Bundesnetzagentur

„Smart Grid“ and „Smart Market“

Summary of the BNetzA Position Paper

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1 Summary

Characteristic of the current process of changes in energy supply is the move away from conventional generation and a reorientation towards renewable energy. In addition, energy supply is being increasingly organised on a European basis. The transformation of the system of supply - analogous to open-heart surgery - will take place as the system operates and will increasingly push the grid to its very limits.

"Smart grids" will not be in operation everywhere within the next three years and nor will all energy be obtained from renewable natural sources. The way towards the energy future will involve ongoing learning and exploitation of all the technical and economic options available with the aim of achieving - by the middle of the century - an electricity supply system which is largely based on renewable energy and which can be run as efficiently as possible. Monitoring and controlling of the entire energy supply system will become more complex and nuanced in the process. In this context, technical, organisational and process-based implementation will call for new conceptual and problem-solving approaches which are currently being tested and discussed.

Contrary to the current public discussion this should not all take place under the (exclusive) banner of the "smart grid". Using the term "smart grid" automatically shifts the focus of the design options for the energy future to the grid. In order to improve the distinctions and differentiations between different fields of action it is therefore important to use "smart market" as the terminological superstructure encompassing the "smart grid". Based on this terminological approach, "smart grid" describes issues which are "internal to the grid" while "smart market" concerns contents geared to the behaviour of market players (producers, prosumers, consumers and - in the future – possibly others as well).

The liberalization of energy markets and the associated separation of the network from generation and sale and its regulation is the not cause of the problems: unbundling of the network from sale and generation must and can - even subject to the changed requirements of the energy future - be retained and should even be intensified in some areas.

It is important to take a differentiated approach to determining the extent to which the energy revolution requires networks to be expanded and whether such expansion can be avoided by implementing "smart grids". The transformation of the energy system will initially require huge efforts to be made in the expansion of the conventional network and particularly as concerns the transmission networks and integration of offshore wind parks. Quite apart from the expansion of grids the transmission networks can already be largely regarded as smart grids.

In qualitative terms action needs to be taken in particular on the intelligent strengthening of networks at the distribution level. There is a real "intelligence gap" in these networks at the moment. Closing these gaps will prove to be increasingly challenging for the operators of distribution networks. However, work will also be required in extending distribution networks. The scope of this work will, however, differ from network to network. Most of the extension work on the distribution network will also be primarily conventional in nature.

The grid is best positioned to contribute to the energy revolution by being efficiently extended by its operators to meet demand and to provide sufficient grid capacity for market-driven shifts in energy volumes. The grid operator must ultimately decide in its function as entrepreneur whether it is more efficient to use intelligent components in the grid than it is to build power lines or lay cables – at the end of the day a mixture (which will be different for every single network operator) of both will make the network fit to absorb as much renewable energy as possible.

In the existing incentive regulation system the anticipated changes in the distribution networks arising from new supply tasks can be secured via the "expansion factor", for example. It is assumed that the capital returns on existing networks will be available in the context of intelligent restructuring for the purpose of financing remaining conversion requirements.

In the networks at the distribution level it will become increasingly necessary to obtain more information than is currently available about system statuses, which change depending on the feed-in situation, and which will have an increasing impact on higher-level network levels. Closing this "intelligence gap" is a real challenge for distribution system operators.

Smart meters will play a relatively minor role in boosting the intelligence of distribution networks. They are more necessary to bring more individual customer groups into the market rather than to meet any grid requirements. Smart meters are used to allow producers (intelligent grid feed meters), consumers (intelligent consumption meters) and service providers to respond to market signals in a smart market. The introduction of smart meters for these reasons should be geared to market exigencies and requirements with the financial participation of the parties which have an interest in the infrastructure.

