

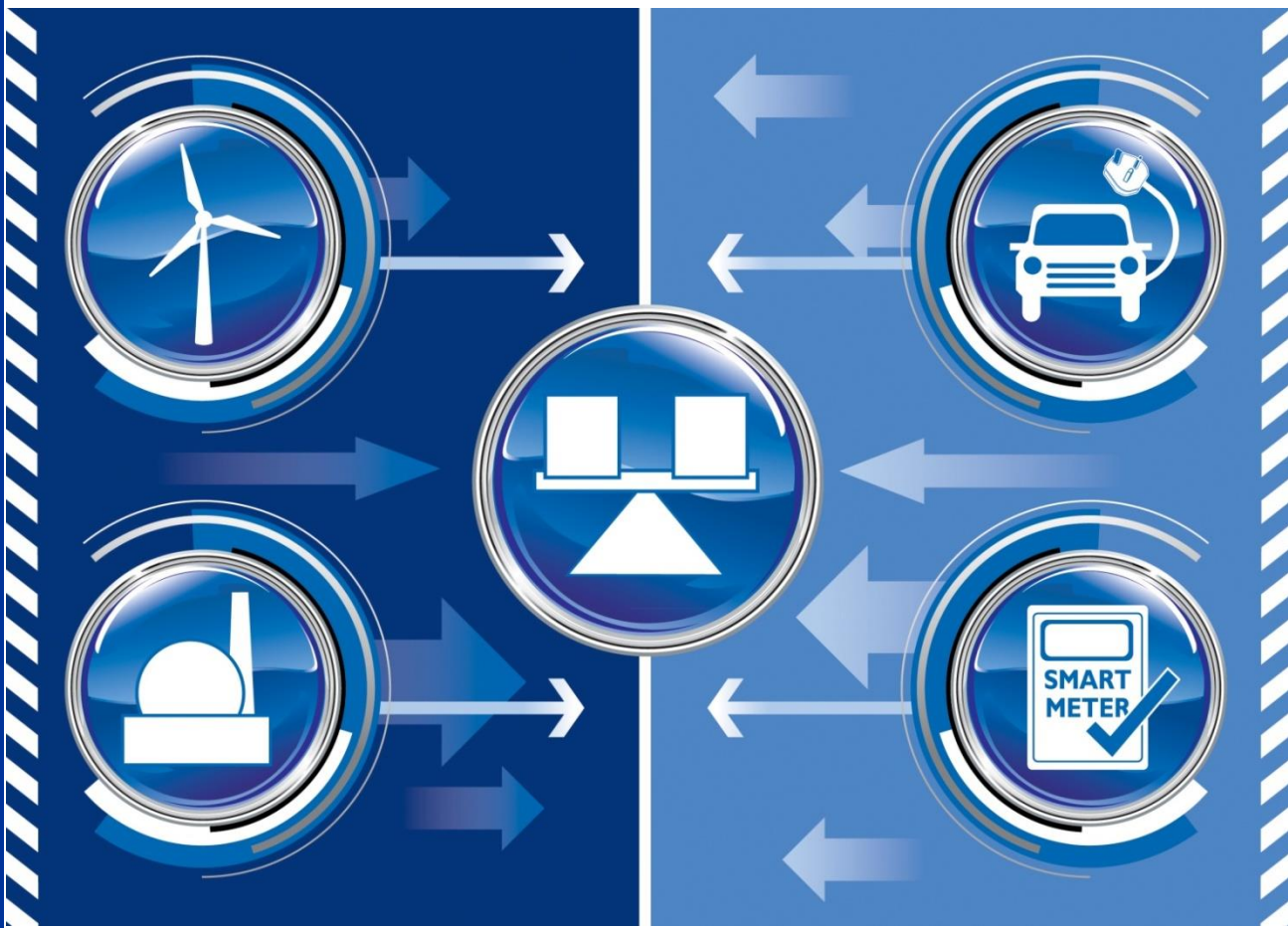
REVEALING THE VALUE OF FLEXIBILITY

How can flexible capability be rewarded in the electricity markets of the future?

A public report

February 2014

REVEALING THE VALUE OF FLEXIBILITY



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EXECUTIVE SUMMARY

Background to the study

European electricity markets will increasingly be dominated by variable renewable generation. This will require flexibility from the other market players, which must be rewarded. This report outlines ways in which flexibility can be valued in electricity markets.

The work has been sponsored by a group of 20 clients, including regulators, network operators, power exchanges, manufacturers, generators and vertically integrated utilities. It has also benefited from dialogue with a wide range of stakeholders and policy makers from across Europe.

The winds of change have overturned the status quo

The onward march of renewable generation is bringing new risks for thermal generation and new challenges for balancing supply and demand. The need for flexibility is growing, and trading must move closer to real time in response to weather forecast error. Market players now face a potent combination of price and volume risk which cannot easily be hedged with standard traded products. For example, 'spark spread' assumes a generation profile which has barely been seen by a CCGT in Europe in the last five years.

The EU Target Model for electricity, due for introduction by the end of this year, embraces these trends. However, there are other steps which must be taken to allow a transition to the low carbon economy.

New market designs will continue to undervalue flexibility

Trading arrangements across Europe generally damp market volatility and shield market players (especially renewables) from imbalance risks. In response to the new circumstances, many EU countries are planning to introduce Capacity Remuneration Mechanisms ('CRMs') which could lower risks for generators and other market players.

Capacity gives the option to deliver energy. The value of any capacity relates to its capability to respond when needed, e.g. in terms of the speed of response and also the price for delivery. However, many proposed CRM schemes are simplistic and run the risk of:

- replacing market risk with regulatory risk;
- damping peak prices;
- undervaluing flexibility; and
- distorting cross-border trading and demand management incentives.

Most such schemes assume a static definition of 'capacity' which will not adapt to changing system needs, e.g. as forecast accuracy changes, generation mix changes and smart metering changes demand patterns.

Even in the latest market coupling arrangements¹, emphasis is given to Day-Ahead at the expense of intraday, but what is required is the sharing of capacity between the different timeframes. The price for intraday capacity on interconnectors is effectively zero, which could block the build of new interconnection (especially to the Nordic region which has a surplus of both energy and capability).

Under these market arrangements, flexibility will continue to be undervalued, and cannot easily be traded between countries. CRMs will need ongoing regulatory involvement. This translates into new risks for investors. As a result, valuable infrastructure may be delayed.

Is there a better approach?

We have worked to create market-based ways of valuing capability, which could support the integration of renewables into the market while allowing all market players to manage their risks. Wherever possible, investment and allocation decisions should be based on the actions of market players. The commercial influence of regulation and of single buyer TSOs on market outcomes should be kept to a minimum.

Our proposals are based on the principle that capability has a value which can be traded in the market in the form of energy options. Energy options can:

- hedge against price and volume risk;
- adapt to system needs over time; and
- promote investment in the right types of capacity.

