Security of Electricity Supply

Discussion Paper

Working Group Security of Electricity Supply
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EURELECTRIC:
Tóth Gábor

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Executive Summary

Society today cannot function without a reliable supply of electricity. As our dependency on electricity grows, the more vital continuity of supply becomes. Even short interruptions can cause damages and economic losses, as illustrated by the major blackouts experienced in Europe during 2003 and therefore most people would agree that security of electricity supply should be given the highest priority in a modern society. However, actually defining what security of electricity supply can be rather difficult.

Similarly, while it is broadly acknowledged that in a liberalised market clear roles and responsibilities must be designated, exactly how they can be formulated is not at all obvious. Many organisations, including EURELECTRIC, have called for published definitions of roles and responsibilities for security of electricity supply for all actors in the electricity market. In this discussion paper EURELECTRIC suggests a possible definition of security of electricity supply, with a view to opening a debate at European level on the possible roles and responsibilities of specific market actors.

There are many definitions available for security of electricity supply. One possible definition could be:

Security of electricity supply is the ability of the electrical power system to provide electricity to end-users with a specified level of continuity and quality in a sustainable manner.

This general definition requires further refinements; these are provided in this discussion paper. Furthermore, it is vital to draw a clear distinction between long-term and short-term security of electricity supply:

Long-term security of electricity supply is the simultaneous adequacy of access to fuels, generation, networks and market.

Short-term security of electricity supply means the operational reliability of the system as a whole and its assets, including the ability to overcome short-term failures of individual components of the system.

As indicated in the above definitions security of electricity supply can be further divided into four major aspects:
- access to primary fuels;
- system adequacy;
- market adequacy;
- operational reliability/security.
EURELECTRIC has strong confidence in the ability of the liberalised market to provide secure electricity supply if it is allowed and encouraged to operate freely in an investment-friendly climate. Creating a stable and predictable regulatory framework is one of the key actions to be taken in order to establish confidence in a properly-functioning electricity market, which in turn is able to ensure secure electricity supply. This is one example of the responsibilities of Member States and regulators. Other roles and responsibilities for the various market actors are suggested in this paper, as summarised in the table below.

Please note that the table below can indicate different types of responsibilities and/or roles for actors; for the exact details, please read the corresponding chapters.

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*Responsibility, contractual obligation, role*
1. Introduction

What is security of supply? The term seems obvious for everybody but proves surprisingly difficult to formulate in concrete words. Many people simply think of no interruptions in electricity supply in their houses (“the lights go on when I turn the switch – and stay on until I switch them off”). This is right and yet superficial: the essence of security of electricity supply undoubtedly distils out at the end-user, but at the same time it has several aspects and elements which all need to work properly to ensure that the lights indeed go on and stay on …

Ensuring security of electricity supply is a high priority for citizens and politicians and not least for the electricity industry itself. Europe has enjoyed a secure electricity supply for decades with very high reliability standards. Liberalisation and the creation of a single European market have changed the environment in which a secure electricity supply must continue to be provided. The earlier model of integrated generation and transmission planning has disappeared. The European networks, designed for mutual assistance, now have to accommodate increased flows over long distances; system operators are more and more inter-dependent; substantial commercial interests have also appeared. Particularly since the blackouts in Europe during 2003¹, general interest in security of supply has increased, both in connection with the European Commission’s proposed “electricity package” of December 2003, and in a broader sense. During those discussions, many organisations – including EURELECTRIC – have called for clear, published definitions of the roles and responsibilities for security of supply of all actors in the internal electricity market in order to ensure that the high level of supply security be indeed maintained in the changed environment. However, to-date not many of these organisations have undertaken the task of actually defining what these roles should be and how the different actors’ responsibilities should look. EURELECTRIC as an organisation comprising all kinds of producers, transmission and distribution system operators, and suppliers, felt it necessary to take the first public step in this direction. Given the complexity and sensitivity of this issue, it seemed appropriate to draw up a discussion paper as the basis for a debate at European level, rather than attempting to present at this stage a fixed set of roles and responsibilities.