This is why the Bundesnetzagentur believes that it would be inappropriate to finance smart meters from system charges alone, just as it also believes that it would be inappropriate to finance investments which primarily benefit the market sphere (smart market) from system charges. Intelligent grid components or supporting ICT for the smart grid are not being procured and operated at present in order to influence market behaviour or to bind consumers or producers in any way. Competitively operated suitable information and communication infrastructure is made available for this purpose or, in the case of infrastructure which is usable in both spheres (e.g. in the field of smart meters) a distribution of costs between the grid and the market agreed at least in order to benefit from potential synergies.

In the long term the grid should not, as a matter of principle, be brought into a position in which the grid user is made subordinate to the restrictions which the grid imposes if, for example, permanent incentives are provided for the most uniform use of the grid possible. The market is not there to serve the grid; on the contrary, the grid is there to support the market. Vigorous congestion management which enables the price for using the grid to be varied according to capacity utilization (variable system charges) would tend to result in management of the status quo instead of creating additional capacities for the energy future. It would not therefore be a good idea to encourage variable system charges as a means of managing grid capacity issues.

The aim must be to ensure that grids are extended in the most economically efficient way possible. The usability of the grid capacities available at a given time must be optimised as far as possible by exhausting the intervention options available, such as reaching contractual agreements in advance about the agreed shut down of loads or the inclusion – for smaller power plants as well - of producers in grid security management. Intelligent solutions may exist in framework agreements on potential shutdowns or in the trading of capacity utilization restrictions on platforms and marketplaces. However, because a permanently stable grid is of existential importance for modern economies the option of enforcing controlling actions will have to be retained for individual users - despite all the efforts to promote market-based methods.

Irrespective of the many uses which can be made of them, storage facilities are a fundamentally normal way of using the grid and can, as with all applications, have a positive impact on the grid. However, this does imply using the grid as the basis of a business model and thus operating according to business management exigencies rather than according to the requirements of the grid. It is therefore doubtful whether it would be appropriate to waive system charges in the future in this context. What is more, estimates of the required bridging potential for periods in which relatively little renewable energy is available in comparison with the installed and in the foreseeable future achievable additional storage capacity obviously suggest that storage facilities may make an important but only a small contribution to the transformation of the energy system. In this respect storage should not be regarded as the panacea for the energy future.

Obviously the changeover in the energy supply system will be best managed if all stakeholders work closely together. Ideas on how to establish distributed supply structures reflect this insight by involving both system operators and market players. Approaches which lead to as much energy as possible being consumed near where it is generated must be welcomed. Ultimately this is a long-standing energy supply principle, if only because it reduces line losses to a minimum. The only new element now is that the generation side is becoming increasingly decentralized and the use of interconnected system to transmit centrally generated energy volumes – locally and temporarily - can only become less relevant. This should be regarded as efficient if transmission over long distances can be reduced and congestion in the transmission network prevented in advance as a result and again if this makes it possible to relieve an otherwise ever more complex grid control system.

Generation close to the point of consumption and vice versa can also mean that the financial burdens for the higher-level grid are shared among fewer participants. In the long term consideration will have to be given to how integrated structures and the associated services, such as maintaining constant frequency, which will continue to be necessary for grid users, can continue to be fairly and jointly financed. In addition, the ability to change providers and non-discriminatory access to the grid must also continue to be guaranteed in alternative structures, such as local marketplaces or semi-autonomous grid cells.

The need for market coordination and the mutual information requirements of both the grid and market will only be successfully mastered with the aid of information and communication technology (ICT) given that these are time-critical processes and that large volumes of date are involved. ICT is only a means to an end, however: the end being to achieve a more fluid market and secure "inconspicuously service providing" grid operation. ICT makes it possible to transform the energy supply system into smart grids and smart markets - without, however, this leading to overhasty analogies with changes taking place in the IT and telecommunications sectors themselves. The simple transfer of experiences from the telecommunications and ICT worlds to the energy sector is doomed to fail because of the energy-specific requirements, as this equation often oversees the need to separate grids from sale / generation and other market roles, the special need for consumer protection (e.g. calibration law) and demanding requirements for long service lives and reliability in the energy world. A functioning smart market cannot be established without including the grid and its operators. For this reason the unconditional willingness of all the players involved to cooperate is absolutely essential and yet, at the same time, only possible in compliance with the strict requirements of unbundling regulations.
The conversion of grids and transformation of markets for the energy future poses huge challenges for system operators whose economic future lies exclusively in absolutely professional and efficiently managed system operations which are strongly oriented to the growing needs of the market. In order to be able to meet these requirements in the future the Bundesnetzagentur believes that networks should continue to be a defined minimum size - an aim which can also be achieved by the cooperation of several smaller networks.

