

EG3 First Year Report: Options on handling Smart Grids Data

SMART GRID TASK FORCE

EG3 REPORT

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**Expert Group 3 - Regulatory Recommendations for Smart
Grids Deployment**

DISCLAIMER

This report is the result of the consensus reached among experts of the Expert Group for Regulatory Recommendations for Smart Grids deployment (EG3) within the Smart Grids Task Force.

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INTRODUCTION

Policy context

Smart Grids¹ play an important role in implementing EU energy policy, which sets ambitious targets for the years to come. Besides the energy targets for 2020² adopted by the European Council in 2007, the Energy Roadmap 2050³ identifies decarbonisation as a goal to achieve by 2050.

These objectives imply a complete transformation of the energy system. The energy mix is about to change significantly. Renewables are envisaged to become the prevailing energy source in the future, accounting for up to 75% of gross final energy consumption in 2050. Not only large-scale RES but also distributed renewable energy sources are expected to contribute achieving this goal.

Consumers are in the centre of these changes. They are expected to evolve from being 'passive' recipients of energy services into 'active' participants in the energy market. It is expected that active consumers will shift to more efficient and sustainable energy consumption paths. For this to happen, consumers must be provided with better information, as well as incentives such as dynamic pricing mechanisms and appropriate ICT tools. It is recognised that for all of the cases described in this paper issues of privacy, data security and cyber-security, are of the utmost importance and will have to be developed in more detail in subsequent work.

Accommodating the resulting massive deployment of renewable and decentralised energy sources, as well as managing complex interactions between suppliers and customers presents new challenges for the electricity networks and markets. Therefore, research and development investments will have to focus on network related technologies and market designs which will facilitate overall efficiency and cost-effectiveness of the electricity supply chain. In this context, the European Electricity Grid Initiative (EEGI) has been identified as one of the European industrial initiatives of the SET-Plan policy framework⁴.

In accordance with Directive 2009/72/EC, concerning the common rules for the internal market in electricity, Member States are required to ensure the implementation of Smart Metering Systems that assist the active participation of consumers in the supply of electricity. Furthermore, in the Commission's Interpretative Note on 'Retail Markets', the Commission services consider that the implementation of more active transmission and distribution systems in the form of Smart Grids is central to the development of the internal market for energy. In this context, the Commission communication "Making the

¹ Smart Grids are defined as electricity networks that can efficiently integrate the behaviour and actions of all users connected to it — generators, consumers and those that do both — in order to ensure an economically efficient, sustainable power system with low losses and high quality and security of supply and safety. (http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/expert_group1.pdf)

² To reduce GHG by 20%, increase share of renewable energy by 20% and to make to make a 20% improvement in energy efficiency

³ COM(2011) 885 final (15.12.2011), 'Energy Roadmap 2050'

⁴ COM(2009) 519 final (07.10.2009), 'Investing in the Development of Low Carbon Technologies (SET-Plan'

internal energy market work"⁵ underlines the various benefits from the roll-out of Smart Metering Systems such as the large-scale integration of RES and the enablement of demand response. It is also emphasised in the communication that "Supply- and demand-side flexibility can and should be rewarded on the basis of market-based price signals (short-, medium- and long-term) to encourage the energy-efficient production and use of electricity". These benefits will be brought to the system and the energy market, as key elements of the response to new challenges, such as the transition to a low carbon economy, cost efficiently and without compromising security of supply. The advent of Smart Metering Systems calls for a joint reflexion on new business opportunities and viable market options. For this reason, the Commission has asked Member States to produce action plans (for the roll-out of smart metering systems) which take account of the opportunity to modernise their grids, including rules and obligations for DSOs, synergies with the ICT sector and promotion of demand-response and dynamic prices, in accordance with the Energy Efficiency Directive.

According to the recent Directive 2012/27/EU⁶ ('Energy Efficiency Directive') Member States shall ensure that final customers for electricity are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use, when it is technically possible, financially reasonable and proportionate in relation to the potential energy savings. At the same time this Directive requires Member States to "*ensure that national energy regulatory authorities, through the development of network tariffs and regulations, within the framework of Directive 2009/72/EC and taking into account the costs 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.*"

Moreover, a series of Network Codes are being developed by ENTSO-E⁷. These codes will contain a number of mandatory requirements (e.g. in relation to demand side response in the Demand Connection Code). The adoption of these codes could impact the implementation of certain market features.

We are currently in a point in time where we have the opportunity to take coordinated actions to describe how the "smart revolution" is brought into the energy market in order to: enhance system flexibility and security; promote collaboration between energy and ICT/Telco sectors exploiting potential synergies; and find consensus on viable options identifying next steps to empower consumers.

Indeed, Smart Grids bring to the energy sector the interaction with ICT in order to deploy innovative products and services. This interaction allows energy grids to handle more complexity (e.g. integration of electric vehicles and distributed generation), as well as empowering consumers, in an efficient and effective way. However, to obtain full benefits from this interaction, regulatory incentives should be explored. In this context, national regulatory authorities, both from the energy and the telecom sector, should provide the required regulatory security and push stakeholders to exploit synergies; creating an innovative, smart, flexible, fully integrated and competitive energy market.

⁵ http://ec.europa.eu/energy/gas_electricity/internal_market_en.htm

⁶ http://ec.europa.eu/energy/efficiency/eed/eed_en.htm

⁷ <https://www.entsoe.eu/resources/network-codes/>

Scope of the paper

The Smart Grids Task Force work programme for 2012⁸ stipulated that the Expert Group for Regulatory Recommendations (EG3) should develop a market reference model exploiting the synergies with the ICT sector and recommend regulatory incentives and obligations that protect and empower consumers and at the same time encourage the roll-out of Smart Metering.

Even though the original intention was to define one single reference model, the diverse situations across Member States and the impossibility of defining a "one-size-fits-all" model has led EG3 to work on three cases. Based on the "Reference Architecture" for smart grids under the mandate M/490, these three cases should represent different options of handling Smart Grids data, built on the Information Layer of the mentioned architecture. As a result, EG3 has developed three Cases which all have the goal of guaranteeing active management and reliable operation of the grid and its connection points, and which should have customers at their very heart. Meeting these objectives calls for models that allow transparent contact between customers, producers, suppliers and network operators. In addition, these three cases should be easily definable and facilitate referencing against stakeholders requirements (especially consumers). Each one of them, by itself or combined with elements from the others, should cover all the possible scenarios. It is recognised that variants of this three cases are also credible (e.g. in relation to metering ownership) and in fact can already be seen in specific Member States.

The first part of the report collectively presents the Cases and attempts to extract high level conclusions under four distinct topics. Data handling and processing has been identified as the distinctive factor between the three cases; therefore, starting from Business-As-Usual scenario (BAU), the way data is handled and processed in each Case is presented in Section 1.

Moreover, the three cases were examined under the following topics: advantages and disadvantages for consumers, business opportunities (synergies between ICT and Energy), and recommendations for regulatory intervention.

In developing different options for Smart Grids data handling, it is vital that the unique characteristics of the electricity system are taken full account of. Most importantly, unlike any other supply chain, the electricity system operates as a single unified system across Member States. Its security and integrity are of paramount importance and any option on Smart Grids data handling must operate in line with the system's physical operation.

To sum up, starting from the BAU scenario, and taking due account of the legal and political context provided in the introduction; this paper's main objective is to give an accurate description of the chosen options to handle Smart Grids data and facilitate analysis towards a future market design. Further work is indeed needed to provide adequate answers to key questions, such as what incentives are needed, why low investments in innovation and who has to pay for innovation?; what are the synergies between Energy and ICT sector?; what new regulation is needed?; etc.

⁸ http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/mission_and_workprogramme.pdf

This report is the result of the consensus reached during 2012 among experts of the Expert Group for Regulatory Recommendations for Smart Grids deployment (EG3) within the Smart Grids Task Force. The list of experts is in the Annex 1.

BUSINESS-AS-USUAL SCENARIO

The electricity markets operating today in Member States have been developed over many decades from different starting points and in order to meet different objectives. While there are commonalities between them, there are also material differences.

The Third Package was designed to strengthen the commonalities and enhance the single market for electricity. The core provisions of the Third Package can therefore be seen as today's BAU market scenario. These provisions relate to: the unbundling of Transmission System Operators (TSOs); the establishment of single, independent national regulatory authorities (NRA); the promotion of co-operation between NRAs and TSOs; the development of common, legally binding network codes; and the promotion of smart metering.

However, the provisions of the Third Package still allow quite different market scenarios to be pursued and this can be seen particularly in the different approaches to smart metering. The provisions of the Third Package provide a high level 'framework' designed to further liberalise the European energy markets so that they offer consumers more choice and better value for money while ensuring supply security and meeting environmental targets.

Benefits for consumers

The BAU market takes an essentially 'top down' approach to the development of the single market with a focus at TSO level. This is also demonstrated by the development of common network codes which is being led by the TSOs through ENTSO-E. It is expected that the benefits of more active cross-border trading will filter down to consumers. However, the 'top down' approach is balanced by consumer protection provisions relating to customer bills and the contents of supply contracts, as well as the time for which supply data must be retained. It also stipulates that it should take a consumer no more than 3 weeks to switch its electricity or gas provider.

Implementation

The EU Third Package legislation on European electricity and gas markets came into force on the 3rd September 2009. It required Member States to implement the legislation by March 2011.

The 'top-down' provisions are very much about cross-border issues and are being developed across Member States on a common basis. However, the consumer and smart meter provisions are much more specific to individual Member States. The flexibility allowed in the Third Package is being used so that implementation of these provisions is showing material differences between Member States.

SECTION 1- DESCRIPTION OF THE THREE CHOSEN CASES:

The three cases described below, by itself or combined with elements from the others, should cover all the possible scenarios of handling Smart Grids data. It is recognised that variants of this three cases are also credible and in fact can already be seen in specific Member States. The three cases are consistent with provisions of the third legislative package.

1. CASE I: DSO AS MARKET FACILITATOR

Description of the case

The DSO as market facilitator case favours a model based on a data hub, which is the standardized centralized or decentralized point for the market parties to collect all operational data as well as all necessary data to facilitate the market (data about customers, their technical possibilities, and their consumption or production). The DSO provides this data to the market via the data hubs, as a regulated neutral market facilitator in a non-discriminatory manner. It is up to the market parties to enrich this data with other information (e.g. price signals, tariffs, etc.) in order to create new innovative services. For data security and privacy reasons customers will always be the owner of their ‘personal’ data and have to approve if data should be sent to third parties.

DSOs are the operators of the technical infrastructure, including data hubs and the enablers of new value-added services, i.e. they are in charge of reliable operation of the distribution grid and act as neutral market facilitators for generators and suppliers. DSOs have the means to plan and manage the new opportunities and risks related to the grid, in cooperation with all other market participants. They also serve as an information conduit to TSOs for generation connected to their networks towards TSOs. Case 1 describes the case where the DSOs act as a market facilitator. Within this case different options exist: market facilitation via decentralized data hubs, or via one centralized data hub.

The DSO Market Facilitator is:	The DSO Market Facilitator is not:
- A model that allows DSOs to provide a platform on which market players can build innovative businesses: value creation on top of smart grids	- A model that requires significant changes to regulation, supervisory mechanisms and has large transition costs (to implement a number of new systems, market processes and interfaces)
- A model with ownership and control by DSOs of the (de)central data hub with clear partnership options with ICT and Telco providers	- It does not fragment integrated market processes (like switching) into multiple complex sub-processes and information flows managed by separated agents
- It complies with the 3rd Energy Package	- It does not prevent synergies from the management of both the grid (quality of supply) and its associated data

Benefits for consumers

- The aggregated data for consumers is centrally or de-centrally stored; this enables effective verification and validation of **privacy, quality and security around customer data** in a regulated environment.
- The **neutrality of data handling** by DSOs within this model towards all suppliers guarantees a level playing field and thus promotes competition in the electricity market.

- Improved **transparency and clear responsibilities in public/ private cooperation**: compatibility with the current system processes will result in less adjustment costs, higher efficiency and transparency. The DSO is and will be the only market facilitator that is constantly available and therefore has the needed information of the system users.
- The data originating within the operations and organisation of the DSO is also directly controlled and used to efficiently deliver the market facilitating role. Therefore additional data transaction costs are avoided. In other words, this case has the potential to deliver a **cost-effective approach**.

Implementation

A trend towards information exchange through such data hubs can already be observed within the EU: some countries have already implemented it (e.g. the Netherlands Central hub), or decided to adopt it (e.g. Belgium); others have decided to adopt it just for some processes such as switching (e.g. Portugal). This does not mean, however, that data hubs should necessarily be nation-wide. Several decentralised hubs per member state are also conceivable.

Case I: DSO as Market Facilitator

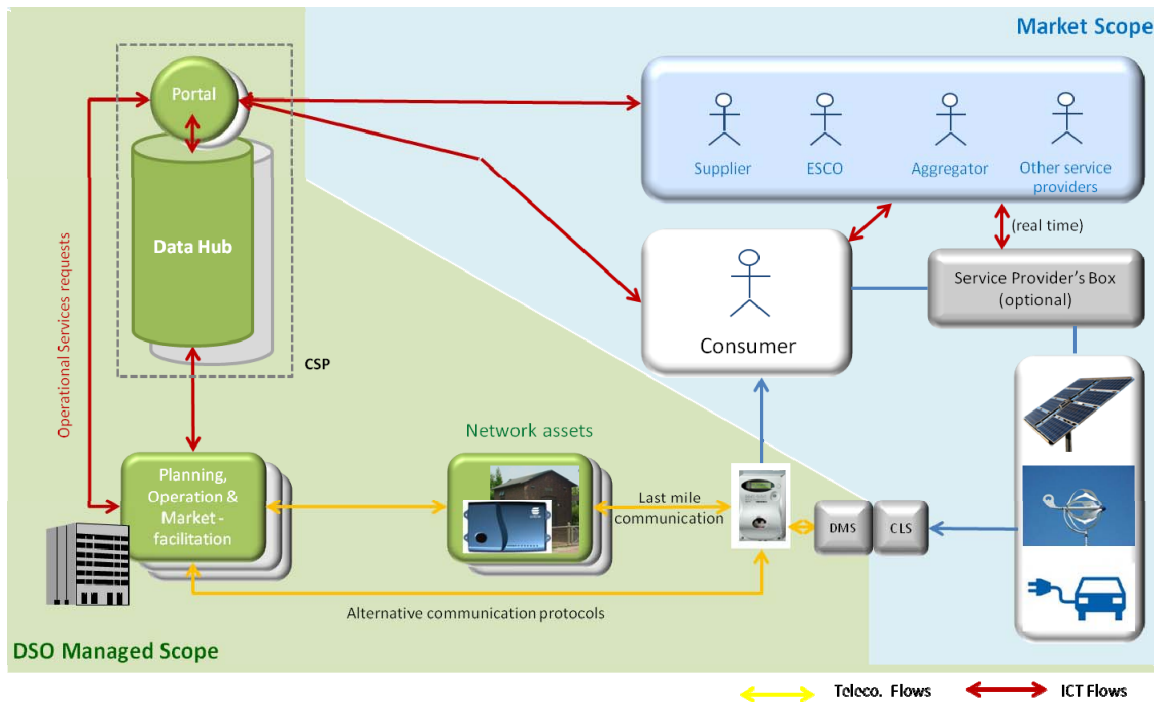


Figure 1. Case I: DSO as market facilitator – high-level model overview

2. CASE II: THIRD PARTY MARKET FACILITATOR – INDEPENDENT CENTRAL DATA HUB (CDH)

Description of the case

This case consists of an independent central communication platform based on one or several data hubs which will interact with different smart grid stakeholders, potentially storing data and processing it. This will allow equal access by all market participants to commercial data facilitating the market in a neutral manner, as the third party is by definition an independent one. The key functions of the hub are access control, receiving data from different parties and delivering it to the authorized parties, as well as aggregation and data storage for retrieval of historical data or tailor made services by end consumers, or their authorized agents, which could be electricity retailers, energy service companies, aggregators or other Services Providers.

The Third Party Market Facilitator is:	The Third Party Market Facilitator is not:
<ul style="list-style-type: none"> - It is an independent communication platform that ensures only authorized parties receive and send data 	<ul style="list-style-type: none"> - The CDH is not a metering service. Metering and its related communications systems would remain under the responsibility of one of the existing entities (e.g. the DSO or the supplier may be responsible for data collection, data quality, timeliness and data delivery)
<ul style="list-style-type: none"> - The CDH is a regulated agent, with oversight by a governmental agency or body. Its responsibilities have to be clearly defined and limited 	
<ul style="list-style-type: none"> - The CDH could be responsible for the processes of supplier switching, commercial data distribution to market participants and aggregation of data for use in market settlement, allocation and reconciliation services avoiding unnecessary or redundant data exchanges between entities. The CDH will not only provide data, but it will process, aggregate, synchronize and redistribute it 	
<ul style="list-style-type: none"> - The hub can be sized for data needed by other parties in addition to the DSO 	

Benefits for consumers

Case II presents several potential strengths: Independence, economies of scale and equal access, effectiveness for smart grid deployment, regulatory control, existing precedents, stakeholder support and bridging possibility towards other forms of regulation.

An example of how Case II could facilitate existing processes is Supplier Switching. The new supplier would communicate and prove to the Central Data Hub (CDH) the desire of the customer to switch suppliers, then the CDH would stop sending data to the old supplier and begin sending

data to the new supplier. This could possibly provide a shorter supplier switching process, enabling consumers to more easily access shopping for the best supplier's offer.

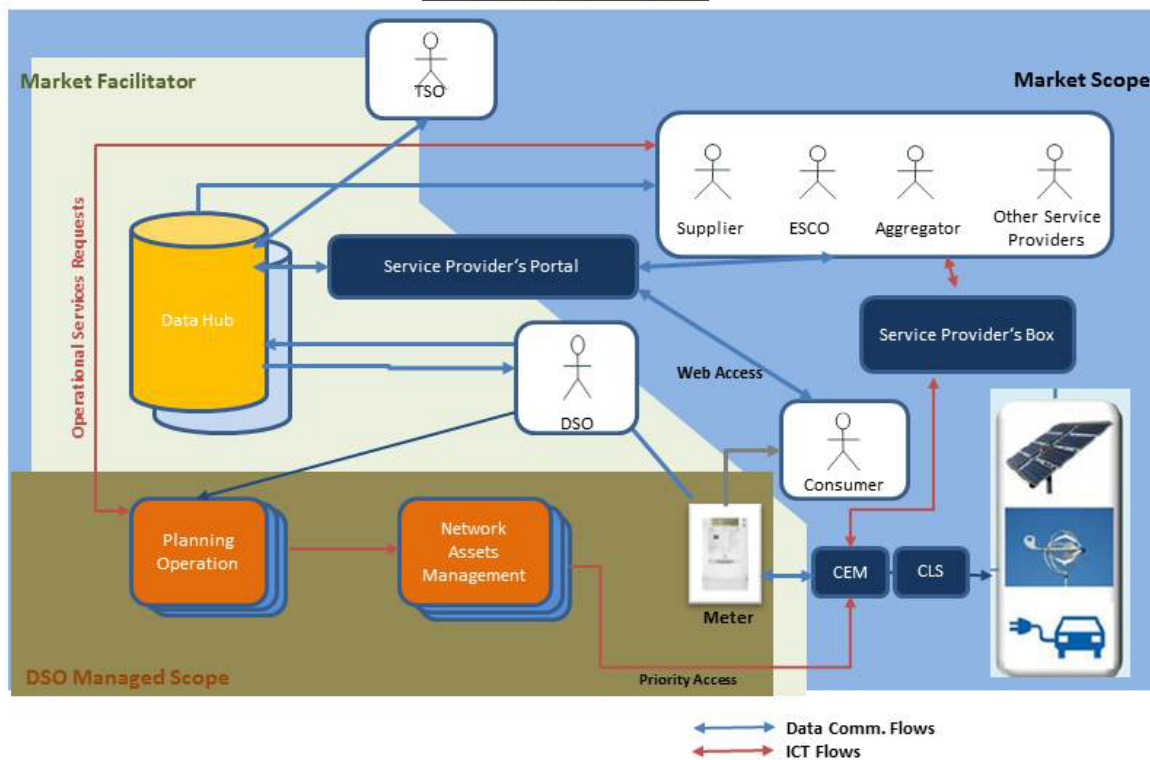
This case has the potential to deliver a good performance in empowering consumers to actively participate in the energy system through demand response, due to the fact that the CDH provider should be able to offer neutral, efficient access to information.

Implementation

Supporters of a CDH Model: GB⁹, Estonia, Denmark, Poland, Nordic Exchange Markets and Italy¹⁰. Other international supporters: Province of Ontario in Canada, State of Texas, Ecuador and Australia.

Some countries will have a *de facto*, a CDH, because there is only a single DSO that will have responsibility for collecting and distributing smart meter data. Ireland is an example.

Case II: Third Party Market Facilitator (Independent Central Hub)



CEM: Customer Energy Management
 CLS: Controllable Load System

Figure 2. Case II: Third Party Market Facilitator (Independent Central Hub)

⁹ Note that in GB the meter is the responsibility of an independent entity not the DSO

¹⁰ In Italy the system is in the first stage of implementation: metering and communication systems will remain under the responsibility of the DSO where the central hub will process this data for aggregation and statistics.

3. CASE III: DATA ACCESS-POINT MANAGER (DAM)

Description of the case

The DAM case foresees the creation of a trusted Data Access-Point Manager (DAM) – a commercial role that shall be played by certified companies who act as a data gate keeper providing data access to any certified market player and/or consumer/prosumer. This Data Access-Point Manager would be designed to enhance existing market structures, roles and responsibilities and would not necessarily change them.

The DAM is designed to handle access to data and remote management of functionalities needed to create value added programmes within the Smart Grid from a wide range of devices such as smart meters, distributed generation, appliances, electric vehicles, etc.

The Data Access Point Manager shall maintain and apply access rights of any regulated and non-regulated market actor (service providers and consumers) via any implemented communication network over the whole lifetime of relevant smart grid resources and devices within the given regulatory requirements.

As a consequence, a suitable mechanism for handling the information and functionalities from a wide range of new and existing devices connected to the grid is required. This mechanism must allow for connections, updates, disconnections and localization of devices, including data and functionality information - without requiring the entire system to adapt and/or without developing single purpose regulatory frameworks. The DAM creates great flexibility in respect to data access and data processing, while maintaining the overall roles and responsibilities within the given market structure.

The DAM concept is:	The DAM concept is not:
- A model that provides fair, open and secure access to data and functionalities of devices on the field level to various actors	It does not add a regulated actor with either a geographic and/or service provider monopoly
- It adds the role of a certified service provider acting in a competitive environment	- It does not hold and handle energy data (e.g. as clearing house) centrally
- It ensures consumer and citizens' rights on privacy and investment security by design	- It does not create new regulatory structures for each type of device or business model
- It eases devices integration and accelerates time to market of innovative technologies and services	

Benefits for consumers

Consumers can potentially benefit by having the freedom of choice to participate in demand-side programs or to invest in resources in order to keep their energy cost stable. One example could be that a rooftop PV owner sells his production to a Virtual Power Plant (VPP) provider – after a certain time, the owner decides to take part in a micro-trading local market. The DAM would organise the de-provisioning of the VPP- and the provisioning of a micro trading scheme without touching the physical infrastructure.

In the long run, the DAM would ease the process of suppliers switching by provisioning services and applications for suppliers directly to the smart metering system. The pre-requisite for the DAM would be the standardization of access, provisioning and security architectures of the smart grid.

Implementation

Elements of the DAM are already in use or being developed within certain European markets. For example, parts of the proposed Smart Energy Code (SEC) in GB (on the process side), and, Germany's BSI protection profile (on the technology side), both take elements of the DAM into consideration within Smart Metering regulation. An abstraction towards the multi-application environment is required to bring the DAM case to a better level of maturity. Other technological domains already deal with millions of connections and dynamic application management - within a multi-stakeholder ecosystem. These include mobile telecoms or near field communications in mobile payment systems. They demonstrate the technical feasibility of the DAM and point to lessons learned for the DAM case. It is undisputable that the physical foundation of the smart grid requires a proper analysis of analogies and differences. Finally, the DAM case could foster a citizen driven, cost effective paradigm change in energy markets.