Our proposals

Our vision for future electricity market arrangements can be achieved through the following four steps:

- Imbalance should not be sheltered:
 - all market participants should be balance responsible; and
 - imbalance prices should reflect the full long-run marginal cost of balancing the system, including reserve costs.
- Market designs should support trading of energy options between market participants (including as insurance against imbalance).
- Market coupling rules should allocate cross-zonal capacity across timeframes based on market values not *a priori* reservations, and should provide a way of pricing intraday capacity.
- Balancing services should be defined in ways which promote innovation and avoid forcing all providers to fit predefined characteristics.

¹ https://www.epexspot.com/document/25834/2014-02-04_NWE_Go-Live_Communication_NWE_PCR_SWE.pdf

Timing is important

Electricity markets in Europe are reeling from recession and rapid growth of renewable generation. Today, there is no real shortage of capacity, and the value of flexibility would be low in many markets even if our recommendations are followed.

However, the need to act is urgent, in terms of both institutional arrangements and also infrastructure. The rules for market coupling will be defined in the coming weeks and months, and plans for national capacity schemes are advanced. Decisions on generation closures are being taken now, and infrastructure plans are being delayed by the prospect of CRMs.

We believe that our proposals are in line with the spirit and the letter of the Target Model proposals but that more could be done to ensure that the ideas are taken forward across Europe.

We aim at influencing the direction of the integrated European market, and seek to ensure that the final Target Model (in the form of Network Codes) supports – or at least does not block – proposals for appropriately valuing flexibility.

Next steps

Further work is needed to persuade more policy makers of the merits of the proposals, to prove the value in different circumstances and to set up pilot arrangements. We will work with our existing group of supporting clients and with other stakeholders to take these ideas forward.

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1. BACKGROUND

The real-time nature of electricity and the high value users place on its reliability means that its economics differ from most other goods and services. An efficient electricity system would have an excess of usable capacity at almost all times, and there would be economic value for reliability (i.e. the potential to deliver energy as needed) which can conceptually be separated from the value of delivering electricity.

1.1 Payments for energy, capacity and capability

Capacity (measured in simple MW terms) gives the option to deliver energy, but this metric does not guarantee adequate reliability. What is needed is the **capability** to deliver energy as required by the system, particularly over the timescales required. For example, the right level of inflexible capacity may not deliver reliability and could therefore be considered as not adequate.

In most European markets in the past decade, revenues were dominated by energy (delivery) payments, and separate payment streams for capability have typically been low. There is some logic in this. Commonly used generation technologies could deliver both energy and capability, and still be flexible enough to meet (most) system needs. New plants were expected to run at baseload, and production patterns by individual generators were broadly predictable. Therefore, the main investment risks were related to price rather than volume. These could be hedged through forward trading of fuel, carbon and/or power offtake (or all three combined in the form of a clean spark or dark spread), using simple baseload or 'peak' products relating to predefined delivery profiles. Re-trading in spot markets was used to adjust to actual system conditions.

For the longer term, beyond the forward curve, market price projections served as a way of understanding (if not hedging) price volatility, and most projects were financed on this basis. Older plants which served mid-merit or peaking roles had typically already repaid their cost of capital and therefore only needed to cover annual avoidable costs. A small amount of capacity for super flexible operation was funded through separate arrangements (e.g. direct contracts with the TSO). Most of the information required for scheduling was available Day-Ahead, and changes between Day-Ahead and real-time were typically dealt with by the TSO, often as a contingency in the event of a plant failure or inaccuracy of its own demand forecasting.

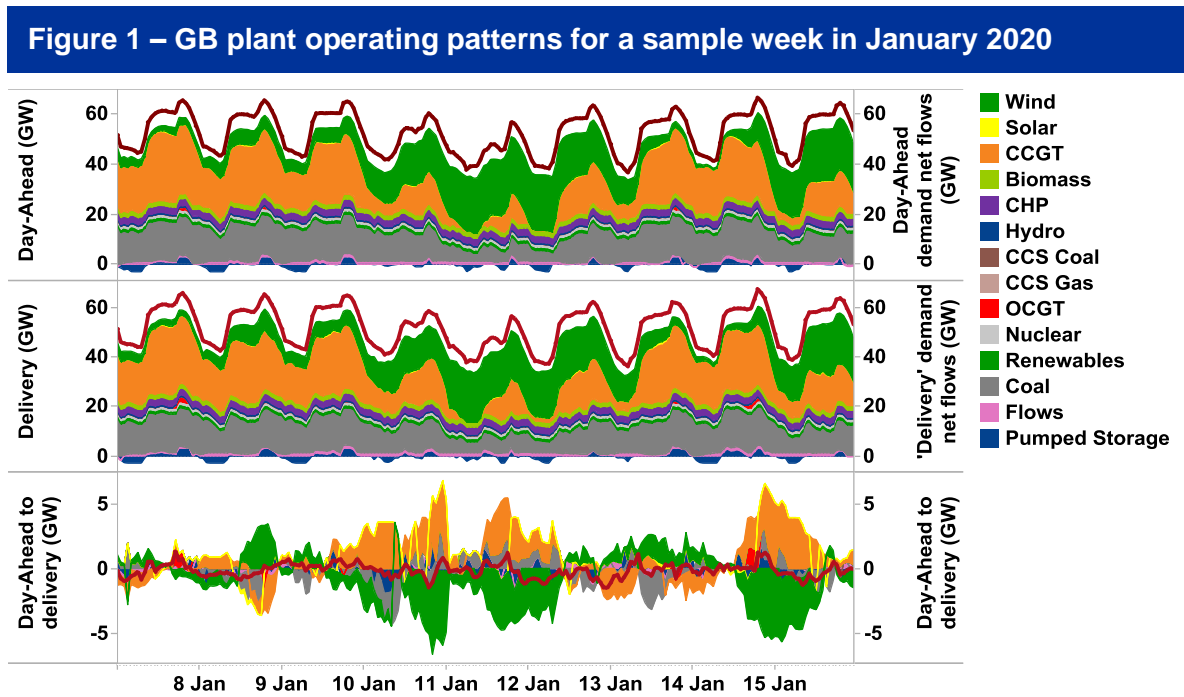
1.1.1 Renewables will need to be backed with plant capability

The nature of electricity systems is changing across Europe. Large scale introduction of weather-variable renewables to the system has radically altered the underlying needs, and therefore the value of capability as distinct from energy delivery. Notably:

- total energy requirements from thermal generation (TWh) are falling relative to requirements for capacity (GW); and
- the residual thermal generation fleet is facing major changes in operating patterns, with increased emphasis on the flexibility to respond to weather variation and forecast error at short notice.

The total revenue (gross, and even net of fuel costs) from sales of energy alone is currently falling in many markets based on arrangements designed with purely energy delivery in mind.

