



# **ERGEG Guidelines of Good Practice for Electricity Balancing Markets Integration**

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## General Considerations

### 1 Introduction

EREG, following presentation to the XII Florence Forum in September 2005 of its *Position on balancing Mechanisms Compatibility*, has developed a draft of *Guidelines of Good Practice for Electricity Balancing Markets Integration*. EREG now seeks views on these draft Guidelines.

EREG invites stakeholders to comment on issues raised in these Guidelines. Responses should be received by 3 August 2006 and sent to: [balancing-integration@ereg.org](mailto:balancing-integration@ereg.org)

Any other questions on this document should, in the first instance, be directed to:

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Unless marked as confidential, all responses will be published by placing them on the EREG website [www.ereg.org](http://www.ereg.org). If there is anything confidential please include it in a separate annex to your main response.

### Background

EREG is committed to the development of an effectively competitive single market for electricity across the whole of the EU, while at the same time taking into account security of supply and system reliability. Moreover, EREG has devoted much of its attention over the last years in considering how such a market might be reached and what issues should be prioritized in reaching it. EREG presented its view of the evolution of balancing mechanisms and of their integration to the XII Florence Forum in September 2005.

A consultation exercise by EREG of the creation of the regional electricity markets during the summer of 2005<sup>1</sup> suggested that differences in wholesale market arrangements were potentially a significant impediment to trade and the completion of the single market. EREG's conclusions paper published in February 2006 confirmed this view.

A lack of integration of balancing markets is therefore a key impediment to the development of a single European electricity market. Such integration is a process of evolution of connecting balancing markets in order to achieve their functioning as a common balancing market.

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<sup>1</sup> *The Creation of Regional Electricity Markets: An EREG Discussion Paper for Public Consultation*, 8 June 2005

Bearing in mind this preparatory work and the identification of balancing market integration as a key issue for an internal electricity market, EREG has in early 2006 further developed its view on the need and method for integrating balancing markets. These Guidelines are particularly aimed at stakeholders, grid operators and market participants and are intended to support EC and national competent authorities, in developing and implementing appropriate policies towards the integration of balancing markets in the EU, within the broader scope of the evolution of the Internal Electricity Market.

These Guidelines restrict attention to the procurement of manually activated power reserves by TSOs based on the services and products from market participants. Hence automatically activated power reserves, intra-day markets and any ancillary services not procured as manually activated power reserves are outside the scope of these Guidelines.

These Guidelines set out EREG's recommendations on the need and method for integrating balancing markets and so this consultation invites views on this subject by all interested parties.

#### Anticipated Consultation Process

EREG will publish and consider responses to this consultation following the deadline. Following this, EREG will publish a Conclusions Paper summarizing responses received. The conclusions should be published in time for the presentation of revised Guidelines at the next Florence Forum, presently anticipated for autumn 2006.

Following the finalization of the Guidelines, EREG would anticipate that regulators and other relevant stakeholders will work towards their implementation. Such work is likely to take place also within the context of the Regional Initiatives that the regulators have established, and which were launched at the end of February 2006.

## **2 Functioning of Balancing Markets**

The real time operation of a power system requires that TSOs ensure a continuous balance between supply and demand. In competitive electricity markets, a balancing mechanism therefore generally exists such that TSOs can undertake balancing actions – that is, they identify the need for, and procure adjustments in, generation or demand – in order to maintain balance in the power system for which they are responsible. Imbalance pricing arrangements can be used to encourage market players to maximize their efforts to be in balance. Balancing markets therefore form an integral part of the overall wholesale electricity trading arrangements and timetable.

The overall trading timetable extends from months or years before a trade is to be executed, to 'gate closure', further to the moment the trade is to take place ('real time'), and then beyond this in terms of settlement of the trade. By gate closure (day ahead, or one hour before real time, or possibly even shorter time), generation and load parties must notify the TSO of their expected physical positions at real time. Additionally, within the balancing market they can submit bids<sup>2</sup> and offers of the extent to which they are willing to be paid to deviate from these positions and what has to be paid for this service.

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<sup>2</sup> In general, the times of notification and bidding can differ.

