that current arrangements will not support investment in required levels of low carbon generation capacity. The reason for this stems from differences in low carbon and conventional fossil generation technology cost structures and operational characteristics.

  Low carbon capacity is typically characterised by relatively high capital costs and low operating costs, while costs for conventional fossil fuel fired generation are more evenly divided between capital and operating costs. Furthermore, the costs of conventional capacity may be well correlated to wholesale prices, as in most markets either gas or coal fired plants still have a lead role in setting wholesale prices.

- **Maintaining security of supply:** A decarbonised electricity system will include a considerable quantity of installed capacity that is less dispatchable than the present fleet, whether due to technical constraints (such as variable or intermittent renewable generation) or commercial attributes (due to low or zero marginal costs, perhaps exacerbated by output-based support mechanisms). Meanwhile, the decarbonisation of the wider economy will require electricity to be used for heating and transport, significantly increasing total electricity demand. In future, we will need to draw on flexibility from a wide range of sources to balance the system and provide security of supply – this will also mean ensuring that demand side resources can participate on an equal footing with generation. The market arrangements should value these various sources of flexibility appropriately.

  Pöyry's work on intermittency[1] has shown that in a future with high levels of low carbon generation, the residual flexible resources will operate at lower load factors and face greater price and volume volatility than today. Investors in low load factor plant may face significant risk in the recovery of capital costs in an energy-only market.

- **Ensuring economic efficiency:** All indications are that decarbonisation will require investment in both low carbon and flexible capacity sources. However, investment must not be undertaken at any cost. It is essential that affordability remains a policy goal to deliver economic and efficient investment.

To achieve the planned transition successfully, electricity markets must be capable of supporting a sustainable, secure and affordable generation mix, taking account of possible changes in demand behaviour, plant operation and investment dynamics. The ability of existing market arrangements to achieve this balance will increasingly be challenged as the low carbon transition progresses.

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1 "Implications of Intermittency", Pöyry, May 2009; "The challenges of intermittency in North West European power markets", Pöyry, March 2011

The resource capability challenge

As the resource mix across Europe shifts increasingly to variable and (relatively) unpredictable renewable generation and, in some countries, lower flexibility nuclear generation, the responsiveness of the residual fraction of the market will take on greater importance. There will continue to be a requirement to maintain adequate available capacity (MW of reliable supply or reliable demand reduction capable of operating during a given period of time), but the ebb and flow of available low-carbon capacity will create a greater need for a range of capacity with flexibility and reserve capabilities within this residual fraction of system resources. It will be essential that the value of different types of capacity is correctly recognised in future electricity markets.

The value of flexibility and reserve resources is inexorably associated with reduced operating hours and/or increased operational variability, and in an energy-only market that value must be recovered in the price received for the energy they produce. The lower the rate of utilisation, the greater the risk that the resource will not be remunerated sufficiently enough to attract investment solely through energy prices. The correct and reliable valuation of flexibility and reserve resources is most important in circumstances when a market requires new build of such resources.

The combination of increased price and volume risk means that, as the residual fraction of market resources is increasingly expected to provide flexibility and reserve services, there is greater risk of appropriate new capacity resources not being delivered under a pure energy-only regime. This is prompting consideration of potential market reforms intended to improve the investment environment for both low-carbon generation and for the portfolio of resources necessary to complement it. Capacity mechanisms are being discussed in this context as instruments for ensuring security of supply.

The introduction of a capacity mechanism can complement a competitive energy market, and need not be considered as a market intervention. However, most capacity mechanisms are highly centralised in nature and thus subject market participants and investors to significant regulatory risk. There is also a tendency, under many capacity mechanisms, to focus on the delivery of generation capacity rather than calling on the flexibility of demand. There is a strong relationship between the nature of the capacity mechanism and the process of price formation in the energy market.

However, compared with existing designs of capacity mechanism, there is scope for a more market-based approach (as opposed to a centralised mechanism) to valuing and delivering needed resource capabilities (in addition to their bulk capacity value) to be applied.

This paper builds upon these discussions and presents a market-based alternative to centralised capacity mechanisms, which complements the existing markets for energy as a means for delivering security of supply.

PRINCIPLES AND OBJECTIVES OF A WELL-FUNCTIONING ELECTRICITY MARKET

The fundamental aims of an electricity market can be considered to be to deliver:

- a supply that is sustainable and reliable in both the short- and long-run; at
- the lowest prices to all customers consistent with those objectives.

In the context of current energy policy, sustainability refers to both delivery of security of supply and decarbonisation. To achieve these aims, an effective market should fulfil the objectives shown in Figure 1.

Figure 1 – Objectives of an effective electricity market

OBJECTIVE TO BE MET

DECARBONISATION	**Support energy policy goals by providing sufficient incentives to decarbonise the electricity system**
SYSTEM SECURITY	**Support system security in both the short and the long run**
ECONOMIC EFFICIENCY	**Encourage economic efficiency in generation, transmission, distribution, trading and consumption of electricity**
ENTRY BARRIERS	**Minimise barriers to entry and exit, for generators, demand-side participants and traders**
TRANSACTION COSTS	**Minimise transaction costs, including those incurred by customers**
FREEDOM OF CHOICE	**Maximise participants' freedom of choice (including demand side) and accommodate different appetites for risk**
TRANSPARENCY	**Provide transparency generally, and specifically in the operation of the pricing mechanism (to customers as well as generation)**
REGULATORY RISK	**Minimise regulatory risks including in the process for amending the arrangements**
CONSISTENT WITH OTHER LAWS	**Be consistent with other laws, but not be used for implementing policies outside their scope**

However, it is well understood that electricity is 'different' from other commodities, which affects the design of electricity markets. There are two key reasons for this difference:

- generation and demand must be equal at all times, since bulk electricity cannot currently be economically stored[2]; and
- electricity is transported via interconnected networks operated at stable frequency and voltage, with the actions of one party on the network impacting upon all others.

2 Pumped storage hydro, the only current bulk storage option, does not actually store electricity but rather increases demand by pumping water uphill during low demand periods and increases generation by releasing that water during high demand periods.

These factors create a requirement for:

- **available capacity** to meet demand at all times;
- **reserve** or ‘available but as yet unutilised capacity’ to maintain system security (i.e. an error margin over and above expected demand); and
- **flexibility** to respond (up or down) as required by uncontrollable events.

In light of these challenges, different approaches for delivering resource adequacy have been adopted in different markets, as discussed in the next section.

