European Distribution System Operators for Smart Grids

Flexibility: The role of DSOs in tomorrow's electricity market

Executive summary

A core element of the transformation of energy systems around Europe is the sharp increase in electricity generated by Renewable Energy Sources (RES). The types of RES growing the most, i.e. solar and wind, are variable and their integration into our electricity networks necessitates additional efforts to balance the system, both when power from RES is available and when it is not.

For distribution system operators (DSOs), this transformation poses a number of challenges. Today, the majority of new RES installed capacity has to be integrated into networks at distribution level. In areas with low demand in particular, where electricity generation from RES may easily exceed consumption, distribution systems have to be reinforced and extended. In a similar fashion, demand may increase significantly due to heat pumps, electrical vehicles and new energy intensive appliances. This requires considerable investment from DSOs and increases the need for flexibility.

Flexibility, in this respect, can be defined as the "modification of generation injection and/or consumption patterns in reaction to an external signal (price signal or activation) in order to provide a service within the energy system. The parameters used to characterise flexibility include the amount of power modulation, the duration, the rate of change, the response time, the location etc."

From a DSO perspective, only services delivered by a market party and procured by DSOs in order to maximise the security of supply and the quality of service in the most efficient way are of interest. These services are referred to as "system flexibility services" in this paper. Using system flexibility services for voltage control and congestion management could provide clear benefits for DSOs, grid users and society as a whole, such as:

- Optimised distribution network capacity investments
- Reduced technical losses
- Reduced curtailment of distributed generation and reduced outage times
- Increased distributed generation hosting capacity.

To make the most of flexibility, a few steps need to be taken:

- DSOs are regulated companies with limited leeway: they must be allowed to procure system flexibility services in all timescales and to recover their costs in an appropriate manner
- New market models reflecting the real value of flexibility should be set up
- Network operator cooperation is pivotal for optimising grid planning and operation
- Communication standards are needed for a secure exchange of data between DSOs and flexibility providers, as well as between the DSO and the TSO
- Engaging consumers will require appropriate incentives and technologies for demand-side flexibility to deliver its full benefits
- Incentivising distributed generators to adapt their power output based on network use is necessary to enable a more efficient use of the existing distribution assets.

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1. Introduction

The European Union is committed to achieving its ambitious climate and energy policy objectives: decreasing greenhouse gas emissions, increasing energy efficiency and the share of renewable energy. Implementing these policies has led to a steady growth of renewable energy sources which, in turn, has triggered a shift in the entire energy value chain.

A more dynamic system based on distributed and variable generation is replacing the traditional static system based on predictable and centralised power generation. Distribution System Operators (DSOs) are at the core of this transformation, connecting solar panels, and wind turbines, empowering consumers with smart meters, and enabling new markets to flourish.

Essential to these developments is the transformation of Europe’s traditional grids into, so-called smart grids, a move that will strongly aid the achievement of the EU’s energy objectives and bring us, cost-efficiently, into a more sustainable and competitive energy future.

Activities emerging under the scope of the European internal energy market (IEM) will empower consumers, contribute to energy savings and could make positive contributions to grid management but could also, coupled with the variable nature of distributed energy resources (DER), pose significant challenges to the DSO’s ability to perform its core responsibilities of network operation management and grid stability. These new market services are soon expected to be in place, and will enable consumers to play a more central role in the electricity system, moving from a passive to a more active role. This calls for an increasingly dynamic operation of the grid. Making the most of renewable energy sources (RES), as well as grid and consumption data, will be the key to a transition towards a sustainable energy system.

In this context, there is need to reach a common understanding of the use of system flexibility as it is crucial for maintaining a high quality supply of electricity, a secure and stable network, and to create a level playing field for innovative services in a cost-efficient, transparent and secure way.

In this report, European Distribution System Operators for Smart Grids (EDSO) presents its views on tomorrow’s flexibility procurement, focusing on the benefits DSOs can bring to market players and society as a whole, provided the right conditions are in place.

2. DSO and Flexibility – concept and challenges

a. Rationale for flexibility

A core element of the transformation of energy systems around Europe is the sharp increase in electricity generated by Renewable Energy Sources (RES). The types of RES growing the most, i.e. solar and wind, are variable. Their integration into our electricity networks necessitates additional efforts to steady the system (voltage and congestion), both when power from RES is available but also when it is not. In parallel, electricity demand is forecasted to rise as society moves away from fossil fuels. In particular, the development of electric mobility is likely to push electricity consumption up, which will transform distribution grids and the requirements placed upon them.