This discussion paper formulates definitions of different aspects of security of electricity supply. It investigates which market actors can play a role in ensuring a given area of supply security, and – going a step further – identifies actors who should be responsible for certain aspects. It is vital to draw a clear distinction between long- and short-term security of electricity supply. Accordingly, this paper discusses four major aspects of security of electricity supply:

- access to primary fuels;
- system adequacy / investments;
- market adequacy;
- operational reliability / security.

¹ EURELECTRIC report “Power outages in 2003”
### Symbols and terms used

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<tr>
<th>Symbol</th>
<th>Term</th>
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<td>♦</td>
<td>responsibility</td>
<td>a legally binding requirement on an actor by law in ensuring the aspect of E-SoS in question</td>
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<td>◊</td>
<td>contractual obligation</td>
<td>a legally binding requirement on an actor through a commercial contract or a licence</td>
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<td>◊</td>
<td>role</td>
<td>expected behaviour and/or actions by an actor, without being legally binding, in ensuring the aspect of E-SoS in question</td>
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For the exact details, please read the corresponding chapters.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>actor</td>
<td>an entity interacting with the electricity market (the EU, government, regulator, network operator, producer, supplier, customer, etc.)</td>
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<td>supplier</td>
<td>a natural or legal person supplying electricity; where 'supply' means the sale, including resale, of electricity to customers (Directive 2003/54/EC)</td>
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<tr>
<td>producer</td>
<td>a natural or legal person generating electricity; where 'generation' means the production of electricity (Directive 2003/54/EC)</td>
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<td>transmission system operator</td>
<td>a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long term ability of the transmission system to meet reasonable demands for the transmission of electricity (Directive 2003/54/EC)</td>
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<tr>
<td>distribution system operator</td>
<td>a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long term ability of the distribution system to meet reasonable demands for the distribution of electricity (Directive 2003/54/EC)</td>
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<td>electrical power system</td>
<td>the entire electricity chain from fuel supply to end-users, which includes several actors besides networks (also referred to as 'system')</td>
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2. Definition of security of electricity supply

In attempting a definition of security of electricity supply (hereafter also: E-SoS), we might use the following formula:

Security of electricity supply is the ability of the electrical power system to provide electricity to end-users with a specified level of continuity and quality in a sustainable manner.\(^2\)

Let us take a look at this definition and its elements:

“to provide electricity […] with a specified level of continuity”: continuity of electricity supply is an unquestionable requirement in today’s world. However, all actors – particularly customers and politicians – must recognise that a completely continuous provision of electricity and 100% reliability is economically unfeasible. Theoretically, reliability can be improved beyond all limits, but this would require disproportionate resources. Hence, the supply chain must ensure a provision as continuous as technically and economically feasible at the contracted prices. In some cases, customers can choose their own desired “level of security” (e.g. by opting for interruptible supply), which they are willing to pay for. The contract between the customer and their supplier can therefore specify either a reliability level or, for example, the maximum duration of an interruption; together with any possible compensation, should the agreed conditions not be fulfilled.\(^3\)

“to provide electricity […] with a specified level of […] quality”: being an integral part of security of electricity supply, the quality of the provision of electricity is also included in the definition. This paper does not elaborate on that issue, since quality aspects are dealt with in the definition of power quality (EN 50160 and related standards).

“to end-users”: one might see it as oversimplification if we define security of supply at end-user level. However, that point appears to be the most appropriate, for at least two reasons:

1. the basic purpose of the electricity industry is to provide electricity to the end-user; therefore, it would hardly make sense to define E-SoS at any other point or points
2. using that point emphasises that E-SoS is fulfilled only if all elements of the electricity supply chain function properly.

It should be noted that we cannot say that security of electricity supply is fulfilled (even if technically and/or from a pure market organisation point of view it were justified) if electricity prices rise enduringly to levels which are not sustainably affordable for a substantial portion of the population. Such a situation would certainly provoke regulatory or governmental intervention, beyond which point we cannot expect the market to function.