Following gate closure, the TSO will make calls on the bids and offers of generation and load in order to balance the system at least cost. Where intra-day markets exist, TSOs will need to take into account further restatements of bids and offers when making such calls.

A general overview of the interaction of balancing and other markets, in relation to the capacity allocation in time, is shown in the Figure 1 below.

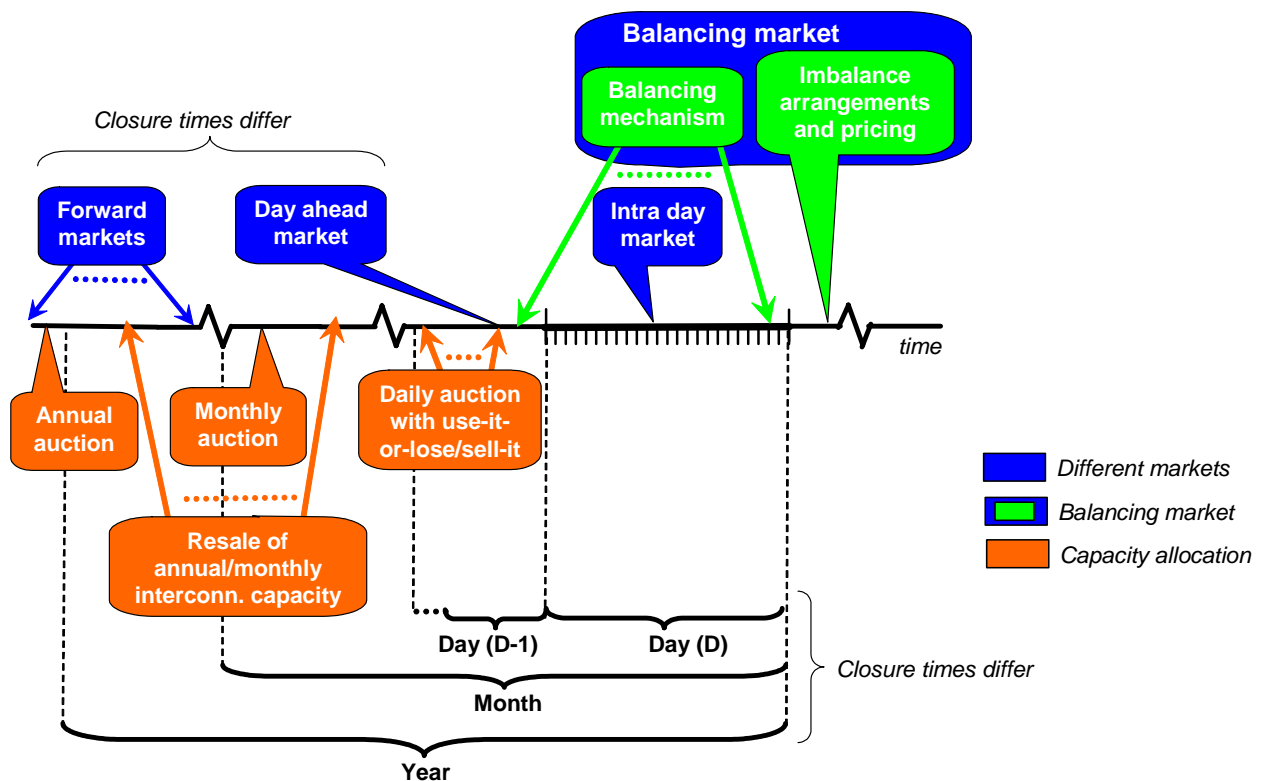


Figure 1: Interaction between balancing and other markets and relation to capacity allocation

### Governance and institutional arrangements

It is important to bear in mind that balancing market integration will raise new issues. Of particular importance will be the issue of the legislative and regulatory basis for the integrated market. In a national market, the legislative basis, regulatory oversight, and set of balancing market rules all coincide under one jurisdictional territory. Where market parties have issues to resolve, they may be pursued via the governance process for the balancing market in that territory, or via the regulator there. Equally the regulator will have the appropriate powers within that territory to monitor and enforce rules.