Case III: Data Access Point Manager (DAM)

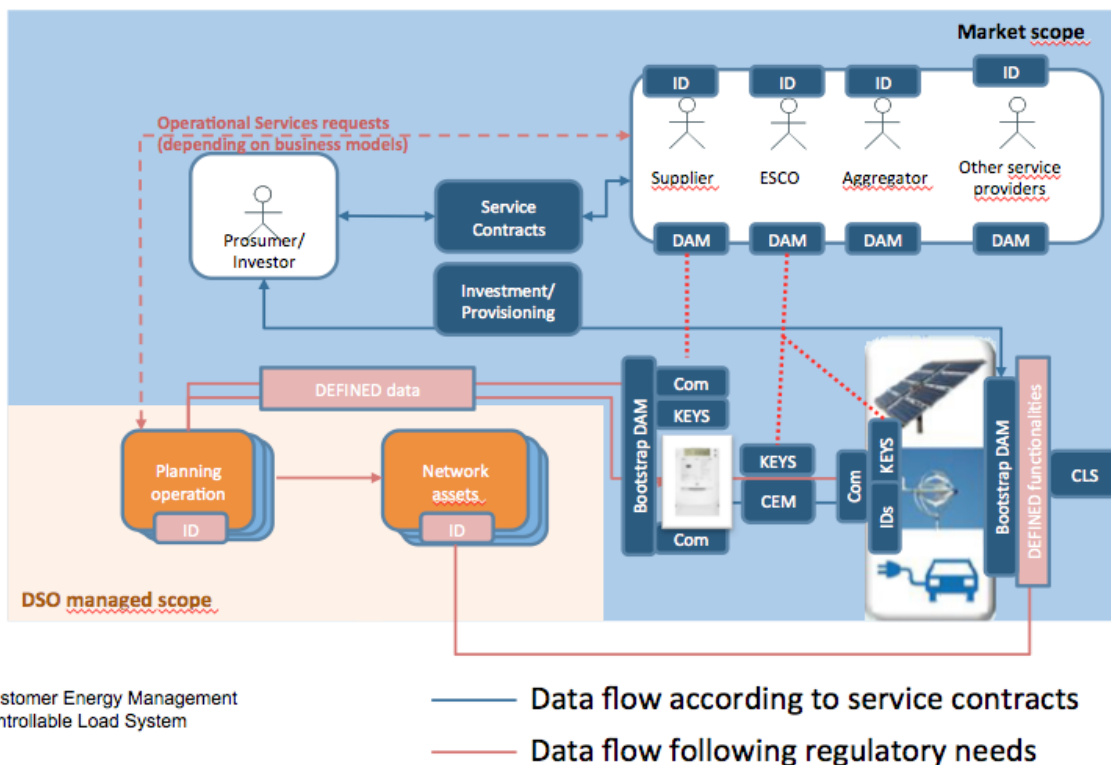


Figure 3. Case III: Data Access Point Manager (DAM)¹¹

¹¹ **Bootstrap node**, is the node that provides initial configuration information to newly joining devices so that they may successfully join the full network

SECTION 2 - SPECIFIC CHARACTERISTICS OF THE THREE CASES IN RELATION TO POTENTIAL CONSUMER BENEFITS

As already stated in the previous section, the key objective of the roll-out of Smart Meters is consumers' empowerment. It is defined in the Mission and Work Programme¹² of the Smart Grids Task Force that "*Consumer empowerment includes capabilities of supplier's customers to have sufficient and timely information on their actual energy consumption/production, to learn and act upon their energy savings potential through energy usage optimisation and more energy efficient technologies, to have access to competitive offers for energy services to develop energy efficient consumption practices and to allow them to become energy providers*". Actually, in a Smart Grids environment (and complying with Directive 2009/72/EC), consumers should benefit from certain advantages allowing them to participate actively in a competitive market.

This being said, five processes have been initially identified as offering advantages for consumers within the deployment of Smart Grids. Each analysed case has presented the way it would facilitate these processes to consumers. The table below summarises the information provided related to each process for each of the three cases.

CASE PROCESS	Case I: DSO as market facilitator	Case II: Third party market facilitator (independent central hub, CDH)	Case III: Data Access Point Manager market facilitator, DAM
Metering	The DSO is the unique agent responsible for all the sub-processes. Combining the meter reading and validation could represent an opportunity to reduce the complexity of the process.	Metering can be done by different actors, respecting the current responsibilities in each country. The CDH receives data and enables communication flow between all relevant stakeholders	It enables the activation of different actors to retrieve data directly from the meter without asking a regulated third party to deliver the data. Only consumer and DAM know about the full set of data the actors retrieve. The DSO receives the data decided by regulation. The supplier can choose any DAM. DAM is independent and certified. This is similar to credit cards companies, telcos, etc. which select their partner of trust in NFC for their services.

¹² http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/mission_and_workprogramme.pdf

<p>Supplier Switching</p>	<p>The DSO acts as a data provider for connection and metering data for the switching process allowing old and new suppliers to exchange information efficiently</p>	<p>The new supplier communicates and proves to the CDH the wish of the customer to switch. The CDH stops facilitating data to the old supplier and changes to the new.</p>	<p>DAM will be responsible for notifying the supplier of the metering point to the DSO (clearing between suppliers and DSO and flexibly facilitated but not provided by the DAM) Technically supplier switch process can be executed by a standardized remote provisioning process on the meter (like it is technically feasible in mobile telephony to switch the operator without changing a SIM card)</p>
<p>Tailor-made services</p>	<p>The DSO enables the offering of tailor made services by granting access to the data required for identified services to different market parties. DSO is not an active party in this process services.</p>	<p>The CDH provides reliable information on key factors which allow suppliers and other market agents to offer tailor-made services to clients. Also, the processes and types of information under the responsibility of the CDH may evolve upon request of stakeholders and approval by the regulator.</p>	<p>The DAM present an opportunity to increase the number, range and flexibility of tailor-made services which can be offered, due to the fact that devices can be quickly and easily integrated into the system. Each device can become subject to innovative tailor-made services with applications being provisioned securely. In order to avoid overinvestment, the DAM offers a secure way to quickly introduce tailor-made services into the existing infrastructure without the need for updating a central database.</p>
<p>Smart Grid User feedback</p>	<p>The DSO data hub can facilitate market parties to offer innovative services by providing</p>	<p>All the feedback is managed and stored by CDH which also keep record of queries,</p>	<p>The DAM guarantees by design data integrity as well as standardized interfaces. Data</p>

	data. The supplier remains the major point of contact ensuring clarity and simplicity for consumer.	complaints, incidents' status and measures taken. The supplier remains the point of contact for consumers to ensure clarity and simplicity	granularity and interfaces will be decided by the consumer.
Reconciliation Services	DSO as regulated party acts neutrally towards all market parties. The data provided should be complete and certified. Metering data will be exchanged between the DSO and suppliers. If the data were fragmented (not in one data hub, but multiple locations), it becomes very difficult to determine whether or not the reconciliation is complete. In this model the data is not scattered around. The advantage for the customer is that all parties have the same up to date information. The same data is then also used in the 'back office' processes like reconciliation.	Reconciliation services will be less necessary once real consumption substitutes profile based estimates. The CDH could potentially carry out this task since it can access data from different sources.	Reconciliation services will be less necessary once real consumption substitutes profile based estimates. The grid operator possesses of all the data relevant for active grid management and can make use of the increasing distributed intelligence and interconnection of generation and consumption devices in the field. Managing actual intrusion based on needed data is one major service grid operators could provide.

Metering

In the majority of the Member States who are deciding to go ahead with the roll-out of smart metering systems, the DSO would be responsible for performing the metering activity. However, other schemes, like those chosen in the UK, have evolved during the past years with third parties (e.g. energy suppliers) involved in the metering activity as well. Deployment of Smart Meters will facilitate the emergence of other schemes in metering, opening the way for additional or diverse benefits for consumers.

In Case I the DSO (in the decentralized option) will integrate the smart metering activity with a number of new sub-processes added (such as remote maintenance, data capture and validation, data storage). Having one regulated entity performing the metering is an opportunity to reduce the complexity of the process. This offers the potential to enhance the efficiency of the operation, so that there are fewer causes for complaint by the customers. The

data for consumers is centrally stored; this enables verification and validation of privacy and security around customer data in a regulated environment.

In Case II the metering can be performed by different actors, in line with the current responsibilities of each of them in each Member State. The CDH will receive in a standardized format metering data once validated by DSO or meter operator, opening a communication flow between metering entity and all relevant stakeholders (market parties, customers, etc.), as well as enabling data sharing, aggregation and other processes in an easy way. This can be particularly useful in the case where there are many DSOs and/or service providers, suppliers, ESCOs, etc. - typical case of liberalized markets - where information must flow in order to allow agents to interact with each other. Advanced encryption methods will ensure data security and only designated actors will be able to retrieve data.

In Case III the metering can be carried out by any other actor currently responsible for this process in Member States. Advanced encryption methods will ensure data security and only designated actors will be able to retrieve data. In addition to the DAM, only the consumer but no third party will ever know about the type of data the actors retrieve. The possible cost for the use of the existing communication infrastructure could be anonymously cleared between the service providers, and the meter operator based on the DAM notifications. It is expected that this simplified service could bring down cost and decrease overall investment needs of smart metering roll-out. One reason for this is the avoidance of discriminatory service costs as the DAM is a competitive role, earning money when services are deployed.

Supplier switching

Supplier switching is a key process in a competitive energy market and switching within 3 weeks is one of the core provisions of the 3rd Energy Package. Deployment of Smart Meters will facilitate the process of changing supplier and reduce respective costs.

Tailor-made services

The consumer can benefit from new tailor-made services that can be offered to him by suppliers, ESCOs or aggregators. In order for these commercial agents to be able to design those services, access to consumers' data and information is required. Innovation is encouraged on the device and service side. The grid operator could be incentivized to use the services provided by commercial products and to have secure access to data and devices with carefully defined functionalities.

Case I and Case II seem to equally provide similar opportunities for such services to be developed. In Case III the tailor made services are seen as core to the integration of local intelligence and device applications to the smart grid. In all cases the local configuration of generating and consuming devices defines the requirement for tailor made (demand-response) services which can be offered to optimize consumption, integrate renewable resources and to manage the grid in a way to minimize additional investment.

User feedback

The consumers can also benefit from new services that Smart Grids will allow commercial actors to provide, such as demand response or energy efficiency products and services. In order for these services to be provided to consumers, the suitable set of data must be available

to service providers. Case I and Case II can facilitate such data flow and coordination between the data handler and the service provider. Case III ensures that the actual data generated by any device in the field is accurately transmitted – meaning that demand response aggregators and DSO work on the same actual data to settle demand-response or related programmes. No party needs to rely on actual data processed by another party. Each party must collect the data himself and create his own history of the data.

Reconciliation services

With the introduction of Smart Metering, availability on real consumption data may gradually reduce the need for profile estimations. Allocation of consumption on real consumption data will facilitate energy suppliers to enter into retail market and incentivise them to offer new services to customers -such as demand response products, accurate billing or provision of information on usage patterns. It also benefits consumer and drive to a wider acceptance of Smart Grids. All the Cases seem to cover equally the scope of this process. For other services like loss control or fraud detection, it is thought that Case I can cover them more efficiently.

Besides the five processes mentioned above, the analysed Cases present other advantages and disadvantages which affect consumer in a direct or indirect way and should be taken into consideration.

The strengths and challenges presented below are based on early discussions within the EG3.

Case I: DSO as Market Facilitator

Strengths

- DSO can support Demand Response processes easily via the "real time" local interface which is in sync with the aggregated data delivery from the DSO (de)central hub to market parties.
- Clear roles and responsibilities, as well as the fact that DSO is already a regulated entity add confidence to consumers.
- The setting up of a central data hub means savings in terms both of the deploying of a communications network and the management of data.
- Well defined market facilitation services delivered from DSO will enable new market entrants in the market since this creates a clear level playing field
- Under regulatory control, improvement of quality of service and costs reductions (per installed power unit) has been achieved by most companies all over the EU.
- DSOs have the advantage of specifying a solution which fits with their physical network while meeting the cost needs of the agreement they can reach with customers/suppliers.
- Customer benefit from having integrated, cost-efficient processes and, in particular, from avoiding the additional costs that would result from a separation of processes.

Challenges

- All new smart metering related tasks (e.g. new metering sub-processes) will have to be performed by a sole entity, which must be determined and in position to employ all required resources in order to carry them out. This could represent a challenge of lack of investment needed to exploit the full potential of smart meters. Effective regulation should mitigate this.

- At the same time, the DSO is presented in this case as a central point for the collection of data originated from the grid and smart meter, thereby excluding data from customer's installation or other market party data. So if market parties plan to build innovative services based on data they will have to obtain this data from multiple sources.

Case II: Third Party Market Facilitator – Independent Data Hub

Strengths

- The services rendered by the independent central entity created under Case II would not only be standardized, but also regulated. However, they would not encroach on the business areas of third parties (generators, suppliers, energy service and ICT providers) but rather restrain to its regulated roles (see section 1 above).
- The setting up of a central data hub means potential savings in terms both of the deploying of a communications network and the management of data.
- All stakeholders commit to their connection to the independent hub, which on the other hand achieves to bring trust and a common interest to the proper functioning of the system. Also, investment is facilitated by the contribution of all stakeholders to the central body's needs.
- It is supported that Case II assures interoperability, since a central independent entity assures the interoperability requisites to which all other stakeholders connected to it have to equally respect.
- It is important that critical information is controlled by a regulated entity. The CDH as centralised regulated entity should be able to control easily the information processed.
- One single regulated body facilitates the control by regulatory authorities both from energy and telecom sectors.

Challenges

Fears of monopoly creation and need for new regulation and regulatory oversight, have been expressed:

- As opposed to cases I and III, Case II implies the establishment of a new regulated body. However, this could be an opportunity of smart grids investments to ensure and promote appropriate exploitation and consumer empowerment
- As well, the creation of an independent data hub managed under a governmental agency or body oversight, means the development of regulation, or clear description of responsibilities.

Case III: Data Access-Point Manager Market Facilitator

Strengths

- The decentralized DAM approach reflects on the main requirements consumer are expected to have. Consumer are seen as active contributors and participants within the smart grid. The DAM enhances the freedom of choice for consumers when it comes to investing in smart grid relevant devices (like DER or CHP) and widens the range of programs in which they can earn off of these investments.
- The case has a high potential to empower consumers and to actively participate in the energy system through demand response, enabling differentiated offerings for electricity consumers and is resilient to new services and business models which are likely to be invented (e.g. in E-Vehicle environment).

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- Privacy is implicitly designed into the system. No party but the owner of the data will possess the full range of actual data. The minimum data rule is reflected in the way the DAM provisions applications securely on the resources interfaces. The consumer himself will have access to all actual data produced in his personal environment.
- Consumers can easily decide, which resources they will provide to which commercial partner. Business models for service providers are not limited to artificial constraints surrounding the availability of data. Furthermore an intelligent implementation of the DAM role could foster both innovation and competition.
- The DAM model would provide smooth path for consumers (step-by-step approach) into the smart grid world. Starting with smart metering and savings, optimized use of stored energy or micro trading, micro-grids and trading of their generated energy. The citizen decides at what point in time he starts to adopt these technologies and services however all options are made available through the DAM.

Challenges

- The DAM model requires a high level of standardization and certification rules across Europe. This would mean a re-thinking of processes in all MS market communication.
- While the DSO remains an important player it is not the only one player to manage devices and Smart Meter data. The business models of the DSO might at one point in time be subject to revision
- Relevant products like PV-Installations or CHP are required to be connected and secured when becoming part of the future smart grid service environment
- Unlike the internet, the energy market remains national and local – governments and regulators will require an effort to define the DAM and integrate it into existing regulatory environments in a manner consistent with other technological standardization.
- DSO will need to trust the DAMs offering services and control cost for quality control needs to be part of the accepted opex of DSO.
- The success of the DAM model will ultimately be dependent on the value that can be extracted from the business opportunities which are possible within a given market/regulatory framework.

SECTION 3 - RELATIONS WITH ICT AND TELCO: TECHNOLOGY AND REGULATORY IMPLICATIONS IN ICT/ENERGY SECTOR

With regards to the technology and regulatory implications in the ICT and energy sectors, there doesn't seem to be a significant difference between the three models. From the technology point of view, the need for reliable and secure communications applies to each of the models, as well as the requirement for seamless connectivity and interoperability between different service platforms. The synergies between these sectors still need to be investigated in more details, but it is obvious that there are synergies there and that they should be exploited. Business relationships (ownerships, operational responsibilities, outsourcing of services, etc.) between the players would be different between the models, but certain operational aspects - for example how and by whom the access to data, the customer services and billing are organised – will need to be done as efficiently and securely as possible.

CASE PROCESS	Case I: DSO as market facilitator	Case II: Third party market facilitator (independent central hub, CDH)	Case III: Data Access Point Manager market facilitator, DAM
Broadband Development	<p>Collection of metering data requires reliable communication services and infrastructure. The current market propositions of Telco's (focusing on broadband and low costs) today do not fulfil all the needs by utilities/DSO with respect to communication solutions for smart meter and smart grid communications (low bandwidth, supreme reliability and latency). This may lead to DSO's building and operating own communication infrastructure (backbone and periphery).</p> <p>Upgrade of existing fibre network by DSO may provide commercial opportunity for joint venture with</p>	<p>There is less risk of inefficiency as it will look at a holistic approach, and duplication will be avoided in case the CDH is in charge of communication deployment. Broadband deployment could be decided by a tender process. Cost recovery would be easier as it is easier for the regulator to check the account of just one part. Otherwise, if CDH not in charge of communication or using existing ones, the use of a single specification could empower competitiveness of communication technologies.</p>	<p>The DAM model reflects a dynamic roll-out and an evolution of the smart grid deployment. This also means that in most cases, existing communication infrastructures can be used. Broadband development could increase the quality of connections and some technical KPIs such as latency etc. which allow additional services from different service providers to be executed via the transmission of more intelligent applications towards the devices in the field.</p>

	telco/utelco formation to extend fibre to the building and therefore increase high-speed broadband penetration		
Business Opportunities	The DSO (de-)central hub will facilitate the provision of tailored services, normally subcontracted, by ICT and/or Telco actors on a level basis	Equal access by all market participants to meter data should neutrally facilitate market development due to the independence of the third party facilitator. It will facilitate the entrance of new actors (in particular from the ICT sector) to provide services in a competitive market irrespective of DSO's interests and priorities.	Both infrastructures adapt and grow in parallel. While the electricity grid operator acts on a regulatory mandate, the communication provider must find ways to re-finance the investments in connectivity. There will be opportunities to develop business cases and demand side programs, mainly based on the integration of resources such as electric vehicles, appliances, machinery and solar power to provide additional services such as remote maintenance or warranty supervision. It will facilitate the entrance of new actors (in particular from the ICT sector) to provide services in a competitive market irrespective of DSO's interests and priorities.
Synergies	Telco expertise may be required to introduce new smart technologies in the different domains and zones of the component layer of the grid e.g. a re-design of the communication and information layers needed to manage the	Being a unique party, we assume it will be more powerful to go to tender and to decide the best market solution, in case communication networks are implemented by CDH. The fact that all the	Telecom operators can leverage their existing communication networks in order to assume the role as certified DAM. Most mechanisms and methodologies used to identify authenticate and certify access to

	<p>grid.</p> <p>ICT companies may provide services to Utilities to manage the grid e.g. demand response or to communicate more effectively with customers e.g. home energy management</p> <p>Telcos may partner with Utilities to provide broadband/cyber-security solutions.</p>	<p>users' market information is gathered in a single location may encourage ICT companies to provide innovative new services to customers.</p>	<p>data and resources, could be adopted from the proven standard approach in cellular mobile markets and developed into the energy ecosystem. Appropriate mechanisms must of course be in place to ensure that the DSO can rely on these communication systems, since he remains responsible for grid stability and security.</p>
Innovation	<p>New forms of cooperation between Telco's and utilities would leverage M2M expertise from the Telco sector, while maintaining the consistency with the current role and responsibility of the regulated DSOs to deliver accurate metering data.</p>	<p>Ability to store and provide aggregated and historical data can facilitate the development and delivery of tailor made services.</p>	<p>Further development of smart grid industry based on equal opportunities to access information and devices is provided. The market would then be able to provide services for consumers as well as support solutions to the DSO and TSO for solving problems in grid stability, balancing, etc.</p>
Member States Benefit (e.g. data integrity)	<p>A reliable communication infrastructure in the public domain for smart meter reading and smart grids communication will contribute to system integrity and security of supply, since this will also be required for the integration of DER and EV charging into grid operations.</p> <p>Reliable communications are required for remote DER control from a</p>	<p>Clearly defined role and regulation by governmental agency or body should protect data integrity and foster consumer confidence.</p>	<p>The DAM architecture reduces security risk and vulnerabilities due to the fact that it does not hold and handle operational data centrally, (in much the same manner as mobile phone billing information.)</p> <p>The DAM is based on security technologies (key storage, provisioning services etc.) and therefore active security management is inherent in DAM architecture.</p> <p>The electricity grid</p>

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	<p>balance responsible party and from a DSO (in case of “code red” override). The DSO guarantees data integrity through the ownership and the managing of the communication. The real-time local interface delivered by the DSO could support Demand Response features and is also consistent with the aggregated data delivery at the DSO (de)central hub.</p>		<p>operations will not be responsible for managing security credentials in the field – the key management can be provided by a DAM infrastructure (in conjunction with the communication providers).</p>
<p>Direct Citizen Benefit</p>	<p>Data on relevant market processes stored in DSO central hub will enable fast and reliable supplier switching.</p> <p>ICT providers / Telco’s might (via normal DSO procurement) support the customer communication channel, which DSOs need in order to communicate with customers.</p>	<p>Much more efficient and quicker switching process.</p> <p>Consumer empowerment via demand response, ease of access by retailers to data and ability to shop around for best offer with no switching hassles.</p>	<p>Reliability and security of personal Data – originating directly from the consumer’s devices.</p> <p>Increased freedom of choice between service-providers through ease in switching suppliers and service providers following service- and supply contracts.</p> <p>The creation and support of multiple service business models due to a quick go-to market for product and service innovations.</p>

SECTION 4 - NEEDS FOR REGULATORY INTERVENTION: RECOMMENDATIONS FOR REGULATORY INCENTIVES FOR THEIR IMPLEMENTATION

Regulatory incentives for Smart Grids deployment is one of the five challenges identified in the 2011 European Commission Communication on Smart Grids¹³ that need to be tackled as soon as possible in order to accelerate Smart Grids deployment. As stated in the Communication "regulatory incentives should encourage a network operator to earn revenue in ways that are not linked to additional sales, but are rather based on efficiency gains and lower peak investment needs, i.e. moving from 'volume based' business model to quality – and efficiency – based model".

Directive 2012/27/EU provides the legal base for Member States to develop regulatory incentives; according to Article 15 of the Directive "Member States shall in particular ensure that national energy regulatory authorities, through the development of network tariffs and regulations, within the framework of Directive 2009/72/EC and taking into account the costs 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.

Performance indicators which incentivise network operators have been already identified and used in some Member States. For instance, indicators on RES and DG integration in the electricity system, as well as on quality of service provided, are already in place in a number of Member States¹⁴.

A further focus is required by the Member States on how the regulatory framework will promote benefits of the Smart Grids associated to demand response and energy efficiency, in the context of the Directive 2012/27/EU. There is a wide consensus on the abolishment of regulated end-user prices and the introduction of time-dependent electricity prices in order for demand response services to emerge¹⁵. Annex XI of the Directive 2012/27/EU includes categories of dynamic pricing for demand response measures that network or retail tariffs may support. Moreover, it must be ensured that future Smart Grids will be in position to deliver such benefits to the consumers; for this to happen, functionalities of Smart Meters which support demand response must be taken into consideration¹⁶.

Whatever the option for Smart Grids data handling, the regulatory framework must ensure that full benefits of Smart Grids can be delivered to consumers. Therefore, proper regulation

¹³ COM(2011) 202 final, 12.04.2011

¹⁴ For example an indicator on hosting capacity for distributed energy resources in distribution grids is used in Italy as a revenue driver, while in other MS is under consideration for monitoring purposes or as a revenue driver. For a detailed analysis on potential performance indicators and incentive schemes for regulating network outputs, please refer to CEER paper 'Status review of regulatory approaches to smart electricity grids' (C11-EQS-45-04, 6 July 2011).

¹⁵ As referred to in COM(2011)202 final "It opens up unprecedented possibilities for consumers to directly control and manage their individual consumption patterns, providing, in turn, strong incentives for efficient energy use if combined with time-dependent electricity prices".

¹⁶ Commission Recommendation 2012/14/EU describe the common minimum functional requirements for smart metering systems for electricity.

must be introduced or adapted accordingly, while clear roles and responsibilities must be defined, in order to coordinate and incentivise the different market actors involved in each Case.