EXISTING MARKET DESIGNS

The electricity liberalisation process across the world has produced a range of market design frameworks. Across this range, several approaches for delivering resource adequacy and system security have been adopted, as summarised in the sections below.

Energy-only market

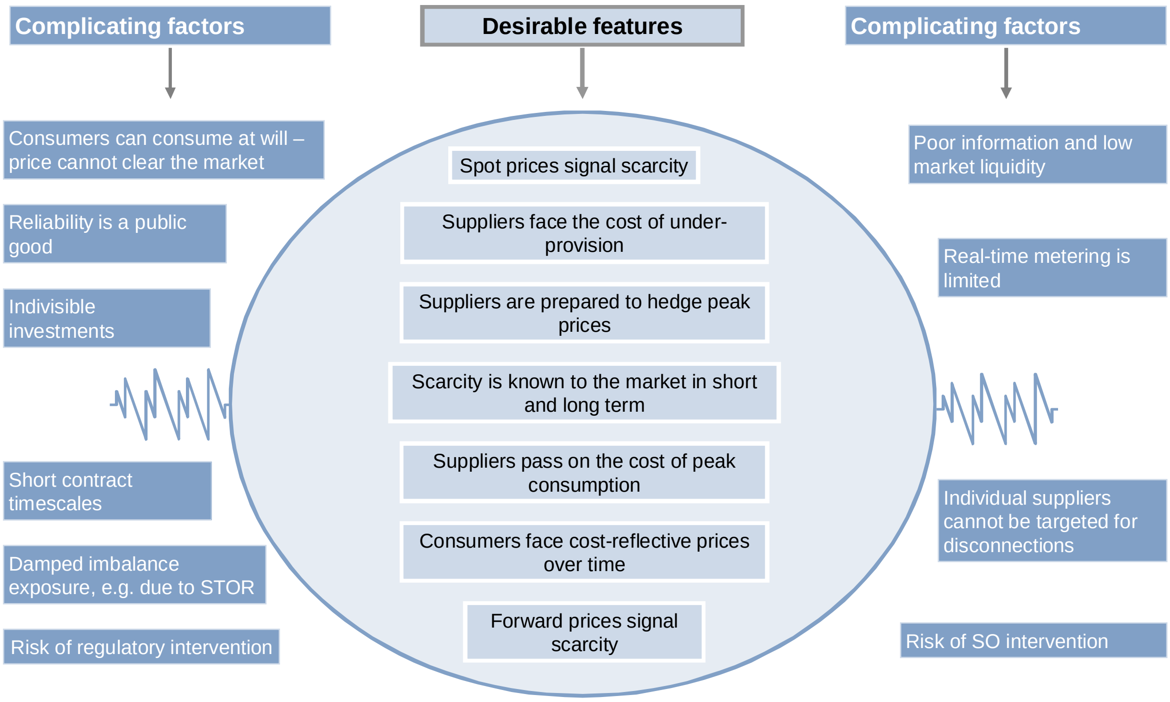
Energy-only markets do not include an explicit capacity mechanism. Instead, capacity provision is remunerated via the market price for energy. As the market price is set based on the bid price of the marginal generator, it allows all other capacity providers to capture infra-marginal rent equivalent to the difference between their own costs and the market price. This rent contributes to the remuneration of capacity provision. As the capacity margin tightens, energy prices and infra-marginal rents increase, which, in theory, provides an incentive to invest in capacity when required to deliver resource adequacy. Energy-only markets are employed in numerous electricity markets globally including most of Europe, as well as parts of the US and Australia.

If capacity is scarce, economic theory suggests that the price attached to capacity should rise, signalling its value and incentivising the provision of additional capacity. For energy-only markets to work, it is therefore essential that energy prices are allowed to rise, and potentially spike to extreme levels, in response to capacity scarcity. This signals to the market the need for additional capacity, with (expectation of) occasional high prices providing an incentive to respond. In essence, a 'virtuous circle' must exist under which capacity scarcity is reflected in spot energy prices and then filters into forward prices to encourage investment. This creates a transparent environment within which efficient, market-led investment is provided, thereby delivering security of supply.

However, there are a number of complicating factors that may hamper the effective functioning of an energy-only market, compromising its ability fully to reflect capacity scarcity in price signals. As flexible plant moves more and more towards a peaking role, market participants must look to recover their investment through higher prices over a shorter (and variable) period of time – which has a consequent impact on the level of risk associated with investment. Furthermore, regulatory and political pressure may also artificially depress prices. High energy prices can be perceived (rightly or wrongly) as an indicator of market power exploitation, and therefore regulators and policy makers face the temptation to investigate and potentially intervene to moderate price spikes, with market rules set to constrain increases in prices. Finally, subsidised investment in low carbon and renewable generation can also have a distorting effect on energy markets.

A selection of other complicating factors is illustrated in Figure 2. There is no guarantee that prices will rise to the level required to trigger new entry or that prices will remain at this level for long enough to justify the new entry once built, with associated risks for potential investors. These factors can all dampen market signals to provide capacity.

Figure 2 – Factors frustrating an effective energy-only market



Such impediments to the operation of the 'virtuous circle' of market-led investment are often highlighted as weaknesses of energy-only markets for ensuring resource adequacy. The concern that the market cannot be relied upon to provide a public good in the form of resource adequacy often provides the basis for some form of explicit capacity mechanism to perform the role instead. Looking forward to an increasingly decarbonised system, the combination of price and volume risk associated with low-merit capacity is likely to heighten such concerns and be seen to strengthen the case for a capacity mechanism. However, a market-based approach to valuing and delivering the required resources can still be applied, as discussed in subsequent sections.

Capacity payments

Capacity payment mechanisms treat capacity as a distinct product, separate from the provision of energy, with an explicit value attached. The explicit capacity price signals the need for existing plant to remain on the system and/or for additional capacity (generation and demand side resources) to be developed. In some markets, there is no differentiation between capacity, reserve and flexibility, while in others (such as that for Short Term Operating Reserve in GB) only a small subset of plants can qualify based on explicit flexibility criteria.

Whatever their precise form, capacity payments provide a discrete revenue stream for capacity providers, which supplements infra-marginal rent earned from the energy market (ideally the prospect of a capacity-based revenue stream should cause a commensurate reduction in average rents available from the energy market). In theory, this changes the risk profile for investors by reducing income volatility for new capacity investments. Variants of the capacity payment approach have been adopted in several international markets including the England and Wales Pool (until 2001), the Single Electricity Market on the island of Ireland, Spain, Argentina, Italy, South Korea and Chile.