For distribution system operators (DSO), this evolution is a challenge: nearly all new RES are connected to distribution networks. Particularly in areas with low demand, where electricity generation from RES may easily exceed consumption, distribution systems have to be reinforced and extended. This requires considerable investment in electricity networks and heightens the need for **flexibility**.

Flexibility, in this respect, can be defined as the "modification of generation injection and/or consumption patterns, on an individual or aggregated level, in reaction to an external signal (price signal/network tariff/activation) in order to provide a service within the energy system. The parameters used to characterise flexibility include: the amount of power modulation, the duration, the rate of change, the response time, the location etc."[1]

With the rise of DER, flexibility services provided by users connected to the distribution grid will grow. As for other energy products, market parties will buy and sell them without consideration for the grid's physical state, which could result in raising the peak consumption or generation in local networks. Distribution systems will have to cope with less predictable energy flows and may have to reinforce and extend their grids.

The reinforcement and extension of distribution networks is not always the most cost-efficient solution to respond to these challenges. In many cases, a better alternative for the DSO would be to complement grid extension with the use of flexibility services. This solution would especially be advisable when it would result in higher welfare for *all* the actors involved, DSOs included.

It should be kept in mind that the DSO tends to need system flexibility for the safe operation of its network exactly at those times when demand for flexibility from market players is also high. For this reason, mechanisms are necessary to co-ordinate different demands and allocate flexibility where it is most valuable to society as a whole and not just for commercial gain. Since a secure supply of electricity is in the interest of the greater good, it is important that DSOs can use flexibility when it is a more cost efficient option than traditional grid reinforcement. With the precondition that the necessary supply of system flexibility to the DSO is guaranteed, all efforts should then be made to make as many system flexibility services available to market actors as possible and to dismantle any unnecessary obstacles to an efficient procurement of flexibility for commercial purposes.

[1] Based on Eurelectric definition in Flexibility and Aggregation: Requirements for their interaction in the market (2014)

b. System flexibility services for Distribution System Operators

System operators (TSOs and DSOs) have the responsibility to ensure system stability and security of supply. Today, the main tool used by DSOs to overcome increases in electricity consumption or generation in their network is to reinforce the grid by laying down more electricity cables, upgrading transformers, etc., but the alternative approach of making the most of flexibility offered by grid users is gaining momentum.

i. Definition of a system flexibility service

A fundamental distinction has to be made between flexibility used by *market players* and flexibility used by *network operators*:

- **Market players** always refers to activities performed with a commercial interest in mind, and actions focused on satisfying the energy needs of customers
- **Network operators** always refers to DSOs and TSOs, which are regulated companies and pursue an objective of efficient grid planning and operation. This kind of flexibility is related to security of supply and quality of service. In other words, this kind of flexibility may help system operators to keep the lights on when the grid is pushed to its limits.

This paper addresses system flexibility services procured by DSOs, and not portfolio optimisation, where DSOs only act as market facilitators by managing and processing data required by market parties in a neutral and non-discriminatory way. To differentiate the two in this report, flexibility used by network operators will be referred to as "***system flexibility services***"[2]. System flexibility services are here defined as any service delivered by a market party and procured by DSOs in order to maximise the security of supply and the quality of service in the most efficient way.

[2] The Energy Efficiency Directive (2012/27/EC) already sketches this concept in Article 15.1 "…take into account the cost and benefits of each measure, provide incentives for grid operators to make available *system services* to network users permitting them to implement energy efficiency improvement measures in the context of the continuing deployment of smart grids".

Table 1 – Difference between flexibility used by commercial parties and regulated parties

Party	Activity	Business model based on	Will procure	Flexibility use	Final aim
Commercial Party (supplier, aggregator, balance responsible party)	Buy and sell electricity (MWh) in a market	Price set by market rules	Portfolio Optimisation	System-wide	Profit maximisation
Regulated party (Transmission System Operator)	Channel electricity between generators and consumers	Regulatory mechanism to cover costs	System Flexibility Service	System-wide	Grid planning and operational efficiency maximisation
Regulated party (**Distribution System Operator**)	Channel electricity between generators and consumers	Regulatory mechanism to cover costs[3]	**System Flexibility Service**	Local, regional or national	Grid planning and operational efficiency maximisation

Sound regulatory mechanisms will be key to incentivise DSOs to fulfil their tasks in the most efficient way. DSOs will decide which situations call for a market based solution and which situations call for grid reinforcement in order to maintain the best quality of service, which is a key indicator monitored by NRAs to assess the efficiency of DSOs.