As we can observe in Case I and Case II, even though the suggested regulatory recommendations vary from one case to another, there are some issues that need to be addressed independently of the case:

1. The agent (DSO, CDH) facilitating the market has to be subject to regulation. The agent facilitating the market cannot also participate in the market (i.e. analogous rules to the unbundling requirements of the second and third package must apply) Information must be provided to parties that need it in a transparent, non-discriminatory and efficient way.
2. To increase efficiency and empower consumers to switch supplier or to contract for efficiency services or Demand Response, regulated end-users energy prices must be phased out, always taking into account different sectors and providing a proper definition of a vulnerable consumer.
3. An investment will be needed in any case. The remuneration for the agent facilitating the market has to be regulated since in both cases (DSOs or CDH) agents hold a monopoly position.
4. The information required by different market actors has to be properly defined. This should help them provide innovative services and at the same time consumers rights must be protected.

The regulatory intervention presented in Case III coincides with Case I and II when it comes to the definition of roles of different market actors.

The primary differences between case III and Cases I and II, from a regulatory perspective, is that the DAM is potentially an unregulated entity operating in a competitive market. Due to the fact that customers' data would be handled by the DAM, some form of regulation would nevertheless be required. However the details of this have not at this stage been identified.

Finally, it has to be noted that there are already some regulatory activities on-going within the European Commission that are relevant for the three cases described: first, cross-sector passive infrastructure sharing and broadband access to buildings; and second, harmonisation of radio spectrum for smart energy grids and smart metering systems. Real exploitation of these synergies would require change in regulation under which, for example, DSO's would be allowed for some revenue outside energy transport

Needs for regulatory intervention in Case I: DSO as market facilitator

Responsibilities definition: The 'DSO as neutral market facilitator' model requires a clear set of responsibilities for the DSO: non-discriminatory access to the grid infrastructure and neutrality to all other market parties as a part of the unbundling policy ensures that new products and services can develop free of discrimination. But most of these rules must be in place anyhow they are just applied to another service.

Costs/Funds: Regulation schemes should consider the evolving (regulated) costs regarding smart meters and smart grids development without any delay. In many markets today, the

DSO cannot receive funds for demand side programmes. As one of the largest cost carriers of Smart Grid development, it is essential to allow and encourage DSO's to use demand side programs and other energy efficiency approaches to increase the efficiency of their own grids and their own systems, as well as enabling other parties such as the TSO, suppliers and consumers to do the same.

Cyber security/information: It is recommended that the regulator allocates frequency spectrum, dedicated for the utilities sector for smart meter and smart grid communication, thereby also contributing to the cyber security measures to be implemented for the public sector. Regulation has to define which information should be collected from grid connected participants and made available at the data hub for other authorized market parties.

Other: In order to enable multi-party access to the data hub there is the need to define an open common protocol/language and the available transactions.

In case of really exploiting synergies between DSO and telco's, external revenue for DSO from non-utility business should be possible, otherwise this blocks joint ventures.

Needs for regulatory intervention in Case II: Third Party Market Facilitator – Independent Data Hub

Responsibilities definition: The CDH should be a regulated agent.

A recommendation would be to make a basic design of the CDH and increase its functionalities and complexity as the smart grids market grows. The CDH must be governed according to the needs of its end-users and whenever there is consensus and CBA results are positive, additional functions and information may be added.

Costs: The CDH fees should also be regulated in order to allow only a reasonable level of return, in order to avoid excess profits which would add an extra cost on market agents and possibly induce market distortions.

Information: To allow consumers to benefit from time of use tariffs it is necessary to provide them with accurate information and appropriate granularity on their consumption, as well as basic information on how to be more energy efficient and make the most of time of use tariffs. This requirement should be tailored to the client's needs since all the clients do not have the same needs of information and / or do not have the same flexibility in shifting their consumption. Action should be taken first with clients with high consumption rates. A CBA should be carried out in order to establish the most effective policy of information for each segment, in terms of level and regular updating of information, able to induce positive changes in consumers' load profile and total consumption.

Segmentation. To make deployment of Smart Grids more effective, cost-effective measures should be considered according to each segment of the market. These measures should focus on segments where bigger efficiency impacts are expected. Agents should have access to aggregated information of client's segments so as to be ready to make suitable offers.

Needs for regulatory intervention in Case III: Data Access-Point Manager Market Facilitator

The primary differences between case III and Cases I and II, from a regulatory perspective, is that the DAM is potentially an unregulated entity operating in a competitive market. Due to the fact that customers' data would be handled by the DAM, some form of regulation would nevertheless be required. However the details of this have not at this stage been identified.

Overcoming present barriers. For establishing the DAM Model, grid operators' natural monopoly and mandate for smart grid operations, need to be clearly defined. For contributions to stabilize the grid as well as for injection of distributed generation, a framework which considers ancillary services and local infrastructures is needed. Especially in market communication and incentives for demand side management, the DAM offers potential to encourage more and less costly transactions. It should be noted that the DAM alone does not overcome the existing market barrier to demand side programs, prosumers programs etc. These issues will remain to be solved.

SECTION 5 – NEXT STEPS

This 'EG3 First Year Report' is the result of the consensus reached during 2012 among experts of the Expert Group for Regulatory Recommendations for Smart Grids deployment (EG3) within the Smart Grids Task Force. The aim is to provide best accurate definition of the three identified cases developed during 2012.

Looking at 2013, the Commission is planning to continue further consultations during the first quarter of 2013 which provides critical views from key different perspectives, such as consumer views, synergies ICT/Energy, standardization, regulation, privacy, data protection and security. To this end, the Commission will prepare the relevant document and questions in close cooperation with the Steering Committee of the Smart Grids Task Force at the beginning of 2013. Results of the consultation will be discussed during 2013 and a second EG3 Report is planned by the end of 2013 with further outcomes and possible advice on regulatory issues for the implementation of smart grids.

ANNEX 1. List of Participants

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GRANT	SVETLANA	GSMA
HEALY	CLAIRE	GSMA
BLANCO	PEDRO	IBERDROLA
SCHENK	MARTIN	LANTIQ
WOLF	CHRISTIAN	LANTIQ
MAYER	CHRISTOPH	OFFIS
ARNDT	MARYLIN	ORANGE
WILSON	IÑIGO	ORANGE
BERNARD	PATRICK	ORGALIME
BRAUN	UWE	PPC (& MVV), GERMANY
BREUER	ANDREAS	RWE
CARRASCO	ALICIA	SEDC
GARELLI	OLEG	SEDC
IDSTEIN	DIRK	SEDC
KING	CHRIS	SEDC
PHULPIN	YANNICK	SEDC
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SARNEY	GEOFF	TELEFONICA O2
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NASLUND	GORAN	VODAFONE GROUP

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Case II	CARRASCO	ALICIA	SIEMENS/SEDC
Case III	STROMBACK	JESSICA	SEDC

ANNEX 3. Full cases reports

Annex 3 includes the full reports with the descriptions of the three Cases as they have been originally drafted by the members of EG3.

There are four reports:

1. Business-as-usual scenario
2. Case I: DSO as market facilitator
3. Case II: Third Party Market Facilitator – Central Data Hub (CDH)
4. Case III: Data access-point manager (DAM)

BAU Scenario

Introduction

1.1 Objective and Purpose of this paper

On 1 February 2012, the Commission re-launched its Smart Grids Task Force. This has been structured as a Steering Committee and four Expert Groups as follows:

- EG1 – Reference Group for Smart Grid Standards
- EG2 – Expert Group for Regulatory Recommendations for Data Privacy and Data Protection in the Smart Grid Environment
- EG3 – Expert Group for Regulatory Recommendations for Smart Grids Deployment
- EG4 – Expert Group for Smart Grid Infrastructure Deployment

The key deliverables of EG3¹⁷ are to define a reference market model, options for viable business models and suitable instruments for accelerating the roll-out of Smart Meters and foster the deployment of Smart Grids and to examine the potential implications for the regulatory frameworks to efficiently facilitate the roll-out. Additionally, the group is expected to identify the necessary framework conditions for establishing new fields of cooperation (legislative, financial and/or other incentives) between the energy and telecommunications sectors.

During the second meeting of EG3 in Brussels on 2 May, four possible market models were identified as follows:

1. Business-as-Usual (BAU)
2. DSO as Market Facilitator including data sharing
3. Third Party (new) Data Facilitator, sharing data
4. New parties for distribution, transaction, providing services

It should be noted that these models were described at a very high level leaving great scope for more detailed characterisation. Also, there is clearly scope to develop variants of these models and/or distinctive alternatives.

CEER was asked by the Commission to lead a group of EG3 members to produce a report describing the BAU model. While there is no single model that applies today across Member States (MS), this report attempts to bring out the key features of current market models and highlight issues and challenges for future market models.

¹⁷ Text extracted from the updated Mission and Work Programme for the Task Force.

1.2 Drivers for a market model

It is vital that any market model is designed to deliver specific outcomes. Any development of an existing market model should only be pursued in order to better meet these agreed outcomes or to deliver new/additional outcomes.

The existing agreed outcomes are set out at high level in the Third Package and these are summarised in Section 2. More detailed outcomes (i.e. services and functionalities) related to smart grids are described in EG1's report of December 2010 [1]. These are summarised in Section 3.2. The actors that deliver these outcomes have been described in EG3's report of April 2011[2] and these are summarised in Section 3.3 here.

Any changes to the BAU model should be designed to meet agreed new outcomes that are clearly defined, or to better achieve existing outcomes.

1.3 Scope

This paper focuses on the fundamental structure of the market model and does not attempt to address detailed implementation issues. In particular, the potential constraints that might be caused by the need for data privacy and protection are not referred to. Expert Group 2 is leading in this area.

The security and integrity of the electricity system is of paramount importance. Currently, a series of Network Codes are being developed by ENTSO-E [3]. These codes will contain a number of mandatory requirements (e.g. in relation to demand side response in the Demand Connection Code). The adoption of these codes could impact the implementation of certain market features. This is not discussed in this paper but should be recognised as the consideration of new market models progresses.

We understand that the Energy Efficiency Directive may also introduce new requirements around demand response. These should be considered in the context of the market model once the final text is adopted.

1.4 Information sources

The main information sources that have been used to prepare this report are:

- Third Package
- EG1 report of December 2010 [1]
- EG3 report of April 2011[2]

1.5 Terms used

Throughout this paper the following terms are used:

- **Total system** – refers to the complete supply chain including the generators and the demand side.
- **Networks** – refers to the electricity transmission and distribution networks.
- **System services** – refers to conventional ancillary services (e.g. spinning reserve, reactive power) but extends to additional services such as storage.

1.6 Group members

The members of the group that produced this report are listed in Annex 1.

2. The Third Package

2.1 Introduction

The term "Third Package" refers to a package of EU legislation [4] on European electricity and gas markets that came into force on the 3rd September 2009. The purpose of the Third Package is to further liberalise European energy markets to offer consumers more choice and better value for money while ensuring supply security and meeting environmental targets. It establishes the fundamental structure of the BAU market model.

2.2 Core provisions

2.2.1 Unbundling Transmission System Operators (TSOs)

Under the Third Package, Transmission System Operators (TSOs) are effectively unbundled, or separated, from generation, production and supply interests. The rationale was that without this effective separation there is an inherent risk of discrimination, not only in the operation of the network but also in the incentives for vertically integrated undertakings to invest adequately in their networks.

2.2.2 A single, National Regulatory Authority (NRA)

Member states are required to designate a single, National Regulatory Authority (NRA) that is responsible for regulating their energy market. NRAs must have regulatory independence in order to act independently of market interest and to ensure its power is exercised impartially and transparently.

2.2.3 Consumer protection

The Third Package stipulates that it should take a consumer no more than 3 weeks to switch its electricity or gas provider. It also sets out new obligations on suppliers relating to customer bills and the contents of supply contracts, as well as the time for which supply data must be retained.

2.2.4 Cooperation of NRAs

A new "Agency for Cooperation of Energy Regulators" (ACER) has been established to facilitate cooperation between NRAs and to oversee and co-ordinate cross-border co-operation for gas and electricity transmission between Member States.

2.2.5 Cooperation between TSOs

Two European Networks for Transmission System Operators – one for electricity and one for gas (ENTSO-E and ENTSO-G respectively) have been established to formalise co-operation between TSOs.

In order to encourage long-term investment in the transmission networks the ENTSOs are required to publish non-binding Ten-year Network Development Plans (TYNDPs) every two years. National TSOs will also be required to individually publish rolling national ten-year network development plans.

2.2.6 Network Codes and Framework guidelines

A regulatory framework is being created to support a single, European Energy Market by developing Network Codes and Framework guidelines. The former being a legally binding set of common technical and commercial rules and obligations that govern access to and use of the European energy networks. Under the Third Package, network codes are developed by the European Network for Transmission System Operators (ENTSOs). Framework guidelines are non-legally binding principles and objectives with which the European Network Codes must comply.

2.3 Third Package and smart metering

The Third Package requires MSs to ensure the implementation of intelligent metering systems, subject to an economic assessment of the long term costs and benefits, to facilitate the active participation of consumers in the electricity supply market. Where this cost benefit assessment shows a positive outcome, 80% of consumers should be provided with an intelligent meter by 2020.

The MSs are required to ensure the interoperability of the intelligent metering systems that are deployed within their territories and shall have due regard to the use of appropriate standards and best practice and the importance of the development of the internal market in electricity.

2.4 Impact on the BAU market model

These core provisions of the Third Package establish the foundations for the BAU market model.

The Third Package Directives were required to be implemented by March 2011. Member States have notified the Commission of the measures taken to achieve compliance. The Commission therefore has a detailed overview of the implementation measures across MSs.

3. Outputs from EG1 and EG3

3.1. Outputs from previous Task Force Expert Groups

The original Expert Groups 1 and 3 of the Smart Grids Task Force produced valuable reports which effectively describe smart grid opportunities from the perspective of the BAU market model. EG1 examined the outcomes that could be delivered, referred to as high level services and functionalities. EG3 summarised the roles and responsibilities of the actors involved.

3.2. EG1

EG1 developed a series of high-level services and functionalities that should be taken into consideration for the deployment of smart grids. Although EG1 assumed that these services should be agreed by relevant parties, they represented a list of the broad services envisaged, showing the provider of the service and the primary beneficiaries. They provide the following definitions:

- *Provider of a service* is a participant that is responsible for such a service alone or in combination with other participants.
- *Primary beneficiaries* are participants that require or directly benefit from the services, recognising that the full benefits from these services may be shared among a much wider group of participants.

The following table summarizes the high-level services identified by former EG1.

High-level Service	Outcome	Provider	Primary beneficiaries
Enabling the network to integrate users with new requirements	Guarantee the integration of distributed energy resources	DSOs	Generators, consumers, storage owners.
Enhancing efficiency in day-to-day grid operation	Optimise the operation of distribution assets and improve the efficiency of the network through enhanced automation, monitoring, protection and real-time operation	DSOs, metering operators	Consumers, generators, suppliers, DSOs.

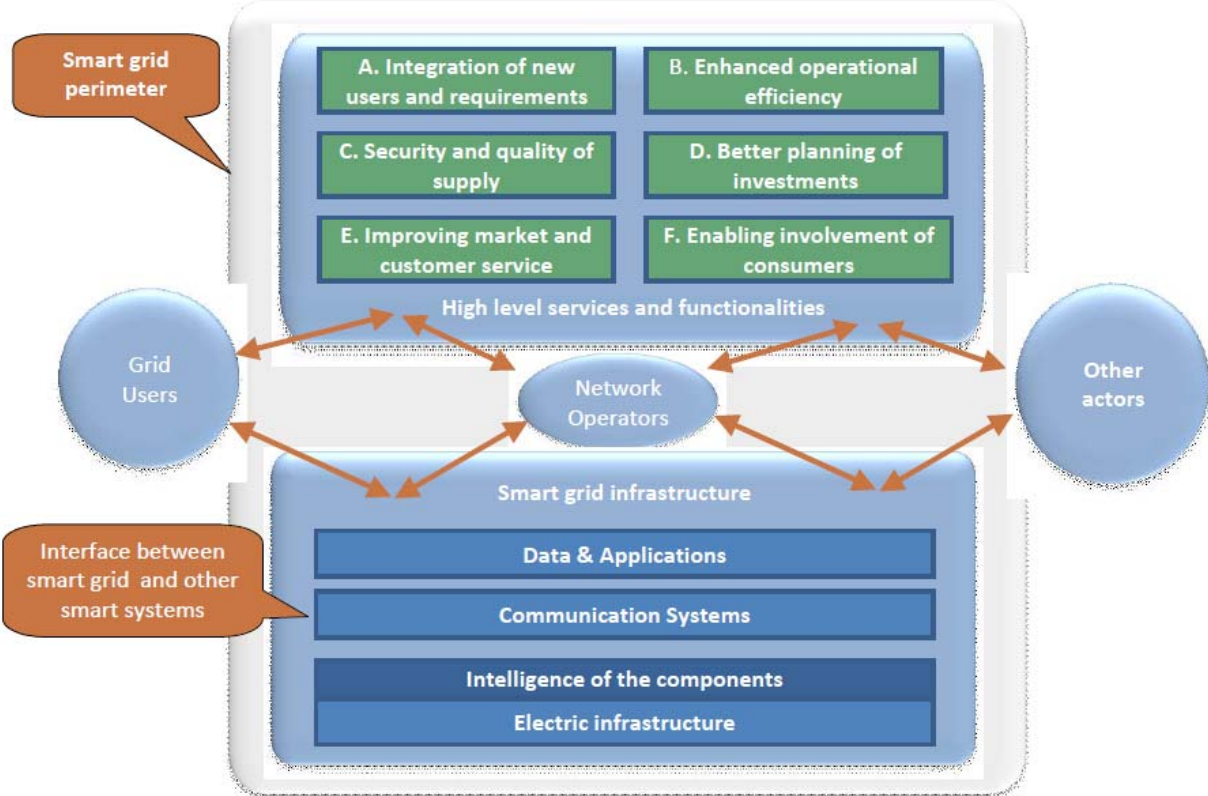
High-level Service	Outcome	Provider	Primary beneficiaries
Ensuring network security, system control and quality of supply	Foster system security through an intelligent and more effective control of distributed energy resources, ancillary back-up reserves and other ancillary services	DSOs, aggregators, suppliers	Generators, consumers, aggregators, DSOs, TSOs
Enabling better planning of future network investment	Collection and use of data to enable more accurate modeling of networks and introduction of new methodologies for more 'active' distribution.	DSOs, metering operators.	Consumers, generators, storage owners
Improving market functioning and customer service	Increase the performance and reliability of current market processes through improved data and data flows between market participants	Suppliers, power exchange platform providers, DSOs, metering operators.	Consumers, suppliers, applications and services providers
Enabling and encouraging stronger and more direct involvement of consumers in their energy usage and management	Foster greater consumption awareness taking advantage of smart metering systems and improved customer information and promotion of the active participation of all actors to the electricity market.	Suppliers (with metering operators and DSOs), ESCOs	Consumers, generators

The delivery of smart grid services requires specific network functionalities. The following table shows some of the functionalities identified by EG1 grouped according to the high-level services previously described:

High-level Service	Functionalities
Enabling the network to integrate users with new requirements	<ol style="list-style-type: none"> 1. Facilitate connections at all voltages/locations for all existing and future devices with SG solutions 2. Better use of the grid for users at all voltages/locations 3. Registers of the technical capabilities of connected users/devices with an improved network control system 4. Updated performance data on continuity of supply and voltage quality

High-level Service	Functionalities
<p>Enhancing efficiency in day-to-day grid operation</p>	<ol style="list-style-type: none"> 5. Improved automated fault identification and optimal grid reconfiguration after faults 6. Enhanced monitoring and control of power flows and voltages. 7. Enhanced monitoring and observability of network components down to low voltage 8. Improved monitoring of network assets in order to enhance efficiency in day-to-day network operation and maintenance 9. Identification of technical and non technical losses. 10. Frequent information on actual active/reactive injections/withdrawals by generation and flexible consumption to system operator.
<p>Ensuring network security, system control and quality of supply</p>	<ol style="list-style-type: none"> 11. Solutions to allow grid users and aggregators to participate in an ancillary services market to enhance network operation. 12. Improved operation schemes for voltage/current control taking into account ancillary services. 13. Solutions to allow intermittent generation sources to contribute to system security through automation and control. 14. System security assessment and management of remedies. 15. Improved monitoring of safety particularly in public areas during network operations. 16. Solutions for demand response for system security purposes in required response times.
<p>Enabling better planning of future network investment</p>	<ol style="list-style-type: none"> 17. Better models of DG, storage, flexible loads (including EV), and the ancillary services provided by them 18. Improved asset management and replacement strategies by information on actual/forecasted network utilization. 19. Additional information on supply quality and consumption
<p>Improving market functioning and customer service</p>	<ol style="list-style-type: none"> 20. Solutions for participation of all connected generators in the electricity market. 21. Solutions for participation of VPPs in the electricity market 22. Solutions for consumer participation in the electricity market 23. Grid solutions for EV recharging 24. Improved industry systems for settlement, system balance, scheduling and forecasting and customer switching. 25. Grid support to intelligent home/facilities automation and smart devices by consumers. 26. Individual advance notice to grids users for planned interruptions. 27. Customer level reporting in event of interruptions.
<p>Enabling and encouraging stronger and more direct involvement of consumers in their energy usage and management</p>	<ol style="list-style-type: none"> 28. Sufficient frequency of meter readings 29. Remote management of meters. 30. Consumption/injection data and price signals via the meter, a portal or other ways including home displays 31. Improved provision of energy usage information 32. Improved information on energy sources. 33. Individual continuity of supply and voltage quality indicators

The following drawing shows the interactions between services and functionalities, actors and smart grids infrastructure:



3.3. EG3

One of the objectives of former EG3 was the development of a series of recommendations on the roles and responsibilities of all actors involved in the implementation of Smart Grids.