Capacity provision under a capacity payment mechanism relies upon a market response to a capacity price signal. The level of or methodology for determining the capacity price is, therefore, critical to the effectiveness of a capacity payment mechanism. But this is a challenging task, which it falls to regulators to address. Some mechanisms have been criticised for creating inappropriate or ineffective capacity signals – whether because they allow windfall profits, or gaming opportunities – and for failing appropriately to target capacity payments into periods of need. There is also evidence that the mechanisms have been susceptible to gaming (e.g. in the England and Wales Pool between 1990 and 2001). These factors have prompted concerns that capacity mechanisms may not improve reliability or offer value for money. It is also possible that they incentivise the wrong type of capacity (for example, they may create an incentive to provide MW from any source, in circumstances when what is really required is flexibility).

Capacity obligations

Like capacity payment mechanisms, capacity obligation systems identify capacity as a distinct product in its own right. But, while capacity payment mechanisms determine a price for capacity and allow the market to determine the quantity of capacity to provide in response, capacity obligation systems instead fix the quantity of capacity to be provided. A specific capacity requirement, which provides the desired level of resource adequacy, is defined. This is translated into individual obligations upon parties to secure the required capacity from generation and demand side providers. This should provide a stable environment for the delivery of new capacity. Obligations are either:

- allocated to load serving entities (LSEs) who must then secure capacity to meet their own obligation; or
- fulfilled centrally by an independent system operator (ISO) or independent market operator (IMO) on behalf of LSEs.

The markets in New England, PJM, New York, Western Australia and Greece have approaches based upon capacity obligations.

The regulatory challenge with capacity obligation systems is to define an appropriate overall capacity requirement that places a sufficient value on capacity. But regulators/policy makers arguably have a bias towards having too much capacity in order 'to keep the lights on' and, potentially, to keep prices low for end consumers. Annual capacity products may fail to reflect the value of capacity in periods of genuine need (i.e. they remunerate simple capacity rather than the ability to provide available reserve at times of system stress, or flexibility). These factors have raised concerns that the value of capacity under obligation systems may not be sufficient to encourage investment or may fail to incentivise investment in appropriately flexible resources. Investment has been further hindered by short commitment periods (e.g., annual) and delivery horizons (year-ahead), although some systems have been revised to operate over longer time horizons.

Energy call option based approaches

Energy call options treat capacity as insurance against imbalances between supply and demand, rather than as a separate product. Capacity providers (or demand response providers) sell call options for an upfront fee to LSEs, which give the LSEs the right (but not the obligation) to obtain the contracted quantity of energy (or demand response) at a specified strike price. When the reference market price exceeds the defined strike price, the option holder is entitled to a difference payment from the capacity provider. The holder is, therefore, insured against wholesale prices in excess of the strike price. The capacity provider forgoes revenue in excess of the strike price in exchange for the upfront option fee, which contributes to fixed cost recovery. The call option acts as a method for sharing risk between resource providers and LSEs – resource providers share fixed cost recovery risk via the upfront fee while LSEs share spot price risk via the difference payment.

This approach is not widely applied, at present. However, the introduction of the 'peak energy rent' reliability option in the New England system provides evidence of a call option working in conjunction with a capacity obligation. In the ERCOT market in Texas, markets for Responsive Reserve Service (essentially payments in return for the right to call on spinning reserves) and Non-Spin (a comparable market in non-spinning reserves) provide evidence of such options markets operating in conjunction with an energy-only market.

While the call option approach has many initial attractions – market based, similarity to other commodity markets, etc. – the means of incentivising options trading are often less appealing. Left to themselves, electricity markets have generally failed to develop functioning options markets, presumably because of a lack of direct individual exposure to the consequences of a capacity shortfall as well as (often) the lack of an acceptable reference price against financial options. To fill this void, it is often suggested that regulators should step in to 'oblige' LSEs to purchase a certain amount of options. However, this centralised approach has many of the drawbacks of an administered capacity obligation, such as market distortions, economic inefficiency and political subjectivity.

While the solution proposed in this paper shares many of the features of a call option scheme, the fundamental difference is that it is specifically designed to provide resource providers and LSEs with the right incentives to invest in sufficient (and fit for purpose) resources, while minimising market distortions of the type created by alternative mechanisms.

PROPOSED MECHANISM

Introduction

The mechanism introduced here provides a solution to the difficulties associated with securing adequate balancing resources, expanding the market-based principles of an energy-only market by creating a clearly defined framework in which trading of options is both incentivised and facilitated. We believe that this mechanism has the potential to solve the resource adequacy problem in a more effective and efficient way than the alternatives outlined above.

Its design is at an early stage and a thorough evaluation is required. However, we consider the approach worthy of further consideration as a mechanism which could be suitable for adoption across a wide set of markets, with limited disruption to the existing process of price formation.

Concept

Capacity can essentially be considered an **'*option*' to produce energy**. While all production capacity represents such an option, some resources offer greater flexibility than others in how the option can be exercised. At the other end of the spectrum is the option to call only very infrequently on certain other resources. In an increasingly de-carbonised system with high levels of low carbon generation, energy market volatility could be significantly greater, increasing the value of such options. The appropriate response is to ensure that market participants are able to trade energy 'options' in the form of a sufficiently broad range of products mirroring the various types of services the system requires (some of which are expected to be in far greater demand than has traditionally been the case), perhaps in the form of reserve contracts, sufficiently far into the future to provide a sound investment case. It is equally important that the market itself is able to reveal the value of, and the required investment in, different types of new capacity or demand response resources. Multiple option variants could be developed to reflect different requirements, such as deliverability and flexibility, and to suit the capabilities of different types of capacity. The impact of low-carbon resource deployment schemes on the evolution of the future supply mix will determine the types of options that are valued most. Our suggested approach develops the concept of capacity as an energy option and proposes a **bilateral model for the trading of energy 'options'** and, in so doing, delivering security of supply. The approach complements the existing 'energy-only' market design that is in force in most liberalised energy markets.

The commercial rationale for the envisaged option contracts comes through their interaction with imbalance pricing arrangements. Current market rules often lead to damped imbalance prices that fail to feed appropriate price signals into short term traded markets. Furthermore, parties typically face imbalance charges when they have a contractual shortfall or surplus, even if they have flexible capacity at their disposal at, or after, Gate Closure which could be used to resolve this imbalance. As a result, **they do not have the potential to hedge directly any exposure to the energy imbalance price**. This acts as a barrier to the development of reserve options.