Figure 1 gives a flavour of the future expected generation patterns as well as the expected re-dispatch between Day-Ahead and delivery due to forecast error and plant failure.



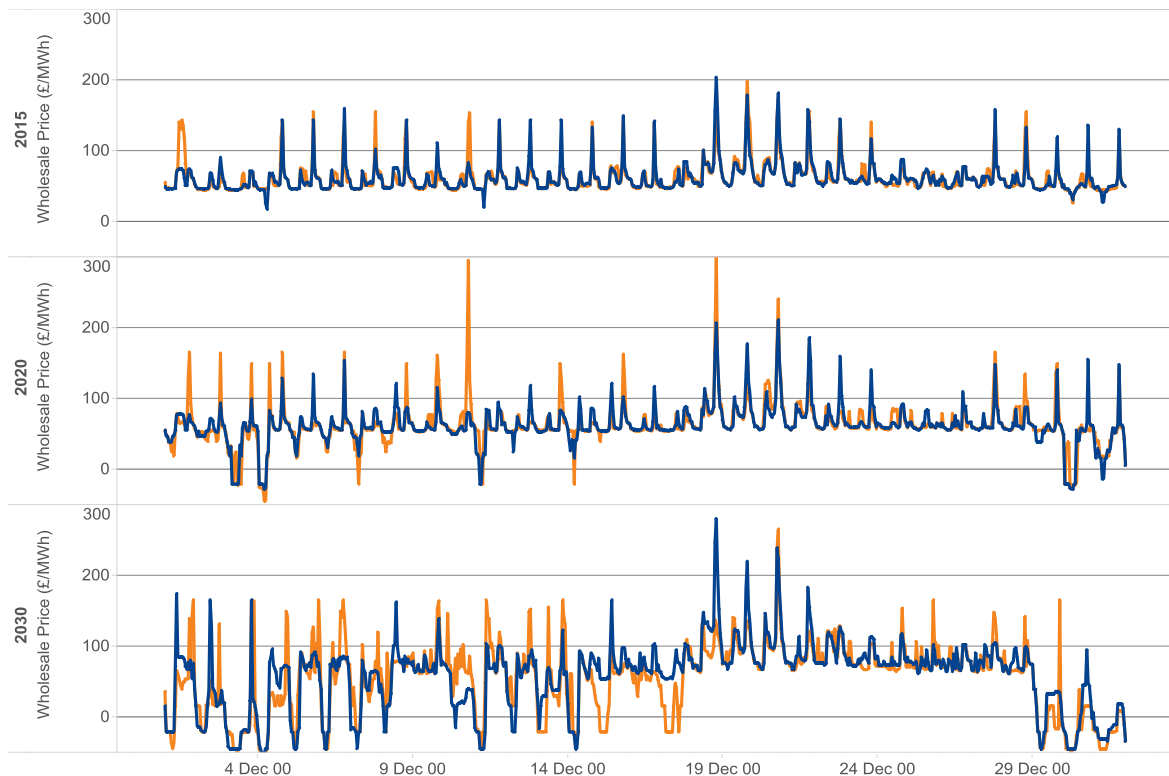
Source: Pöyry Management Consulting; GB-Ireland Within-Day study

Consequently, all generation faces a combination of price and volume risk that cannot easily be hedged though common trading instruments that cover only price risk for a defined delivery period (e.g. physical forwards or spark spreads). Currently traded products are becoming too simple.

For example, a CCGT does not accurately know its production profile for the next week (let alone the next year) as its place in the merit order will vary directly (inversely) with the wind output. Any forward commitment is likely to mean that the trader will have to re-enter the market and unwind some of the position at a later stage. Trading needs to become more advanced to cover the volume risk arising from weather variation. This is analogous to the agricultural commodity markets, in which producers have sought to hedge against future production which is dependent on weather conditions.

Apart from volume risk, the widespread introduction of weather-variable renewables is also expected to further increase price volatility (both at the Day-Ahead stage and even more in the intraday timeframes). Figure 2 shows the hourly Day-Ahead and real-time prices in GB for December (under the weather pattern of 2006) for 2015, 2020 and 2030.

Figure 2 – GB hourly Day-Ahead and real-time prices for December (weather pattern 2006)



Source: Pöyry Management Consulting; GB-Ireland Within-Day study

New investment in thermal generation (when needed) is typically for plant which is expected to run in mid-merit or even peaking mode in many European markets. The reliance on energy-only markets alone appears much more risky for this type of plant than one which is expected to operate at or near baseload. For such plant, a large share of the plant value relates to the (volatile) scarcity rent and a much lower share relates to (more predictable) infra-marginal rent ('IMR'), compared with baseload plants.

Further, because there will be wind or solar output for some but not all of the peak hours, then the number of hours facing system scarcity will diminish. As a result, the scarcity rent to cover investment costs must be recovered from fewer periods with higher and higher prices, and the volatility of scarcity rent must therefore increase as new capacity is required. This further increases the risk premium for investment in thermal generation.

There is therefore a growing need from the majority of market participants for market instruments that reward capability separately from energy delivery. These trading instruments – options – that solve the combination of price and volume risk have been widely used in other markets but are still immature in European power markets.

1.1.2 Growth of Capacity Remuneration Mechanisms ('CRMs')

Many European countries have advanced plans to introduce CRMs and other centrally-engineered means of securing generation adequacy. CRMs often have several (potentially conflicting) objectives, including:

- removing medium term volatility in revenues;
- improving long term investment security; and

- retaining efficient incentives for availability in the very short term.

Balancing these objectives will require compromises and often involves a high degree of regulatory adjustment.

Capacity is an option to deliver energy. However, depending on its characteristics, different types of capacity will have different value to the electricity system at different times. In principle, separating trading of energy from the capability to deliver energy respects the underlying economics. However, trading of capability should reflect its value at the time, based on the notice period and also the price at which the capability can be delivered.

Most of the CRMs currently under discussion have a narrow definition of capability, typically focused on peak hour availability, perhaps with some predetermined provisions for flexibility around a single qualifying notice period. Generally, CRMs are expected to reduce the volatility of energy prices (particularly close to real time). This reduces the value of flexibility that can be captured from the market and increases the importance of the (often) regulated revenue stream.

Capability requirements are not static. They will continue to evolve as renewable support regimes alter and as technologies adapt (e.g. deployment of renewables, demand side action, smart metering, plant reliability and the accuracy of wind forecasting). Flexibility needs for the future cannot accurately be predicted, but in most CRM designs there is no in-built ability to adapt. This brings future regulatory risk to most CRMs, in the event that their predefined requirement for flexibility (if any) fails to meet system needs and deliver reliability. This will inevitably lead to future change to CRM designs. The effect could be that market risk is replaced by regulatory risk.