The Bundesnetzagentur will provide vigorous support to both network operators in their enormous efforts to set up a smart grid and to market players on the way to establishing smart markets for the energy future and will continue to follow developments in close dialogue with the players.

2 Key concepts

Key concept 1: Grid capacity and energy volumes as distinguishing criteria for grid and market

A fundamental starting point for a consideration of issues relating to the energy future and a basis for the distinction between "smart grids" and "smart markets" is deciding whether the issues involved relate to the grid, as a natural monopoly and the suitable locus for tasks which should appropriately be made the responsibility of a single function, or to the market to which all tasks for which competition, heterogeneity and differentiation may produce better solutions should be left. The line of separation defining these two arenas corresponds to legal requirements which require the industry to separate network operations and management from the generation and supply of energy (*unbundling*).

The idea underlying the separation of grid and market spheres is identifying the core capacities involved: "grid capacities"("kW") or "energy volumes" ("kWh"). This simplified approach, which almost always provides a reliable guide to the issues involved from the very start, is based on the fact that the core business of system operators is usually limited to providing (usable) "line width", in other words grid capacity. In contrast, the operation of generation installations and associated conversion of energy and the sale of energy is the core business of other market roles.

Although grid capacity is a necessary prerequisite for the delivery of electrical energy and electrical energy is what enables grids to be operated at all, it is nonetheless helpful to separate these two activities conceptually. While there are fields of activity beyond an operator's grid capacity business in which both aspects overlap (such as in the procurement of balancing energy, sale of renewable energy, compensation for grid losses, etc.), deciding whether grid capacities or energy volumes are primarily concerned usually helps in weighing up whether the issue has more to do with a smart market or smart grid and therefore whether a solution is most likely to come from the network operator or from a market role.

To reiterate: there will be areas of overlap where decisions have to be made about whether the solution to an issue should have "more of a grid" or "more of a market" oriented character. Conditions must be framed in a way that enables a market to emerge for as many aspects of the energy future as possible which - quite separately from any grid issues and related regulatory interventions - is capable of providing an efficient solution itself.

Key concept 2: Clarification of discussion about the energy future through the terms of "smart grid" and "smart market"

Once a distinction has been made between capacity and energy it is possible to apply the term "smart grid" to electricity network issues and "smart market" to energy (volume) issues.

The need for grid capacity is determined by producers and consumers. Renewable energy increases supply-side variability while flexible pricing and other services enhance variability on the demand side. Prosumers switch between feeding electricity into and taking electricity from the grid. The grids will have to be expanded to cope with greater fluctuation in grid use, but average network usage will sink.

As it is also probable that, for climate change mitigation reasons, renewable electricity - i.e. electricity which is produced from renewable sources and which is thus CO_2 neutral – will displace other sources of energy in many fields[2], it is already possible to predict that

[2] E.g. petrol by electromobility, oil or gas as a source of heating by heat pump electricity, etc.

electricity consumption will increase, at least in relative terms, even in the context of an overall drop in energy consumption.

The need for grid capacity will in fact also grow for quite a different reason: a single European market for electricity with different key forms of renewable energy production will increase the amount of electricity exchanged across networks, and more storage capacity will mean that the same volume of energy may need to be transported through the grid several times. This will all have an impact on the amount of grid capacity required: flexibility (on the market side) requires capacity (on the grid side)!

Apart from a few exceptions, electricity grid capacities at least are currently subject to regulation and are not left to the unhindered play of the forces of supply and demand, but are subject to a regulatory regime which, inter alia, aims to improve market efficiency. The current legal framework envisages the mandatory expansion of the electricity grid with the aim of eliminating shortages of grid capacity; this will of course take quite some time to achieve. This means that network congestion should only arise in the short to medium term and it should be possible to remedy these in the meantime by implementing grid or market-related measures.