Our suggested mechanism removes this barrier by enabling a **'balancing resource option' contract holder to mitigate their exposure to energy imbalance**. Options could be exercised prior to Gate Closure if the holder becomes aware of a shortfall or surplus, or held to mitigate imbalance penalties arising from unexpected events closer to real-time. Such options could conceptually be extended to virtually any volumes and traded over multiple timeframes – from day-ahead to many years into the future – which, in turn, would allow the investors in new resources to reduce uncertainty over project returns and pass on a share of market risk to those who would ultimately benefit from the new resources.

Imbalance regime must allow price signals to emerge

Under the proposed model, the motivation to secure balancing resource options stems from the objective to mitigate energy imbalance exposure rather than any new obligation relating to capacity or reserve. It is important, therefore, that the imbalance arrangements provide appropriate incentives for parties to balance their positions in the first instance, which then provides the stimulus to secure option contracts to assist with balancing.

While an appropriate imbalance regime is a pre-requisite for reserve options, in many cases the imbalance arrangements themselves need improvement. Market participants have little incentive to contract for such insurance, for a variety of reasons:

- the imbalance prices are often damped by imbalance price calculations which use average rather than marginal prices;
- through system operators' use of pre-contracted generation (e.g. under short term operating reserve contracts where, typically, reserve availability fees are not appropriately targeted to periods of system tightness) which socialises part of the cost of the reserve; and
- even if a participant chose to hold an option contract with a flexible resource, it has no way of calling delivery of that contract after Gate Closure. Essentially, there is a basis risk between the price at which the flexible resource will respond and the imbalance price which the participant faces if they are short.

Irrespective of the arrangements for dealing with reserve and capacity, in general there is room for improvement to the imbalance regime in most electricity markets. We would advocate that changes should be made more accurately to reflect the marginal cost of imbalance on participants, given the linkage between appropriate incentives to balance and security of supply. Such developments are not dependent upon the progression of the reserve option model and should be made in any event. Possible improvements to imbalance arrangements for security of supply purposes could form the topic of another paper and are not considered further here.

Building blocks

Table 1 provides a high-level summary of the proposed approach, focusing upon principal building block components. These details and the end-to-end option contract process are developed in the following section.

Table 1 – Option contract building blocks

Building block	Feature	Details
Definition	**Product**	▪ Option contract for supply of energy (whether through increased generation or demand reduction) ▪ Initially, the option is financial and not backed by physical capacity but at some point ahead of operational timescales the option becomes physical ▪ Single or a small number of products with varying ramping and response profiles, with granularity down to the individual settlement period for the market
	Duration	▪ Multiple potential variants ranging from multi-year to daily
	Obligations	▪ The option does not need to be backed by physical capacity from the outset but at some point in advance of operational timescales, the option provider must be able to demonstrate physical availability (or trade out the obligation) ▪ All option providers must be able to demonstrate sufficient financial capability to deliver option (if the option is physically backed, the requirement may be lower than for pure financial option providers) ▪ Option holder must pay an option holding fee ▪ Option provider must make contracted capacity available with appropriate terms for physical delivery to option holder before Gate Closure or submit it into the balancing market at prices specified in contracts

Building block	Feature	Details
	Rights	▪ Option holder has right to call option before Gate Closure, with no subsequent entitlement to revised imbalance exposure; in this case the contract becomes a contract for physical delivery of energy from either the contracted plant or the provider's portfolio of capacity ▪ System Operator has right to call option after Gate Closure; option holder has subsequent entitlement to revised imbalance exposure up to contracted volume if in imbalance or remuneration if contracted capacity utilised on behalf of another user ▪ Holders of option contracts that are not called before Gate Closure, meaning that the capacity is available to the System Operator in the balancing market, are entitled to revised imbalance exposure up to the contracted volume
Allocation	**Requirement**	▪ Parties determine their own volume requirements – there is no centralised requirement determination
	Method	▪ Options traded bilaterally (though a coordinated 'trading platform' may be highly desirable to ensure liquidity, including re-trading)
Price	**Option holding fee**	▪ Agreed bilaterally between contractual parties ▪ Paid by option holder to option provider
	Utilisation fee	▪ Agreed bilaterally between option provider and option holder ▪ Paid by option holder to option provider if option called before Gate Closure ▪ Paid by System Operator to option provider if option called after Gate Closure
Settlement	**Hedged**	▪ Imbalance that is hedged by reserve contracts cashed out at the option contract utilisation price
	Unhedged	▪ Unhedged imbalance volumes cashed out at the system imbalance price
	Ex-post trading	▪ Parties with imbalance able to trade with holders of unused reserve ex-post in order to reduce exposure to the unhedged imbalance price; i.e. swap the unhedged imbalance price for a hedged imbalance price

Process

The reserve option contract approach operates over three timescales:

- in advance;
- on-the-day; and
- after the event.

Details of each phase are discussed below.

In advance

Element 1: product definition

Product characteristics: The contract secures capacity for the physical production of energy at a specific location in operational timescales. The product can be financial in nature initially to support investment in new capacity and trading of options, but must ultimately be backed by physical capacity.

A single product definition would have significant advantages for the secondary trading of balancing resource options, since all options would effectively be interchangeable. To include the greatest range of market participants, this would imply that the product characteristics would need to be within the capability of a range of generation and demand participants. Any enhancements over the minimum requirements of the product definition could be arranged by the system operator, which could contract separately for enhanced parameters thorough ancillary service contracts, potentially with a 'top-up' payment for more attractive characteristics. In principle the option would need to be usable by the system operator within balancing timeframes.

Duration: Option products can be defined over various timescales – e.g. annually (looking forward a number of years), monthly, daily and for specific periods of the day.

Rights to call the option: *Before option becomes exercisable:* clearly, no one has the right to exercise the option in this timeframe and the option can remain a financial product that is not backed by physical capacity.

Before Gate Closure: The contract holder can call the option bilaterally in advance of gate closure as part of its own trading strategy. The contract will be fulfilled as a notified bilateral (physical) energy trade (note that this does not require the capacity provider to source the energy from the specific asset which underlies the contract). The capacity provider has flexibility in how it honours the option (e.g. via the market or any resource in its portfolio) – as long as it provides the requisite energy, the source is not relevant. In this case, the contract holder will not receive the imbalance exposure mitigation offered by the option contract.

After Gate Closure: The system operator will have the right to call capacity linked to non-exercised reserve option contracts in the balancing market to assist in balancing the system.