Directive 2003/55/EC assigns to the regulator the sole competency for the functioning of the balancing market within a Member States. With regard to cross border issues, there is a need for regulators to co-ordinate. It may not be clear for example about which regulator has competence to oversee or enforce any breach of rules, to whom an aggrieved market party should turn where a difficulty arises, or which regulator or regulators may approve or veto

modifications to balancing market rules. This cross border 'regulatory gap' will need to be addressed in any market integration question.

### **3 Principles and Benefits of Efficient Balancing Market**

#### Fundamental features

The purpose of balancing markets is to serve short-term operational security of supply (security of grid operation) in a market oriented way.

Hence, balancing markets should operate in an economically efficient manner. Procurement of balancing power by TSO shall be made using market based methods. Balancing markets should further promote effective competition, should not aggravate market power and should be non-discriminatory.

The roles and responsibilities in the balancing market need to be defined explicitly and clearly. Finally, balancing markets shall have clear and transparent processes governing the proposals for modifications of the balancing market rules.

#### Balancing mechanisms

Balancing markets are generally designed such that market participants each have incentives to minimize their contribution to the overall costs of the balancing mechanism. For example generators who are 'short' compared to their notified position will generally be required to purchase the difference between energy notified and delivered at a price determined under the balancing mechanism rules. This price is likely to reflect the costs to the TSO of procuring the 'missing' energy and is likely to be relatively high compared to the price which the generator might receive for production. This minimizes the amount of balancing energy needed and thereby the overall balancing costs. Similarly, TSOs themselves may be subject to incentive mechanisms by the regulator which are designed to encourage the TSO to call off balancing actions in a least cost manner.

Balancing markets may be at risk from the exercise of market power, even where the market is relatively unconcentrated, because relatively small players can have a large market impact when the supply/demand margin is small, they have specific geographical position and/or technical characteristics and where the demand side or other generators are already committed or are unable to respond in very short timescales to price signals. A well functioning balancing market should be robust, to the extent possible depending on market structure and concentration, to any such exercise of market power. Transparency of operations in the market by players will enable other players and the regulators to expose and therefore discourage any anti-competitive behaviour.

In order to allow the TSO full control over system stability, it is generally compulsory for all wholesale market players connected to the transmission system either to be a direct balance responsible party or to contract through some form of aggregator who is a direct balance responsible party. Market participants are then either directly or indirectly bound in a mandatory fashion by the prevailing balancing market rules. Furthermore, given that the market legislative and regulatory environment is dynamic and affects all market parties, it is desirable that governance processes exist such that the rules can be modified in the light of circumstances. Such governance processes should enable parties to the balancing market to propose

modifications and for such proposals to be assessed and accepted or rejected against transparent criteria. The regulators will usually retain a right of veto over any decision to modify rules.

#### Imbalance arrangements and pricing

Imbalances can occur only during operational hour and they will be balanced using balancing power provided by balance responsible organisations like e.g. the TSOs. The costs of dealing with imbalances can be dealt with by distributing them across all users, by allocating the costs to the market participant that is out of balance or by a combination of both. In any case, parties out of balance will be subject to some form of 'imbalance charge'.

Imbalance arrangements and pricing shall be simple and transparent so that principles behind them are easily understood and justified so that economic risk for market participants can be easily assessed. Imbalance arrangements need to enhance the efficient operation of the balancing market and the wholesale market. Balance settlement arrangements shall enhance accuracy in settlement and short time schedules for the final settlement and invoicing.

An efficient balancing market corresponding to the principles listed above will in itself provide benefits. TSOs will for example be able to efficiently procure balancing services using an appropriately designed mechanism. This will promote efficient and competitive price discovery and market liquidity. A high degree of transparency concerning market rules, price formation, and market participation will also facilitate the functioning of the market by allowing market parties to make informed decisions and minimize risk concerning investment and operation. Altogether the benefits of such features will encourage market entry and competitive pressures to develop, and for overall system costs to be minimized.