The principle of expanding the grid to meet demand must continue to be upheld in future energy scenarios. At the same time, however, account must also be taken of trends towards much more fluctuating production and loads without the need for grid expansion growing on an exorbitant scale or jeopardising the objective of keeping grid expansion requirements within reasonably efficient bounds.

Managing grids stably in an energy future shaped by large fluctuations in generation and consumption will not only require underlying grid-related measures (smart grid operations, smart grid) but also that generation and consumption can be guided in the right direction by market signals. The price-sensitive behaviour of grid users in a smart market will then point the way towards the improved and more market-oriented integration of renewable energy into the overall system.

This does not mean that quite considerable conventional expansion of grids will not be necessary for the energy future. Smart grids cannot solve every problem. However, it is the case that grids would have to be expanded even more if no smart grid / smart market measures were taken.

This means that the energy future will consist of a mix of grid expansion and skilled capacity management.

Key concept 3: The energy future requires more responsibility on the market and more negotiated solutions. The grid should play a predominantly service role and should be separated from competitive activities as far as possible.

Information and communication technology developments over the last two decades can also be exploited in the energy sector. Computer and internet technology can be used to reduce transaction costs and enable smaller scale interactions to be automated or run at minimum costs. This technology could also provide final consumers with the opportunity to participate more intensely in energy markets. This means that new services in particular are very likely to emerge in the energy markets of tomorrow.

In some e-energy model regions, for example, markets are being created on which both energy volumes and services are traded and, where there is a threat of grid overload, it may even be possible to negotiate potential reductions in consumption to stabilise grids. This shows how traditional roles could well be dramatically altered.

"Demand side management" and "demand response" indicate a transition: from the predominantly network (operator)-oriented issue of load management to the more market-oriented issue of using price signals to manage demand. This means that certain issues can indeed by shifted from the grid sphere to the market sphere - and this must remain the objective.

Innovation in the energy future will be enhanced to the degree that grid restrictions can be progressively overcome and a role found for market-oriented action beyond the scope of traditional energy trading through to grid (capacities), at least to the extent that this does not jeopardise reliable grid operations.

For this reason an ultima ratio option of enforcement measures in the shape, for example, taking producers or consumers off the affected girds will have to be retained for the network operators. The objective must be to use this option as little as possible, however.

Unbundling means that competitive functions cannot be given to network operators. The separation of grid operation from competitive activities is required under European law and cannot be arranged otherwise at the national level. However, it would not make economic sense anyway to assign competitive functions to network operators. Integrated network operators naturally do have a certain interest in subsidising competitive functions at the cost of regulated areas. This leads to competitive distortions and market foreclosure and is extremely difficult to get to grips with by regulatory means. Creative market forces will be unable to emerge.

Key concept 4: Smart meters are part of, but not an absolute prerequisite for, the energy future

As well as pulling together grid and market issues, open discussion of the energy future is often reduced to the key role which smart meters are supposed to play in it.

However, the data which is needed for reliable grid operations can also be obtained without having to install smart meters in customer homes by, for example, resorting to data available from local grid stations and installing meters to capture grid-specific data at particularly "critical" or "potentially critical" junctures in the grid. Data need only be measured at relatively few points for this purpose.

A smart meter which is able to capture corresponding grid status data could be just such a grid-based measuring point: The assumption that smart meters could also be used to record grid status data does not necessarily mean that smart meters need to be rolled out on a large scale to meet the requirements of a smart grid.

At present data collected using smart meters are mainly used for delivery and accounting purposes. They are, and will be in the future, the basis for variable prices, for additional offers designed to stimulate energy-efficient and energy-economising behaviour and to visualise consumption. They will also provide the foundation for more extensive energy service provision. The data recorded by smart meters therefore primarily serve the market and not the grid. In this respect smart meters play an important role in establishing a smart market.