Pricing: The contracts will include both an option fee and a pre-determined utilisation fee, agreed between the contractual counterparties. The contract buyer will pay the option fee to the capacity provider on a 'pay as bid' basis. The contract will specify utilisation prices, which could vary over different delivery windows or be indexed in some way (e.g. indexation in input fuel prices). When called, the capacity provider will be paid as bid based on these pre-defined prices. Payment will be made by whoever calls the option;

the option holder if called before Gate Closure and the system operator if called after Gate Closure.

Commitments: The option contracts will require the capacity provider to make the contracted capacity available in real-time. The capacity will be available to the option holder ahead of gate closure and, if not already used, to the system operator after gate closure. In the case of the latter, the capacity provider is required to submit offers to the balancing market with pre-determined utilisation prices and other characteristics.

Element 2: balancing resource option market

Coordinated market: Trade in option products will be via a coordinated market. This could potentially be managed by a power exchange, a broker, the transmission system operator or a new market agent. Participation in the market will be voluntary, involving willing buyers and sellers only.

Forward trading: Options will be traded forward as many years in advance as participants choose. At a defined point ahead of delivery (e.g. 6 months ahead), option holders must declare their holdings and capacity providers must demonstrate to the system operator that they are physically and financially able to deliver a volume of capacity (which meets the required technical specifications) equivalent to their overall contractual commitments. If the system operator considers that insufficient reserve option capacity has been procured at this point, it will act as the buyer of last resort and secure outstanding capacity requirements.

Secondary trading: Option contracts can be re-traded, with associated obligations and commitments transferring to the purchaser. This will facilitate the development of the forward market and foster the development of a spot market. This could include an on-the-day reserve market.

Since the sum of individual requirements will tend to be greater than the system-wide requirement (as opposite imbalance positions can be netted-off at a system level), procurement of options by individual industry participants, rather than a centralised authority, has the potential to lead to over-procurement of reserve if not addressed within the market mechanisms. A well-functioning secondary market where option positions can be revised and unwound as confidence in generation/demand increases will therefore be essential if over-provision of reserve is to be avoided.

On the day

Element 3: utilisation

Bilateral exercise: Before Gate Closure, contract holders can bilaterally call upon their counterparties to deliver energy (or provide demand response) on their behalf if, for example, they have experienced a generation outage or need additional output. The capacity provider is paid-as-bid by the contract holder at the pre-defined utilisation prices.

Interaction with reserve: The options would be notified to the system operator at some point close to physical delivery. The system operator would then take a view on whether the total system requirements were met or whether additional reserve is required, and could conduct a final ‘reconfiguration’ tender round to procure any additional reserve needed. The intent of running such a ‘reconfiguration’ option close to physical delivery is to permit reserve obligations to be passed to participants best able to provide them on the day; e.g. part-loaded plant or demand side response, which may not have been in a position to make longer-term commitments.

Balancing market bids: Contracted reserve providers (who have not been called bilaterally) will bid into the balancing market at their pre-determined utilisation prices and technical capabilities. The system operator will then balance the system using all of the tools at its disposal, including the various reserve option offers submitted into the balancing market.

After the event

Element 4: settlement

Hedged imbalance exposure: Participants who are short and who hold (adequate) reserve options will pay the utilisation price in their option contract to settle imbalance volumes. If a participant holds multiple reserve options, settlement will be made at the cheapest utilisation price first, then moving progressively up the party utilisation price stack for any remaining imbalance volume.

Un-hedged imbalance exposure: Participants who are short and hold either no or insufficient option contracts to cover their imbalance position will pay the full marginal imbalance price for any un-hedged imbalance volume. The calculation of the system imbalance price will have specific rules for the treatment of reserve volumes. One option could be to tag pre-contracted offers and adjust their offer price upwards to reflect the availability fee component. Another option would be to exclude pre-contracted offers from the calculation and instead use an ex-post unconstrained schedule approach such that imbalance prices are calculated based on uncontracted offers only, whether accepted or not. The intention is that the imbalance prices include the full cost of balancing, which over time would include the long run marginal cost of resource adequacy.

Ex-post trading: The proposed mechanism also allows ex-post trading between holders of unused reserve contracts and parties with an outstanding imbalance position. This process will occur after the initial energy imbalance volume calculations. Ex-post trading will not alter imbalance volumes. However, it will enable those in imbalance to alter the price at which some or all of their imbalance is cashed out from the unhedged to the hedged imbalance price (option fee). Parties with an imbalance will have an incentive to trade if the utilisation price of unused reserve is lower than the system imbalance price. Parties with unused balancing resource options have an incentive to trade in order to secure revenue. Trade will occur at a price somewhere between the utilisation price of unused reserve and the system imbalance price. The existence of ex-port trading of options will also address concerns about over-provision of reserve by individual participants, since it will allow a ‘netting-off’ process to occur after delivery.

Element 5: enforcement

Validation of physical capability: Although balancing options could initially be financial in nature, at some point they will need to be underpinned by physical ability to deliver, and there must be confidence that this physical ability really exists. It may be possible for the balancing resource options market to be self-policing, with option providers that persistently fail to deliver on their obligations being unlikely to be able to sell additional options in the future. However, we consider that, to provide the required degree of market confidence, it might be better for a central authority (probably the system operator) to have responsibility for validating the physical capability of resources to deliver. This could take a two tier approach (similar to that employed in many ancillary service markets) where a first level of validation is to check the declared parameters of the plant for consistency with options obligations, and a second level involving periodic random testing of capability to deliver.

Contractual penalties for non delivery: If contracted capacity providers fail to fulfil their obligations they will face financial penalties and ultimately contract termination with associated compensation payments. For example, non-delivery penalties will apply in the event that a contracted provider is called but fails to supply the required output. We note that the mechanism will also need to contemplate financial failure of market participants, and that some form of underwriting may be desirable.

Worked example

The simplified example in Table 2 illustrates how holding an option contract can reduce imbalance exposure. The option holder's has paid an option holding fee of €10/MW/hour for a volume of 50MW, with a utilisation price of €50/MWh. Its imbalance (up to 50MW) is therefore settled at the contractual utilisation fee of €50/MWh, whereas the equivalent imbalance would have been cashed out at the system imbalance price of €200/MWh in the absence of an option contract. In this example, the option holder has made a significant saving by procuring the option. Conversely, if its imbalance volume had been zero, then the option holder would have paid the holding fee without gaining any immediate benefit in this trading period.