#### Benefits of Balancing Markets Integration

Given that there are gains from trade to be reaped, the benefits can be enhanced if adjacent connected balancing markets<sup>3</sup> are made compatible such that TSOs and market parties can access both markets. EREG suggests that balancing markets integration can provide the following further benefits:

- Provide TSOs with access both to a more diversified generation technology mix and further opportunities to offset deficit and surplus net generation positions, so helping them to minimize balancing costs and increase efficiency.
- Increase competitive pressures so that possibilities for the exercise of market power in any one of the balancing markets are reduced.
- Contribute to sharing reserves and security of supply. In an area where TSOs have compatible balancing mechanisms, each TSO will be able to call balancing power from neighbouring TSO in a market based way, and so contribute to the reduction of the risk of supply interruption.

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<sup>3</sup> Even if technical reasons (e.g. no AC connection) could prevent it, everything possible must be done to ensure that areas which are not synchronously connected could also trade balancing energy.

Balancing market integration shall therefore enhance the development of further price formation and liquidity, competition, and overall cost minimization. Integration will also be an opportunity to further consider and where necessary reinforce the extent to which balancing markets provide a sufficient degree of transparency to market participants and regulators.

#### Guidelines of Good Practice

Given the advantages described above, ERGEG's ultimate aim is to integrate European balancing markets as far as technically possible in order to minimise costs and improve security of supply.

As there are several obstacles, the integrating of balancing markets will be a long-term goal. To enable a process of evolution of balancing markets integration, these Guidelines also refer to a medium-term goal of making balancing markets compatible.

Compatibility of balancing mechanisms in the context of these Guidelines refers to

- a process of adaptation of the most important features of connected balancing mechanisms (i.e. balancing mechanisms established in adjacent control areas) with the aim of providing to every TSO access to balancing power reserves existing in the neighbouring systems in real time, considering the cross-border interconnection capacity available. Compatibility means that products type, timescales definition, etc., will not stop exchange possibilities among different markets.

Integration of balancing markets is

- a process of evolution of connecting balancing markets in order to achieve their functioning as a common balancing market. The process consists of the harmonisation and standardisation of the involved markets features, e.g. technical requirements, types of allowed participants, timescales, format and contents of the notice to delivery, products characteristics, bidding process and platform, payment procedure, data exchange and information publication, etc. Integration means that there is a single market.

These Guidelines intend to foster the achievement of that aim by laying down general principles and detailed rules needed for integrating European balancing markets. Therefore the Guidelines of Good Practice include a roadmap which proposes options for the integration of balancing markets.



## Guidelines of Good Practice for Balancing Markets Integration

### 4 General Principles

Integrated balancing markets shall be designed in a way to balance supply and demand in real time in a market oriented way, contributing to maintain and improve operational security at least cost. Exchange of balancing energy across borders utilizes certain amount of cross-border interconnection capacity. The way this kind of exchange is liable to compete with commercial trade needs to be defined in compliance with the relevant requirements from the Regulation (EC) 1228/2003. The Article 6.3 of the Regulation may be of particular relevance in this context.

Integrated balancing markets shall operate in an economically efficient manner. Procurement of balancing power by TSO shall be made using market based methods.

Integrated balancing markets shall promote effective competition, shall not aggravate market power and shall be non-discriminatory.

The roles and responsibilities of all involved parties in the integrated balancing market need to be defined explicitly and clearly.

Balancing markets shall have clear and transparent processes governing the proposals for modifications of the balancing market rules.

Where balancing markets become integrated, the responsible regulators must clarify the regulatory route by which the integrated balancing market is monitored and its rules enforced.

Appropriate standards for automatic data and information exchange between balance responsible organisations and market actors during planning, operation and settlement phases of balancing shall be in place to ensure secure system operation and to facilitate transparency.

Imbalance arrangements and pricing rules shall be made compatible in a truly integrated balancing market. They shall be designed in order to facilitate and to promote competition in wholesale electricity markets and not do distort the competition between balancing market participants from different control areas.

### 5 Balancing Mechanisms

#### Security of grid operation

In most Member States (control areas) the potential participants of the balancing mechanism must demonstrate that they fulfil certain technical requirements e.g. in the pre-qualification procedure, whereas in some Member States (control areas) no explicit and uniform pre-qualification procedures exist.

- Whereas the technical requirements have to be common in any participating control area in order to enable the integration of balancing markets, compatibility of balancing mechanisms can be reached without changing the control area specific pre-qualification requirements.