In this sense, EG3 analysed the current roles and responsibilities of the actors in the electricity supply chain and identified the changes in such roles and responsibilities derived from the development of Smart Grids. The main conclusions from that analysis can be summarized as follows:

Actors	Current Roles & Responsibilities	Changes in current roles
Grid	Transmission System Operator	Further investment and innovation

<p>Operators</p>	<p>(TSO): responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.</p> <p>Distribution System Operator (DSO): responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.</p>	<p>will be required by both TSOs and DSOs.</p> <p>The TSOs will have to provide more support & communication of data to the DSOs, but will also require more specific information from the DSOs. In this sense, the standardization of communication protocols as well as clear rules for the handling and the security of this data will have to be developed and enforced.</p> <p>Both TSO and DSO should be able to execute their active role in Smart Grid management by ensuring more sophisticated legal provisions for system security management under increased uncertainty.</p>
<p>Grid Users / Customers</p>	<p>Generator: Generating electricity, contributing actively to voltage and reactive power control</p> <p>Electricity Installer / Contractor:</p> <p>Customer / consumer: depending on their characteristics, they can be classified into different categories. Maybe involved in contract based Demand/Response.</p> <p>Supplier: A grid user who has a grid connection and access contract with the TSO or DSO. They will provide new services, real-time information, energy efficiency services and dynamic energy pricing concepts with Time-of-Use (ToU) and local aggregation of demand and supply.</p> <p>Retailer: Entity selling electrical energy to consumers – could also be a grid user who has a grid connection and access contract with the TSO or DSO.</p>	<p>The responsibility of distributed generation in contributing to grid stability and operational security will progressively increase.</p> <p>Consumers will become more engaged in Demand Side Response (DSR) and DSR will become increasingly important to enhance the overall system efficiency and effectiveness.</p> <p>The DSOs and Retailers will have to develop transparent and easy understandable rules for Demand Side Response, such that they are accepted and trusted by all consumers.</p> <p>To make Demand Side Response possible, standard load profiles used by suppliers for customers will have to be replaced by 'dynamic' load profiles (or the use of actual consumption data) in case of flexible energy prices and / or grid tariffs.</p>
<p>Energy Market Place</p>	<p>Power Exchange: Provides a market place for trading physical and financial contracts for capacity allocation</p> <p>Balance Responsible Party: ensures that the supply of electricity corresponds to the anticipated consumption of electricity during a given time period and financially</p>	<p>With the increase in distributed generation, new energy market places will have to be promoted, contributing to a further optimization of the system. It can be expected that an increasingly flexible formation of energy prices and ancillary services as well as increasingly flexible grid tariffs will be required.</p>

	<p>regulates for any imbalance that arises.</p> <p>Clearing & Settlement agent: assumes liability for clearing and/or settlement of contracts and provides contractual counterparty within a Power Exchange and for Over the Counter (OTC) contracts.</p> <p>Trader: a person or entity that buys and sells energy goods and services in an organized electricity market (Power Exchange) or Over the Counter.</p> <p>Supplier: Has a contractual agreement with end customer relating to the supply of electricity.</p> <p>Aggregator: offers services to aggregate energy production (or consumption) from different sources (generators/customers) and acts towards the grid (or another counterparty) as one entity.</p>	<p>In order to best cope with short-term intraday changes in generation patterns and congestion at the same time, it would be helpful to introduce a common implicit auctioning (“market coupling”) intra-day platform which allows continuous wholesale power trading across Europe.</p> <p>The emergence of more dynamic energy pricing being offered by suppliers/retailers to consumers is expected. Retail suppliers will be more and more confronted with supplying customers that produce some of their electricity as well.</p>
<p>Providers of Technologies, Products and Services</p>	<p>Electric Power Grid Equipment vendors:</p> <p>Ancillary Services providers:</p> <p>Metering operator: the entity which offers services to provide, install and maintain metering equipment related to a supply. In most EU Member States the DSO is also metering operator.</p> <p>ICT service providers:</p> <p>Grid communications network providers: This function is mostly executed by the TSO or the DSO, or may be performed by an independent actor but the overall responsibility and ownership of information remains with TSO and DSO.</p> <p>Home Appliances vendors: Building Energy Management Systems: Electric Transportation / Vehicle Solutions providers:</p>	<p>An open standards based approach will be key for market development with standards set at the European level.</p> <p>New business models and service offerings will evolve as actors take advantage of the new information that results from the new data sources that become available to them.</p> <p>Consumers must have free access to their energy consumption data in a format that will help them compare all offerings in the market, and effectively manage their energy use. They must have the choice to share their own energy consumption information with third parties.</p> <p>The services related to Electric Vehicles will induce further innovation both in terms of technology and business models.</p>
<p>Influencers</p>	<p>Grid User / Customer / Consumer: Entity or person being delivered electricity.</p>	<p>Consumers (especially residential) acceptance of Smart Metering, specifically on the</p>

	<p>Regulators</p> <p>Standardization bodies</p> <p>EU and national legislation authorities</p> <p>Financial Sector undertakings: Provide capital to other actors or invest themselves into the projects within the electricity supply chain</p>	<p>perceived benefits and particularly on the perceived implications to the cost of bills, privacy and security will be key.</p> <p>NRAs and European institutions should ensure a long-term-predictable and stable regulatory framework, including adequate incentives for investments.</p> <p>Open, standards based approach is crucial for the deployment of Smart Grids. Policy makers should ensure active support for market and competitive business activities.</p>
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Taking into account the roles and responsibilities described, EG3 proposed a number of specific and directly applicable recommendations in relation to Interfaces, as it is described below:

Interface	Recommendations
<p>Enhanced cooperation of TSOs and DSOs with Focus on Bi-directional Electricity Flows</p>	<ul style="list-style-type: none"> • DSOs and TSOs should implement a two fold strategy in a coordinated way, including supply management and capacity expansion in regions with high generation potential. • An appropriate framework and incentives should be introduced for Distributed Generation to provide a range of ancillary services relying on a market based approach. • TSOs and DSOs must significantly enhance the exchange of information and coordination, embracing activities such as power flow management, voltage control, alarm surveillance & fault management, in order to be able to maintain a reliable and stable system. • WAMS (wide area monitoring system) are already being used by TSOs to get a view of wide-area phasor oscillations and detect dynamic instabilities. Similar systems adapted to the properties of LV and MV networks could be a benefit for the operation of DSOs in the future. • Future cooperation between different TSOs and between TSOs and DSOs will include reporting of actual power and energy values for all participants in the new market places down to distribution level for settlement but also for data analysis for planning.
<p>Interfaces between the DSOs, TSOs, Aggregators, Consumers and Generators</p>	<ul style="list-style-type: none"> • Consumers, generators and those who do both, cooperate with traders and suppliers (possibly via aggregators) and establish their participation in any kind of market places under contractual arrangements pre-defined with the related DSOs.

Interfaces of DSOs, Customers, Suppliers and other actors concerned with Smart Meters (Interfaces around the Meter)

- Interfaces must be specified between communication service providers and the following actors: TSO, DSO, Aggregators, Grid Users, BRP, Storage Owners. These interfaces are typical user to network interfaces and specify the agreed service level agreements which have a legal and technical part.
- Regulatory authorities should promote maximum standardisation and interoperability and establish level playing fields that encourage the market to work efficiently and to secure customer participation and market integrity.

4. BAU Market Model

This section describes the BAU market model, accepting that in reality the implementation of the Third Package takes different forms in different MSs. It does this by describing the three fundamental 'layers':

- The physical component layer;
- The information layer; and
- The business/transactional layer.

The scope of the BAU model embraces the supply chain from the source of electrical energy (i.e. the wind turbine, gas-fired power station etc.) to the customer's meter. References back to the work of EG1 and EG3 are provided where appropriate.

The model is based on the EG3 Actors with minor changes as follows:

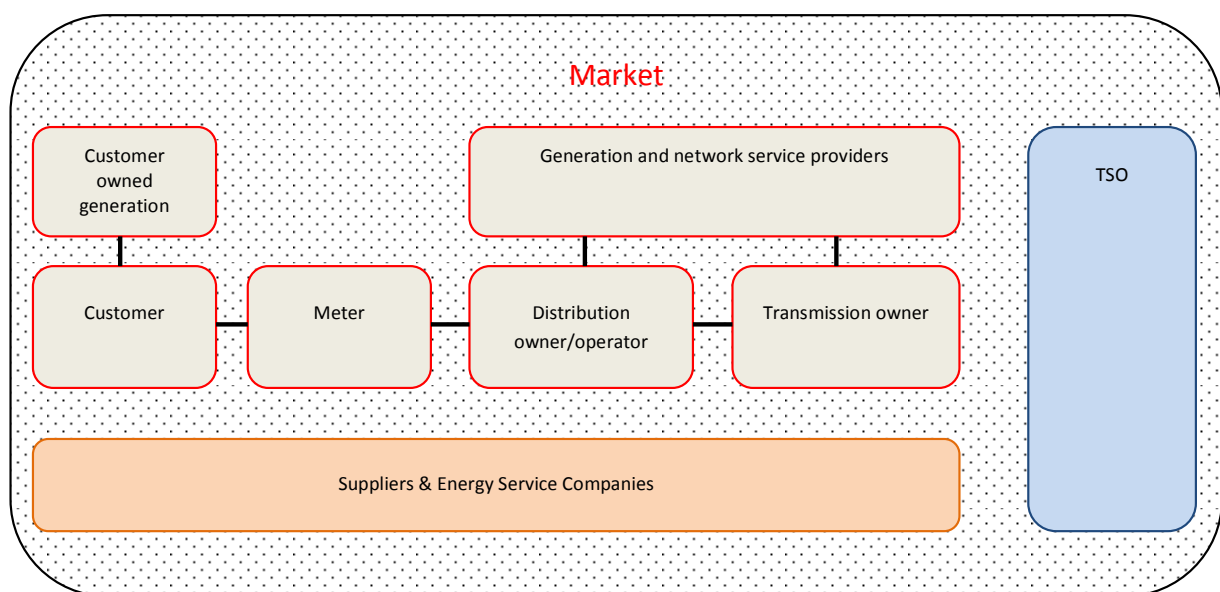
EG3 Actor	BAU Actor	Comment
Grid Operator	Network operator and TSO	This is essentially consistent with EG3 which recognises the split between TSO and DSO. It recognises that a network can be owned and operated by different legal entities.
Grid Users/Customers	These are identified as Customers, Generators, Network Service Providers and Suppliers	For simplicity, EG3's suppliers and retailers are grouped together.
Energy Market Place	No single actor	The market is by definition a collection of actors as recognised by EG3.
Providers of Technologies, Products and Services	Network Service Providers	
Influencers	Not explicitly recognised in the BAU model here	

4.1. Component Layer

At the highest level, the component layer of the supply chain (i.e. excluding consumers at this stage) can be divided into three parts:

- sources of electrical energy (i.e. generation);
- the networks; and
- equipment that provides system services to the networks and the total system (e.g. storage).

The physical connections between the actors are shown in the diagram below as solid lines.



4.1.1. Sources of electrical energy – generation

Generation can in principle be owned by any party, subject to the appropriate licenses and permissions being in place. It can be at any scale from a few kW (e.g. domestic PV) to power stations of over 1GW and can connect to any part (i.e. voltage level) of the network.

In some market models, generators of different sizes and technology types are treated differently (see Business/Transaction layer) but at the Component Layer they are all essentially the same having a clear connection boundary with the network.

The performance and the methods of dispatch vary between technologies and this is discussed in the Business/Transaction Layer.

4.1.2. Networks

The BAU approach to networks is quite consistent across MSs. There is a universal consensus that electricity transmission and distribution networks are natural monopolies and this model is adopted across MSs.

A further, almost universal, convention is that there is a division between the owners of transmission and distribution networks.

However, the actual organisation of transmission and distribution companies varies greatly. Transmission networks are generally owned by significant entities that provide the network for an entire MS or a very significant part of it. In contrast, distribution networks can be owned by very small companies with some MSs having hundreds of distribution companies, sometimes community owned. In some MSs, a degree of competition has been introduced for the provision of new networks.

As there are three options in the Third Package for achieving TSO unbundling, it is possible for transmission systems to be owned and operated by different legal entities.

However, the principle that networks are owned and operated by regulated monopoly companies can be considered to be a robust element of the BAU market model.

4.1.3. System Services

Traditionally, the services needed to ensure that the total system operates securely have been provided by generators, the network companies and, in some cases (e.g. reactive compensation) customers.

However, there are opportunities for the components necessary to provide these services to be owned by other parties and there are examples of this. For example, the owners of large-scale pumped hydro storage plants fill this role and storage at a smaller scale could be owned by independent network service providers.

So, the position of parties that own equipment that is able to provide system services is fundamentally the same as the generators. Like generators, this equipment can also be connected at all voltage levels of the total system.

4.1.4. Meter

The meter is a key component in the physical layer and will become more significant as smart meters are deployed. In most MSs, the meter is owned and managed by the distribution network company. However, there are exceptions to this general rule in which a separate entity owns and operates the meter. It is therefore shown here as a separate part of the Component Layer.

The transition to smart metering is part of the Third Package (see 2.3) and is therefore considered a component of the BAU market model. However, most MSs are at an early stage of deployment of smart meters and there are different approaches being pursued to meet the Third Package requirements. The challenge for smart meter deployment programmes is to extract the maximum value from this new element in the Component Layer either within the BAU model or future developments of it.

4.1.5. Summary

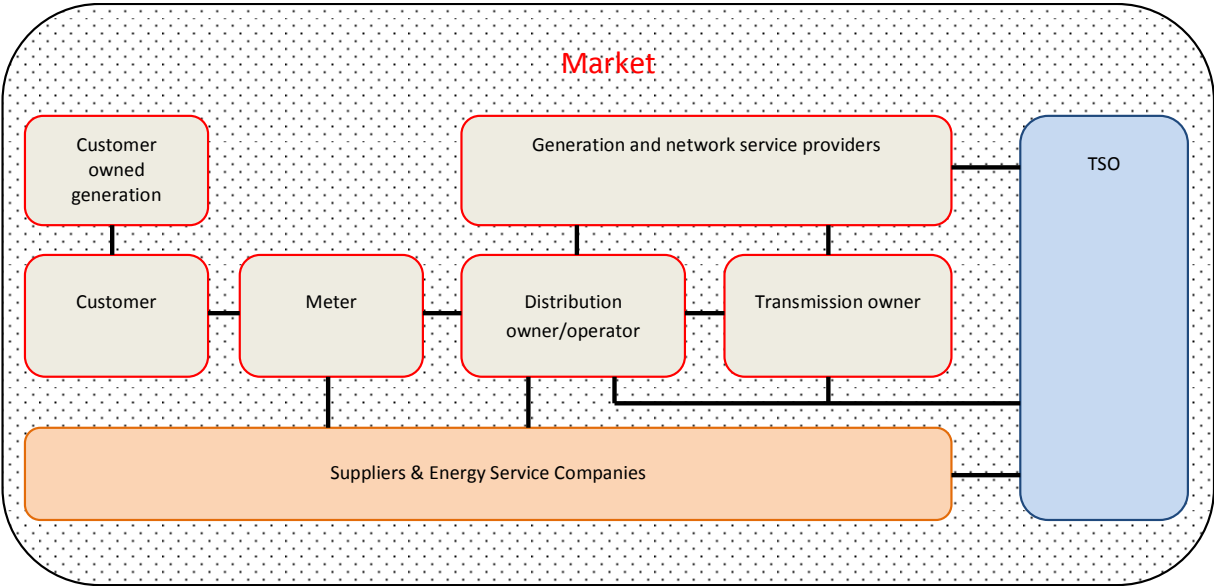
So, at the Component Layer there is a reasonable degree of consistency across MSs in terms of the ownership and operation of the physical system, with the caveat that there is potential for quite different smart meter deployment strategies.

4.2. Information Layer

Compared with the Component Layer, there is much less commonality of approach across MSs in relation to the Information Layer. This layer meets two fundamental needs. Firstly it allows the flow of information necessary to allow the physical system to operate in a safe and efficient way. For example, generators provide data to network companies to ensure that protection systems can function effectively. Secondly, this layer facilitates the flow of data that 'feeds' the commercial operation of the system at the Business/Transactional Layer.

The diagram (next page) shows the main information links between the actors. This shows that, in contrast to the component layer, information flows across multiple boundaries. The diagram does represent a simplification of the real world and therefore does not show every 'connection'. Also, the information linkages are not necessarily achieved electronically. In particular, the information flow between a Customer and a Supplier will still in many situations involve manually reading a meter and sending a bill by post.

The diagram also shows an additional actor – the Energy Service Company – which includes any party that wishes to offer a service to customers that requires data from other actors/the market.



It is broadly true to say that the Information Layer has, to date, developed to meet specific needs rather than being planned in a holistic way. For example, the network companies have developed information systems to enable the safe and efficient operation of their networks but these systems do not provide information to other parts of the total system unless there is a specific need to do so. Similarly, the information flows that take place to allow suppliers to sell electricity to customers are also generally 'ring fenced'.

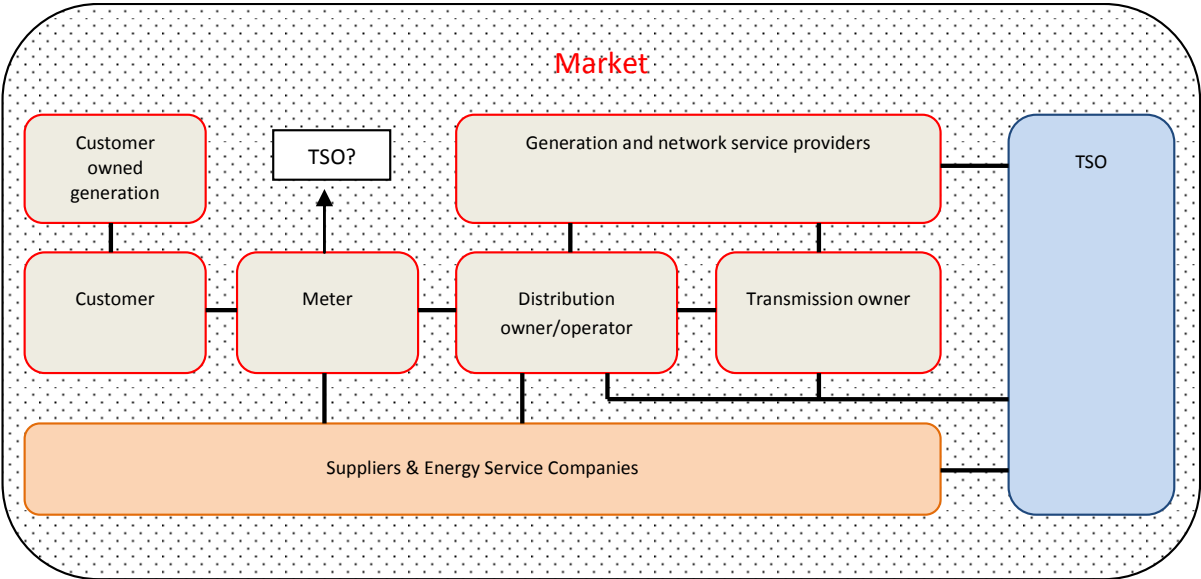
A further reasonably robust assumption is that there is more commonality across MSs in the way that information flows between physical assets for operational purposes than for commercial transactions. This is due to the fact that the physical infrastructure was largely designed and built before the commercial unbundling of the supply chain commenced.

So, it is broadly true to say that the BAU model does not have a structured, holistic Information Layer. It is also generally true to say that the ability of actors to gain access to data that exists in the Information Layer also differs between MSs. However, these observations would need to be substantiated by detailed research to be considered robust.

4.3. Business/Transactional Layer

The Business/Transactional layer is discussed here from the perspective of each of the main actors. The diagram is essentially the same as for the Information Layer. Where additional 'connections' are shown, it follows that these would be replicated in the Information Layer.

Once again, it is stressed that the description that follows will not necessarily apply in all MSs.



4.3.1. Customer

There is a broad consensus at present that, seen from a consumer’s perspective, the BAU model for this layer is supplier-centric; the customer deals solely with the supplier in order to obtain the required energy services. This is generally seen as having advantages in terms of simplicity but may in some circumstances constrain particular trading opportunities.

There are now examples of customers offering services (e.g. demand response) to the DNO/DSO that they are connected to and/or to the TSO. These transactions are possible in the BAU model. Regarding supplier switching, the Third Package requires that this should be achievable within three weeks (see 2.2.3).

A customer with generation also has opportunities to trade surplus energy. For smaller generators this can also be facilitated by a Supplier in order to avoid the complexities of becoming a full market participant.

4.3.2. Suppliers

In this supplier-centric model, suppliers act as a focal point. They purchase energy from generators, transact with network companies to transport energy to customers and contract with customers to supply them with energy. They also transact with the TSO in the system balancing market. Suppliers have significant opportunities to create new

products for customers in the BAU model, particularly where smart meters are able to provide much more granular data about the energy consumption pattern of individual Customers.

4.3.3. Energy Service Companies

The BAU market model does allow independent actors to interact with the market and provide services to the actors within it. An example of this would be acting as an aggregator between multiple customers and the TSO to offer demand response in the reserve market. The scope for this kind of activity differs between MSs.

4.3.4. Generators

Generators have three transaction paths. They sell energy to suppliers, they pay network companies for the use of their systems and they transact with the TSO in relation to balancing and other services.

4.3.5. Network Companies

The network companies provide an energy transport service to any other market actor on a transparent, non-discriminatory basis. Traditionally, the network companies have aimed to meet all reasonable demands for network capacity. However, the BAU model does offer opportunities for network companies to offer commercial terms that incentivise more efficient use of network assets, particularly in conjunction with smart network management technologies. Examples of such arrangements are now being seen.

4.3.6. TSO

In the BAU model, while the majority of the energy is traded on a bilateral basis, the TSO provides the vital role of market maker for the balancing market. The TSO also has responsibility for ensuring the security of the system and does this by purchasing ancillary services (e.g. spinning and other reserve products) from generators and demand customers, whether directly or through intermediaries such as aggregators. These ancillary service markets vary between MSs with different degrees of access and transparency.

4.4. Examples of Best/Good Practice

It has proven difficult to identify specific examples of best or good practice, partly because no criteria have been agreed at this stage for such an assessment and because the scope of these practices has not been defined.

Following the first meeting of EG3, four groups produced reports that attempted to collect together examples of best practice. In Annex 2 here, a summary of all the examples from these reports has been produced. It is notable that no EG3 member has proposed an existing MS market to be an example of best practice. Instead, the examples quoted refer mainly to specific projects. It is also interesting that most of the examples reported focused on smart metering and demand side response/management.

The BAU group recognises that markets have been transitioning from different starting points to meet the requirements of the Third Package. In March 2011, all MSs were required to make submissions to the Commission setting out how they were implementing the Third Package. These submissions will give the Commission a complete overview of the different implementations of the Third Package across MSs.

Regarding specific smart grid/meter projects across Europe, the JRC database [5] provides a very helpful resource.

5. New Market Models – development issues

This section outlines some important considerations for assessing business as usual as well as new market models. The factors outlined could form the beginnings of a framework for assessing market models, by examining what these models require of participants and whether they would be likely to deliver efficient market outcomes for energy consumers.

Market design could influence a range of factors which affect how well a market model performs. The factors outlined below do not form a comprehensive list, but they do provide a starting point for assessing any new market models and understanding their potential strengths and drawbacks.

5.1. Property rights

Well-defined property rights can provide consumers and market participants alike with clarity around what they are consuming or providing. This clarity is needed to ensure that parties can transact efficiently around the products which those rights define. Any market model should, therefore, be clear about the property rights within the model.

For competitive markets to deliver efficient energy systems for consumers, property rights within the supply chain need to be clearly defined – any efficient market requires clear property rights. Market models play a key role in determining the market structure and the scope of participants' role within that structure. Wherever the market structure generates interfaces between different parties, property rights are needed, so the market structure itself determines the role property rights need to play.

Some property rights could be strongly influenced by the regulation and market rules in place within the framework that governs the market model. Other property rights will depend on the contracts between parties and sit within the business / transactions layer. Understanding new market models, therefore, depends crucially on a full appreciation of the property rights required by the market model.

For example, end-customer contracts define the product or service which they purchase. Property rights for an unrestricted secure supply of electricity look different to those for a limited, capped, or interruptible supply, where conditions for interruption need to be closely defined.

5.2. Transactions

Market models are built around transactions – whether for energy consumption or to provide the means for others to consume energy. Any market model involves transactions between a customer and a supplier or another entity. In disaggregated market models, transactions are required between multiple types of market participant, generating different types of transactions, as well as the need for property rights to be defined for a greater range of products.

In creating, designing or assessing new market models, it will be important to assess what types of transactions are necessary for the effective functioning of the model. For example, in a disaggregated supply chain, many transactions might be required to capture the full value of products such as demand-side response, if that value is spread across many different parties in the supply chain.

It is therefore essential to understand the types of transaction required within a new market model in order for it to function as intended, not least because participants' appetite or aptitude for certain types of transaction might be limited. For example, it might not be reasonable for some types of customer to participate in multi-lateral transactions that are inevitably more complex than bilateral business-as-usual supply contracts.

Furthermore, wherever transactions are necessary, an efficient market will only arise if parties have the correct incentives. Inevitably many of these incentives are set within the market rules and arrangements, as well as being a consequence of the set of property rights within the system. Regulation of markets and of regulated natural monopolies therefore has a key role in determining whether incentive structures allow for an efficient market to the benefit of consumers. Regulators will therefore have different roles to play within different market models. Their capability to effectively fulfil these roles will help determine the overall desirability of different market models.

5.3. Contracts and agreements

Any market model requires a set of contracts and/or agreements to be in place to govern the transactions around the property rights within the market. These contracts and agreements then define the commercial relationships between parties and in themselves reflect the property rights within the market.

The nature of these agreements and resulting commercial arrangements is closely linked to the types of transactions required within a market model. Generally, the more disaggregated the supply chain, the more complex the contracts and agreements required for the market model to function.

Of course, any complexity should be weighed up against the potential benefits to be gained from disaggregation.

This level of complexity across these contracts and agreements can be an important factor contributing to the level of information in a market model and the comparability of products within the resulting market (see below).

5.4. Information / comparability

An efficient market model requires that participants can access and understand clear information provides comparability of one kind or another. Within any regulated market segments, information is one key contributor to the effectiveness of economic regulation. For competitive markets, information is vital for consumers to be able to compare products and services they are offered as well as to make decisions about their own consumption.

Different new market models will lead to different informational requirements, of different types and on different parties. One aspect of understanding the potential success of a market model will therefore be to assess the extent to which these information requirements could be met. Furthermore, different participants will have differing capacities to effectively use this information, leading to different levels of product or service comparability, using this information.

Therefore, assessments of new market models should be clear about the information that they require in order to be efficient and successful, as well as the level of involvement this requires from a range of participants.

5.5. Consumer Interface

The consumer interface itself is one of the most important aspects of energy market models involving competitive retail markets. All of the factors outlined above are vitally important to consider in the context of the consumers' interaction with their energy supply and with the energy market.