Key concept 5: The smart grid is part of an evolutionary, not a revolutionary, development

Germany is home to around 850 electricity grid operators and will not introduce intelligent grids from one day to the next. Quite apart from the fact that transmission networks are already "smart", there is also considerable pressure to convert in some power distribution networks while, at the same time, no need for change is perceived at all in other networks. The Bundesnetzagentur assumes that as well as there being a large need for the expansion of conventional grids for the energy future, e.g. in the context of connecting offshore wind parks, many small steps will have to be taken in order, above all, to gradually enhance, convert and modernise distribution networks for the energy future.

The way forward may differ for each network operator. Given the highly heterogeneous nature both of grids themselves and of their supply functions in Germany in particular, introducing a uniform "intelligence standard" for the grid would be inefficient. This means that every (distribution) network operator will therefore have to adopt its own strategy towards achieving efficient grid operations in the energy future.

It is actually quite helpful in this context that so many networks are in any case due for modernisation. In many cases, then, it will be possible to take a low-capital approach to converting to smart grid standards by investing the returns from existing systems (intelligent restructuring). Whenever new supply tasks need to be met - such as when new PV systems are installed in one part of the grid - a financing option becomes available via the expansion factor and cost recognition in the base year following the event as part of the incentive regulation: this means that system operators are provided with additional financial resources to meet these new tasks.

Key concept 6: If targets for the use of renewable energy are to be met it is essential that these producers, too, respond to market signals and grid exigencies

In the pioneering early years as the potential of renewable energy was slowly growing the uncoordinated feed-in of power from these systems was not a problem. The actual amount of energy produced from these sources went completely unnoticed amid the general "'noise" in the grid.

In this respect it is a sign of just how successful renewable energy has become when more and more people are beginning to talk about the implications of a maturing industry for the future: that renewable energy must become more market driven and also enabled to contribute its part to grid support. Otherwise it will never be possible to make even the first step towards a future in which, when high levels of supply meet low levels of demand, it is possible for renewable energy to cover practically 100% of energy requirements.

Alongside the active response of consumers to market signals - in the form, for example, of variable electricity prices - the generation side will also have to respond more decisively to market signals and grid requirements in the future. If this does not happen the falling share of power produced with conventional generating capacity will be accompanied by increasing price volatility or, alternatively, the feed-in from plant which produces renewable electricity will have to be restricted at ever more frequent intervals. The only other possibility apart from a strong market orientation would be to expand the grid even more on a scale which would enable it to take up a practically unlimited volume of kWh without damaging the grid and to maintain an "excessively large" minimum contingent of conventional reserve power stations. Ultimately, inflexible renewable energy plants which cannot be sufficiently controlled would be inappropriate for supplanting conventional power stations in grid serving areas for which, given the right technical facilities, they would otherwise be basically suitable. The upshot would then be an excessively high minimum contingent of conventional power plants to meet grid requirements.

This means that for the energy revolution to succeed renewable energy must be integrated into the market in the future. This does not mean that it should not be subsidised in the meantime, only that such subsidies should not stand in the way of its participation in markets. This might mean that the politically desirable feed-in priority given to renewable energy, which is (still) necessary in economic terms, must be designed more intelligently to ensure that the ultimate objective of more market-based operations is achieved.

Bearing grid requirements in mind renewable energy plant must be configured so that they can work in a way which supports the grid. This applies in particular to voltage control and reactive power, frequency-dependent reductions in effective capacity, enabling primary control and the option of taking plant off the grid or significantly reducing the amount of power generated in troughs when supply exceeds demand.

3 Definitions

A distinction has to be made between conventional grid (expansion), intelligent upgrading to create smart grids as well as the creation of the technical requirements for intelligent energy markets (smart markets). As smart grids are generally (i.e. beyond the confines of this paper) understood in an all-encompassing sense as both intelligent grid technologies and as a way of establishing intelligent electricity markets the difference between the two must be explained while bearing in mind the problems of delimitation and the interfaces between smart grids and smart markets.