The harmonisation of technical requirements might be difficult as such requirements can be established differently in each Member State (control area). It can be established e.g. by law, decrees, agreements and contracts approved by the regulator or based on common practice.

- Integration of balancing market requires harmonisation of technical requirements of balancing mechanism, especially regarding the following issues:
  - In an integrated balancing market the requirements for participating in the market are the same across all control areas. Currently, the type of participants accredited to the balancing market still differs among the Member States (control areas). This will be a barrier to integration. Except for the exchange of balancing power between TSOs within compatible balancing markets any further integration will require harmonization in this issue.
  - Besides generation, participation of load can be beneficial for promoting competition and reduction of costs. Again, to avoid market distortion and discrimination, the requirements of participation have to be adjusted across the Member States (control areas) if balancing markets are to be integrated.
  - Another technical feature important for maintaining system security is the ramp-up and down capability of the participants (generators / loads) including the requirements on the timescales, format and contents of the notice to deliver. Currently, the requirements differ across control areas (Member States). Integration of balancing markets requires compatibility of requirements.
  - The compatibility requirement applies to the minimum offer size. Harmonization should have the focus to minimise barriers to market entry.

#### Acquisition of transmission capacity for balancing purposes

- Whether the interconnection capacity should be reserved for balancing purposes in advance must be determined within the competitive market framework. In any case the exchange of balancing power is dependent on the availability of adequate transmission capacity between adjacent control areas.
- In general there are a number of alternatives for the acquisition of transmission capacity for balancing purposes. The balancing market participants can either acquire the amount of capacity in the day-ahead stage or a certain amount of capacity can be reserved for balancing purposes by the TSOs. Alternatively, cross-border capacity for balancing can be made available from the capacities not nominated in the day-ahead market, from previously not allocated capacities, or from additional capacities resulting from actual network security calculations. Furthermore there are different alternatives for the allocation of cross-border balancing capacity. Market based methods should be preferred and any method must be compliant with the Congestion Management Guidelines according to the Article 8 of the Regulation (EC) 1228/2003.
- System security depends on the availability of sufficient balancing power and energy. Even in a situation where the existence of congestion eliminates cross-border balancing trade, system security within each control area has to be maintained.

### Efficiency and competition

- The payment procedure has to be non-discriminatory in order to minimise the risk of market distortion. Currently participants of balancing markets are mostly either paid as bid or receive the market clearing price. The coexistence of different payment rules within compatible balancing mechanisms might result in for example suboptimal differences in the number of attracted participants between the single markets.
- There is another important characteristic of payment of balancing participants. Currently in some Member States (control areas) the participants of the balancing market are paid either both, for the availability of capacity (capacity payment) and for delivering balancing energy (energy payment) or only for delivering balancing energy. Harmonisation of, or at least making consistent<sup>4</sup> payment structure is required in order to enable a functioning integrated balancing market.
- Additionally, the criteria for the selection of bids are different across Member States (control areas). Where a capacity payment exists the selection of bids might be based on the price of power and/or energy. Integration of balancing markets requires a common pricing and payment structure.

### Operation of balancing mechanism and market

- Integration of balancing markets might benefit from the establishment of a kind of “balancing market coordinating party” (that can be for example a part of the TSO, of the association of the TSOs, or of other market operators) that partly or fully takes over the task of operating the integrated balancing mechanism.
- The operation of the balancing mechanism requires exhaustive and secure data exchange between participants and transmission system operators as well as between transmission system operators themselves. Therefore data exchange for pre-operation, operation and clearing & settlement has to be as automated as possible. Furthermore, the integration of balancing markets requires standardisation of data exchange.
- For reasons of overall efficiency the selection of bids should be based on the merit order of the balancing offers. Any deviation of the merit order can only be accepted as long as it is necessary to maintain system security and has to be precisely justified in accordance with pre-defined criteria.
- The products of the balancing mechanism represent the characteristics of the operation window (duration and starting time). The same required duration (i.e. minimum time for which the called product must be “on-line”), ramping and start-stop time must be applied for each of the (possibly) different products in the integrated balancing market.
- For pre-operation timeframes the same applies as for the operation timeframes (products). They have to be compatible to enable participation of loads and generators from other control areas and increase exchangeability.