A mechanism which delivers capacity to meet system peak (in MW terms) without consideration of flexibility may not be adequate to meet actual system needs, and is therefore a necessary but not sufficient condition for system reliability. In such a case, a further payment stream may be needed². Conversely, **a mechanism which delivers the capability to meet system needs over all relevant timeframes and notice periods should also deliver generation adequacy** in simple MW terms.

1.1.3 *The Target Model will need to embrace capability*

The European Electricity Target Model should be a clear step towards integrating renewable generation because it:

- **Places increased responsibility on market participants for trading energy up to as close as possible to real-time** with balance responsibility for all market participants and imbalance charges which reflect the full marginal cost of balancing.
- **Fosters greater integration of national electricity markets** through trading and allocation of cross-zonal capacity across timeframes, covering forward, Day-Ahead,

² For example, the BDEW proposals for a decentralised CRM notes that if flexibility is not delivered, and additional instrument may be required (Design of a decentralised capacity market, Position Paper, BDEW, 18 September 2013)

intraday and balancing to increase the sharing of resources across Europe (with estimated annual benefits ranging between €12.5bn and €40bn by 2030³).

Some areas of the Target Model are well advanced with markets preparing for a series of legally binding European Network Codes ('NCs'). The main development for the near-term has been on the cross-border trading of delivered energy, particularly in forward and Day-Ahead timeframes. Day-Ahead market coupling in the 15 countries of the NWE region started on 4 February 2014. Intraday market coupling, pricing of intraday capacity and arrangements to permit cross-border exchange of balancing services are less well developed. Crucially, it is in these less-developed markets that flexibility should find its true value.

In the following sections we give more detail on the four components of our proposals:

- balancing and imbalance arrangements;
- national energy options;
- cross-border trading of capability; and
- innovative reserve procurement.

³ 'Final Report. Benefits of an Integrated European Energy Market. Prepared for: Directorate-General Energy European Commission', Booz & Company, 20 July 2013.

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2. PROPOSALS

2.1 Our objective

This report suggests practical **market-based measures to reveal the value of flexibility** by facilitating trading over the full range of timescales, especially close to real-time. This is in line with our interpretation of the Target Model's intent.

Specifically, the objective was:

“To find the most economically efficient way of facilitating European goals for decarbonisation and security of supply, through signals and behavioural incentives for all market participants based on ‘market’ values for all services, with ‘simultaneous’ optimisation across timeframes and locations”⁴.

2.2 Proposal for balance responsibility

2.2.1 Recommendations

If all market participants face full balance responsibility, they will seek access to replacement energy to resolve forecast errors or risks of generation failure. This will directly lead to a value for flexibility which could be revealed in the intraday markets.

The intention of marginal balancing and imbalance pricing embodied in the Electricity Balancing Network Code ('EB NC') appears sound. We advocate no major changes to current provisions other than strengthening the principles and reinforcing that it will apply to all participants.

Within the balancing (and other spot) markets, there should ideally be no price caps or regulatory controls on bidding, and any market power mitigation should be done in ways which does not distort short term energy price formation. The effect of reserve contracting on balancing and imbalance prices should be removed. Balancing and imbalance prices should fully reflect the long-run marginal cost of balancing the system. This tackles the 'missing money' problem for (uncontracted) capacity used to balance the system whilst targeting reserve costs over periods where reserve is actually deployed. Different measures could be used to reflect the full cost of balancing actions in the price while excluding the impact of non-energy actions. While they need further definition they could include combinations of:

- a 'tagging' process to exclude non-energy balancing actions;

⁴ Meeting this objective should also help develop a healthy demand side market. Active demand participation should reduce the risk of future regulatory intervention and lower risk profiles for generators and suppliers alike. At times of system stress customers could choose not to buy (rather than being disconnected), reducing the need for (or legitimacy of) political intervention.

- an appropriate ‘adder’ for distributing the upfront reservation fees for contracted reserve capacity procured by the TSO in the balancing prices based on expected utilisation⁵;
- changing the nature of TSO-procured reserve to avoid fixing the activation price;
- a reserve scarcity (VoLL/LOLP) function for pricing reserve (when used to balance the system); and/or
- an Ex-Post Unconstrained Schedule (‘EPUS’) for revealing an unconstrained merit-order (this could remove some actions by the TSO and add some others).

The proposal suggested in this report for balancing and imbalance arrangements is in line with the EB NC although we suggest it could be strengthened in a number of areas as detailed in Table 1.

Table 1 – Changes in balancing and imbalance arrangements

	Preferred solution	Current proposals for the implementation of the Target Model	Actions needed to implement preferred solution
Balance Responsibility	Full Balance Responsibility for all market participants	Balance Responsibility for all participants is central to the EB NC	Support implementation of full Balance Responsibility through the EB NC
Nature of balancing and imbalance prices	Marginal imbalance and balancing prices	Default position of marginal balancing prices, with imbalance prices greater than or equal to the average	Strengthen requirements in EB NC for balancing and imbalance prices that reflect the marginal cost of balancing energy actions, with provisions for Balancing Resource Options (see below).
Costs reflected in imbalance and balancing prices	Imbalance and balancing prices to reflect long-run marginal costs of balancing energy provision including reserve procurement	Imbalance prices to reflect costs of activated balancing energy	Explicit requirement in EB NC for imbalance and balancing prices to reflect long-run marginal costs of balancing, minimising the distorting impact of any TSO procurement of reserve.

2.2.2 Delivery

It may appear challenging to move immediately to an unconditional European requirement for full marginal balancing and imbalance prices. For that reason we also advocate the promotion of appropriate trading instruments (energy options) to allow risks to be managed.

⁵ CfDs would be taken at a fixed activation price to avoid double payments for contracted reserve

Depending on the exact nature of the balancing and imbalance arrangements in each area, extra provision may need to be made for Balancing Resource Options ('BROs')⁶, which permit participants to hedge against balancing and imbalance prices. These are further described in the following section.

2.3 Proposal for trading of energy options

2.3.1 Recommendations

The move towards 'sharper' imbalance prices will reveal the need to develop appropriate risk management tools. These tools should take the form of energy options. **Energy options are market-based products for managing both price and volume risk which mitigate the risks of volatility.**

Capacity confers the option to deliver energy. Energy markets will reveal at any time a single 'best guess' of the value of energy for a particular delivery period, which will change as markets close on real time and many uncertainties crystallise. The energy price will likely include a value for scarcity at times although it is also likely that there will be a wide distribution of views on this figure. This 'best guess' fails to reveal the probability distribution of value around the 'best guess' price.

Trading of energy options (with different strike prices and delivery times) would permit traders to reveal their view of the volatility around the 'best guess' of the energy price. This market-derived view of the value of volatility should be a powerful way of determining how the capacity of networks, generation and other dispatchable resources should best be committed in different timeframes. Options have a rich set of dimensions, including the notice period (how flexible) and at what strike price (how much risk is transferred from buyer to seller).