3.1 Conventional grid

Thesis: "Grid" refers to the conventional network and includes the existing network.

The existing network and any conventional expansion are subsumed under the term "grid". Strictly speaking all the electronic components needed in order to make an electric connection between producers and consumers make up the "conventional grid". However, this highly differentiated perspective serves mainly an explanatory purpose as these days no grid is built or operated exclusively with such passive components.

Whenever reference is made in the following to conventional grid expansion (such as in connection with the transmission network), this means that attention is focused on expansion of a physical network in those areas where no grid previously existed or where capacity is to be expanded using new cables or overhead lines and powerful transformers, additional switchpanels or converter stations, etc.

3.2 Smart grid

Thesis: Information and advanced control technology will turn conventional electricity grids into smart grids.

The conventional electricity grid will become a smart grid by being upgraded with communication, metering, control, regulation and automation technology and IT components. Ultimately "smart" means that the system status can be recorded in "real time" and that means exist for controlling and regulating grids to enable full use to be made of existing grid capacity.

Smart grids enable better use to be made of conventional grid infrastructure and thus reduce the need for expanding this infrastructure or improve the stability of grids at constant load levels. In relation to distribution networks smart grids are understood as an increasingly better way of understanding and intervening locally in the system status of a grid. This means that as well as ensuring that consumers are supplied from both local and inter-regional sources there are also more ways of using power generated regionally and transmitting this to higher-level voltage levels without compromising grid reliability.

It also means that it will be possible to modify the different parameters which were fixed in a conventional grid. As an example it will be possible in smart grids to increase capacities (depending on the cable temperature) or to change the direction of power flows (depending on the feed-in situation) across parts of the grid.

Smart grid structures should also create the foundations which will allow for more market-based activities, including for small grid users (smart market), in the future, without compromising grid reliability.

Clearly, the term smart grid can be used quite vaguely, even when used with close reference to the grid (i.e. in contrast to smart market). If the entire grid expansion which is needed for the energy future - in other words all the work which will be required to expand the conventional grid - is considered to form part of a smart grid, then the energy future really will require the massive use of just such smart grids. If the term smart grid is used in a narrower sense then a smart grid can be seen to be developing in a more evolutionary fashion by incrementally integrating new and "intelligent" components into the conventional grid as the need arises. Seen from this perspective a conventional grid is not immediately smart. Only technical development and upgrading gradually gives a conventional grid the capabilities which make it controllable and more responsive.

3.3 Smart market

Thesis: The smart market is the area outside the grid in which energy volumes or services derived from them are traded among market participants on the basis of the available grid capacity. Alongside producers, consumers and prosumers there may be many more service providers active in these markets in the future (e.g. energy efficiency service providers, aggregators, etc.).

Thesis: Components which do not serve the grid (smart market components) will not be financed via the grid.

The smart grid / smart market distinction is mainly based on whether energy volumes and flows (market sphere) or capacities (grid sphere) are being considered. It is not the electricity volumes which will need to be integrated, and which it is envisaged will be produced on an increasingly renewable basis in the future, which are the primary issue when considering the smart gird and its implications; more to the point is that the smart grid concerns these volumes and the capacities they require at particular times, bearing in mind that the core business of system operators is the provision, maximisation and optimisation of grid capacities.

Players in the smart market are both all those involved in providing or purchasing energy volumes and service providers who upgrade energy volumes and flows into more sophisticated services. Efficiency services are based, for example, on reductions in the energy flow, and the principle of variable electricity pricing results in a shift in energy flows depending on the availability of energy volumes, i.e. a temporary reduction or expansion in the energy flow to a consumer as influenced by price signals.

The smart market is always based on the grid - be it the previous grid or an intelligently upgraded grid - and the available capacity of the grid to take up or release energy volumes. In this respect available grid capacity has an indirect limiting impact on what the smart market can offer. This can be visualised in simplified terms as a "capacity traffic light" which can be in one of three states:

- "Green": all the market participants are able to realize their plans and there is no need to devote special attention to grid capacity management ("there is enough space in the grid"). This status allows all market participants to realize their plans.