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<sup>4</sup> It may be possible to have 'capacity' type payments existing in energy markets, such as where the TSO contracts for reserve, so that capacity elements in energy markets are consistent. Making payment structures consistent may then be less of a problem and require less direct harmonization.

- In the longer-term, a common platform (e.g. a common website) where all the information relevant for the integrated balancing market is available will be needed. For the integration of balancing markets this platform should be extended to a common bidding platform.

#### Regulation and governance

- Regulators should in particular agree to exchange information and data necessary for the oversight of the market as a whole and to consider and remedy any breaches of balancing market rules in the home territory that have effects in the wider integrated balancing area.
- Modification of balancing market rules shall be carried out only where it can be demonstrated to lead to an improved functioning of the competitive market, and subject to veto from the relevant regulator or regulators of the integrated balancing area.

## **6 Transparency and Information Management**

EREG considers that the establishment of a clear pan-European framework for information transparency is of particular importance – within that context, reaching a high level of transparency concerning balancing is of the utmost importance.

A common set of rules shall set down requirements on the way in which information has to be published. All information required for the effective functioning of the integrated balancing market shall be structured, aggregated appropriately and made available to the public in a format which takes into account the needs of all concerned players.

In addition to the information listed below, which is required from the market and market operation perspective, TSOs (or other parties responsible for clearing and settlement) must allow regulators to monitor precisely and jointly the integrated balancing markets.

Information related to balancing should be released on a non-discriminatory basis across and between control areas (Member States).

The availability of balancing information both across and within Member States (control areas) at all levels of the electric power supply value chain is of vital importance to ensure the efficiency of national markets and of the overall European market.

TSOs (or other parties responsible for clearing and settlement) are consequently requested to publish the data presented in the following table<sup>5</sup>.

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<sup>5</sup> ERGEG Guidelines of Good Practice on Information Management and Transparency, public consultation at [www.ereg.org](http://www.ereg.org).

Information	Publication	Timeframe	Key benefits of information	Provider
<b>Volumes of bids and offers used</b>	Just after real time, to be kept at least for one month	Per balancing mechanism time unit	<ul style="list-style-type: none"> <li>To help market players to formulate their balancing offers</li> <li>To increase the level of transparency in the management of TSOs</li> </ul>	TSO or responsible for clearing & settlement
<b>Average and marginal prices of bids/offers with prices corresponding to global imbalance</b>	Just after real time, to be kept at least for one month	Per balancing mechanism time unit	idem	TSO or responsible for clearing & settlement
<b>Imbalance prices</b>	Just after real time	Per balancing mechanism time unit	<ul style="list-style-type: none"> <li>To help balance responsible to optimise their imbalance's level</li> </ul>	TSO or responsible for clearing & settlement
<b>Control area imbalance volumes and volume of manually activated reserve (balancing power) used</b>	Just after real time	Per balancing mechanism time unit	<ul style="list-style-type: none"> <li>To help balance responsible to optimise their imbalance's level</li> <li>To enable monitoring</li> </ul>	TSO
<b>Information on the financial balance of the whole market (expenses on the balancing market / payment of imbalances)</b>	Month M+1 for month M, to be updated until final reconciliation	Per month	<ul style="list-style-type: none"> <li>To increase the level of transparency in the management of TSOs</li> </ul>	TSO
<b>Market information on the type of balancing bids/offers used</b>	Month M+1 for month M	Per day	<ul style="list-style-type: none"> <li>To help market players to formulate their balancing offers</li> <li>To increase the level of transparency in the management of TSOs</li> </ul>	TSO

Table 1: Transparency and information management for balancing

Information required for monitoring by the regulators includes at least

- Detailed bids and offers made by participants (at least offered power, price, notice to deliver, minimum and maximum time of use)
- Those bids that were selected by TSOs.

The data published in each Member State (control area) which forms part of the integrated balancing market should be identical in terms of type and availability of information.

This way any asymmetry in the level of transparency will be avoided, preventing thus the better informed market players from benefiting unduly from their unjust preferred position.