System flexibility services could be used for a range of DSO activities: planning, connection, access, and operation. Existing European regulation already makes room for, and in some cases encourages, system flexibility services that support these activities. The Third Energy Package[4] requires DSOs to take into account DER as well as conventional assets like substations and transformers when **planning** their networks. In this sense, the challenge will be to secure adequate "firmness", i.e. secured availability for flexibility from DER. It is worth noting, however, that new system flexibility services should not be interpreted as a substitute for conventional assets, but as a complement to them that

[3] The procurement of services, maybe market-based or not, but in the end the DSO always cover its cost according to a specific mechanism defined by a national (or regional) regulation.
[4] Article 25.7 of Directive 2009/72/EC

will in most cases lead to a more efficient use of the assets. As for conventional asset investments, system flexibility services should be covered by tariffs, as any other DSO CAPEX.

Regarding **connection and access**, DSOs undertake network connection studies before connecting DER. These are designed to guarantee that, under normal operation, the network can cope with the maximum possible injection of generated electricity combined with the minimum level of consumption at any time of the year, and can cope with maximum consumption with no local generation. The current European regulatory framework[5] establishes priority and guaranteed network access for electricity from RES. In this sense, the challenge will be to have the right combination of long and short-term system flexibility services to allow DSOs to bring more efficiency to the system. Variable access contracts and/or firm distributed generation, generation dispatching via tendering for commercial services may all be seen as potential solutions[6].

In terms of **operation**, the Energy Efficiency Directive hints[7] at the use of system services by DSOs to enable them to operate the grid within the security standards. As for other operational costs, system flexibility services should be covered by tariffs, as any other DSO OPEX.

Flexibility could, thus, help DSOs to manage their grid in a more efficient way, provided that the right services are available.

ii. System flexibility services procured by DSOs

Three characteristics of grid users providing flexibility are key for distribution networks: location, firmness and power. Flexibility on distribution networks must be located at a lower voltage level than the infrastructure that needs to be alleviated. However, the lower in voltage the infrastructure is, the less possibilities there are in terms of providers and location of flexibility. This is limiting the pool of available system flexibility service providers and the degree of firmness they can offer.

This considered, the chosen mechanism should always be the most cost efficient from a system point of view (enough competing players are needed for a functioning market). If these obstacles are lifted, DSOs will be able to make the most of system flexibility services such as congestion management and voltage control.

- **Congestion management -** Improved network capacity planning and congestion management will be required to maximise the grid DER hosting capacity, while keeping a high level of security and quality of supply. Flexibility from distributed generators and consumers would help to optimise networks in the most cost-efficient way and to solve local grid constraints. Network reinforcement could be deferred until the moment when it becomes more cost-effective than procuring services from DER. This service could be set up with a long-term perspective (network planning) or with the aim to avoid/solve security issues very close to real-time (see table 2 and 3)

[5] Art. 16th of Directive 2009/28/EC and art. 14th of Directive 2012/27/EU
[6] See Eurelectric paper Active Distribution System Management : a key tool for the smooth integration of distributed generation, full discussion paper
[7] Annex XI of Directive 2012/27/EU

- **Voltage control -** European draft network codes forbid or limit the ability of DSOs to export reactive power to transmission grids. There are also physical operating boundaries to respect with regard to voltage. With more and more distributed generation connected to distribution networks, injections of active power lead to voltage profile modifications. However, with more monitoring and coordination, distributed generation could be used by DSOs for voltage control and losses management.

Table 2 (below) proposes a list of system flexibility services procured by DSOs and TSOs. An empirical method has been used to create this table: detecting a network operator's need (TSO or DSO), determining which service could cover that need (an existing service or a future one), and which could be the arrangement for this service to be procured (market or regulation).

This classification is not exhaustive: the list could vary from one country to another depending on regulatory arrangements, network operator needs and the number of system flexibility service providers available. Potentially, a service could become a requirement set in grid codes in one Member State, and become a service sold on a market in another country, depending on the needs resulting from different levels of RES and grid design.