Table 2 – Impact of option contract on imbalance exposure

	No option contract	Option contract
System imbalance price (€/MWh)	200	
Individual imbalance	Short	
Imbalance volume (MWh)	50	
Option contract holder	No	Yes
Utilisation fee (€/MWh)	n/a	50
Discounted imbalance price	No	Yes
Option holding fee (€/MW/trading period)	n/a	10
Option volume (MW)	n/a	50
Total option holding fee (€/trading period)	n/a	500
Imbalance price (€/MWh)	200	50
Imbalance exposure (€)	10,000	2,500
Imbalance cost including holding fee (€)	10,000	3,000

Assumes trading period with one hour duration

Balancing Resource Options can also support flexible demand

The transition to low-carbon energy production is likely to lead to increasingly high proportions of commercially inflexible (low marginal cost) or technically inflexible ('must-run') generation. In some markets today – and in many more, as renewables penetration increases – a surplus of generation can exist at times when high renewable output coincides with low demand for electricity. This leads to periods of low wholesale prices and even generation curtailment, and has important consequences for the income of renewables projects in particular. Ultimately, the reduction in revenues could prevent optimal resource deployment unless a sustainable solution is found.

In markets where these situations arise, 'reserve demand' is likely to emerge as a valuable commodity, and resource providers that can shift demand to periods of high generation output should be able to capture value in the wholesale market. Balancing Resource Options could support the investment case for these resources, by replacing reliance on volatility in the short-term energy markets with a more stable income stream from option fees.

Roles and responsibilities.

Who sets the overall capacity requirement?

Individual market participants identify their own capacity requirements. The system operator will also develop its own view of overall capacity requirements, but this will not be a centrally mandated volume that the market must deliver. This allows market participants to take responsibility for assessing their own reserve requirements and contracting accordingly.

What is the incentive to procure reserve options?

In the short term, the ability to avoid high imbalance prices should incentivise market participants with any volume uncertainty – on both generation and demand sides of the market – to procure Balancing Resource Options. In a well-functioning market with good foresight, this incentive should extend to the longer term as well, ultimately resulting in new resources being funded through the options mechanism. In the real world, market imperfections and a tendency to focus on shorter term risk management may mean that option market liquidity does not extend as far forward as would be required to underwrite new capital intensive investments. This is a potential weakness of the proposed mechanism.

Who procures reserve options?

Again, market participants (on the generation and demand sides alike) will be able to contract reserve options to meet their own requirements. The system operator will only procure additional capacity if it considers that the market will not provide sufficient capacity to meet its system-wide requirements.

Who can provide capacity under option contracts?

Ultimately, only creditworthy resources that can achieve a defined technical specifications to the requisite standard for reliability will be able to provide reserve option service. However, in the longer term – perhaps further ahead than 6 or 12 months – it might be possible for purely financial players to sell options, so long as they have the financial capability to unwind their position closer to real time. Providers are expected to include, *inter alia*, predictable and controllable generation capacity, demand side response, storage and interconnection, as well as possible financial participants.

Who exercises reserve options?

Beyond Gate Closure, the system operator remains the sole participant that can instruct changes to generation or consumption patterns. In this context, it is the system operator only (and not the contract holder) who has the ability to exercise reserve option contracts in the balancing market. Prior to Gate Closure, the contract holder can, however, exercise the option (noting that this then prevents the system operator from accessing the capacity in the balancing market).

Who pays for reserve options?

The option contract purchaser pays the option holding fee directly to the capacity provider. If the contract holder exercises the option in advance of Gate Closure, it will pay the pre-defined utilisation fee directly to the capacity provider in return for delivery of the energy (in the form of a contract notification for a physical volume). If the system operator exercises the option in the balancing market, it will pay the pre-defined utilisation price to the provider.

Who carries out settlement?

Imbalance settlement will continue to be conducted centrally by the relevant market agent. Imbalance systems will need to be adjusted to reflect a hedged and an unhedged imbalance price, to factor in reserve option holdings and to recognise ex-post trading of reserve options.

Fit with principles and objectives

Table 3 provides a qualitative assessment of the proposed reserve option mechanism against the objectives for an effective market outlined earlier in the paper. Our assessment is that the mechanism has the ability to perform positively against these objectives and as such is worthy of serious consideration as a potential alternative to capacity mechanisms.

Table 3 – Assessment of reserve options against objectives for effective market

Criteria	Performance	Comment
Decarbonisation	(✓)	By delivering resource adequacy, the mechanism will indirectly support the pursuit of decarbonisation.
System security	(✓)	The mechanism provides an opportunity for market-led provision of security of supply
Economic efficiency	✓	Parties will have the ability to secure reserve requirements to meet their own needs and attitude to risk (as opposed to centralised procurement of an administratively determined reserve requirement). Also, as long as there is liquid trading, the mechanism allows reserve providers to trade the obligation to fulfil option requirements close to real-time, thereby enabling reserve to be provided by the most economically efficient provider.
Entry barriers	✓	For providers of reserve options, the option holding payment provides greater certainty of fixed cost recovery than an energy-only market (although this depends on the reserve options market operating sufficiently far in advance and with sufficient liquidity to support investment). Also, by providing a hedge to imbalance exposure, the option contract may reduce barriers to entry for other parties, including wind and other variable resources.
Transaction costs	(×)	While parties will incur transaction costs when trading reserve options, this mechanism avoids the costs linked to central procurement of capacity. Arrangements for settlement and monitoring of actual reserve holdings will need to be introduced however.
Freedom of choice	✓	Parties are free to determine their own particular resource needs and appetite for risk by procuring their own reserve options (or by choosing not to).
Transparency	(✓)	While trading activity is bilateral, it could be conducted via a common platform. Secondary or ex-post trading will also improve transparency.
Regulatory risk	-	A well-functioning market-led approach should reduce the risk of regulatory intervention (though some regulatory risk will inevitably remain).
Consistent with other laws	✓	No inconsistency with legal framework apparent.

Key: ✓ = positive; (✓) = slightly positive; - = neutral; (×) = slightly negative; × = negative

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IMPLICATIONS FOR THE MARKET

In this section, we consider interactions between the market and the proposed balancing resource option model.

Liquidity and interaction with energy market

Liquidity is central to the success of bilaterally traded electricity markets. Participants must be able reliably to access the market in order to buy or sell power both forward and spot. This requires market depth and appropriate product granularity along the curve. Liquidity in the trade of balancing resource options is similarly important, both in the long-term and the short-term:

- In the long-term, several years ahead of delivery, liquid trading of options will allow a robust forward curve to develop, which will be required if participants and financiers are to have confidence in the value of their investments.
- In the short-term, dynamic trading of options close to real time will enable responsibility for providing reserve to be transferred to the most effective and efficient providers. For example, it may be desirable to shift some obligations to whichever part-loaded plant happens to be operating at the margin in any given period and liquid trading of options will enable reserve provision to complement the prevailing merit order rather than being based upon long-term contracts.