Different market models might require different levels of interaction from the consumer in order to deliver the same outcomes. For example, a 'supplier-hub' model in which the customer contracts only with their supplier, might deliver greater comparability and ease of engagement for consumers. Nonetheless, such a model has other impacts on the factors outlined above.

5.6. Summary

Any market model will have both advantages and disadvantages, which will need to be weighted up in any comparative assessment of these

models. The factors outlined above attempt the beginnings of a framework within which these alternative market models could be assessed.

Group Members

Name	Affiliation
Gareth Evans	CEER (Ofgem)
Paula Mandatova	Eurelectric
Peter Beumers	Alliander
Paul de Wit	Alliander
Michael Guldbæk Arentsen	Dansk Energi
Kim Møller Mikkelsen	Dansk Energi
Alicia Carrasco	Emeter
Werner Friedl	CEER (E-Control)
Kai Paulssen	CEER
Ines Handrack	CEER
Marielle Liikanen	CEER
Veli-pekka Saajo	CEER
Miriam Salguero Mayoral	CEER

Summary of EG3 “Best Practices” Reports

Following the first meeting of EG3, four groups were asked to report on smart grid “best practices” as observed across MSs. Four reports were produced and circulated. The tables here attempt to capture the examples contained in these reports.

Smart Metering		
Country	Title	Brief Description
Sweden	Swedish Smart Metering Billing Practices	As of the 1 st of July, 2009 all electricity meters had to be read once a month. The new law required smart meters from with data could be collected remotely. The DSO’s - who owns and operates the meters in Sweden – where allowed by the regulator to finance the investments through the grid tariffs.
Italy	Smart meter rollout in Italy	Italy is a leader in smart metering implementation with over 94% customer penetration. The regulation supporting this rollout was based on functional requirements definition and deadlines (with penalties) for installation or commissioning. But the real driver of this process was the strong support of the main DSO, ENEL, to the smart metering technology.
Netherlands	Smart Meter Rollout the Netherlands	The smart meter rollout in the Netherlands is on-going. It started in 2011 and is seen as part of the creation of a smart grid in the Netherlands.
Germany	Smart meter introduction Germany	Meter data provision in Germany was liberalised in 2008. Electronic meters have to be installed in all new buildings and in case of significant modernisation since then. They do not need to be remotely readable. Utilities are allowed to ‘push’ installation; consumers must get electronic meters on request as well as monthly billing. Nevertheless penetration with electronic meters is still low.
Portugal	Smart metering	Pilot of 30k end customers and 400 secondary substations. Focus on assessing the benefits of the smart grids across the whole electricity distribution chain (e.g. reduction of technical losses or improved asset management)
France	Smart metering	35 Millions smart meters will be deployed. Communication will be managed by PLC at the LV level and GPRS from secondary substations to the national data collection centre

Demand Side Participation		
Country	Title	Brief Description
GB	Energy Demand	EDRP was a major project in Great Britain to test

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	Research Project, GB	household consumers' responses to different forms of information about their energy use.
Italy	Demand Response Program Description	The ADDRESS Active Demand (AD) program is designed for residential and small commercial consumers (below 100 KW connected to the LV network).
Italy	Enel Smart Info	Enel Smart Info is a device providing customers with information about electricity consumption. It communicates with the smart meter and gives customers easier access to the information in the meter via a number of visual devices and dedicated displays.
Sweden	Hyllie, Malmö, Sweden	Hyllie will lead the way for Malmö's future development as a sustainable city and be at the forefront in terms of innovative strength and the ability to combine supply with consumption and behaviour.
France	EDF Residential Dynamic Pricing Tariffs	Day ahead guidance to customers to encourage demand-side participation.
France	Industrial Demand Response	TSO based demand management for system balancing and reserve provision.
Slovenia	Commercial Industrial Demand Response	CyberGRID is developing and implementing Virtual Power Plant energy solutions, enabling utilities to remotely manage, reduce or shift electricity consumption and production across a wide network of commercial, institutional, industrial electricity consumers and distributed generation sources.
Germany	Demand Response Germany	The first commercial demand response program in Germany was rolled out by the fifth largest German utility in 2011 in collaboration with a Demand Response Aggregator. Industrial and commercial businesses are offered to participate in the Demand Response program by providing their flexible load potential which is aggregated and marketed into the tertiary balancing power market in Germany.
N America	Demand response programs in US and Canada	Demand response programs in United States are encouraged by requiring that compensation for providers of demand response participating in wholesale power markets be the same as providers of generation in those markets.
The Netherlands	PowerMatching City	PowerMatching City is a living lab Smart Grid demonstration in the Netherlands consisting of 25 interconnected households. It focuses on the development of a market model for intelligent network operation under normal market conditions that allows simultaneous in-home optimization (prosumer), technical coordination (distribution system operator) and commercial coordination (balance responsible).

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Electric Vehicles		
Country	Title	Brief Description
Portugal	National Platform for Electric Mobility Portugal (MOBI.E)	To establish a discrimination-free network of electric charging stations based on a for profit business model distributing renewable energy to the transport sector.

Network Regulation		
Country	Title	Brief Description
GB	RIIO	A new approach to network regulation relating revenues to outputs through targeted incentives and innovation.
Italy	Network Funding Scheme Italy for the better use of TOU tariffs	AEEG has allowed funding for eight smart grid projects under its incentive scheme.
Germany	Integrating DG	The current German regulation (EEG 2012) for integrating distributed generation in the power system specifies the technical requirements to reduce power output by remote means in the event of grid overload. For small installations which are not controllable (such as installations generating electricity from solar radiation) a capping in the power output of the installation has been established as alternative to the remote communication.

Network Innovation		
Country	Title	Brief Description
GB	Dynamic Line Rating, Central Networks (now WPD)	Deployment of dynamic line rating to allow more renewable generation to be connected without network reinforcement.
Sweden	Swedish Easy connection of micro production	Easy connection (both technically and administrative) of micro production to the electricity grid is an important part of the smart grid concept.
Germany	E-Energy	E-Energy project: regional marketplaces can be used to optimize system stability in an unbundled world (i.e. DSO can buy “ancillary services” to stabilize the grid and avoid congestion).
Netherlands	PowerMatcher – the Smart Energy Collective	PowerMatcher technology is a distributed energy systems architecture and communication protocol, which facilitates implementation of standardized, scalable Smart Grids, that can include both conventional and renewable energy sources.
France	Demonstration projects	ERDF (the DSO for 95% of the territory) is running 13 demonstration projects, testing different technological solutions in various contexts.
Belgium	Demonstration projects	A consortium brings together academia, network operators, IT companies and the Flemish government to invest in Smart Grid trials.
Spain	Demonstration projects	The Basque Regional Government Energy Board and IBERDROLA have created a consortium (BIDELEK SAREAK AIE) to deploy the Smart Grids in two cities: Bilbao and Portugalete (410,000 inhabitants in total).
GB	Low Carbon Network Fund	Five year, £500m scheme to encourage network innovation to meet the low carbon challenge.

New Tariffs		
Country	Title	Brief Description
Germany	Feed-in-tariff scheme Germany	The regulatory framework (Renewable Energy Sources Act - EEG) in Germany for RES has been supported by a strong CO ₂ reductions policy aiming to increase the share of RES and supporting its technology development. The implemented policy is based on guaranteeing primary access to the grid and a nationwide equalisation scheme for the quantity of electricity purchased for which a tariff or premium will be paid.
Spain	Feed-in-tariff scheme Spain	The regulatory framework in Spain to support integration of RES started with an overestimated feed-in tariff system impacting on a very quick and ambitious growth of the penetration of renewable sources. This quick growth soon had to face

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		bottlenecks both administrative and infrastructural and repercussions on high associated costs and operational issues. The solution proposed (limiting maximal number of new installations and lowering feed-in tariff) impacted the further development of the RES market and despite the significant volume of wind and solar installations connected and integrated to the Spanish grid infrastructure, during the last few years this evolution become stagnated.
Denmark	Feed-in system Denmark	Since 1986 Denmark has driven the transformation of its electricity system. Up to now this resulted in the highest share of new renewables, in particular wind in Europe. At the same time the contribution of distributed generation, often as co-generation, increased and the share of centralised generation was reduced.

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- [2] Expert Group 3 - Roles and Responsibilities of Actors involved in the Smart Grids Deployment
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Case I: DSO as Market Facilitator

Introduction

The key deliverables of EG3 are to define reference **market models**, options for viable business models and suitable instruments for accelerating the roll-out of Smart Meters and foster the deployment of Smart Grids and to examine the potential implications for the regulatory frameworks to efficiently facilitate the rollout. Additionally, the group is expected to identify the necessary framework conditions for establishing new fields of cooperation (legislative, financial and/or other incentives) between the energy and telecommunications sectors.

During the second meeting of EG3 in Brussels on 2 May 2012, a Business-as-usual scenario plus three possible cases were identified as follows:

- Case I: DSO as Market Facilitator including data sharing
- Case II: Third Party (new) Data Facilitator, sharing data
- Case III: New parties for distribution, transaction, providing services

This led to the four reports describing these cases in July 2012.

In order to assist the EU commission in their decision making, a short document containing eight recommendations related to the “DSO as market facilitator” model was presented to the EU commission in September 2012.

During the meeting of 18 September the European Commission requested EG3 working groups to elaborate from a process point of view on:

- 1. The market processes**
- 2. the implications (advantages/issues) for the consumer**
- 3. The relations with ICT & Telco: technology and regulatory implications in ICT/Energy sector**
- 4. Financial implications & horizon**
- 5. Needs for regulatory intervention; recommendations for regulatory incentives for their implementation**

This **implications addendum** attempts to add insight on these implications, following further reflection on the ‘DSO as market facilitator’ model as described in the initial report and the recommendations document.

1. Processes

How will the ‘**DSO as market facilitator**’ Case run key market processes? The following EU classification has been proposed.

EU Classification	
A. Consumer issues	Metering Supplier switching How easy is it to offer tailor made services User feedback Reconciliation services
B. Trading & Flexibility	Virtual power networks Aggregated buying Ancillary services Storage EV How to sell power to my neighbours
C. Energy management	Demand side management Demand Response
D. Operational processes	Forecasting Programming /Planning Real time operations

A. Consumer issues

Metering

Before energy delivery can take place, the customer should sign a contract with an energy supplier for energy delivery. Based on this, the customer requests the DSO (via its chosen supplier) access to the grid, with a meter installed on this access. In the majority of the European countries the DSO is responsible for installing, operating and maintaining the meters.

The process of delivering metering data is shown in figure 1.

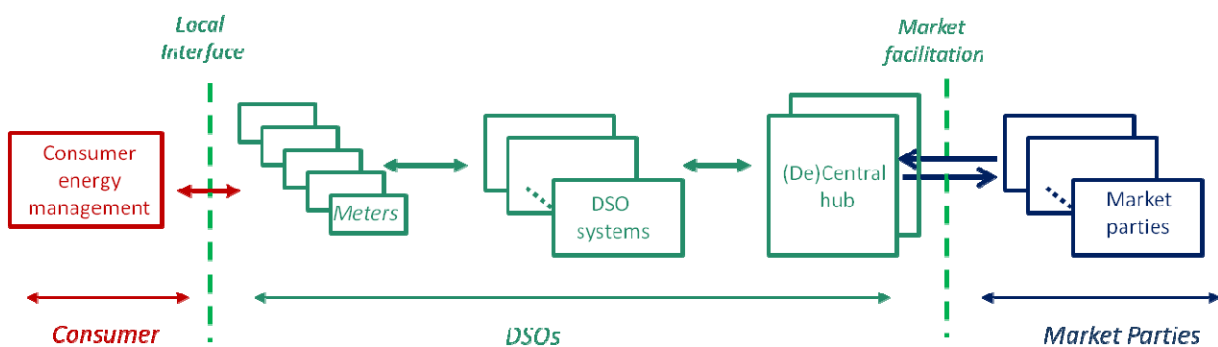


Figure 1 providing metering data

Behind the service that DSOs are delivering to the market parties, there are a complex range of processes:

- Installation of the meters
- Registering the meter location and giving it a unique identifier
- Safety and accuracy of the installation
- Establishing and continuously ensuring good communications infrastructure
- Initial set-up and continuous management of meter configuration (TOU tariff parameters, contracted power limits, etc.)
- Collection of metering data manually or via automatic meter reading (smart meters)
- Maintenance of the meter and communications and handling of breakdowns and incident management
- Data capture, validations and storage in DSO systems (for network operations) and the DSO data hub system (for market delivery)
- Provisioning of data in the data hub, access permits management for public and private data

Next to the delivery of metering data to market parties, the DSO also delivers metering data through the local interface of the smart meter directly to the customer (aligned with the aggregated metering data delivered to market parties). Via this local interface customer energy management applications (e.g. displays) could be enabled and near real-time data for demand response purposes delivered.

Supplier switching

The DSO facilitates the market process in which a customer switches from one supplier to another; the DSO acts as a data provider for connection and metering data for that process that allows old and new suppliers to exchange information efficiently. He also synchronizes the supplier switching process with the allocation and reconciliation processes between market parties. This process is shown in figure 2.

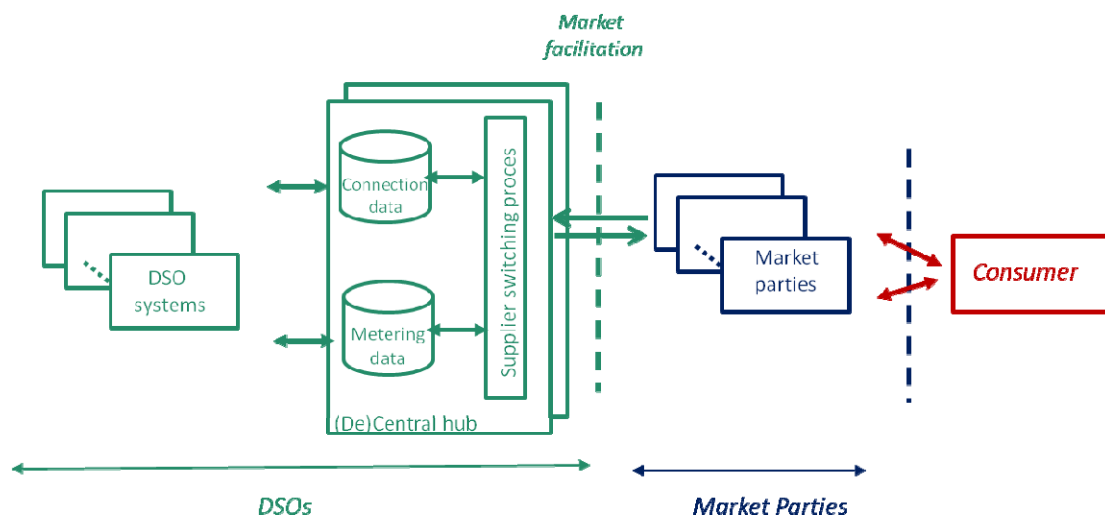


Figure 2 supplier switching process

The following high-level supplier switching model can be deduced from the country-specific switching processes:

1. The customer contacts the new supplier. A variety of means to agree a contract are available: in person, by e-mail, via internet or a written contract.
2. The new supplier informs the DSO of the customer's desire to switch supplier.
3. The DSO checks the (technical) consistency of the switch inquiry and will send a (possible) confirmation message to the new and old supplier.
4. Smart meter metering data are collected by the DSO.
5. After the acceptance or the estimation of the metering data, the DSO will subsequently send the meter value and/or energy consumption values to the old and new supplier.

How easy is it to offer tailor made services?

As stated by the Directive 2009/72/EC, a well-functioning internal market in electricity should provide incentives for all energy consumers and generators to invest in the most energy efficient technologies, and real choices and business opportunities in all the liberalized activities. Therefore, the tailor made services for consumers and generators needs - beyond efficient and non-discriminatory network availability- must be provided by non-regulated, commercial agents like suppliers, ESCO's or aggregators.

In this framework the DSO plays a key role by enabling the offering of tailor made services by market parties to consumers. This process is shown in figure 3.

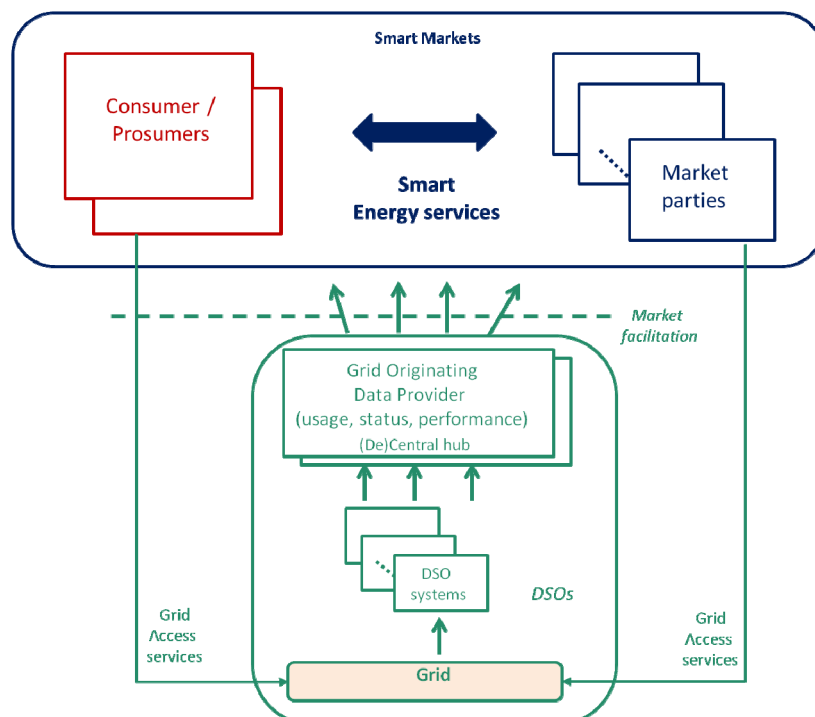


Figure 3 Providing data for tailor made consumer services

Differentiated data will be collected in line with the smart grid services which have been previously identified. Tailor made services can be created in the market and offered to consumers based on these data. Access to these data will be granted by the DSO under a set of agreed and relevant conditions. The DSO will be reasonably rewarded for maintaining the data hub and facilitating the access.

Next to providing data for tailor made smart energy services the DSO delivers grid access services. These universal access services are regulated, and a shift towards more “tailor made grid access services”, is - today, under current regulation, - not possible.

User feedback

The DSO data hub contains data which may be used by market parties to create new and innovative services for the customers’ benefit. The kind of new services could be energy savings advice, active cost overview, budget planning, the amount of generated electricity, sold and bought energy, etc. The DSO data hub can facilitate market parties to offer these services.

An essential part of market design concerns the organisation of the customer interface. The DSO as market facilitator case advocates a customer-centric approach with the supplier as the major point of contact. This ensures clarity and simplicity for customers and therefore facilitates their active involvement in the market. The need for a market model supporting such customer-supplier interface is likely to be strengthened within demand response markets with smart meters.

Examples of such (**commercial type** of) consumer interaction with markets parties comprise:

- Signing up (energy) services contracts, for energy consumption and delivery and more enhanced services such as demand response programmes (flexibility contracts)
- Switching of supplier (initiated by the new supplier)
- Receiving information and advice on energy efficiency savings
- Receiving invoices on energy services (and on grid access and transport services, depending on the market model arrangement between market parties and DSOs)
- Bill complaint handling
- Financial benefits as agreed in the contract for being prosumers

However, this model does not imply that all customer issues should be handled by suppliers. Network-related issues will remain the responsibility of DSOs.

Examples of such (**technical type** of) consumer interaction with DSOs comprise:

- Signing up for grid access, and /or changes in type of grid connection
- Installation and maintenance related to smart meters, enabling metering of both consumption and generation for prosumers
- Complaint handling in case of a network outage including receipt of financial compensation
- Real-time metering data, automated and provided through a local interface at the smart meter communication module
- Real-time technical interaction with consumers’ Distributed Energy Resources (DERs) on behalf of a market party, and following a contract between the consumer and this market party
- Real time interaction with consumers’ DERs directly following from the DSOs responsibility for system integrity and security of supply (code red emergencies)

The user feedback processes are shown in figure 4.

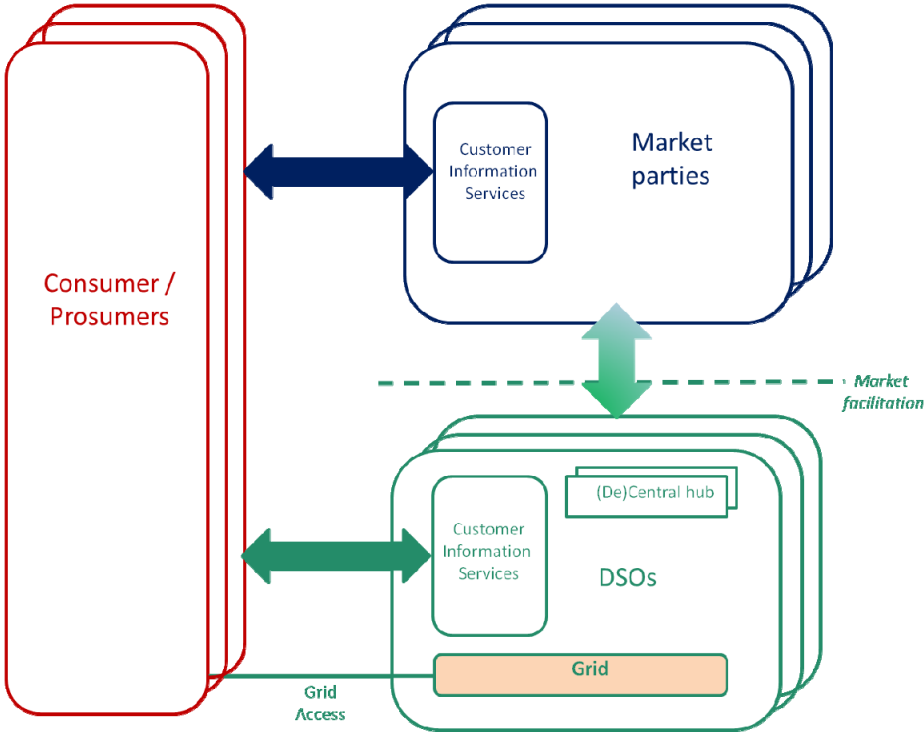


Figure 4 user feedback processes

If new services (e.g. aggregators, ESCO, VPP communities) are introduced by third parties, this will lead to additional feedback channels between the customer and these new parties.

In order to provide good quality of customer services by market parties to consumers, the DSO enables these customer information processes with data delivery through the central hub.

Reconciliation services

The process of dividing the energy which is produced among the balance responsible parties is called the allocation process. The daily amount of energy used by a connection can be measured (by a smart meter for example) or can be estimated based on the yearly consumption and a profile. When the amount of energy is estimated the estimated energy can be corrected if the meter is physically read. When the customer doesn't have a smart meter the customer must provide the meter index by a postcard, internet, etc. The meter index can also be read by a meter reader (i.e. an employee of the DSO or – as in some member states - a metering company on behalf of the DSO).

The process of correction after several months of the estimated energy which is used in the allocation process with a physically read meter index is called the reconciliation process. Of course when the meter is read daily no correction would be needed in the ideal situation. This can be achieved by using the smart meters in the allocation process.

When the used energy is estimated, based on a load profile, no time of use tariffs can be used by a supplier. This is because the used energy per time period is determined by the profile and not by the measured amount of energy. Allocation of millions of connections on a profile basis is still a very efficient way, however it limits the possibilities for the customer, supplier

and other market parties. Therefore both options (daily read and profile based) should be available also in the smart grid environment.

Based on these differences settlement takes place between market parties (done by the system operator). The overview of the reconciliation process is shown in figure 5.