## 7 Dealing with Market Power

Regarding the exercise of market power, regulatory authorities must have full access to all relevant information for the purpose of monitoring activities, any ex-post investigations and implementation of necessary measures to mitigate market power.

Regarding the exclusive position of TSOs, the integrated balancing markets must provide incentives for TSOs to solve imbalance in the most efficient manner, bearing in mind the need to maintain an adequate level of system operational security and other relevant standards.

New market entry will facilitate the mitigation of the exercise of existing market power. Objective, non-discriminatory and transparent balancing market rules will help new market entry.

## 8 Options for the Integration of Balancing Markets

This chapter proposes options for the integration of balancing markets without intending to propose a specific sequence of activities to be followed in the process of the balancing markets integration. In general, integration of balancing markets shall not weaken or deteriorate the functioning of balancing markets in respective control areas (Member States) but it should lead to improvements. In the process of the balancing markets integration, the following implementation options exist:

- A “direct participation system” where two or more TSOs work towards establishing compatible balancing market which allows the participants to decide into which balancing market they want to bid. Some (or all) components will be in common for those compatible balancing markets. Cross-border capacity acquisition will most likely have to be ensured by the participants.
- A “TSO to TSO” (or multiple TSOs) model in which the bidder is related to “own” TSO. TSOs themselves therefore exchange balancing energy in an efficient manner. The balancing market participant can only submit bids to the TSO it is directly or indirectly connected to. The TSOs are responsible for the acquisition of cross-border capacity.
- An integrated balancing market with a common merit order and a common balancing settlement. Generally, the market participant will not be required to acquire cross-border capacity for the exchange of balancing power. The TSOs will be allowed to deviate from the merit order curve in the case congestion impedes cross-border balancing exchange.

Imbalance prices in compatible markets need not necessarily be the same. But in an integrated balancing market, depending on the level of integration, the structure for imbalance pricing must be harmonized in order to avoid market distortion.

Common standards for participation in the balancing market, that will enable future evolution and integration need to be developed for the balancing markets integration “candidates” and commonly agreed and adopted by the involved TSOs and regulators.

Practical experiences with balancing markets integration will depend on Electricity Regional Initiatives. In any case, the compatibility of these developments needs to be ensured between the different regions.



## 9 Glossary

Balancing market is that part of the overall electricity market that provides for meeting the needs for balancing electric power in the electric power system operation by the TSOs, market participants, etc. Balancing market consists generally of two important parts:

- (i) Balancing mechanism defining features of balancing market, e.g. the way of bidding, constraints/requirements on the balancing market participants, way of payment to the bidders, constraints on the TSOs, who/how makes the merit order, etc.
- (ii) Imbalance arrangements and pricing where the cost-reflective and transparent prices (i.e. non-manipulated prices) for the “users” (i.e. balance responsible parties) emerge according to the predefined, transparent and agreed rules and regulatory framework; these rules include also the way how the TSOs determine the imbalance prices for the balance responsible parties. Different ways of calculating the imbalances exist, e.g. only one imbalance for generation and demand or separate imbalances of them.

Balancing market participant is any entity providing balancing power/energy to a TSO.

Balancing responsible parties are those market players that are financially responsible for balancing their injections and withdrawals (including possible purchases and selling) of energy.

Gate closure is the time up to which a market player can modify its physical and commercial position and make offers in the balancing market.

The pre-qualification requirements are the technical conditions for generators or loads in some control areas (Member States) to be authorised to participate in balancing markets.

Ancillary services are the processes and services associated with power system operation, which are provided by market participants and generally managed by the TSO. Whereas the kind and characteristics of ancillary services can differ in every control area, balancing services comprise those ancillary services used to ensure balance between supply and demand in real time by manually activated power reserves.

Manually activated reserves are those balancing services that are not automatically delivered when required, but are instead instructed manually by the TSO. They become generally available under the 15 minutes notice.

Notice to deliver is the minimum notice needed by a balancing market participant to deliver the power of its balancing offer.

Control area is a coherent part of an interconnected power system, operating at the common synchronous frequency, usually coincident with the territory of a company, a country or a geographical area, operated and supervised by a single TSO (control area manager) responsible for load-frequency control, with physical loads and controllable generation units.