There are serious concerns about liquidity in many energy markets, and this paper does not attempt to address the issue comprehensively. We note that market structure and the degree of self-provision within vertically integrated groups can have a major impact on market liquidity in energy markets; and the same is likely to be true of option markets. A centrally facilitated platform for trading options may be desirable as it would help smaller players to participate on an equal footing with larger groups.

Robustness to high intermittency scenarios

Going forward, expectations are that the penetration of intermittent generation sources will increase as decarbonisation goals are pursued. To be effective in this context, the reserve option approach must be robust to a high intermittent generation future.

Intermittent plant is unlikely to be able to offer significant reliable capacity forward under a balancing resource option contract. The intermittent nature of its generation production effectively means that it cannot offer its capacity to a potential counterparty with any certainty until close to real time. As the reserve option contracts are initially expected to be traded several years ahead of real time, the forward option market is unlikely to be one in which intermittent capacity can participate as a seller of options[3]. Rather, intermittent generation is more likely to be a buyer of balancing resource options, since they would complement their variable output. By buying options an intermittent generator could sell firm power further forward than at present, as it would be able to manage the risk of non-availability and consequent imbalance costs.

3 We note that whilst individual resources (a wind farm or PV installation, for example) would have little firm capacity to sell, an owner of a large portfolio of geographically dispersed intermittent resources may well have quite a bit of marketable resource available.

Moreover, the existence of significant quantities of intermittent generation is a driver for balancing resource option contracts and complements their development. The utilisation of reserve options and their value will be influenced by patterns of intermittent generation:

- In periods of plentiful, but not excessive, intermittent generation output, the system will generally be well supplied with power whilst not being oversupplied. The relative abundance of low marginal cost generation will also tend to result in low imbalance prices, meaning that the value of mitigating imbalance exposure will be relatively low. This means that balancing resource options will be of relatively little value in these periods and utilisation of the contracted capacity will be relatively low.
- The real value of reserve options will become apparent, however, in periods of low intermittent generation output. At such times, supply-demand conditions are likely to be tighter and generation with higher short-run marginal costs are likely to be required to balance the system. Imbalance prices are likely to be higher as a result, increasing the value of hedging exposure to the system imbalance price. The nature of these tight supply-demand periods is likely to be different to past experience, occurring at virtually any time in any season rather than primarily during peak demand periods and having shape and duration that are less predictable and highly variable. Furthermore, these tight supply-demand periods are exactly the circumstances under which the system operator is likely to call upon the contracted capacity. This means that individual parties' incentives to secure reserve are correlated with the system's need for it.
- The value of these options will also become apparent as it becomes more common for systems to experience oversupply conditions, arising due to the coincidence of high levels of production from near-zero-marginal cost must-run generation (both intermittent and non-intermittent) with lower demand levels. Curtailment of must-run resources can have very high opportunity costs for owners or for the holders of off-take contracts with those resources. Supply options are of limited value in this circumstance. Traditional capacity mechanisms are poorly suited to address this situation, whereas balancing resource options – if appropriately designed and if backed by suitably flexible demand and generation – are well suited to do so given their ability to adapt to different commercial requirements and the fact that they are not primarily tied to supply-side solutions. The balancing resource option market could also provide a better means of revealing the value of investments in interconnectors and expanded balancing areas.

We consider, therefore, that reserve options will complement the delivery of increased levels of intermittent generation capacity in ways potentially better suited than traditional capacity mechanisms to dealing with the emerging needs of such a system. Indeed, the value of such options is expected to increase as intermittent generation penetration increases. The intention is to give both sides of the market a means of managing the combination of price and volume volatility which will result from the increased level of intermittent generation.

Implications for project 'financability'

In a future system with increased low marginal cost renewable or low carbon capacity, flexible capacity with higher marginal costs is expected to have reduced windows within which to recover fixed costs. The prospect of lower (and more unpredictable) load factors in the future makes investment in flexible capacity a riskier prospect due to the danger of failing to capture the highest prices (if, for example, the plant is unavailable, or has already sold output forward), and the expectation that there will be significant variation in net revenue from year to year (e.g. dependent on weather patterns at peak periods).

While price risk can, to some extent, be dealt with through traditional forwards markets, an options based approach would significantly improve the ability to manage volume risk.

The prospect of regulatory intervention to prevent price spikes may also deter investors. The proposed balancing resource option model will reduce both market and regulatory risk and improve the investment environment for flexible capacity providers (including demand response and storage alongside conventional thermal capacity).

The key feature of the reserve option contract structure for supporting investment in flexible capacity is the option holding or availability fee. As running patterns and revenue from the wholesale market become more uncertain, the availability fee provides the potential for a stable revenue stream that can be used to recover the fixed costs of investment in flexible capacity. While the value of the availability fee will be the subject of negotiation between contractual parties, once secure the capacity provider will have a fixed revenue stream. Greater certainty will be provided the longer the option contract duration, though willingness of market participants to strike long term options contracts is yet to be tested.

Meanwhile, by providing an opportunity to hedge imbalance exposure, imbalance insurance options offer a route by which to reduce balancing risk for investors in intermittent generation or demand. For example, investors in wind or solar generation projects may purchase reserve option contracts in order to offset balancing risks. While securing reserve option contracts incurs a cost, as long as this is outweighed by the value of reduced potential imbalance exposure, this should be worthwhile and so has the potential to aid investment. Furthermore, the use of a decentralised market system to address the situation should expand the range of options, reducing the cost and minimizing the risk of over-procurement of expensive supply-side resources.

Interactions between ‘system’ and ‘energy’ balancing

In all electricity market there is a distinction, whether explicit or implicit, between energy and system balancing actions:

- Energy balancing actions are those taken to resolve imbalances at the trading period level (usually hourly or half-hourly, but occasionally different). Market participants contribute to these imbalances by failing to buy or sell sufficient energy contracts to match their physical positions.
- System balancing actions are those taken to resolve imbalances at a sub-trading period level or to resolve local transmission constraints. It is possible for system balancing actions to have no impact on energy balancing (as when matching bids and offers are accepted to resolve a transmission constraint, for example).

In general, imbalance regimes are designed to incentivise participants to manage their energy balance positions to the extent within their control (i.e. balancing at a trading period level), while system balancing costs tend to be in some way socialised.