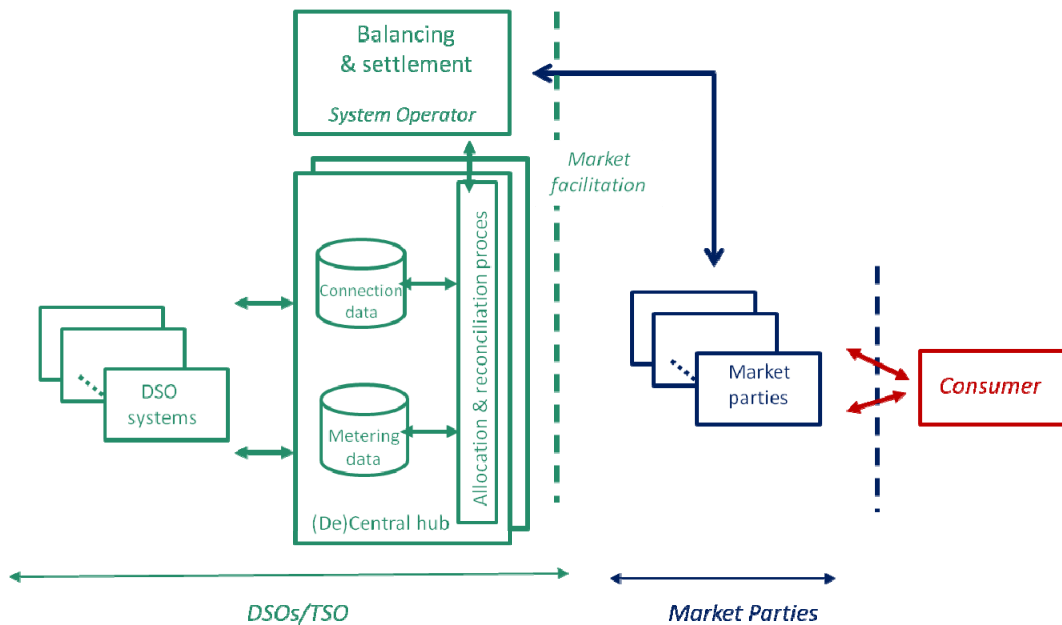


Figure 5 allocation & reconciliation processes

It is especially in this reconciliation process that the “DSO as market facilitator case” excels. The process is carried out by a regulated party (neutral towards all market parties) and the data should be complete. If the data were fragmented (not in one data hub, but multiple per grid), it becomes very difficult to determine whether or not the reconciliation calculation is complete.

B. Trading & Flexibility

Trading is regarded as trading in the wholesale market and trading between a consumer and a producer. A customer can also be a consumer and a producer, i.e. referred to as a ‘prosumer’. “Trading & Flexibility” must be considered as customers being able to sell their generated electricity via certain market parties (e.g. an aggregator) on the wholesale market as well as to sell their generated energy to other customers. This creates market flexibility because a lot of new small producers and small customers are gaining access to market.

In an electrical system all generation and consumption must be balanced. When the consumption they aggregate grows, Balance Responsible Parties (BRP) will search for more production capacity to start. Also in today’s system a BRP is responsible for keeping the balance of all the connections in his portfolio. Every 15 or 30 minutes the production and consumption is measured (smaller consumption like households are estimated). The difference between the production and consumption is settled. In today’s system, smaller production units like PV panels, small wind turbines or micro CHPs are not always measured every 15 or 30 minutes. This is not such a problem when the penetration of distributed

generation is small, but when there is a large scale penetration of distributed generation this can become a problem. The problem is that distributed generation from renewable energy sources do not follow the household consumption profile. This leads to distortion of the predictability of the household consumption profile, which causes uncertainties for BRPs.

Large scale penetration of distributed generation from renewable energy sources can also cause local technical problems in the distribution grids. A distribution grid is designed to transport electricity from the transmission grid to the households. When there is more production than consumption in a distribution grid the surplus is fed into the transmission grid. When the flow is reversed reinforcements of the grids might be necessary. This becomes more imminent when the production capacity in the distribution grids grows excessively.

New smart grid devices (as stated in the 'DSO as market facilitator' report):

CLS – Controllable Load System

Controllable Load Systems (CLS) are -individually or grouped collections of demand or generation points - connected to the electricity grid and can be used as either energy source or drain in order to balance supply and demand. Therefore CLS can be disconnected and reconnected to the grid or their load can be increased or decreased. Preferably the CLS reacts automatically to price signals. Examples are electric vehicles (EV) and Renewable Energy Sources (RES) like photovoltaic systems or wind generators or small CHP units.

The CLS device is operated by market parties. Indeed market parties must be able to control the loading facility of an Electrical Vehicle (EV) and renewable energy sources like photovoltaic systems or wind generators in order to make a firm offer on the wholesale market. The BRP decides which action is required (more or less load or production); the aggregator decides whether or not he can deliver the required action (start or stop - consumption or production). The aggregator (in most of the times being the customer's supplier) interacts with his customer's service provider boxes. The service provider boxes control their CLS to physically control the user's installation.

DMS – Distribution Management System

A Distribution Management Systems is operated by the DSO. A DMS enables the DSO to manage distributed (renewable) generation, to implement grid efficiency improvement measures, and to control the isolation and restoration of outages. With DMS, real-time information about the distribution grid and connected users is available. It is an important component for the DSO to guarantee distribution grid reliability. When the system integrity is jeopardized and every other option has failed to restore the system integrity, the DMS can shut off the connection. It should not be seen as competing with a CLS.

A. Virtual Power Networks

- In a smart grid environment, distributed generation has the opportunity to participate in a Virtual Power Plant, also called a Virtual Power Network. A Virtual Power Plant consists of aggregating the capacity of many distributed energy resources (DER) and their associated storage capabilities in order to make them more accessible and manageable across the energy market.

- In a smart grid environment also small PV panels, small wind turbines or micro CHPs can actively participate in maintaining the electrical balance and avoiding problems in the distribution grids.
- A customer can choose a supplier and normally behind the scenes for the customer the supplier arranges a Balance Responsible Party for his connection. This is also the basic scenario in the DSO data hub model. When the customer wants to sell the flexibility of his production or load capacity he can turn to his supplier/BRP. Of course when this flexibility is utilised by the BRP, the measurement interval of the production and consumption must be adequate (15 or 30 minutes interval).
- It is also possible that the customer prefers his supplier/BRP for the basic consumption and turns to an aggregator (i.e. most of the cases the supplier) to sell his production and/or his load flexibility. In both cases the production and load must be adequately measured (15 or 30 minutes interval).
- When the customer installs a PV panel, small wind turbines, the storage capacity of an EV or a micro CHP production unit this unit can be connected to a CLS. The CLS allows generated electricity from the production unit to flow into the grid (or allows the consumption to be taken from the grid). The CLS is operated and controlled by market parties like a BRP, aggregator or ESCO.
- In the DSO data hub every connection is linked to a Balancing Responsible Party (BRP). The electricity which is stopped or started by an aggregator can be included into the balance calculation of a BRP. When the produced electricity is included in the balance calculation of the BRP the virtual power plant participates on the power exchange through the BRP as if it were one larger generator or load. In other words, the aggregator offers the capacity of the VPP to the market.
- The most likely actor for controlling the CLS is an aggregator/supplier, however several market actors (like a BRP, ESCO, etc.) could in theory take on the aggregator role. The aggregator has a contract with one or more BRPs. The BRP asks the aggregator for extra production, load or less production or fewer loads depending on the real time balance position of his portfolio. The BRP pays the aggregator for the delivered service according the contract between the BRP and the aggregator. This is an open market. The aggregator pays the customer for the delivered service according to the contract requirements.
- The customer can choose an aggregator for a specific period of time. There are different options to accomplish this.
 - Option 1: the customer selects an aggregator and the aggregator can put this connection in a certain group. Then the aggregator can offer the production or load capacity of this group to a BRP on the market.
 - Option 2: The aggregator is also a BRP party. This aggregator can trade on the power exchange. The customer receives offers from many aggregators/BRPs. If the customer accepts an offer from the aggregator/BRP the connection must be linked to this aggregator/BRP for the specified period of time of the offer (a minimum of 15 minutes). This is not something a customer can easily do. It is more likely that an in-home energy management system will automate this for the customer.
- Due to operational issue conflicting with security of supply and quality of service that may occur in both transmission and distribution networks, not only the TSO but also the DSO should be notified about the planned actions of aggregators/independent power producers connected to their networks. This kind of technical supervision would enable DSOs to ensure that market schedules are not in conflict with network operation or that transmission and distribution network operation are not in conflict with respect to one another (e.g. TSO asking for a modification which is not ok for the distribution operator).

- Further work is needed to define more precisely the role of the aggregator. It should be clear however that the aggregator's role must be carefully integrated into the existing current market model.

B. Aggregated Buying

- In a smart grid environment there are two ways of aggregated buying.
 - a. The first form is a group of consumers who can decide to jointly select a supplier for their base load. This makes it easier for consumers to negotiate a better price.
 - b. The second form is using an aggregator to sell DER generated electricity or to generate extra load which can be used to charge a storage facility or to start for instance a cooling installation.
- The first form is already possible today but in the future this can also be initiated by an aggregator or an ESCO. This way a customer can select an aggregator or ESCO which handles all the behind the scene processes like switching. The aggregator or ESCO negotiates with the supplier to get the best proposition for the customer. The aggregator or ESCO can then also decide to go to another supplier if this is in best interest of his customers. How this works is described in the supplier switch section of this report.
- The second form (aggregated buying or selling DER produced energy) is described in the Virtual Power Network section.

C. Ancillary Services

- When electricity markets are not able to function optimally due to possible distribution grid bottlenecks or other technical limitations, ancillary services – including reserves - could allow constraints to be resolved.
- Optimising or steering the local load, especially distributed electricity resources, is an important instrument in this context. Electricity system services are required in order to maintain the integrity, security and quality of the system. Today, ancillary services are procured by the TSO, largely from large power producers, to manage the system as whole.
- In future, DG and other DERs (including demand side management and decentralised storage) could provide ancillary services which could be procured by the DSO as one of the tools it uses to maintain the quality of service and the security of supply.
- To achieve this, DSOs must be put in the best position to optimally manage distribution networks against the background of new instability factors such as intermittent RES. In light of increasing connection of PV panels, wind turbines, generating intermittent supply and electric vehicles, heat pumps, changing use profiles, with micro-CHPs and energy storage, and more flexible loads providing balancing possibilities, DSOs must be able to develop tools to closely monitor how the grid is performing – in real-time if appropriate.
- They should be able to maintain the stability and balance of the distribution grid by handling electric power flows in both directions. Grid codes and ancillary services should provide the tools for DSOs to optimally manage the local distribution grid not only in short term operational timescales, but also in long-term planning timescales. The DSO as data hub is therefore vital in ensuring grid security and efficient grid investment.

DSOs should perform load management measures and direct Demand Side Management only in critical situations to avoid jeopardising system security. In non-critical situations the retail market is facilitated and flexibility is part of commercial products and services.

Looking ahead, the large-scale market penetration of intermittent and distributed generation will see DSOs increasingly move towards more local system operation and coordination functions. In the near future they might thus be put in a position to perform local balancing or islanding. Further research will be needed on these aspects, in particular on the interaction between TSOs and DSOs in demand-side management processes.

Local system operation and coordination functions:

- Aggregators can divide their Virtual Power Network capacity into local pools. A DSO can contract an aggregator for delivering local generated electricity or load from the local capacity pool. This can be facilitated by the DSO data hub.
- Direct contracts between DSOs and customers to shut-down production or load when there are no market parties (enough) willing to offer this service.
- Part of the DSO data hub model is a “Distribution Management System” (DMS) device. A DMS enables the DSO to manage intermittent renewable generation, to implement grid efficiency improvement measures, and to control the isolation and restoration of outages as they do today, but smarter. With DMS, real-time information about the distribution grid and connected users is available. It is an important component for the DSO to guarantee distribution grid reliability. When the system integrity is jeopardized the DMS can shut off the connection. Of course this the last measure taken by the DSO when every other options failed to restore the system integrity.
- In order to meet its responsibilities the DSO must be able to actively monitor the grid and request services from the DER, in order to maximize the ability of the grid to cope with an increased volatility in operating conditions. Smart meters provide relevant monitoring functionalities, such as real-time local voltage and load data, the DSO as data hub model best ensures security of supply by seamlessly allowing the use of relevant data in distribution network management processes and systems.

D. Storage

Peak production of intermittent renewable sources that feed into the medium and low voltage grid can require additional small-scale, grid-connected electricity or heat storage solutions. This ‘decentralised’ storage can support the development of distributed generation. It can also provide a range of applications and services to the distribution system operators (DSOs) facing challenges such as increasing peak loads and stricter power quality requirements.

Decentralised storage systems could affect the management of the distribution grid in a number of functional areas, including energy management, system services and the internal business of the DSO:

- **Energy management** refers to the decoupling of electricity generation from its instantaneous consumption, as delivered by electricity storage facilities.
- **System services** offered by storage systems could offer a significant contribution to the quality of service and security of supply in the electric power system.
- Finally, for some special and well defined applications (which cannot be provided by market players and which are exclusively used to ensure system stability) storage devices could be installed as a grid asset to primarily support the core operational tasks of the grid operator.

Situated within the low- and medium voltage grid or on the customer side of the network, the present small-scale storage technologies could provide a large spectrum of performances and capacities to support and optimise the operation of the power distribution system.

Storage devices which are installed as grid assets by DSOs may not participate in the market; they can't be used for trading purposes. Using a DSO owned and operated storage device for this purpose is a violation of the European Union's third energy package.

Energy management by using storage:

- When a storage facility is used to store electricity from the grid the connection acts as a normal consumption connection. When the storage facility is filled with electricity generated from the users own DER facility, then there is no interaction with the grid. For customers the electricity stored in a storage facility, which can also be the customers EV, can be sold by using an aggregator.
- The customers home automation (or the users own manual intervention) decides whether he buffers the generated electricity in his storage facility, sells the stored electricity via an aggregator to the market or uses the stored electricity for his own purpose. For instance the customer can use his own generated solar energy which is stored in a storage facility in the evening for his own purpose. This decouples electricity generation from its instantaneous consumption and makes the customer more independent from the grid and the supplier.

From a DSO data hub point of view the storage system is located behind the CLS. So the control of the storage system is a task of the market parties; only the electricity which is exchanged with the grid is taken into account by the DSO. The exchanged electricity is allocated to portfolio of the BRP of the aggregator. For the DSO data hub this is a normal smart grid connection which can produce or consume electricity. This makes also a customer local small scale storage system an integral part of the BRPs wholesale processes.

System services provided by storage systems:

- Decentralised storage systems can instantaneously provide local system services. The local (customers) storage (e.g. EV storage) will be controlled by the CLS. The CLS is controlled by the aggregator market role. The aggregator can offer load by charging hundreds of local storage systems or he can offer generation by releasing the electricity from the storage systems.
- As mentioned above, aggregators can divide their Virtual Power Network capacity into local pools. A DSO can contract an aggregator for delivering local generated electricity or load from the local capacity pool. This can be facilitated by the DSO data hub.

Storage systems as grid assets (only for specific applications):

- Local storage systems could be installed as a grid asset to primarily support the core operational tasks of the grid operator. When there is a thread of local congestion a local storage can be used to (temporarily) shave the peak load. The same amount of electricity which is stored locally must also be released somewhere else in the grid (locally or nationally) otherwise the balance portfolios of the BRPs are distorted. A small storage unit can also be a part of a smart DSO connection. If the connection is equipped with a small storage unit then large peak loads can be avoided (peak shaving). This way the customer can be equipped with a smaller (therefore cheaper) connection.

When local congestion is emerging it can be beneficiary for the DSO to deliver smaller connections with a buffer capacity instead of a larger connection for supplying certain peak loads. When this smart DSO connection solution is cheaper than reinforcing the grid at certain

specific areas it becomes beneficiary for the DSO as well as for the customer (smaller connection). Of course this small scale storage system cannot be used by the customer for trading purposes.

E. EV

Electric Vehicles can be used as a storage facility as presented here above. It depends on the customers preferences whether or not he/she wants to use the EV's storage capacity for trading and flexibility purposes.

F. How to sell power to my neighbours?

Selling energy from one customer to another is facilitated by commercial parties. The DSO data hub model is a flexible model which imposes no restrictions for this kind of commercial services. However the concept of a customer selling electricity to another identified customer (e.g. his neighbour) does not appear realistic or acceptable. A customer will be able to sell electricity to the market, not specifically to his neighbour.

Possible solution:

- The supplier/aggregator can couple a (local) DER producer to a (local) consumer. The amount produced should also be consumed otherwise there is an imbalance. This is not a function of the DSO data hub but it can be a commercial innovative product.

C. Energy management

Demand response

- In the energy system of tomorrow industrial, commercial and household consumers will steer their electricity consumption much more actively than today. Many large and energy intensive industrial consumers already use demand response services, and further services will develop over time.
- Innovative demand response products packaged by suppliers will deliver – given market-reflective end-user prices – powerful messages to consumers about the value of shifting their electricity consumption.
- Market players such as aggregators propose consumers demand response programmes, rewarding them for accepting to being flexible in their demand when demand flexibility can be useful to other market players and SOs.
- Access to flexibility will create opportunities for the customers to become more engaged. There are broadly 3 cases under which customers would be willing to be more flexible:
 1. Customers *choose to be more flexible* via a commercial contract – at its simplest this could be peak/off-peak pricing.
 2. The *flexibility is invisible* to them – they continue to have the services electricity provides as and when they wish, and systems manage the actual electricity usage, for example a thermostat or an efficient freezer.
 3. There is an *emergency situation* whereby the network operator must manage some load to avoid critical system failure.

- The willingness, ability and potential for customer engagement in demand response varies, and there is no single measure (technology, set of data/information or pricing structure) which will motivate all customers to be more flexible or energy-efficient. Therefore, end consumers need to have attractive products and services tailored to their preferences and circumstances. Incentivising customers to become part of the smart energy system can only be done within a competitive market by retailers (e.g. suppliers, ESCOs, load aggregators) via innovation, marketing and customer service.
- At the DSO data hub the service provider can register the service according to the contractual agreement with the customer at a specific metering point.
- When an automated service is provided, it should be as easy as “plug and play” for the customer. However customers should also be able to decide for themselves by using a user interface based on the same protocol.
- The data hub can be of great help here because the metering points per connection are available. A connection can only be connected to one data hub; this makes it easier to offer this standardized service to all interested market parties. Market parties only have to send a query to the data hub to find out which connections can provide these services.
- DSOs may offer through the data hub enabling services such as provision of the information necessary to implement demand response to solve local network issues (topological information are necessary to localise demand response actions on the network) and technical validation of the demand response programmes requested by market players who may jeopardise the network safe operation.

Demand side management

- Demand-side management is usually a task for power companies to reduce or remove peak load, hence deferring the installation of new capacities and distribution facilities. The commonly used methods for DSM are: combination of high-efficiency generation units, peak-load shaving, load shifting, and operating practices facilitating efficient usage of electricity.
- At operation timescales DSOs will act as market facilitators by enabling the offering of market products and at the same time ensuring the security, integrity and quality of supply. DSOs act as enablers of these services, making available the technological solution to leverage on the metering data that are necessary to support them.
- When market products are not compatible with distribution grid security standards, new DSM system services will be required. Therefore, new agreements between DSOs and suppliers/large customers will allow DSOs to solve grid constraints through demand flexibility. In other words, DSOs will perform load management measures and direct Demand Side Management only when grid stability and power quality are at risk, avoiding that system security is jeopardised.

D. Operation processes

Forecasting

- In a system with high share of DER, well-structured and organized information exchange between relevant actors will be necessary for facilitation of real-time or close to real-time operation of the distribution network.

- DSOs will have to reinforce supervision of their networks. DSOs should have managed access to communication and monitoring assets of DG to collect information that will be necessary for operation of their networks. Granularity of data exchange will depend on the size of the generating unit.
- The necessary information should then be exchanged between the DSO and the TSO (in both directions). DSOs should provide the TSO with information on active power that the TSO needs to facilitate system balancing.
- DG (where applicable via aggregators) should deliver information on their planned market activities to the DSO and the TSO.
- At the transmission level, generators already send schedules to the TSO for system balance and to guarantee that their realization is technically possible.
- In systems with high DG penetration, the DSO will need information about DG forecast, schedules and active dispatch to improve their visibility and to assist with real-time or close to real-time management of distribution network including local network constraints.
- Such information exchange will serve also for DSO planning and asset management purposes and will enable the DSO to optimise their networks while ensuring that all customers see the absolute minimum impact of DG on power quality and continuity.

Programming/Planning

- DSOs are in charge of developing their network. They design new lines and substations and ensure that they are delivered or that existing ones are reinforced to enable connection of load and decentralised power production. DSO can also implement smart technologies in order to limit new investments and reinforcements. In this case new planning rules could be defined.
- Depending on the size of a DG/RES system, DSOs may require the connection to be at a particular voltage level. They are obliged to provide third party access to all eligible customers and provide system users all information they need for efficient access and use of the distribution system. They may refuse access only when they can prove that they lack the necessary network capacity (Art. 32 of Directive 2009/72/EC).

Real-time operations

- DSOs maintain the system security and quality of service in distribution networks. This includes control, monitoring and supervision, scheduled and non-scheduled outage management.
- Transmission system operators (TSOs) are typically in charge of the overall system security. TSOs are responsible for keeping frequency in the European power system at an appropriate level (50 Hz). They are allowed to intervene with production and consumption of power in their grid area irrespectively of their place of connection, typically for balancing and frequency control purposes.
- DSOs are responsible for operations directly involving their own customers and support the TSO in such actions where necessary in a predefined manner, either automatically or manually (e.g. via load shedding in emergency situations). Such systems of cooperation for intervention in generation and demand in cases of system security events are defined in detail in national regulations.

- DSOs should generally accomplish the established requirements at the TSO-DSO interface in order to keep the system stable and provide the TSO with all relevant information. Any action on distribution network users requested by the TSO should be agreed with the DSO(s) as system operators.
- DSO(s) will provide the TSO with the operational information on significant grid users, both generators and demand facilities. For users connected to MV and LV networks, DSO(s) should provide only the necessary aggregated information. It is of utmost importance that DSOs have full knowledge of these operational data to ensure security of supply and quality of service in their networks.

2. Specific advantages/ issues for consumers

A. Consumer issues

Metering

- Metering is a crucial behind-the-scenes process, necessary for the fluent operation of all the other market processes, since they all are dependent on metering data. The DSO being the unique agent responsible for all the sub-processes, doing the meter reading and validation, significantly reduces complexity and guarantees a fluent and efficient operation, leading to a minimum of customer complaints.
- Decoupling of metering data collection and treatment processes by DSO from metering processes (e.g. billing) by market parties create flexibility and provide choices for consumers. It also creates a controlled level playing field, since DSOs are regulated.
- The aggregated data for consumers is centrally stored; this enables effective verification and validation of privacy and security around customer data in a regulated environment.
- The DSOs can, via the DSO data hub, effectively safeguard that only data to market parties' processes are delivered, which is approved by the customer (DSO in a “privacy assurance” role)
- Since the central data hub is in the DSO domain, the DSO can ensure consistency between the real-time data, locally provided, and the aggregated data delivered via the (de)central hub to market parties (via “time stamping” the consumer should be able to verify this)
- Only the data that it requested, and allowed can be retrieved by market parties. This contributes also to ensuring privacy and security.
- When the DSO delivers differentiated metering data (e.g. usage and production metering data), then this can create new business models in the market (e.g. for aggregators) from which a consumer can benefit (see DSO as market facilitator recommendation 8).
- Above all, having the DSO – a regulated entity – as the central market facilitator reinforces accountability and makes it easy for the regulator to supervise outcomes and determine corrective actions if necessary. In particular, this model avoids the dilution of responsibility and decreased control that would result from having core market facilitation processes dispersed by different entities.

Supplier switching

- The DSO guarantees that the correct metering data is available for a quick and smooth supplier switching.
- Once the DSO data hub is implemented, a quick and easy data transfer, directly between the market parties involved in the process, is provided.
- All suppliers will be able to query the static data hub that is public to build offers to customers.
- Once the consumer approval for switching is received by the DSO, the new supplier will automatically have access to all private and specific data of his new client. Therefore, regarding the availability of data, the switching process may be reduced to hours.
- The neutrality of data handling by DSOs within this model towards all suppliers guarantees a level playing field and thus promotes competition in the electricity market. It is important that the DSO provides access to relevant customer information to all suppliers under equal terms and conditions.

Tailor made services

- Tailor made services are delivered by market parties. Since most/all of these services will depend on data originating from the grid (usage, status, performance data), the DSO will be involved in delivering this data as input for new services from market parties. In order to create tailor made services, as specifically requested by consumers, it is therefore important to define this data in a “3 partite” setting in which next to consumer and market party, also the DSO is present.
- The DSO could act as an energy efficiency advisor to consumers, as foreseen in the Energy Efficiency Directive, depending on the policy choices of the Member State. Moreover, the DSO – as a neutral market party – could act as far as requested by the regulator/ policymakers, and only if regulators/policy makers would request DSOs to do so.
- Today striving towards energy efficiency is in conflict with the supplier’s business model, while achieving energy efficiency might lead to deferring/ avoiding network cost, and therefore is in line with DSO objectives.