\(^2\) Relating to existing standards and contractual agreements at the points of delivery.
\(^3\) In certain cases, the “specified level of continuity and quality” of electricity provision, depending on economic development, social and political factors, may also be defined by the Member State, as the representative of the society. The government can adopt decisions and policies so as to establish rules, quality standards, or requirements regarding security of electricity supply. Consequently, society chooses – through its government – the level of continuity and quality of electricity supply, defines priorities in policies and assumes the consequences and related costs.
3. Long-term security of electricity supply

Long-term security of electricity supply is the simultaneous adequacy of access to fuels, generation, networks and market.

Long-term E-SoS relates to the availability and not the actual delivery of electricity: availability (accessibility) of primary fuels, availability of generating capacity, availability (operability) of networks, and so forth. Although each of them is needed, the different elements of long-term E-SoS are independent of each other:

1. access to primary fuels
2. generation adequacy
3. network adequacy
4. market adequacy.

3.1 Access to primary fuels

Access to primary fuels means that electricity producers are allowed to choose freely from primary energy sources at reasonable prices, without being hindered in their choice by political and/or geopolitical constraints.

The above constraints will apply not only where there is a total lack of access to a certain fuel, but also in a situation when a fuel is available only at excessively high prices, e.g. due to political macro-economic considerations. Ensuring and maintaining the broadest possible portfolio of available fuels, from which investors can freely choose at reasonable prices, is clearly beneficial not only for household customers but also for national and EU-wide economies. Therefore, the role of developing and maintaining a wise geopolitical agenda lies with the EU and individual Member States.

Although fuels those indigenous to Europe have some advantages in terms of supply security, it does not mean that imports should be reduced at all costs. Import dependency is not necessarily detrimental, provided that the sources of imports are sufficiently diverse and politically and economically stable.

Customers, as citizens, have a role in accepting the use of fuels for electricity generation according to their proper merits (see public acceptance under generation adequacy).

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3.2 System adequacy

The term “system adequacy”, which is sometimes used in a narrower sense, is used in this document to cover adequacy of the electrical power system in the long run.

System adequacy is the ability of the electricity system to convert primary fuels into electricity and transmit that electricity to end-users in a sustainable manner.

In the case of long-term E-SoS, the issue is not the actual delivery of electricity but rather the availability of adequate resources (generation and network capacity) and their co-ordination. In this sense:

- generation adequacy is a resource issue
- network adequacy is a resource and co-ordination (cf. cross-border interconnections) issue.
3.2.1 GENERATION ADEQUACY

Generation adequacy is the presence of sufficient generating capacity to meet demand – both in base load and in peak periods - taken together with imports of electricity.

It should be stressed that ensuring sufficient generating capacity for national markets or even regional ones at all costs would hardly be the most cost-effective and/or reasonable way to proceed. Import potential must always be taken into consideration when talking about generation adequacy. The “presence of generating capacity” does not only mean the mere existence of the physical plant but also its readiness for operation connected to the grid.

It is clear that in a liberalised environment, the market should ‘define’ – through market forces – the necessary level of generation and also provide adequate incentives for investors to ensure this level. EURELECTRIC has strong confidence in the ability of the free market to do so\(^4\). However, an adequate framework and an investment-friendly climate are vital for the market to function. This is not in any way meant to imply regulatory interventions in the market but rather that the market must be allowed and encouraged to operate freely within an attractive business climate. The responsibility for establishing and ensuring this framework lies with the EU, the Member States and the regulators.

In order to ensure generation adequacy, the most important task of the EU is to set up an appropriate framework that enables and encourages the market to function. The liberalised market can deliver generation adequacy provided it is allowed to function. The roles and responsibilities of each market actor must be clearly defined in a harmonised way throughout the EU. This document provides some suggestions concerning roles and responsibilities towards security of electricity supply.

It must be noted here that to this aspect of security of electricity supply is linked diversity of primary fuels and generating technologies. The EU and Member States must allow for all options in order to ensure that investors can make their own decisions regarding fuels and technologies. This does, however, not exclude politically-mandated internalisation of environmental and other justified costs.