The value of plant technical characteristics (such as start-up times, or ramp-up/down rates) would need to be appropriately captured and valued within the proposed approach. Characteristics that influence deliverability at a trading period level will have value to all option buyers, while those that help balance supply and demand at a sub-trading period level will only have value to the system operator. Whilst in theory it would be possible to have a wide range of defined products to encompass all possible combinations, in practice this would be likely to stifle liquidity and prevent the development of a secondary market in options (since no two option holders would have the same type of contract). We therefore believe that a better approach would be to have a single (or possibly a small number of) product type(s) which can be traded easily in the forwards markets. The system operator would then contract separately for intra-settlement period characteristics through ancillary service contracts, making 'top up' payments where appropriate.

In order to maintain the system/energy balancing distinction in the settlement of imbalance prices, a number of mechanisms can be applied, including 'tagging' of system balancing actions by the system operator, for example excluding short-duration actions, or by calculating an ex-post unconstrained schedule (EPUS) which is a retrospective view on what actions would have been taken if only energy balancing (i.e. no system balancing) was required.

Implications for security of supply

Balancing resource options are based upon the premise that market participants are in the best position to identify their own reserve requirements. Parties essentially have responsibility for procuring reserve to meet their own security of supply requirements. We believe that market-led identification and procurement of reserve requirements is likely to be preferable to a centrally mandated approach. A centralised approach will inevitably involve an administered and potentially somewhat arbitrary methodology for determining and then fulfilling overall reserve requirements.

The incentive for parties to procure reserve options stems from the imbalance pricing regime and specifically the motivation to hedge exposure to the system imbalance price. Provided that the imbalance regime provides appropriate incentives for all parties to balance (including renewable generators), the desire to mitigate potential imbalance exposure should encourage parties to contract for reserve capacity via option contracts. This will, in turn, deliver security of supply for the system as a whole. In addition, as a backstop, the system operator will have the ability to procure additional reserve if it is of the opinion that the market has not secured enough. However, the incentives created by the market should, in principle, deliver an appropriate level of reserve capacity, at least for delivery of bulk energy as measured by the imbalance regime.

As mentioned above, the option contract structure envisaged should support investment in the flexible capacity and active demand response that will be required to deliver security of supply in future. The option holding or availability fee can provide a certain revenue stream for reserve option providers.

Implications for demand-side participants

The proposed mechanism should be effective at levelling the playing field between participants on the generation and demand sides of the market. We believe that it could also encourage the development of 'smarter' technologies as it would be more effective at revealing the value of, and thus supporting investment in, new and more dynamic real-time demand response opportunities. There will be potential for option market participation by aggregators of, for example, flexible electric water heaters and commercial chilling systems (and in future, time-shiftable charging systems for electric vehicle batteries).

UNRESOLVED ISSUES AND CHALLENGES FOR IMPLEMENTATION

Our balancing resource option is presented as a straw man for further development. We recognise that several aspects require more detailed thought and that there may be implementation issues which need resolution. We present the issues that have already been identified in the sections below.

- It will be important to ensure that there is an adequate **separation of 'energy balancing' and 'system balancing'** actions taken by the System Operator. We have mentioned above that this may be best accomplished by creation of an Ex-Post Unconstrained Schedule (EPUS). However, as with any such mechanism, the details of how calculations are performed will be of paramount importance, and will require careful consideration if they are adequately to reflect the realities of system operation and remove incentives for 'gaming'.
- The spectre of **insufficient liquidity** is equally likely to threaten option markets as energy markets, and could prevent both long-term investment signals and short-term market clearing. While it is beyond the scope of this paper to address market liquidity in depth we consider that, in some countries, wider reforms may be desirable.
- It is possible that these **arrangements could favour larger vertically integrated players**, since they will be able to buy insurance to cover their total portfolio-level imbalance, which will tend to be lower than the 'gross' imbalances of the individual parts of the portfolio. It should be noted that this distortion already exists under many market mechanisms (including energy-only markets); nevertheless, it may be worth investigating ways of mitigating market power of major incumbents. The existence of ex-post trading of the resource options should ensure that larger players do not 'hoard' their own unused cover. If required, some form of 'use it or sell it' obligation could be considered.
- The **financial viability of market participants** will be key, particularly in long-term trading of options contracts. Sellers of option contracts would almost certainly be expected to put in place some form of credit cover to provide confidence in their ability to deliver financially in the event that they are unable to deliver physically. It will be important that the level of credit required does not become an entry barrier for smaller generators or demand side participants. It may be necessary for some form of pooling of credit cover or underwriting of contracts to develop, so that smaller providers (in particular) can demonstrate some financial security to the option purchasers. Given the existing commitments of energy and utility companies, it may be desirable to involve the financial community in these arrangements.
- The proposed mechanism could have **implications for cross-border trading**. This paper has so far considered only how an imbalance insurance option approach could work in a single (islanded) market. In the real world, there is likely to be considerable complexity surrounding the interaction of different markets – especially where one market has a capacity/option payment and another is energy-only. However, the norm in Europe is for energy-only markets, and we consider that the balancing resource option instrument would introduce minimal distortion to the price patterns in such markets. Thus, in addition to its other attractions,such a mechanism would be far less disruptive than the piecemeal introduction of capacity mechanisms.
- A further question is w**hether interconnector capacity could be eligible to underwrite options physically**, or whether it should be considered as non-firm capacity. Indeed, one potential benefit of a balancing resource options market is that individual market participants could make that determination for themselves, with the

planning treatment of interconnectors coming into play only in regards to the SO's top-up decisions. This could open up new opportunities for interconnector investment. If similar reserve options markets exist on both sides of an interconnector then the process would become simpler, as a check on physical availability would be able to ensure that firm capacity could not simultaneously be offered in both directions. For interconnectors as well as other types of resource, the existence of a close-to-real-time reconfiguration of the options is important, to ensure that the reserve on the day is delivered by the cheapest providers.

- **'Regulatory' risk** – the balancing resource option as described is an option to hedge against imbalance charges. The nature of balancing calculations (e.g. whether shorter balancing periods are introduced) and the algebra for imbalance pricing will directly influence the value of the options and this 'regulatory' risk needs careful consideration, given that the aim is to develop trading of products significantly in advance of delivery to support investment. For that reason it is important that a robust and enduring imbalance regime is in place from the outset.
- Finally, the **transition from the extant arrangements** towards the proposed approach will need to be managed carefully. Investors will tend to see any market reform as a period of greater uncertainty and will often refrain from making firm commitments until outcomes are clear. We believe that a well-functioning secondary market in options trading could facilitate the transition from existing arrangements, as it will allow gradual transfer of obligations from centralised bodies to individual market participants.

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