User feedback

- In order to provide adequate customer services by market parties to customers, it is essential, that the underlying “market party – DSO” relation supports this customer service and is aligned. Therefore the market facilitation from DSOs to market parties should be well defined and based on a service portfolio that DSOs should deliver. Benefits that follow from this are:
 - The, in this way created, “product unbundling” creates full transparency and is understandable for the end customer (e.g. in the case dynamic pricing in transport capacity is introduced).
 - A simple and well defined DSO market facilitation service portfolio offered to market parties, and delivered via a (de)central hub, enables new entrants to come into the market relatively easy, leading to more choice for the consumer, and at the same time, since regulated, safeguarding a level playing field.
 - This also makes it easier for new entrants to enter the market.

Reconciliation services

- Once smart meters provide real consumption data, there will be a strong reduction in profile based estimations, and, as a consequence, will be reduced significantly¹⁸. Allocation based on real metered data, instead of profiles, will incentivise suppliers to come with new business propositions to customers. This will also drive the acceptance of smart meters, since customers will choose for a business proposition of a supplier which can only be offered with a smart meter.
- As conventional meters will be there for some time to come, it will be necessary to implement two different Allocation and Reconciliation regimes: one based on profiles (current situation), and one based on real data from smart meters.
- For other services like losses control or fraud detection, the DSO as a market facilitator case is the only one that guarantees that these important processes are aligned with the responsibilities of the DSO. For the customer this means that when these processes can be performed efficiently, he/she has to pay less to compensate the losses and fraud.

B. Trading & Flexibility

1. Virtual Power Networks

- The DSO data hub model enables customers to jointly create Virtual Power Plants to sell the DER generated electricity to as many buyers as possible.
- By linking the customer's connection to an aggregator, a customer can sell his DER produced electricity even on the national power exchange. The aggregator creates a bridge between the customer and the national power exchange market. This enables the customer to have access to a huge amount of buyers. This could increase the customer's awareness and interest in engaging with the market.

2. Aggregated Buying

- The DSO data hub model not only enables a group of customers to buy their base load from a certain supplier (which can be achieved already today) but also to collectively sell or buy (DER) generated electricity even on the power exchange.
- An aggregator can also be seen as a collective or a local energy supplier or a supplier 'light'. The rise of aggregated buyers or sellers on the market will enlarge the customer's choice and will lead to more competition in the energy market and lower prices for the customer.
- The DSO data hub is one point of access for aggregators **acting on behalf of customers.**

3. Ancillary Services

¹⁸ There will always be the need for forecasting and the associated adjustments, as well as the need to deal with missing data due to meter failures, communication failures or other errors.

- Ancillary Services can also be delivered by small scale customers in the DSO data hub model. An aggregator can deliver local balancing services to the DSO on behalf of the customer.
- The customer can via an aggregator not only participate on the national power exchange but can also contribute to maintaining the local grid stability and thus avoiding investment and minimising the network charges seen in his bill.
- Additionally, the existence of a mechanism to enable the provision of local grid services will, in itself, enable additional DER penetration rates and increased dynamics, while maintaining service quality and safeguarding required technical conditions.

4. Storage

- Integrating storage into the smart grid environment is mainly a technical issue. The DSO data hub model is capable to facilitate DER production and extra generated load.
- Whether or not this is achieved by installing a separate storage system or other means to generate electricity or extra load is not relevant for the DSO data hub model. Only the exchanged electricity with the grid is taken into account.
- The benefit for the customer is that **new innovative products and services can be created by market parties**. This leverages the innovative potential of all market parties and gives the highest possibility of a very active and competitive energy market where customers will benefit the most from.

5. EV

- The DSO can guarantee the EV recharging infrastructure which can be used by the customer who can choose without constraints a recharging contract with his preferred retailer.
- Of course the DSO data hub model will also support EVs but they are not handled separately. From the DSO data hub model point of view only the exchanged electricity with the grid is taken into account.
- Whether the electricity is used to charge an EV or is used by other devices is not relevant. The benefit for the customer is that he can fit his EV into his own household energy system - without any constraints from the grid.
- The EV smart recharging infrastructure can also give to the customer the possibility to select flexible load profiles to reduce the recharging cost.

6. How to sell power to my neighbours

- The DSO data hub model also enables customers to sell their local DER generated electricity to local consumers.
- An aggregator in its most simple form can connect local DER producers to local consumers. By offering this functionality on a local scale it can increase the customer engagement with the energy system as a whole.
However the concept of a customer selling electricity to another identified customer (e.g. his neighbour) does not appear realistic or acceptable. A customer will be able to sell electricity to the market, not specifically to his neighbour.

C. Energy management

- Providing customers with information on usage, directly via the local interface (real-time) on smart meters, or indirectly via aggregated information from the DSO data hub to market parties (which is synchronized).
- The DSO should support variable pricing in commodity via smart meters (typical 15 minute intervals); data to be provided via the DSO (de)central hub to market parties.
- In principle Demand Response is a fully market process with no DSO involvement (as long as the network is not congested).
- The DSO can support Demand Response processes easily via the real time local interface (which is in sync with the aggregated data delivery from the DSO (de)central hub to market parties).
- The traffic light concept (green, orange, red) creates transparency to customers because it identifies three well-defined states of the grid including the rules of when and how the DSO is allowed to interfere in the market process. Such traffic light concept needs to be worked out further.

D. Operation processes

Cost Efficiency, Simplicity, Reliability and Accountability

- The agents responsible for the correct management of all these critical processes are the same that will manage the associated data: the DSOs and TSOs. There is no need for unnecessary agents that may cause communication interferences and duplicated data and processes, thus creating important inefficiencies and increasing the costs for the consumers.
- The operation processes have very complex technical and operational implications behind. Some are critical for system stability if everything doesn't work coordinated and synchronized. Opportunities detected with DG penetration may turn into problems if not correctly managed.
- Consumers don't need to worry: roles and responsibilities are clear and aligned. TSOs and DSOs have done their jobs quite well till today. Improvement of quality of service and costs reductions (per installed power unit) has been achieved by most companies all over the EU.
- This case allows TSOs to have own data hubs, in coordination with the DSO's hub.
- This case guarantees there is a single responsible entity for each core process, thus favouring accountability and controllability. To guarantee that market facilitation services are provided as desired, regulators have at their disposal all the usual tools that are used to control the provision of services by TSOs and DSOs (incentives, penalties, regulations, etc.).

Maximizing customer benefits

- Customers benefit from the DSO's performing task since the DSO is a regulated body and there is an independent supervision on the process (all tasks listed).

- DSOs have the advantage of specifying a solution which fits with their physical network while meeting the cost needs of the agreement they can reach with customers/suppliers.
- DSOs make the processes transparent and simple (all tasks listed).
- Correctly implemented customer benefits from DSO performing tasks.
- In the case where the consumer is also a producer both functions can be related through one meter in a way that is optimal for the network.
- Finally, customers benefit from having integrated, cost-efficient processes and, in particular, from avoiding the additional costs that would result from an “artificial” separation of processes.

3. Relations with ICT & Telco: technology and regulatory implications in ICT/Energy sector

A. Consumer issues

Metering

- Collection of metering data requires reliable communication services and infrastructure; the DSOs have to ensure this, the Telco’s can deliver this.
- It is commonly accepted that current market propositions of Telco’s (broadband and low cost focus) today do not fulfil utilities/DSO needs with respect to communication solutions for smart meter and smart grid communications (low bandwidth, supreme reliability and latency). This may lead to:
 - DSO’s building and operating own communication infrastructure (backbone and periphery).
 - New forms of cooperation between Telco’s and utilities, realizing a good communication infrastructure with ownership in the regulated domain for smart meter reading and smart grid communication, built and operated by Telco’s.
- This new form of cooperation would leverage M2M expertise from the Telco sector, while staying consistent with the current role and responsibility of the regulated DSO to deliver accurate metering data.
- Realizing a reliable communication infrastructure in the public domain for smart meter reading and smart grids communication, will contribute to system integrity and security of supply (DSO’s mission) since this will also be required for the integration of DER and EV charging into grid operations.

Supplier switching

- In the case of DSO as market facilitator via the DSO central hub, it is essential and required that all data relevant for the relevant market processes are stored there. The fact that connection data and metering data are both stored in the DSO central hub, enables fast and reliable supplier switching. For example, storing metering data in the Telco domain and connection data in the Utilities/DSO domain would lead to very complex and inefficient processes in supplier switching and allocation and reconciliation processes.

Tailor made services

- Tailor made services will be provided by market parties, who next to existing energy companies, could also be ICT and/or Telco providers. The DSO central hub concept will facilitate this and, in this respect, will also safeguard a level playing field to these “new entrants”, while at the same time also complying to EU tendering procedures, when requesting services from ICT/Telco Providers for grid operations.
- It is therefore in the interest of new entrants in the markets that the market facilitating interface from DSOs to all market parties is defined in a well-defined and transparent way. This urges the need for the definition of (regulated) market support services portfolio offered by DSOs to market parties.

User feedback

- User feedback/ customer services on product delivery and billing are closely related to the market party who delivers these services to the market. In case ICT/Telco’s decide to act as ESCO’s, it will be their responsibility to organize their user feedback channel to the consumers (this will be in competition with existing parties in the energy market).
- ICT providers/Telco’s might support the customer communication channel which DSOs need to communicate with customers. Selection of ICT provider/Telco should comply with existing EU tendering procedures in order to ensure fair competition, but is, in essence, just another DSO procurement decision.

Reconciliation services

- Since ICT providers/ Telco’s, as commercial parties, in the future might act as ESCO’s, it is important that data collection and delivery towards the system operator for billing and settlement is done by a market neutral party, like the DSOs are. The DSO central hub concept, comprising all metering and connection data contributes to this in a market transparent way.

B. Trading & Flexibility

- Aggregators use the Telco’s infra-structure for controlling the CLS devices. Of course the reliability of the Telco infra-structure must be high. If the reliability is not high enough the aggregator cannot be certain that the CLS devices receive the correct commands in the correct order.
- The aggregator is liable for providing the services which are sold on the specified time. If a DSO or a Balance Responsible Party depends on the services of an aggregator they must be sure that the aggregator can deliver the services. This is the aggregator’s responsibility; otherwise the aggregator will face high penalties. Therefore the aggregator must be able to depend on his ICT systems and the Telco’s infrastructure to deliver his services.

The aggregators and the Telco’s are operating in an open market. Business risks can be handled by normal legal contracts. Therefore no special regulatory implications in the ICT and Telco sector are to be foreseen.

- The DSO owns the meter and the specific communication infrastructure it needs to support the provision of regulated market facilitation services with adequate quality.

Different meters can require different communication infrastructures. It is up to the DSO to select and find the best optimal solution.

- Different communication infrastructures are now being tested and are being implemented. It looks like there is no winning infrastructure that best fits all the DSO needs at this moment. Therefore it is most likely that there will exist different infrastructures for the next decades to communicate with smart meters.

C. Energy management

- Reliable communications are required for remote DER control from a balance responsible party and from a DSO (in case of “code red” override). The DSO guarantees data integrity through the ownership and the managing of the communication.
- The real- time local interface delivered by the DSO could support Demand Response features and is also consistent with the aggregated data delivery at the DSO (de)central hub
- As market parties, ICT Providers /Telco’s might provide Customer Energy Management applications to customers.

D. Operation processes

- New communications and data needs do not justify by itself a business model change in the electricity sector. Without any doubt, introducing new smart technologies in the different domains and zones of the component layer of the grid will imply a redesign of the communication and information layers needed to manage the grid. But this doesn’t justify by itself that structural changes have to be introduced in the business layer.
- As in any other sectors that deal with huge amounts of data (banking, gas & oil, etc. -even with less critical real time needs compared to the electricity system), the ICT and Telco companies are suppliers of products and services, not agents with direct responsibilities. The process should always be distinguished from the technology behind it (e.g.: SAP is not responsible of any company budget, although most of them are planned and controlled with SAP tools. Likewise, banks and not telco’s, are the sole responsible for the security of their customer’s transactions.)
- The most interested party in choosing the right tools to make a good job is the responsible of the job. TSOs and DSOs will always search for the solutions available in the market (of ICT & Telco, like any other suppliers), will implement the most efficient solution for their needs, and will work in a cooperative way to improve them. Regulators don’t have the tools or knowledge to do this.
- The DSO is well placed to commission new ICT applications around the meter which also link effectively to the rest of the DSO network (forecasting and planning).
- DSOs and TSOs act according to a regulatory incentives model, which reflects societal interests. As such, they have no particular interest in forcing unnecessary investments or promoting expensive technologies (e.g. there are no conflicts of interests).

4. Financial Implications & time horizon

Any scenario where metering information collection and management are not done by the DSO risks the introduction of additional costs and/or forgoes important benefits. A scenario where the ownership and management of the meters is also outside the DSO further aggravates the problem, bringing additional inefficiencies for the system. Some of the most relevant impacts of these scenarios are considered below.

Increased meter communication costs due to the impossibility of using grid-integrated technologies

Most smart metering solutions that are currently in operation or development are based on PLC (power line carrier) technology for the last mile. This reflects the fact that there are important cost advantages to this solution, relative to other alternatives such as the use of radio networks (public or private).

The use of PLC technology is possible only if the PLC network and infrastructure is operated by the DSO, as the technology is highly embedded in the electricity distribution grid (uses electrical circuits, requires concentrators in LV substations, etc.). Additionally, the entity managing the PLC infrastructure, must also own, or at least manage, the PLC meters, as they incorporate PLC modems and implement specific communications protocols. Also this PLC infrastructure is to be used for access to DER at customer premises in case of a grid emergency situation (“code red”).

So, the option for a scenario where metering information is not collected and managed by the DSO effectively rules out the possibility of using PLC technology. Given the significant cost advantages of this technology, such an option implies a large increase in communication costs.

It is worthwhile to note that in many of the smart metering CBA analysis that have been conducted by DSOs and regulators, the incremental cost of moving from PLC communications to alternative solutions, such as the use of public carrier networks, is enough to tilt the balance from a positive to a negative NPV.

Additional costs due to duplication of metering information systems and processes

DSOs need metering information for their traditional network operation business. Among the most relevant processes that require metering information are network planning and network operation. The shift towards a smart grid paradigm will only reinforce this need, implying additionally an increase in the granularity and accuracy of metering information.

To handle highly granular metering information with nationwide scope the DSO will always need dedicated systems and processes that can serve both network planning and operation processes and market support processes. A scenario where a separate entity has to implement similar systems and processes, dedicated exclusively to market support, implies significant redundancy.

Even worse is a scenario where meters are owned by multiple retailers, each of which each has to implement its own meter management IT system.

Loss of synergies in local metering operations

For conventional meters all operations have to be conducted locally, implying a strong local presence of the entity responsible for their management. Even smart meters require a local

presence, not only for installation and replacement, but also for meter maintenance and whenever communications fail, requiring operations such as connection/disconnection of customers, configuration of contracted power and tariff parameters and collection of readings to be done locally.

The DSO can extract important synergies from performing local meter management activities with the same resources that deliver other network management services, such as LV network operation and maintenance. Placing meter management activities outside the DSO prevents such synergies, leading to increased costs.

Costs due increased number of entities and process fragmentation

Separating processes that are currently integrated and managed by a single entity into multiple sub processes that are managed by separate entities introduces costs and complexity (beyond the obvious dilution of responsibility, alluded elsewhere in this document). Incremental IT costs arise because the total number of systems increases and they have to be integrated using interfaces, implying the definition and maintenance of protocols and, in general, an increased coordination effort in IT system development and maintenance. Beyond IT, operational costs increase due to the duplication of process control activities and the need for additional coordination and communication efforts.

Costs for the customer due to slower service

In some instances the fragmentation of currently integrated processes will lead inevitably to higher response times and other negative impacts for the customer. This is the case of outage communication and handling; currently the DSO receives and handles all customer contacts related to power outages, whether the problem is in the meter or elsewhere in the distribution grid. With a separate entity owning the meters, there would have to be some kind of previous diagnostic to establish the nature of the problem and determine who has the responsibility of taking corrective action. It is unclear who would perform the diagnostic, but it is clear that it would add to the outage resolution time.

Another example is customer switching. The additional information exchange and validation activities necessary due to process fragmentation would increase switching time. In this respect, the UK provides an extreme example, where the average time a customer has to wait to change supplier is 4 to 6 weeks.

Transition costs

The case where the DSO is responsible for market support processes is BAU in most countries. The transition to a case where the DSO loses responsibility for market support processes may have significant transition (non recurrent) costs, as it would be necessary to implement a number of new systems, processes and interfaces, capable of handling both smart and legacy meter technology requirements. Even regulations and supervisory mechanisms would require significant changes.

Incremental costs to implement smart grids concepts and functionalities

The concepts of smart metering and smart grids are closely related. In most smart grid scenarios meters assume a number of functions beyond pure metering, such as load/generation monitoring and control (e.g. DR and DG dispatch), voltage profile sensors or power quality monitoring devices. Implementing this kind of functionalities with dedicated devices (e.g.

independently of the meter) implies a very large increase in costs. Large scale integration of DER will strongly require these functionalities.

Even a scenario where the DSO owns the meters, but there are separate data communication infrastructures for pure metering data and for grid management data, implies high incremental costs due to the obvious redundancy, relative to the situation where the DSO operates a single data communication infrastructure.

Incremental costs due to loss of scale

In general DSOs are larger than the hypothetical entities that would be created specifically to manage market support processes. In principle this should give DSOs some cost advantages, resulting from synergies in common support processes such as financing (lower financing costs), HR management, etc.

The financial muscle of most DSOs provides, in itself, an additional guarantee of stability that is important for an entity that manages critical market processes. (Note this item was highlighted by OFGEM in the consultation process for the DCC licence, as it should be a requisite for the owner of the licence).

Some particular financial implications for the category processes include:

Consumer issues

- The DSO data hub case reduces complexity and the number of different agents, data is not duplicated unnecessarily, and it avoids infrastructure redundancy. As the DSO also needs to read the meters for the operational management of the grid there is no need in duplicating communications and data hubs.
- Possible future dynamic pricing schemes for transport, and distributed generation, can be implemented in a timely and cost effective and generic way in the DSO central hub, instead of many costly decentralized solutions. This would increase the speed of smart grid deployments.
- Since the more technical relation between DSO and consumers is also already defined, this also contributes to an efficient organized user feedback. If such technical communication relationship (which is directly related to technical operations of the grid) needs to be set-up with market parties, this would cause complexity and additional costs.
- The DSO data hub concept, comprising all metering and connection data, contributes to the allocation and reconciliation processes in an very efficient way since it builds on data and functionality used for providing metering data to market parties and supporting the supplier switching process.

Trading and flexibility

1. Virtual Power Networks

- The current market facilitation market model should be adapted to create the role of an aggregator. Once the roles and responsibilities of the aggregator are well defined a financial impact can be created. However this change doesn't look to be huge. The bulk of the work must be done by the aggregator himself. This is a commercial market party.

When a new open market platform is created for these new market parties it is up to these commercial market parties to invent new and innovative products and services that attract customers.

- The aggregator role needs to be incorporated into the market model and connections can be allocated by using a smart meter and (administrative) virtual power networks can be created.
- Since the DSO data hub model already contains the customers, their connections and the balancing responsible parties creating administrative links between these entities and using them in the allocation process is much cheaper than creating a new market platform which should run synchronised and in parallel with the current existing market facilitation platforms.
- The DSO data hub model only creates a platform for the settlement of the energy flows. All the development of new and innovative services must be created and invented by commercial market parties. Which CLS devices are used and how to communicate with these devices is up to the commercial party self.
- Whether or not these commercial parties decide to work together in sharing the same technologies and standards for gaining access to the in-home devices is up to the commercial parties. It is likely that new commercial industrial standards will emerge.
- We believe that the DSO data hub model creates the best of both worlds. The DSO data hub model enables a correct and neutral administration of the energy flows in the regulated domain. This must be handled in the regulated domain because the customer must be able to rely on a correct and neutral measurement of his consumed or produced energy. While on the other end the DSO data hub model creates the maximum freedom for all commercial parties to invent and create new and innovative services. Leveraging the maximum capacity of innovative resources available in the market.

2. Aggregated Buying

- Aggregated Buying from a supplier is already possible today but this can be created easier for the customer once the aggregator role is implemented.
- Once the aggregator role is implemented an extra commercial option becomes available, namely the aggregated buying or selling of DER generated electricity.
- Again the DSO data hub model only creates an open market platform which can be used by commercial parties to use for instance to create a service like aggregated buying (or selling).
- Whether or not this service is offered by the commercial market parties to customers is up to the commercial market parties self.

3. Ancillary Services

- When the aggregator role is implemented in a well-defined and correct manner the aggregator can also supply ancillary services to the DSO.
- This is a clear example why the DSO data hub model is an adaptable and versatile model which can accommodate new functionalities and roles easily.
- It is of course mainly up to the market parties to realise the potential of the smart grid possibilities. The DSO data hub model only creates the platform. The financial implications for the market parties are difficult to estimate. In the beginning this will be a lot of test and learn which is common in new emerging markets.

4. Storage

- The usage of small scale storage systems will depend heavily on the availability, the maturity of the technology and the price of the storage system. The customer can use a storage system to store his generated electricity which can be used when the price is high. The electricity can also be sold when the price is high and the customer has enough in his storage.
- The DSO data hub model is versatile enough to enable customers to use a storage device to optimise the commercial opportunities the market offers. The DSO data hub model enables customers to sell their electricity on the power exchange with a potential of millions of buyers by using an aggregator as intermediary.
- Whether this is financially feasible for consumers depends on the price of the system, the electricity prices and the fluctuation of the prices.

5. EV

- The customer can use his Electrical Vehicle as a storage system when the EV is connected to his home energy network.
- The financial implication is that the DSO data hub model enables the customer to not only use his EV as an vehicle but also to make some money with it as an electrical storage. Off course this depends on the offerings of the commercial market parties and the customer's own choice.
- The DSO data hub model only enables the market platform. It is up to the commercial market parties to leverage its potential.

6. How to sell power to my neighbours

We believe that the DSO data hub model is the most cost efficient model and that the potential is huge. This is demonstrated by describing these new and innovative services for the customer.

Energy management

- Effective demand side management will deferrer (and avoid additional) network extension costs.
- The DSO data hub concept already facilitates “providing metering data to market parties”; so by increasing the frequency of data delivery, demand side management can efficiently be supported.

Operation processes

- DSOs are in a good position to come up with a workable financial proposition for implementing the data infrastructure in an efficient way. Since the DSO as market

facilitator is a model already in place in many countries, implementation should be quicker and easier: the starting point of each country is critical when assessing a model review. Therefore, DSO data hub model implies less costs and time for its full implementation.

5. Needs for regulatory intervention: recommendations for regulatory incentives for their implementations

Summary

- The DSO as market facilitator model is a model that allows DSOs to provide a platform on which market players can build innovative businesses; it's about the value creation on top of smart grids.
- Regulation schemes should consider the evolving (regulated) costs regarding smart meters and smart grids development without any delay.
- The 'DSO as neutral market facilitator' model requires a clear set of responsibilities for the DSO: non-discriminatory access to the grid infrastructure and neutrality to all other market parties as a part of the unbundling policy ensures that new products and services can develop free of discrimination.
- Regulation has to define which information should be collected from grid connected participants and made available at the data hub for other authorized market parties.
- In order to enable multi-party access to the data hub there is the need to define an open common protocol/language and the available transactions.
- Most of the European Members States have the 'DSO as market facilitator' model or a very similar one already in place. This should make implementation quicker and easier: the starting point of each country is critical when assessing a model review.
- The DSO as market facilitator requires only a minimum of specific regulatory changes compared to other potential market models.

Particular recommendations for each of the process categories include:

A. Consumer issues

- Allow implementing market processes that are efficient and comply with the requirements set out in the 3rd Directive (e.g. supplier switching requirement within 3 weeks). No additional regulation is needed here.
- In order to cost effectively manage the dynamics, which will emerge from implementing DER and EV's in the grids, we could imagine that metering data coming from DER and EV are identified and differentiated from existing business and residential metering data, so that new business models can emerge and from which all stakeholders including the customer can benefit.