Effectively, options allow the holder to transfer responsibility for volume (and price) risk to the provider of the option, in exchange for an upfront option fee. This fee allows the sellers (providers of capability over different timescales) to swap a volatile income for a more stable one. Options for intraday delivery are expected to be physical, so exercising the option results in delivery of a MWh contract nomination between the balancing accounts of the seller and the buyer⁷.

This report identifies two pre-conditions to the development of energy options. The first is that balancing and imbalance markets have to reveal the full value of flexibility so that participants have strong incentives to trade to avoid exposure. Subsidised balancing services procured by the TSO should be removed or nullified. The second is that intraday markets are in place with a sufficient level of market volatility, both in terms of volume and price.

Development of (national) energy options markets should emerge naturally when both of these conditions are met as they provide an alternative mechanism for the trading of delivery and risk management close to real time. Nevertheless, development of options

⁶ An early version of this concept was developed by Pöyry in 2011: <http://www.poyry.com/sites/default/files/imce/balancingresourceoptions-nov2011-.pdf>

⁷ Purely financial contracts could develop eventually but would need liquid intraday reference prices (e.g. through intraday auctions).

could also be encouraged by policymakers, both in developing BROs, and also in allowing the option value to be respected in the allocation of cross-zonal capacity.

The options approach, unlike most formal CRM schemes which have a very precise definition of qualifying capacity, should adapt naturally as the system evolves physically. There is no further need for regulatory intervention for intraday options.

The concept of options can be extended to allow exercise after intraday Gate Closure ('GC') in the form of BROs. These are a specific type of energy options that would allow market participants to hedge against imbalance risk. If the market adopts single marginal pricing for energy balancing and imbalance, and if balancing offers are always called if their price is better than the marginal price, then BROs could take the form of purely financial contracts between the participants. If balancing and imbalance prices could diverge or if balancing offers are not called in strict merit order, then additional provisions would be required in the imbalance arrangements to allow the risks to be effectively insured.

Critically, the revenue deriving from the sale of energy options is not expected to be a diversion of a portion of the overall value of energy. It is rather a replacement of a volatile (delivery-based) for a more stable (capability-based) revenue stream, retaining the full value of energy and scarcity within the spot markets. Energy market volatility should continue to govern cross-zonal trading (through market coupling) and should also deliver efficient prices to producers and consumers.

Effective markets for energy delivery close to real time should support forward markets for capability. A liquid forward market for capability in the form of options (with delivery at or after the Day-Ahead stage) could theoretically complement formalised CRMs, but should ideally be able to supplant them as a market-based equivalent. An options market could provide appropriate rewards for different capability, and these values could adapt to appropriately reflect changing system conditions through market adjustments. Such an approach may have less regulatory risk than more centralised solutions such as CRMs.

2.3.2 *Delivery*

Implementation will need a process of 'product' discovery, starting by listing a small number of option products to help develop liquidity in the options market. This would then build up confidence and experience to increase the sophistication and range. A natural process of 'product discovery' in competitive markets is one of the benefits of relying on decentralised trading of delivery (and the associated capability).

Compared with a firm energy trade, the minimum additional specifications for an option contract are:

- strike price;
- expiration time; and
- conditions for exercise.

The pricing and calculations of valuation and credit requirements are expected to develop as the market becomes more sophisticated.

As the needs of buyers and sellers evolve, energy options might well become more sophisticated and include block products as well as linked products.

The provisions set out for the implementation of the Target Model do not appear to provide any obvious barriers for energy options markets with delivery before intraday Gate Closure.

However, BROs that expire after intraday GC may carry risks that are not manageable through options struck between market participants. These will depend on the nature of balancing and imbalance arrangements. Rules will need to ensure that insurance contracts can play a part. A measure that could be used is an EPUS as described in the previous section. Ultimately, widespread use of BROs could even substitute for reserve procurement by TSOs (or at least limit its role to one of last resort).

2.4 Proposal for cross-border trading of capability

2.4.1 Recommendations

So far the report has described changes that could encourage market participants to trade products more actively within markets, until close to real time. The Target Model is designed to allow effective trading between markets, defined in terms of price zones.

The Target Model requires **appropriate allocation of capacity across all timeframes** but the emphasis of its implementation has so far only been on the Day-Ahead market.

Increasing importance of wind and solar generation will raise the significance of intraday. The optimal allocation of capacity between timeframes will be dependent on system conditions on the day, and in practice any allocation between timeframes which is fixed in advance is likely to be suboptimal⁸. Allocating (i.e. reserving) the entirety of cross-zonal capacity primarily to the Day-Ahead market may not deliver the optimal social welfare in all market circumstances, since it forecloses the opportunity value of flexibility for use in shorter market timeframes.

A major challenge for effective cross-zonal trading is that the Target Model implementation does not include a market-based mechanism to compare the value of using network capacity in different timescales. The EB NC embraces this point. It suggests dynamic allocation mechanisms between Day-Ahead and balancing timeframes (for Balancing Capacity) rather than static ex-ante reservation. We have extended this logic beyond the strict boundaries of Balancing Capacity (reserve procurement) to the intraday timeframe.

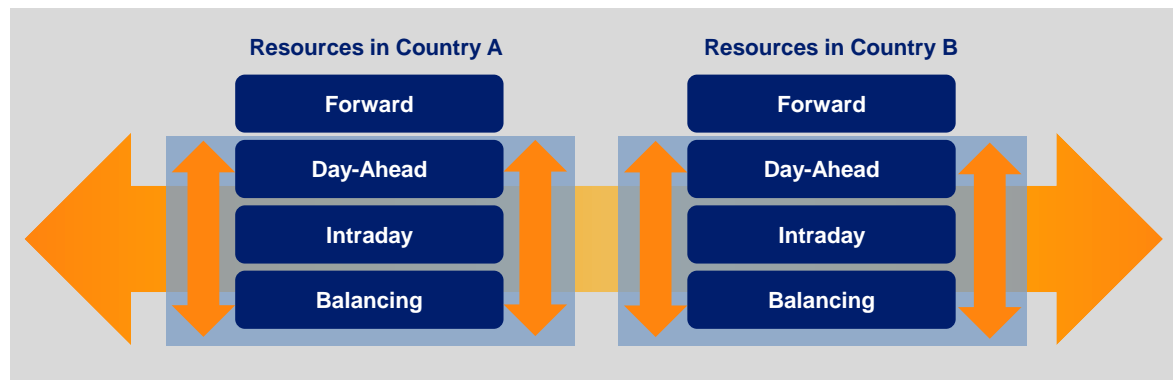
In line with the philosophy of allocating capacity between balancing and energy delivery, we advocate efficient allocation of cross-zonal capacity across different timeframes. Prices should be offered (or derived from option prices) for cross-zonal capacity for use intraday, ahead of the intraday market. This should deliver market-based values which can then be used to allocate cross-zonal capacity across timeframes. Such an approach should better respond to system conditions on the day compared to just "reserving" all

⁸ The 2012 RAP advisory note on the Balancing Framework Guidelines states "*With a generation mix that contains a high level of intermittent renewable generation, the optimum allocation of interconnector capacity will be highly dependent on weather conditions and therefore difficult to identify accurately much in advance of real time.*" (RAP, Advisory Note: Balancing Framework Guidelines to Promote an Integrated, Low-Carbon, European Electricity Market, June 8, 2012)

available capacity at Day-Ahead and deliver more efficient use of resources between bidding zones across different timeframes. This is visualised in Figure 3.