- "Red": the system operator must make a coordinating intervention (by taking capacity offline or issuing corresponding instructions) because the grid does not have sufficient capacity to satisfy demand. To keep the grid stable measures could be taken such as the forced shut down of generating plant, of transits or even forced reductions in power for consumers (section 13(2) of the German Energy Industry Act (EnWG).

- "Amber": A transitional area in which greater attention must be paid to the available grid capacity and market participants may need to be informed that the system operator may have to intervene to ensure that the grid remains stable. In all other respects the system operator must exhaust all the grid and market-related measures under section 13(1) EnWG.

Even a temporary redirection of energy flows (shifting of the electrical energy per time unit = change in capacity) will have direct implications for grid capacity demanded by the smart market players. For as long as and to the extent that energy volume flows have to be rerouted owing to restricted grid capacity (amber to red area), the grid requirements impact the market sphere. If grid capacities are not restricted in any way (amber to green area), there is no need for special capacity management.

However, the energy future not only requires an expanded grid, it will also call for stronger measures in this area, unless the grid is to be expanded in an economically inefficient way. Smart grids and smart markets should both foster intelligent solutions which contribute to increasing the usable capacity of conventional power lines (smart grid aspect) as well as to the exploitation of existing grid capacities by shifting generation and loads (smart market aspect), improving the grid's average utilization and ultimately, thanks to both effects, enabling the grid to be expanded in an economic fashion.

A key issue for the energy future and for the continuing legal and regulatory framework of the entire industry is whether the mechanism for balancing supply and demand (or at least a mechanism for coordinating short-term demand for grid capacities) according to the available grid *capacities* should be driven by the market, i.e. negotiated by market players, or optimised by system operators.

An upfront decision of this kind leads to decisions on who should bear the brunt of responsibility for organising the relevant marketplaces, controlling interventions, pricing – in brief, for a considerable part of the future structures:

The Bundesnetzagentur rejects the option of assigning this field from the word go completely and without further ado to the system operators. On the contrary, the agency proposes that system operators should at least refrain from making controlling interventions as long as market players are able to find their own solutions in negotiations, to coordinate all but instantly their demand for grid capacity among each other (green to amber lights on the capacity traffic light). In this respect it would be a good thing if system operators were not only to expand the grid but were also to take active steps to avoid shut downs and to cooperate with capacity consumers who are willing to negotiate on this issue. The grid should assume an enabling role, even if the appropriate strategies currently appear unconventional or alien to the system operators.

In the public debate calls are sometimes heard for distribution systems and distribution system operators to be given the task of providing smart market functionalities for all market partners in the energy future.[3] This becomes something of a chicken and egg argument whereby it is said that without across-the-board and centrally installed components - i.e. smart meters - it will not be possible to extract any or sufficient utility from a smart market or that no such utility would be produced.

[3] BDI: Smart Grid. Paradigm Shift in Germany. On the way to the Internet of energy. Competition alone is not enough. BDI Drucksache No. 450.

In contrast, the Bundesnetzagentur takes the view that the components which are required for the smart market but perform hardly any functions which serve the grid, and which can enable consumers and suppliers to coordinate their activities (marketplaces, etc.) should not be provided by the grid or at least not financed by the grid. A solution which is initiated by one player for third parties is too imprecise, both in terms of innovation and in terms of customer wishes. The risk of large-scale capital misallocations is far too great. What is more, the question also arises as to how customers can be motivated to use an infrastructure which they have not expressed any interest in or for which there is no apparent demand. The launch of the iPhone and the market transformation engendered by it - with a large and growing panoply of smartphones made by various manufacturers – shows that, provided that the offers and services available are good, options other than state prescribed hardware are possible. The market roles whose core business consists in persuading consumers to take particular actions should also take on the job of creating incentives and demand for corresponding products. If synergy effects with the grid can be exploited in the use of hardware, marketplaces or services, this should lead to negotiations on joint financing and use of the infrastructure.