The European Commission should focus on the implementation of the IEM Directive (2003/54/EC), without further interference or undue derogations, in order to obtain the necessary harmonisation of market rules and conditions. In order to create and maintain investor-confidence and thus give the market a chance, it is vital to consult market participants and would-be investors on the expected and actual effects of legislative proposals and other measures affecting the market and/or market participants.

Member States must recognise that electricity price fluctuations are intrinsic to functioning electricity markets, and realise that price caps have a destructive effect on markets. It is essential to leave the market to function and moreover – since the mere threat of sudden intervention can be as damaging to market-confidence as an actual intervention - to assure market players that there will be no unexpected interventions. Member States must ensure that a stable, predictable framework for market-functioning is in place, with the least possible distortions, applying market-oriented mechanisms such as emissions trading where intervention is deemed necessary - for example for supporting renewable energies, setting taxation, etc. If the market fails to deliver generation adequacy and makes intervention necessary, it must be crystal-clear as to who is entitled to take the necessary measures and what the measures in case of a crisis would be. Those measures must come from the existing toolbox provided by the Electricity Market Directive and the Cross-Border Trade Regulation (1228/2003), setting out clear responsibilities and time-limiting the measures as far as possible.

Regulators, whose role is to be a key facilitator in the competitive segments of the market, must ensure stability and predictability in the regulatory regime. The distinction between stability and predictability means that although the ideal situation would be one of unchanged rules creating the most stable environment for market-functioning, this is clearly not a realistic scenario. Therefore, as market players will probably be faced with changes in the legislative environment, these changes should be as foreseeable as reasonably feasible, and there should be consultation with those affected well before and also during

\(^4\) EURELECTRIC report “Ensuring Investments in a Liberalised Electricity Sector”; also PriceWaterhouseCoopers survey “Movers and Shapers 2003 – Utilities Europe”
implementation. Sudden, unexpected or harmful changes in the regulatory regime would certainly discourage investors. Lead times for permitting for new capacity must also be shortened.

System operators, a term which covers both transmission and distribution system operators, should undertake transparent network-planning so as to facilitate investments in generation and ensure maximum transparency in network access. It must be recognised by system operators and particularly by regulators that published development plans, especially if stamped by authorities, may hinder projects brought forward after publication of the plans. Development plans must therefore be flexible enough to avoid a return to a set-in-stone centralised planning approach. System operators cannot be responsible for generation adequacy. They do however have an important role to play in identifying possible shortfalls.

As far as producers are concerned, it is not compatible with their competitive environment to impose any obligation on them to generate power or to invest in plant. They provide electricity when it makes economic sense, and (always respecting their contractual obligations) will cease provision when it does not. In EURELECTRIC’s view, this is the only interpretation that is in line with a liberalised and competitive market framework. Generating companies are responsible for fulfilling their contractual obligations, but cannot be made responsible for security of electricity supply if the financial consequences are to fall on them.

Suppliers have a contractual obligation to purchase adequate capacity to fulfil contracts with customers.

Customers can play a role in decreasing the demand for peaking capacity through demand-side response measures. This can either be through exchange participation or interruptible contracts or managing consumption where suitable metering is available. Through demand-side management, the overall need for generating capacity can be affected.

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An important aspect of generation adequacy is public acceptance of the various technologies and fuels, and this factor can dramatically change the generation mix.

The provision of electricity always implies environmental impact. Over the last decade, there has been increasing public awareness of and concern over environmental issues with a growing number of environmentalist organisations and “green parties” all over Europe exerting increasing influence on government decisions on energy policy. A typical feature of the resulting energy policies – strongly based on a genuine concern for real environmental problems, but also sometimes affected by distorted viewpoints not subjected to fair neutral criticism – has been their restrictive impact on power generation choices. The effect of this is to restrict the range of technologies and fuels that will be able to provide significant amounts of power generation in the future. This is in turn bound to have an adverse effect on security of supply.

A significant consequence of this process is that diversification of technologies and primary energy sources – a concept traditionally paradigmatic in security of electricity supply – is subject to severe constraints.

The current lack of sound information and public debate - in particular on the various available means of reconciling secure electricity supply and public environmental concern - and the resulting distance between public positions on the one hand and public assumption of their consequences on the other is a gap that must urgently be filled.