Table 2. Short-term system flexibility services procured by DSOs and TSOs

System Need	Potential Service	Potential procurement mechanism	Procurer
Avoiding frequency instability	Frequency containment reserve	Regulation: can be mandatory or not, with or without compensation	TSO
Restoring frequency within security standards	Frequency restoration reserve	Balancing market	TSO
Restoring active power reserves for frequency control purposes	Replacement reserve	Balancing market	TSO
Congestion management to keep the system running within security standards	Generation adjustment	Market / bilateral agreement	DSO/ TSO
Voltage control	Reactive power provision	Grid code	DSO

Table 3: Long-term system flexibility services procured by DSOs

Maximising DER connection and integration	Curtailment	Market / Bilateral agreements / Grid code	DSO
Investing efficiently in distribution grids	Peak shifting	Market / Bilateral agreements / auction / Grid codes	DSO

iii. Procurers and providers of system flexibility services

As previously explained, TSOs and DSOs will procure and use system flexibility services. The DSO will procure these services, plan and operate its network in the most cost efficient way. Flexibility is an additional tool through which this can be accomplished. System flexibility services are not a substitute for planning, connection and access investments (CAPEX) or operational costs (OPEX), but a complement in order to bring more efficiency to the system. System flexibility services will lead to a shift from CAPEX to OPEX, and regulation should recognise this by accepting "riskier" expenses. For example, upgrading a transformer is a proven solution, which comes with a known cost and very few risks. Using system flexibility services might slightly increase risks if the service provider fails to deliver its service, but could provide a clear cost reduction. It should, therefore, be a part of the 'normal' regulated cost-base of the DSO.

However, safeguards should be created to avoid market players from "gaming". Some flexibility services could be delivered to a balancing responsible party for his own portfolio optimisation in a specific area, with the aim of creating a local peak, thus forcing the DSO to contract a system flexibility service at a high price.

Technically, flexibility used by DSOs could be dispatchable generation, responsive consumption, and reactive power regulation. The potential service providers are active users who have the capabilities to modify their injection/consumption patterns, i.e. (aggregated) small industrial and commercial users and aggregated household customers and DER:

- **(Aggregated) small industrial and commercial users**
  Small industrial and commercial users could provide services to DSOs, either under the umbrella of an aggregator or individually. SMEs using electricity-intensive machinery, having a fleet of electric vehicles or using electricity for thermal control, such as air conditioning, water heaters, boilers, freezers, or refrigeration would be of particular interest, due to thermal inertia.

- **(Aggregated) household customers**
  Household customers could be an important source of flexibility for network operators, as long as providing flexibility is a transparent and effortless process. Individual household provision of system flexibility services is highly unlikely due to its weak impact on the system. However, household customers could potentially contribute to a pool of flexibility through their supplier or an aggregator. Several domestic appliances, if pooled, could have an impact on grid management.

Electric vehicles, heat pumps, electrical heating and air conditioning are examples of devices which can provide flexibility.

It must be noted that demand-side flexibility is based on the assumption that consumers are willing to engage in demand-response activities. Engaging consumers will require incentives and technologies and is crucial for demand-side flexibility to work and deliver its full benefits. Incentives could be, for example, dynamic grid tariffs or incentive based demand response, enabling the consumer to save money by offering controllable loads to market and network operators.

- **(Aggregated) distributed energy resources**
  A number of different DERs could be used to provide flexibility. Research projects such as REserviceS[8] have shown the potential of PV and wind, but other technologies such as cogeneration and combined heat and power could also be resources worth tapping. Whereas large DER units could act individually in flexibility markets, small units, such as solar panels on a single house, will have to be represented by an aggregator to provide services.

DER controllability and forecasting will be key to making the most of its flexibility potential. If variable energy forecasting methods are reliable over a large territory, these techniques, today, lack the necessary accuracy to predict local energy patterns on day-before to intra-day timeframes. New smart prediction or other contingency tools will be needed in distribution management systems. These management systems will, in the future, be similar to the tools used in a transmission control centre.

iv. System flexibility service procurement mechanisms

Matching system flexibility services and DSO needs will require clear procurement mechanisms. An obvious precondition is for regulation to allow DSOs to use these services. In addition, efficient and secure information exchange will be needed between TSOs and DSOs. Coordination with market players will also be a crucial aspect of flexibility.