So a long-term vision is to create **effective competition in cross-zonal capacity between timeframes by using energy options**. At any point, this would confer a choice between committing now and retaining the option to commit later. It should be supported by long-term transmission rights that allow for trading cross-zonal capacity over the full range of timescales (including forward).

Figure 3 – Optimisation across different timeframes and bidding zones



2.4.2 Delivery

Two potential mechanisms could be used to allocate cross-zonal capacity between Day-Ahead and intraday without using ‘reservation’. Although they are quite different, we believe both should be taken forward to the next stages of definition of the Target Model:

- **either** implicit energy options market coupling; **and/or**
- cross-border energy options trading supported by explicit transmission rights.

Under the first, the market coupling algorithm at the Day-Ahead and intraday would consider the effective value of cross-zonal capacity from cross-border trades of energy against a value of capacity from cross-border energy options trades. The allocation would be based on a net export curve that combines firm energy products and energy options. The allocations between options and commitments should evolve as markets move closer to actual delivery. The ‘time value’ of the options should collapse as expiry time approaches and so the capacity would tend to be committed for firm energy trades. This mechanism would allow the possibility of committing flows closer to real time rather than at Day-Ahead, foreclosing their value and locking out flexibility. Equally, if the option value rose during the day, the value of a cross-border option could trigger a counter-trade for energy. It could also become a tool for TSOs to hold cross-zonal capacity for balancing, instead of long term ex-ante reservations which are being proposed between some markets.

Even though this mechanism would be the ideal solution, the lack of liquid energy options markets may mean that it is not immediately realisable. A viable alternate could be to allow energy options trading supported by explicit transmission rights for optional use intraday. This would have the benefits of faster implementation whilst supporting TSO countertrading. Participants in the Day-Ahead or intraday markets could bid for explicit rights for later use, and if the value is high enough it would attract capacity, potentially through counter-trading of committed energy flows. Introduction of explicit transmission rights is permitted within the current provisions of the NCs as a transitional measure for a

non time-limited period pending the development of more sophisticated products (which could be interpreted to include energy options).

Either approach would allow the opportunity value of cross-zonal capacity to be realised in the Day-Ahead algorithm. It would also permit additional value to be realised by interconnector owners (or capacity holders) and give stronger incentives for new interconnection, especially from the Nordic countries which have a 'flexibility surplus' and an expected energy surplus.

We note that trying to accommodate energy options in the Day-Ahead market coupling now could divert effort from delivery of a robust Day-Ahead market coupling solution.

When it comes to explicit rights, there are concerns they could compromise transparency and even provide a means for market participants to withhold capacity. If mitigation measures are deemed necessary, they could include a requirement for transmission right holders to offer the rights back to the market at a transparent price, regulatory 'pricing' rules, and specific market monitoring.

We recommend that both alternatives are permitted within the Network Codes until final decisions are taken on the intraday market arrangements.

Whichever alternative is preferred, there should be adequate access to long term transmission rights as they form important hedging instruments that allow participants to trade energy options cross-border in the forward timeframe. Ideally they should take the form of FTRs, which support liquidity in the relevant spot markets. However, PTRs could be considered in the situation where liquid energy options markets have yet to evolve.

Finally, the exact implementation of the allocation mechanism (to account for subsequent timeframes) into the Day-Ahead algorithm should not act as a barrier to existing implementation plans. The Day-Ahead algorithm should be sufficiently flexible to accommodate future adaptations.

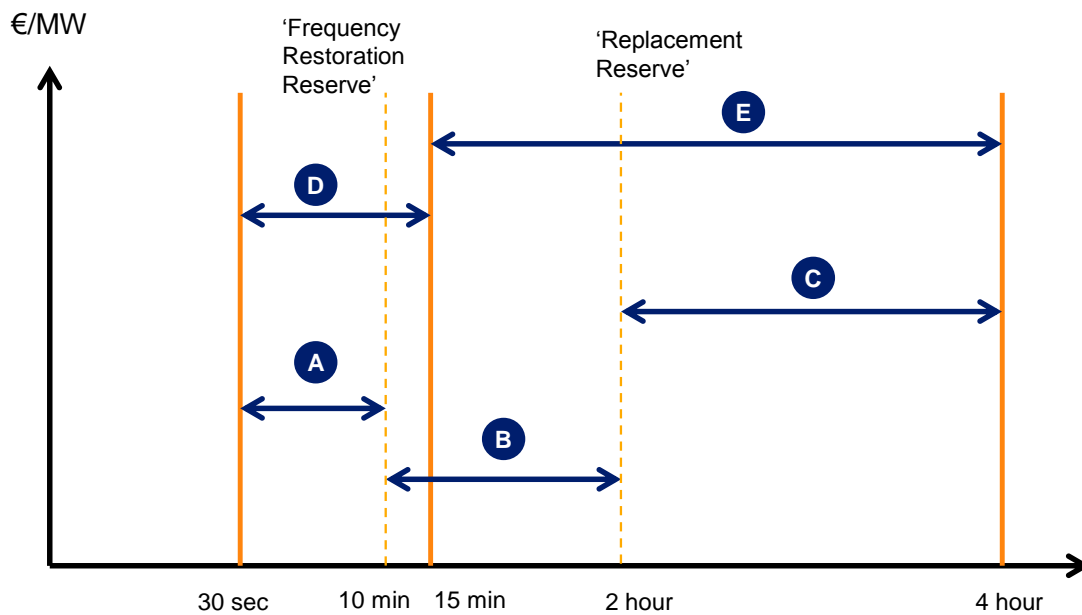
2.5 Proposal for innovative reserve procurement

2.5.1 Recommendations

Balancing services are typically the preserve of TSOs. Commercial incentives on participants to balance generally covers only total MWh within each settlement (or balancing) period. Having shorter settlement periods would require costly changes to metering and data communications, and is not a viable way forward⁹. The objective of the EB NC and underlying Framework Guidelines ('FGs') to create liquid trading among a limited set of Standard Balancing Products is laudable, but in our opinion will be very difficult to achieve. Balancing is complex, with the system needs and the capabilities of generators varying between systems that have very different histories. Harmonisation will be very hard. TSOs are now trying to define common dimensions for Standard Products (ramping etc.), but these can give a huge number of potential products, even assuming delivery can be standardised.