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5 It is important to draw a clear picture of what role a producer plays in today’s market. From a system security point of view, one might tend to see a producer as a pure source of electricity and certain services, acting according to available capacity and technical conditions, being ready to answer the call from the system operator to balance, provide services, and so forth. However, producers are market players, who follow signals from the market. It must be recognised that any balancing measure, services provided, etc. may interfere with the producer’s participation in the electricity market.
3.2.2 NETWORK ADEQUACY

Network adequacy – covering both transmission and distribution and also cross-border interconnections – is the availability of sufficient network infrastructure to meet demand.

Unfortunately, when it comes to where infrastructure is needed and what level of capacity is sufficient, views can differ widely on who should make that decision and how.

The European Union, in particular the Commission, must ensure that a harmonised framework is in place which provides for a transparent determination of necessary cross-border capacities. The actual determination must be left to the system operators involved and regulators (involving their respective Member States, if necessary), who need not only to determine the capacity and other technical issues, but should also settle in advance the share of investment costs and future cost-recovery schemes.

The planning and development of transmission and distribution networks should remain under national competence as European harmonisation would not bring any particular benefits. At the same time, the European perspective must be taken into account, so as to ensure coherent development of the integrated European networks.

The best way to trigger the necessary investments in networks is to draw up the investment plans in consultation between the system operators with the regulator providing economic incentives to system operators to make the investments in question. Again, the responsibility for determining an appropriate level of ‘economic reward’ for an investment, most likely built into the tariffs, lies with the regulator. It must be clearly defined how the costs of new connections should be shared between networks and the producer seeking grid connection. Regulators should also take measures to shorten lead times for investments. System operators, being “natural monopolies”, are responsible for carrying out proper monitoring to enable an adequate prognosis of capacity needs. To allow them to carry out this activity, necessary data and projections from producers and other network users should be provided, always ensuring an adequate level of confidentiality.

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Observations made in the previous chapter on public acceptance of generation technologies and fuels are also applicable to transmission facilities. Strong opposition to new cross-border transmission lines from environmentalist groups or local organisations has been a constant hindrance to carrying out important projects in the last decade. This factor is nowadays one of the most significant obstacles to network development.

3.3 Market adequacy

Beyond the (geo)political implications of fuel supply security and the technical requirements of generation and network adequacy, there is another key link in the electricity supply chain, whose significance has dramatically increased in the last decade. This is the electricity market, which brings together electricity producers and consumers.

Market adequacy means the ability of the market to facilitate the link between producers and consumers of electricity.

Markets allow efficient and competitive producers to survive in market conditions and they enable customers to choose their suppliers. Regulated network charges ensure that system operators earn enough income to cover their capital and operational costs while providing a sustainable service to both producers and consumers. It is essential that the market be non-discriminatory and transparent. Market adequacy is a coordination issue.
As with all commodities, the electricity market has its own rules. These rules are based on the classic balance between demand and supply. However, there is one circumstance that makes the electricity market special and different from all other markets: inability to store electricity in large amounts. This means that electricity demand and supply must be balanced on a continuous basis. As with other basic needs, even short interruptions in electricity supply have fundamental effects on our lifestyle and technologies to an increasing extent.

To function properly, the market needs an adequate framework, and as few distortions as possible. EURELECTRIC believes that that adequate framework is already provided for by the 2003 Electricity Market Directive and Cross-Border Trade Regulation. If the market established by these legislative acts is to function, the utmost responsibility lies with the EU and Member States (and hence the regulators) to ensure that the framework is properly implemented and the market is not only allowed but actually encouraged to function.

EU policymakers must ensure that no new legislation appears which can affect markets before the liberalisation package has been adequately implemented and experience of its functioning have been gained. However, this does not mean that developments in the European electricity market do not need to be closely monitored: there is clearly a need to avoid market failures which might impair security of electricity supply.