That coordination is only possible if some information exchange is in place. DSOs have to gather information from all users connected to its networks and pass on the necessary data in an aggregated way to the TSO. The same communication channels, going through DSOs, will be used by the TSO to give instructions to DSO, and DSOs will also use them to give their own instructions. Sharing communication channels is an easy solution to limit double investments.

In this set-up, TSOs and DSOs:

- Have the right to fulfil their responsibilities, as they are enforced by law
- Have visibility over each other's actions and needs that could affect them
- Have visibility on their users' planned and real-time actions. If their users are using aggregators, DSOs will need disaggregated and locational information

[8] REserviceS, Deliverable D6.2,"Report on the evaluation and conclusion of the DSO case studies", March 2014 [http://www.reservices-project.eu/wp-content/uploads/REserviceS-D6.2-Final.pdf]

- Have the right to procure system flexibility services in any timescale to solve grid constraints, either by incentivising the user creating a constraint to address the problem or by procuring a service that will counter-act the negative effect of a user
- Cannot send contradictory signals to the same grid user.

Additionally, a TSO's actions on DSO network users should be monitored, and potentially blocked by the DSO if it jeopardises the security of supply and quality of service. Instead, the DSO will provide the TSO with the equivalent effect at the TSO/DSO connection point.

3. Value of flexibility versus business as usual

From a DSO point of view, and as evidenced in the REserviceS project, using flexibility services provided by DER, such as wind and PV, at distribution level could bring a number of quantifiable benefits, both for network operators and grid users:

- **Optimised distribution network capacity investments**
  In cases of high generation or demand of electricity, parts of the electricity grid can be subject to congestion due to a limited distribution capacity. Network operators traditionally fix this issue by investing in network reinforcements. Using flexibility can help to defer an investment or could solve congestion when reinforcing the infrastructure would not be possible. If flexibility prevents an investment, the value of flexibility then equals the CAPEX and OPEX of the avoided reinforcement. If flexibility services enable the DSO to defer investments, the value of flexibility can be calculated as the avoided return on capital cost over the deferral duration.

- **Reduced technical losses**
  Transport of a KWh from generators to consumers creates network losses (power dissipation in distribution lines and transformers) which are proportional to the length of the electricity route. Flexibility services can help to reduce losses. Network losses are already given a value. The value of flexibility then corresponds to the amount of electricity that has not been lost.

- **Reduced curtailment of distributed generation and reduced outage times**
  By using flexibility services, DSOs could better control voltage profiles in areas with a high number of variable sources of electricity. Flexibility can, thus, directly benefit grid users (eg. solar panel owners) who would be able to feed-in more energy to the grid. The value here is determined by avoided investments and maintenance costs in voltage control.

- **Increased distributed generation hosting capacity**
  This point is related to the previous. By helping to keep the network stable, flexibility services could, in some areas, increase the distributed generation hosting capacity of the grid. The value here is also determined by avoided investments and maintenance costs in voltage control.

  The REserviceS project shows that in some areas, such as Bavaria in Germany, the cost of accommodating DER would be decreased by 50% if using flexibility instead of traditional grid reinforcement. An Italian case study also shows that the total installed capacity of DER can increase by 28% thanks to the use of flexibility to better control voltage. Benefits will vary from one network to another, but it is clear that the higher the penetration of RES, the more cost-effective system flexibility services will be.

  Other studies, commissioned and performed by other companies than DSOs confirm these results. This is the case for a study[9] from the consultancy CE Delft which finds that "In all the scenarios,

[9] CE Delft, "The social costs and benefits of Smart Grids", Frans Rooijers, Martijn Blom, Rob van Gerwen (http://www.cedelft.eu/art/uploads/file/MKBA_Website/CE%20Delft%20-%20Maatschappelijke%20kosten%20en%20baten%20van%20Intelligente%20Netten.pdf)

Smart Grids (a concept which, in this study, includes the use of system flexibility services) have a major contribution to make to [the] creation of a future energy system. This study leads to the expectation that Smart Grids will have economic benefits for the consumer, which will ultimately translate to lower delivery prices and lower grid tariffs for consumers and industry alike”. This document also lists the expected costs and benefits of smart grids and flexibility, which are summarised and complemented in Table 3.