⁹ That said, energy balancing periods should ideally be fully aligned with the imbalance settlement periods, thus providing the right incentives to market participants to be fully balanced (in MWh terms).

Figure 4 – Non-standard products for reserve procurement



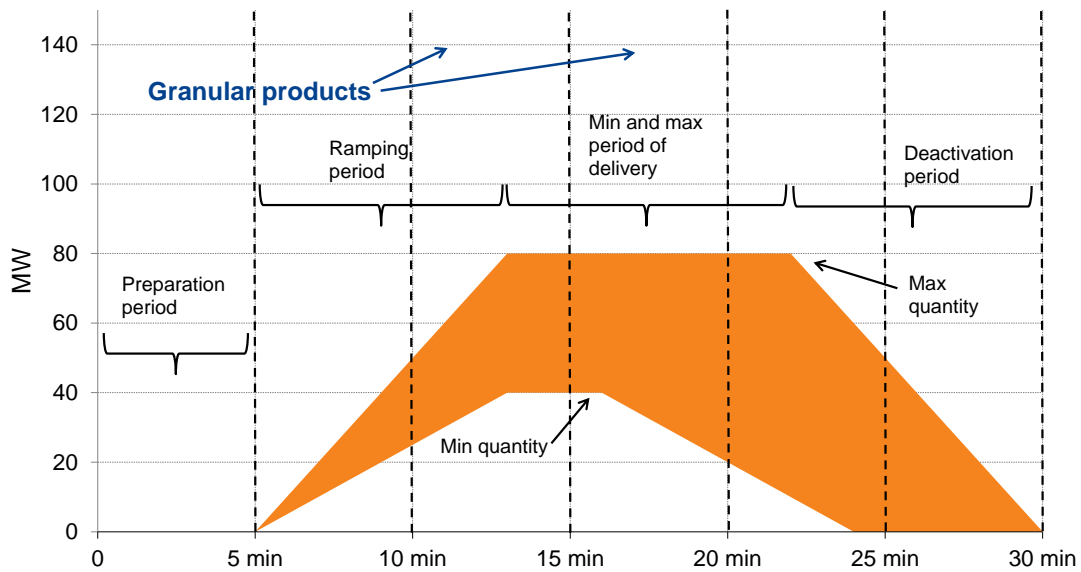
With a small number of ‘product buckets’ some providers would be excluded as a result of not meeting a predefined set of criteria. These providers could still be in a position to offer a valuable service and in some cases even help meet the overall TSO requirements with a lower cost.

This is illustrated and can be more easily explained by the simplified example shown in Figure 4, which defines services in terms of their speed of response, duration and price of delivery. The solid orange lines show the strict definitions of two products (i.e. Frequency Restoration Reserve and Replacement Reserve) as well as the capabilities of providers D and E. The dotted light orange lines, on the other hand, show the capabilities of providers A, B and C. The price at which each provider offers the service is defined by the y-axis, whereas the speed and duration is defined by the x-axis. For example, provider A can respond in 30 seconds and last for 10 minutes. Under the strict definitions of the two products (Frequency Restoration Reserve and Replacement Reserve), a TSO would procure the required service from providers D and E that fully meet the predefined requirements (in terms of duration, ramp rates etc.) of each product. However, a TSO could meet the same overall requirement at a lower cost by procuring from providers A, B and C.

One attractive alternative is allowing providers declare their own capabilities to meet an overall reserve requirement set out by the TSO. Reserve products have two essential attributes: the speed of response and the maximum duration of delivery. As plant operators have very different capabilities and do not conform to one set of standard parameters, it makes sense to be less prescriptive. This would encourage ‘non-standard’ providers (demand side resources, pumped storage, compressed air storage and batteries) to compete on an equal footing.

This might stimulate development of more granular products based around the ability to deliver energy between certain points in time. For example, a product could emerge for energy delivery between 5 and 10 minutes after the TSO requests activation. This is illustrated in Figure 5.

Figure 5 – ‘Envelope’ of delivery and granular products



New balancing arrangements should embrace innovation from providers and TSOs alike. TSOs would trade off delivery times for different products and providers with non-standard characteristics. Meeting the reserve requirement in such innovative ways may however come at the expense of liquidity that a small number of Balancing Products would create. There is a clear trade-off between accommodating a lower cost solution through more complex structures and liquidity arising from the use of small number of reserve products.

The Reserves Procurement Optimisation Function would have to take different characteristics into account in optimising the cost of meeting TSO requirements using these more granular products. It should produce clearing prices using granular products and these should be used to provide indicative values to all market participants.

2.5.2 Delivery

The main challenge for this approach is to ensure that any Standard Products are sufficiently adaptable to allow a set of more granular products to emerge.

Scope for the bid formats for reserve procurement should be expanded, allowing more sophisticated bids which reflect the ‘delivery envelope’ rather than a simple price bid for a single Standard Product. These bid formats could draw on the examples from energy markets – e.g. different varieties of block bids, minimum income condition bids, fully complex bids (start-up and no-load costs bid separately from incremental energy costs).

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3. CONCLUSIONS AND NEXT STEPS

3.1 Future vision for the trading of flexibility

Based on current trends, the future arrangements for electricity markets with high levels of intermittent renewables might be characterised by:

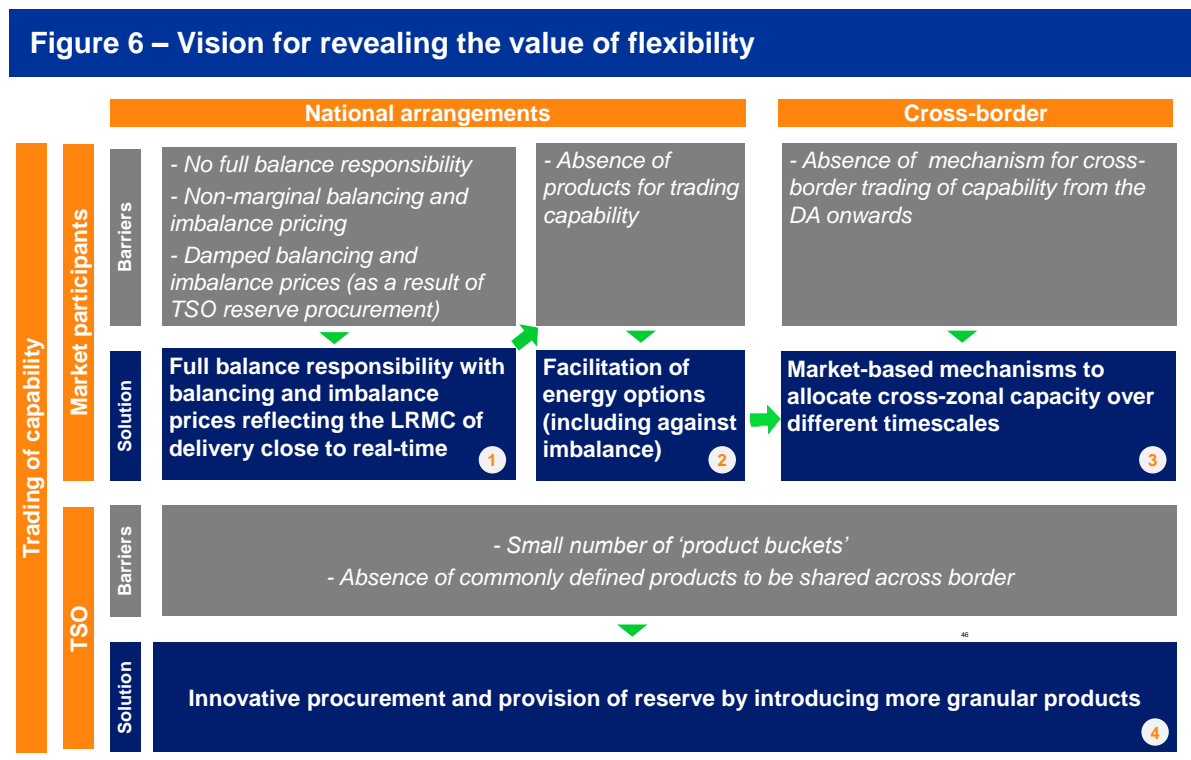
- trading of delivery but not capability between market participants;
- CRMs making a significant contribution to plant remuneration; and
- a central role for TSOs in procuring capability, giving them a strong influence (as a ‘single buyer’) over the total value of those services.

As an alternative, our proposals support a more market-based vision for revealing the value of flexibility in future electricity markets:

- trading of both delivery and capability between market participants, even in different price zones and across all timeframes;
- reduced scope for centralised CRMs; and
- a more limited role for the TSO in capability procurement.

3.2 Proposals

Figure 6 summarises our vision for the future trading of flexibility and the four steps necessary to make this vision a reality.



The value of flexibility will be enhanced by assigning full balance responsibility to each participant and exposing it to full marginal balancing and imbalance prices¹⁰. To allow participants (especially those with variable renewable generation) to manage imbalance risks we advocate trading of energy options for delivery intraday, including balancing timeframes. Such options could be traded before Day-Ahead. This would allow more predictable revenues for peaking and mid-merit generators and other providers of flexibility.

Cross-zonal capacity should be made available in all forward timeframes. A mechanism should be included in the Day-Ahead coupling process which permits capacity to be allocated against energy options for use later (i.e. intra-day or balancing). This can be achieved through both implicit energy option market coupling and explicit transmission rights to support trading of energy options.

We also outline a way which would permit TSOs to exchange more granular balancing products, in a way which supports innovation by service providers and by the TSOs in their procurement. This is designed to address the expectation that the existing plan to create a liquid cross-border trade of a small number of Standard Balancing Products may face difficulties in further design and implementation.

3.3 Delivery

While this vision fully supports the spirit of the Target Model, a phased approach will be required given:

- **Current situation:** We could crudely characterise today's situation as a range of national arrangements with cross-border trading of delivery by market participants that is focused primarily on the forward and the Day-Ahead markets. There is a trend towards more centralised procurement of capability (largely on a national basis) particularly for delivery close to real time either through reserve products or different forms of CRMs.
- **Coordinated approach:** There needs to be a coordinated approach to implementation for markets to recognise the value of flexible capability. Resolving short term unpredictability may cost more and, therefore, mitigation tools need to be developed to allow parties to better manage these risks.
- **Proposed pace and focus of implementation of different aspects of the Target Model:** Any changes to the details of the Target Model must not unduly delay progress in areas where more headway can be made in the short term. For example, it is worthwhile to consolidate robust cross-border trading mechanisms for Day-Ahead delivery whilst not prohibiting the delivery of our vision in the medium term.

3.4 Next steps

We have only discussed areas where there seems to be scope to influence discussions. This paper is a first step of several that are required to implement the vision described in this paper. Next steps should be:

¹⁰ The arrangements should explicitly avoid imbalance prices from being distorted by TSO procurement of reserve, and we propose ways of achieving this.

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- further discussion and dissemination to develop a common understanding amongst all stakeholders on the ideas in this paper:
 - including regulatory validation to confirm that the concepts are in support of market efficiency and the underlying vision of the Target Model;
 - assessment of the economic benefits and setting principles, identifying the markets where cross-zonal intraday trading is the most advantageous;
 - development of the ideas in terms of a detailed design stage:
 - to test the inclusion of options in the market coupling algorithms; and
 - discussion between trading participants to develop pricing algorithms for intraday options; and
 - testing the interaction with CRMs designed on a national level and influencing them to be consistent with the philosophy of energy options.

In taking these steps we can create an opportunity to build a more robust and enduring market for valuing capability. While there may be new difficulties to overcome, the potential benefits should easily outweigh the effort.

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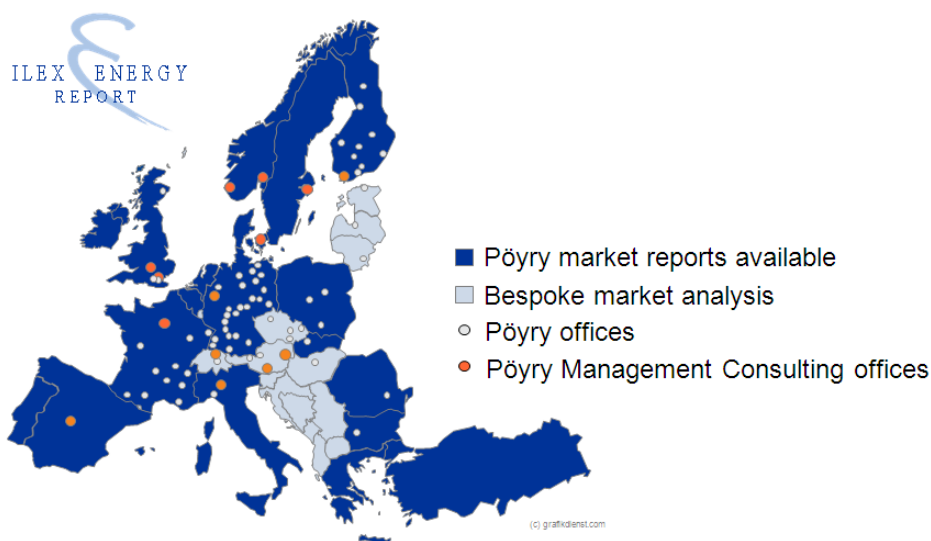
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