Member States must work for the quickest and deepest possible implementation of the liberalisation package, without undue derogations or exceptions. Together with regulators, they must create an appropriate national framework, where all current and would-be players have transparent and non-discriminatory access to the electricity market, networks and all resources. Preferential treatment for incumbents, hindering new entrants to the market, is as unacceptable as inequitable and distorting benefits for newcomers.

Apart from this, regulators have the special task of policing the market to ensure that all players compete fairly and comply with market rules. This involves continuous monitoring of the wholesale market.

System operators must facilitate the functioning of the market – both domestic and cross-border – without unnecessarily hindering free trade.

To ensure that adequate investment is forthcoming, competitive market actors – customers, suppliers and producers – must be allowed to use any risk management tools on the market; in particular, they must be allowed to take out contracts of varying lengths, including longer-term and interruptible. To this end, Member States together with their regulators must make available contractual and financial instruments for both customers and producers thus allowing them to shield themselves from the economic risks of price volatility.

It is also vital for a liberalised market that wholesale markets have the necessary level of liquidity and that they contain all necessary functions, such as spot-market, financial market, balancing market, clearing function, etc.

Producers and suppliers, who live and function in the competitive segment of the market, have to fulfil contractual obligations, while respecting the corresponding market rules and competition legislation. Companies should adhere in their energy trading business to the highest standards of probity, honesty and fair dealing. These standards should be applied throughout a trading unit’s front, middle and back offices and professional or support functions.

Customers, as market players, should use available instruments in the market fairly and to their best advantage.

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4. **Short-term security of supply**

Short-term security of supply means the operational reliability of the system as a whole and its assets, including the ability to overcome short-term failures of individual components of the system.

Before liberalisation, technical reserves were kept by utilities at a level high enough to confidently ensure supply security. The costs of this safety margin were passed through to consumers. With the introduction of competition, producers can only maintain technical reserves for the system if they are adequately remunerated. Placing obligations on producers to keep certain technical reserves would on the one hand conflict with the principles of a competitive market, and on the other hand would entail market distortions. EURELECTRIC believes that reserve adequacy can be best ensured through market mechanisms, based on commercial contracts for technical reserves.

One can envisage a separate market for ancillary services (technical reserve and other system services, e.g. frequency control, voltage control, black-start capability, back-up capacity, etc.), parallel to the energy market. These two markets are highly interdependent. In some cases provision of energy and provision of ancillary services run directly counter to each other, while in other cases they can complement each other, for instance where producers who do not manage to bring their full capacity to the energy market can still provide ancillary services such as spinning reserve. In this scenario, system operators – derived from their responsibility for ensuring system security – purchase technical reserves, for example through auctions, from providers, mainly producers and customers. The price of the capacity should be recovered through network tariffs. Producers then have the choice of maximising their electricity production or selling a portion of their capacity as technical reserve. If they choose the latter, it must of course be ensured that they actually keep the contracted technical reserves available. The same applies to decreasing production when necessary.

Customers can also play an important role through exchange participation, interruptible contracts and managing their consumption where suitable metering is available. During peak-load situations, industrial demand-side response can be decisive in balancing supply and demand.

Therefore, responsibility for keeping adequate technical reserves should be assigned to system operators. The level of that technical reserve should be defined by the system operators themselves, consulting with neighbouring system operators or at European level if necessary. Regulators must monitor the situation to ensure that technical reserves are in line with system operators’ planning, and that other system services are contracted on an ‘as required’ basis. They should create the framework for system operators to purchase technical reserves and other system services from producers and customers through transparent market mechanisms and recover those costs through network tariffs. They should also ensure that purchased technical reserves are indeed available. For the same purpose, regulators should allow contractual measures to provide an amount of load which can be interrupted instantaneously or at predetermined notice. Producers have a role to play in this market within their possibilities and economic interest. Where they enter into contracts for providing technical reserves, they will have consequent contractual obligations.

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<tr>
<th>Roles and responsibilities</th>
<th>European Union</th>
<th>Member State</th>
<th>Regulator</th>
<th>System operator</th>
<th>Producer</th>
<th>Supplier</th>
<th>Customer</th>
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6 EURELECTRIC report “Ancillary Services – an Emerging Market”