Table 3: Comparison of potential costs and benefits of developing smart grids and flexibility

Type of effects	Cost	Benefits
Direct	Investment in smart grids	Avoided grid investment
	Smart Grid Operation and maintenance	Avoided grid losses
	Cost on location for equipment	Avoided investments in central generation capacity
		Avoided investments in storage
		More efficient use of central generating capacity
		Additional energy savings
		Reduced Imbalance
Indirect and external	Welfare losses due to adaptation to new energy demand patterns	Welfare gain due to new services
		Reduced CO_2 emissions
		Reduced outage time
		Reduced curtailment of distributed generation
		Increased grid hosting capacity for distributed generation

4. Conclusion and recommandations

DSOs could make the most of their grid provided that they are allowed to use system flexibility services. In a similar fashion, increasing flexibility in the electricity market (when technically and economically appropriate) would result in a number of benefits for DSOs, consumers (all grid users) and society as a whole. This, however, implies that distribution networks are planned differently, incorporating new risk margins and uncertainty, are not only managed as they used to be, but rather as networks with enhanced observability, controllability and interactions with market stakeholders.

DSO regulation

- DSOs should be allowed to procure flexibility services in all timescales in addition to traditional grid reinforcement
- DSOs should be able to decide which situations call for a market based solution and which situations call for grid development, while maintaining a high quality of service
- System flexibility services are complementary to traditional grid reinforcement. New regulatory frameworks should include mechanisms that both allow DSOs to procure system flexibility services and to recover their cost, also taking into account the shift from CAPEX to OPEX that system flexibility services will trigger.

Market design

- Besides being able to procure system flexibility services, DSOs should be allowed to act as neutral market facilitators for other new emerging market based services
- For congestion management, DSOs should have the right to use system flexibility services from distributed generation and load in order to solve grid constraints. However, if there are too few suppliers of system flexibility services in an area, the DSO should have the possibility to conclude individual contacts with customers
- Safeguards should be built to avoid “gaming” by market players: deliberate creation of a peak in an area to sell system flexibility services to network operators at a high price
- Clear price signals, indicating the real demand for system flexibility services, are needed for the development of flexibility markets
- The market for local flexibility must be thoughtfully designed to avoid jeopardising national generation/consumption balances.

Network Operator Coordination

- Using system flexibility services will require extensive cooperation and clear boundaries between TSOs and DSOs rights and duties
- Direct signals from the TSO to DSO grid users should not be authorised. The DSO should always be the interface and agree upon system management practices with the TSO. Coordination obligations should be introduced.
- European Network Codes, such as Demand Connection, Operational Security and Electricity Balancing should not hinder the use of system flexibility services at distribution level.

Data exchange

- Communication standards are needed for a secure exchange of data between DSOs and flexibility providers, as well as between the DSO and the TSO
- The development of DER is heavily impacting low and medium voltage networks, requiring a high level of control over the (electricity supply) service level parameters, particularly through the use of advanced sensors and metering data. Monitoring networks and making timely use of available meter data is essential for DSOs.

Consumer engagement

- Demand-side flexibility is based on the assumption that consumers are willing to engage in demand-response activities. Engaging consumers will require incentives and technologies for demand-side flexibility to work and deliver its full benefits. Appropriate incentives should be set up, such as, dynamic tariffs or incentive based demand response[10] in order for the consumer to make savings by offering controllable loads to network operators
- A revision of grid tariffs with, time-dependent and site-dependent components or incentive based demand response, is an essential step towards realising the benefits, as well as for passing on the costs of flexibility.

Distributed Generation

- A mechanism incentivising distributed generators to adapt power output based on network use is necessary to enable a more efficient use of the existing distribution assets and deferral of grid reinforcement
- Even if forecasting methods for variable energy generation are quite reliable when considering a large area (such as a country), these techniques lack the necessary accuracy to predict local energy patterns on day-ahead and intra-day timeframes. New smart prediction or other contingency tools will be needed in distribution management systems.

EDSO for smart grids

EDSO for Smart Grids is a European association gathering leading Electricity Distribution System Operators, cooperating to bring Smart Grids from vision to reality.

[10] Incentive-based demand response relies on pre-defined discounts for customers willing to alter their consumption in response to a technical signal sent by the programme manager.