- It is recommended that the regulator allocates frequency spectrum, dedicated for the utilities sector for smart meter and smart grid communication, thereby also contributing to the cyber security measures to be implemented for the public sector.
- Ensure a regulatory environment that could support the effective set-up of joint ventures between Telco's and DSOs, in which synergies can be exploited.
- Regulation has to consider smart meter costs which consist not only of the smart meters as such, but – as described in the process – also investments into ICT infrastructure and process costs for data handling, maintenance, incidents management, etc.
- The DSO, as a regulated agent, is subject to a strict regulatory supervision and unbundled from all the activities that may interfere with a neutral data management, and is therefore today the only agent that may provide a cost efficient and neutral access to all the data of the consumer/ generators connected to their network.
- However, no regulatory constraints (legal and financial) should be in place that limit a proactive attitude towards market parties in delivering information needed for tailor made services.
- In case the regulator would grant the DSO the role as energy advisor for consumers, with the objective to accelerate energy efficiency programmes, regulation and legislation would need to be modified, if not already in place.
- It is recommended that the DSO market facilitation portfolio (towards market parties), and the DSO transport services portfolio (towards end consumers) are well defined. In a regulated (de)central hub configuration, these DSO market facilitation services can be implemented in one “software instance” and therefore quickly changed when appropriate (and in sync with what is delivered to the consumer directly via the local smart meter interface).
- It is recommended that in the future market model two types of allocation and reconciliation regimes are supported; one based on manually read meters and one on smart meters.

B. Trading & Flexibility

- It is recommended that the aggregator role is well-defined in order to support customers with creating virtual power plants, aggregated buying, storage and EV.
- This will enable customers to sell and buy on the wholesale market through their selected aggregator without losing the security of their supplier and balancing responsible party.
- The aggregator role must be carefully integrated into the existing current market model. This new role must be linked to one or more balancing responsible parties otherwise there is no relation with the wholesale market. There are different ways to implement the aggregator role. These different options must be further exploited together with all stake holders in the energy market.
- The option for the aggregator role to be able to provide ancillary services to DSO as well as the coupling of local consumers to local producers. This does not represent an imbalance; commercial arrangements would need to be in line with market prices.
- This creates a flexible and versatile model.

C. Energy management

- Demand side management and demand response are to be offered by the market as long as system stability is not at risk. To ensure system stability, DSOs must in all times be enabled to maintain the quality service to the customer.
- Currently, DSOs are sometimes de-incentivized to improve the efficiency of their networks. Network capacity is set according to the highest projected capacity requirements (even though this maximum capacity may only be needed on very rare occasions) and DSOs receive funds only to increase or maintain their network capacity. This incentivizes perpetual grid expansion through high capacity projections and discourages flattening the load curve. The challenge is to change this existing approach and to develop one that is focusing on overall improved efficiency.
- In many markets today, the DSO cannot receive funds for demand side programs projects but only for copper. As one of the largest cost carriers of Smart Grid development, it essential to allow and encourage DSO's to use demand side programs and other energy efficiency approaches to increase the efficiency of their own grids and their own systems, as well as enabling other parties such as the TSO, suppliers and consumers to do the same.
- DSOs could improve the efficiency of the local network through local Demand Response programs. DSOs could be empowered to enable regional Demand Response programs offered by local service providers, such as suppliers and aggregators. These can be designed both to lower peak consumption and also to better integrate distributed intermittent generation and local storage facilities.
- This will enable local and regional Demand Response and dynamic pricing programmes to take place and will allow DSOs to optimize network use, increase efficiency and lower costs through avoided investments into grid and capacity expansion. Empowering DSOs to support the development of such programs and to lower costs in this way, fulfills the objectives of the Energy Efficiency Directive (Article 12, Annex 11). Furthermore, as the primary investors in the smart grid, DSOs should be enabled to maximize the efficiency of this grid.

D. Operation processes

- Regulation already sets incentives for an efficient network planning (e.g. benchmarking) and for quality of supply. Further efficiency incentives are usually not necessary and micro-management has to be avoided. The prevention of congestion is closely related to investment incentives for DSOs set by the regulator, who has to ensure a fair achievable rate of return.
- Regulatory intervention is/may be needed is to clarify aspects of data privacy and minimum requirements to guarantee non-discriminatory access.
- Furthermore, appropriate standardization of products, communications and technologies is needed for the efficient and effective functioning and smooth data flows between the grid and connected agents.

6. Conclusions

In the European electricity system where, as stated by the European Commission, the distribution network will be critical to achieve the de-carbonisation objectives, the management of this network is one of the responsibilities of the DSO. Therefore, it is logical to think that the roles and responsibilities of this regulated agent should be enhanced, and not diminished.

The main advantages guaranteed by the DSO as a Market Facilitator Case are:

- The DSO has the responsibility of the full distribution network, which encourages the integration of the consumer in the most effective and economical way to maintain the integrity, safety and service level of the network, while ensuring overall energy efficiency (i.e. network losses control)
- With this case there is a single responsible entity that ensures the provision of well-defined market facilitation services, guaranteeing accountability and transparency.
- The “DSO as market facilitator” case generally has the advantage that today’s processes (e.g. change of supplier) may be left intact or may evolve with the general market model; it is not necessary to change IT systems and processes to adapt to completely new structure and chains of information or data flow.
- The DSO is used to deal with new technologies and is most interested to implement them in the grid to improve quality and reduce costs.

The DSO, as an entity directly physically linked to the customer base, has a key role to play in tomorrow’s energy system. Limiting the tasks and responsibilities of the DSOs in this respect will have a strong negative impact on the future development of the European energy market. By allocating additional tasks and responsibilities, well regulated, to DSOs, the development of the internal energy market will be accelerated, since DSOs, in providing market facilitation services and data services, enable this in a logical and evolutionary way.

Cases that propose that the management of the data from the distribution network-customer frontier could be done by another “independent and neutral” agent instead of the DSO should be carefully addressed. The possible benefits identified for all stakeholders when implementing a smart grid, depend on the correct data management of all the frontier points of the distribution network, and this includes the smart meters. Beyond the market model adopted, many operational processes that are the responsibility of the DSO will rely critically on the availability and reliability of the smart grid and metering data.

In implementing the needs of the smart grid the reporting group stresses that all cases should be submitted to a detailed and well assessed cost-benefits analysis discovering the overall advantages of each. In addition to the CBA analysis, there should take place a careful consideration of required timings and execution risks of each case. Those who explored the position of DSOs in delivering a value based solution for customers consider that the DSOs, as established entities, under a stable regulatory framework, are in a favoured position to deliver a timely and effective execution of the proposed case.

Case II: Third Party Market Facilitator – Central Data Hub (CDH)

INTRODUCTION

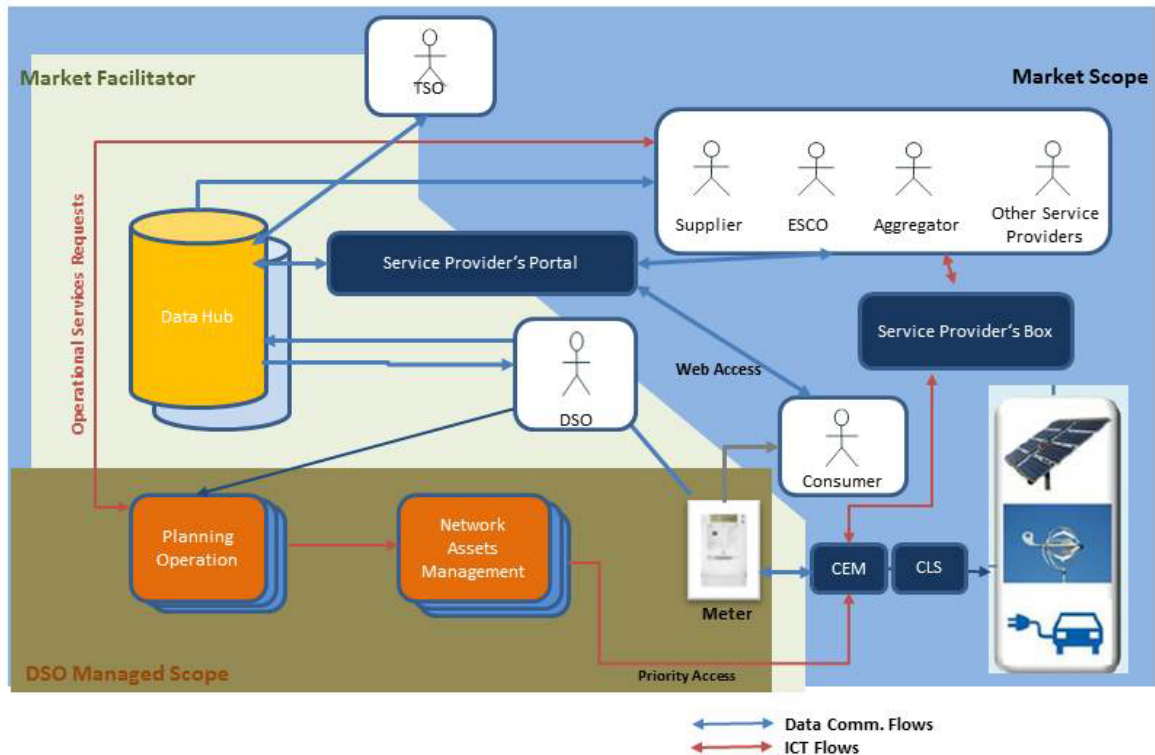
This model consists on an independent centralized repository platform, or independent central communication and data hub that will interact with different smart grid stakeholder, storing data and processing it. Since they are several purposes for which data could be processed, the introduction of an independent single part handling data, would open competition opportunities, as well as facilitating the market thanks to equal data distributing.

Those countries that consider the implementation of a centralized information and communication hub, will have to nominate who will be responsible of the hub. When this model was presented in the EG3 working groups, it was focused into the centralized idea, and it was highlighted that independency was mandatory. However who is responsible for securing a good functioning of the centralized hub, should be decided according to different intrinsic market structures and circumstances.

The introduction of smart meters is expected to increase market liberalization, promoting competition of the retail market. As a result of having access to more detailed data, as well as reacting to market signals, new business opportunities will arise as well, and a central hub, will provide equal access to different markets participants when they need data depending on their purposes:

1. Suppliers to optimize pricing formulas will see benefits of having access to processed data two to three times.
2. Aggregators might request additional aggregation processes to create energy portfolios
3. Suppliers might request processes to recognize peak saving for billing purposes
4. Balancing responsible parties need access to processed data in peak times

Case II: Third Party Market Facilitator (Independent Central Hub)



CEM: Customer Energy Management
 CLS: Controllable Load System

SECTION 1. DESCRIPTION OF THE MODEL, INCLUDING INFORMATION PROCESSES, AS PART OF THE:

Metering

The metering could be done by different actors, respecting the current responsibilities in each country, in many of them DSO (in UK suppliers). The meter reading would be sent to a DSO database, as ultimate responsible for the measurements. The CDH will receive in a standardized format metering data once validated by DSO, opening a communication flow between DSO data and all relevant stakeholders (market parties, clients, etc.) as well as enabling data sharing, aggregation and other processes in an easy way. This can be particularly useful in the case where there are many DSO's and/or service providers, suppliers, ESCOs and so on, typical of liberalized markets where information must flow in order to allow agents to interact with each other.

Supply switching

The new supplier would communicate and prove to the Central Data Hub (CDH) the willing of the costumer supplier switching, then the CDH would stop facilitating data to the old supplier and changes to the new. DSO billing process is not affected as billing info is always passed on the CDH, who will facilitate it to the correspondent supplier.

Tailor-made services

As all the information is gathered in one place, suppliers can have access to aggregated information regarding certain type of consumers/prosumers state wide, so configuring special offers, as telecoms do at present, would be extremely easy. At the same time European wide studios or comparisons are facilitated, as well as the upcoming into the market of new actors. The CDH can act as a reliable information provider on key factors which allow suppliers and other market agents to offer tailor-made services to clients: type of client and connection, type of contract, consumption data and type of metering equipment, energy response equipment and so on, of course always under the client's permission.

User Feedback

In order to avoid consumers to know a new different agent, consumers' feedback would be done through their supplier, who will contact DSO if applicable as today's practice. All the feedback could be managed if desired through the CDH, who could store data in order to compare between companies' performances. The CDH cannot only channel this process but also keep a record of queries, complaints and incidents' status as well as measures taken to deal with them, which can be consulted any time by the client himself, the supplier and any other applicable party.

Reconciliation services

Like suppliers' changes are managed by a third party, consumers would find easier to switch suppliers. Regarding customer care, contract or services changes; these processes are not affected by the existence of the CDH, as they are performed by the supplier or energy services company. Reconciliation services will be less necessary once real consumption substitutes profile-based estimates. The CDH serves as a natural instrument to carry out this task since it can access data from different sources, on individually or aggregated basis, according to time periods or geographical areas, as required.

2. TRADING AND FLEXIBILITY:

Virtual Power Networks

Need for clarification of this topic. If referring to balancing locally demand and supply to avoid networks development, CDH would not intervene in this process as all of the information would be contained in DSO database, and the DSO would perform the required actions. If by VPN we understand the aggregation of several prosumers or distributed generators to sell their energy, this may be done through an aggregator that represents them on the wholesale markets. Information for all relevant parties coming from the aggregator systems could be shared through the CDH.

Aggregated buying

The CDH can act as a node between aggregators and their clients and/or other interested parties. As having all the information already centralized, aggregated buying would be extremely simple.

Ancillary Services

First of all ancillary services for the system from Distributed Energy Resources could only be possible if the measurements are procured (near) real time. Ancillary services to DSO would be direct as DSO has all the info of its network and would prevent many inefficient investments, as avoiding dimensioning distribution networks for coping with situations that are present some hours per year. Ancillary services to TSO, via for example providing balancing reserves, would be facilitated as the system load is directly concentrated. Providing balancing ancillary services to TSO from Distribution Network would need the DSO to have the supervision for ensuring that the Distribution network is not endangered, and the tools to act in case of such danger, to provide equivalent result without jeopardizing security of supply. The CDH could serve to share this information, though only for reference / consultation, and not as the main tool since it is a critical issue to the network operators and thus it would be considered risky to put this in the hands of a third party which is not directly responsible for delivering the final outcome.

Storage

Storage would be facilitated as DSO and TSO would have the info they need with the correspondent aggregation, in order to evaluate and supervise their networks and security of supply, as TSO would control directly the amount of energy stored state wide. On the other hand companies with storage services would find all their information in the CDH, independently of the network they are connected to. The CDH can offer data about storage facilities / services; however, their energy flows would be considered in the same way than those coming from any other generator or load.

Electric Vehicle

Same idea as previous point, the whole picture of the EV would be contained in the CDH, so the TSO has the tool to supervise the whole fleet. DSOs have the supervision of the EV connected at its network and, following the commands of the TSO, can control the charge in order to plane the demand curve and at the same time not to endanger the distribution network. The CDH can register recharge points and offer information to relevant parties about consumption, billing and other issues. Direct operational orders, however, could be put at risk if assigned to a third party with no direct responsibility in the final outcome, so they should be entrusted to the dedicated operational systems of network operators.

Power sale from DER to consumers

All the power sales are managed trough the CDH that contains all the market info, but at the same time DSO has the tools to control that distribution network is not endangered.

3. ENERGY MANAGEMENT

Demand side management

Demand side management as service for the electric system, remembering that for this real time measurements would be needed, would be extremely easy from the point of view of DSO to manage congestion in its grid, and from the point of view of DSO for balancing purposes. For the latter, DSO would need to supervise that activated reserves do not endanger

distribution system, and would need tools to ensure the overall system balancing needs without jeopardizing distribution networks.

Demand Response

As price respondent behavior, demand response could be directly monitor real time, as price signals for consumers could be directly correlated to real aggregated residential demand. The CH can register service contracts provided by ESCOs, suppliers, etc., at any metering point and also which type of controlling device is installed at that point. This will make it easy for companies to offer new services and also know which clients have demand response implemented and through which kind of device.

4. OPERATIONAL PROCESSES

Forecasting

Could be performed more accurately as all the info would be contained in a single place, so studies regarding certain climate conditions and the different generation for these conditions could be processed differentiating technology and size, locally (with DSO data bases) or state wide (via CDH).

Programming

All the programmed unavailability should be communicated to DSO for operational planning, who would communicate it, so the TSO could plan system operation more accurately, and commercial parts could foresee that unavailability for accurately perform their market actions. However, programming through the CDH could be risky since it would mean assigning a critical mission to a third party with no direct responsibility in the final outcome, so it should better be entrusted to the dedicated operational systems of network operators.

Real time operation

Real time operation with real time measurements would be immediate for DSOs and for System operation. For real time operation real time measurements would not be needed continuously, as historic values could be valid to perform simulations accurately and real time analysis, so real time operation would be facilitated via historical information. Again, the CDH does not seem the tool to perform this task since real time operation is a direct responsibility of network operators and is critical for security of the grid and quality of supply.

SECTION 2. SPECIFIC ADVANTAGES / ISSUES FOR CONSUMERS: INDICATIONS OF POTENTIAL FOR CONSUMER BENEFITS

In its follow-up note to EG3, CEER has noted that “different countries might require different retail market data management models” (CEER, 2012). This statement by the council of European regulators for energy means, on the one hand, that all cases have advantages and disadvantages, to be pointed out by the European Commission but ultimately to be taken into consideration by the respective member states. On the other hand, it implies that, amongst

models, the data management layer is to be regarded as the most relevant in terms of model differentiation.

This section aims to enumerate which main advantages Case II offers, both with regards to other cases as well as ultimately for consumers, with a particular focus on the consequences driven by the way data is to be managed under this model.

As seen below, Case II offers seven advantages, versus two disadvantages. The advantages are: independence, economies of scale and equal access, effectiveness for smart grid deployment, regulatory control, existing precedents, stakeholder support and bridging possibility towards other forms of regulation.

1. INDEPENDENCE

The German regulator has clearly expressed that Case I “could not be effective and it will even distort the competition giving such a power to the DSOs... There is also a concern regarding the independence of the DSOS” (Minutes from the 3rd meeting, 2012). These are strong words against Case I, reciprocally in favour of either Case II and/or III.

Case I states that “DSO could also offer these data communication services” (EG3, 2012), but DSOs, as per today, are not meant to offer communication services, but only regulated energy distribution services. As expressed in the EG3 minutes, “the DSO... will not play the role of a broker” (European Commission, Minutes from the 3rd meeting, 2012).

Case I extends regulated activities to free market areas, where free business should prevail. The description of Case I aims at “standardized business services” (EG3, 2012) to implement a EU smart grid market model, but business services need not be standardized.

Services by DSO are, of course, generally regulated, rather than standardized. Standardization is meant to be non-binding regulation, but that surely should not characterize DSO’s main tasks.

On the other hand, it should not characterize either free players’ main tasks. Their business services should not be standardized, regardless whether their systems should be (see Interoperability below).

On the contrary, the services rendered by the independent central entity created under Case II would not only be standardized, but also regulated. However, they would not invade the business areas of third parties (generators, suppliers, energy service and ICT providers) but rather restrain to its regulated roles (see section 1 above).

Some DSOs, when defending Case I, even propose, with regards to new data services, that “the DSO may provide them with no extra cost”, but this apparent advantage, however realistic it might seem or not, would in fact be killing a market for data services, whereas the central entity could always outsource in whole or in part, according to national configuration and scope or stage of regulation/deregulation (see paragraph 8 below).

As to Case III, the description of same even recurs to the central feature of Case II, when it states that “some form of common platform should be put in place to enable effective coordination and efficient use of demand-side response by different end-users” (EG3, The

new role, 2012). The fact of being independent and regulated is what makes it more coherent under Case II than Case III.

2. ECONOMIES OF SCALE AND EQUAL ACCESS

Both Case I and III entail building communications networks per DSO or per DAM.

On the contrary, the setting up of a central data hub means savings in terms both of the deploying of a communications network and the management of data.

With regards to the deployment of a communications network, it is clear that it avoids duplications risked under Case I. Just one infrastructure is built to satisfy links between data hub users and data hub, as opposed to all links necessary between data users and DSOs in Case I. This fact was highlighted and recorded in the minutes of EG3, by pointing out that “DSOs are going for centralized models high investments in developing a communication infrastructure” (European Commission, Minutes from the 3rd meeting, 2012).

With regards to data management, the advantage to Case III is evident, while the advantage to Case I needs a brief explanation: data management is performed in a centralized versus decentralized manner, therefore offering economies of scale. However, one could argue that, under Case II, management of data is duplicated with regards to Case I, because here DSOs are responsible for data management, while in Case II they still have to keep some data for network operation, while that same data accesses the central data hub. However, even this duplication entails some economies of scale, as shown by the fact that, despite files existing in both the central independent body as well as the DSO databases, the number of exchanges is lower from all data users to the data hub than between all data users and all DSOs under Case I.

In any case, when defending Case I, its representatives have stated that “in order to keep the neutrality of the process an independent body should take the responsibility” (European Commission, Minutes from the 3rd meeting, 2012), so that it means that, in order to achieve independence, Case I would get close to Case II by the creation of a “lesser” independent body, thereby destroying a potential advantage in terms of data duplication avoidance.

Some DSOs, when expressing their preference for Case I, point out to a supposed inefficiency of Case II when “replicating the huge amounts of data the DSO already manages” (IBERDROLA, 2012). However, this is rather a petition of principle, for under Case II, the DSO do not “already” manage all data, but rather the independent data hub.

As for Case III, its own description recognizes that “the DAM increases initial cost as manufacturers need to implement specific hardware” and ESCO or other service operators need to take cost as well (EG3, The new role, 2012). Decentralization of investments reduces economies of scale and produces duplicities.

3. EFFECTIVENESS FOR SMART GRID DEPLOYMENT: MODULAR

One of the main difficulties for smart grid deployment in the EU lies within unbundling of networks and positive externalities. No investment is produced where benefits are dispersed along the value chain and this does not completely belong to the same stakeholder investing.

This barrier falls when a new body centralizing smart grid data management appears. All stakeholders commit to their connection to the independent hub, which on the other hand achieves to bring trust and a common interest to the proper functioning of the system.

Also, investment is facilitated by the contribution of all stakeholders to the central body's needs, as opposed to other models, where it is the end users that typically pay for the grid update (through network tariffs under Case I, through DAM services under Case III).

It has been said that assigning the smart grid data activity to other parties different than DSOs “may be a solution if the regulator has the evidence of a poor performance, or if the service is too expensive and doesn't give any added value to the customer” (IBERDROLA, 2012). However, there might be another reason: boosting for smart grid deployment, with the possibility of later assigning the task to either regulated or unregulated parties (see paragraph 8 below).

“Introducing smartness in a grid doesn't justify”, it has been said, “changes in the business layer” (IBERDROLA, *ibid.*). However, if smart grid deployment is to be effective, changes in the market model need to be brought about to enable investments. Case II, as opposed to I, concentrates those changes in a single, neutral body, to which all stakeholders contribute under regulatory control. It is a change in the business model, though an effective one.

Case III, on the other hand, has inherent risks in terms of effectiveness for smart grid deployment. As the same DSO quoted above has put it, it may be difficult to achieve for new agents (IBERDROLA, *ibid.*). The very description of Case III expresses a caveat to it by recalling that “a first step would be research and development funding allocation” (EG3, *The new role*, 2012). The basic role of the DAM under Case III is that of “provisioning and prioritizing rights” of third parties (EG3, *idem*); this looks as insufficient for boosting smart grids. As opposed to Case III, which is bottom-up, Case II is top-down (as Case I), but it can drive smart grid deployment.

As we will mention later on, Case II could serve as the first step towards smart grid deployment, without prejudice to a later regulatory evolution towards other models or adding new functionalities (either by assigning roles to regulated entities or to market players through deregulation at a second step, as commonly known in best-practice sectoral regulation; or adding new communication flows and processes to the central hub to comply with situations like the upcoming single market in the Nordic Countries).

4. INTEROPERABILITY

Other models claim they will assure this important factor towards smart grid implementation. But Case II assures it, rather than claiming it.

Even amongst Case I representatives, interoperability contradictions arise. While the common position speaks, for instance, of “15-minute intervals” for meter readings (EG3, 2012), some DSOs will rather defend “hourly readings” and these paradoxes could be repeated as many times as there are DSOs in charge of smart grid models.

DAMs under Case III incur in the same weakness.

A central independent entity, on the contrary, assures the interoperability requisites to which all other stakeholders connected to it have to equally respect, rather than imposing a jungle of interoperability standards per DSO (or per DAM, under Case III).

The description of Case III attempts to arrive at some interoperability requisites by stating that “IP-based networks is appropriate to serve as the convergence layer between the networks, the meter and the consumer” (EG3, The new role, 2012). But it does so because, under the logics of the model, no market agent is able to assure such interoperability, being DAMs’ role to provision and prioritize roles, not to assure interoperability for the benefit of all data users. The decentralized character of the model requires either that a type of network is required, as proposed for IP-based networks, or else interoperability might not be achieved, each decentralized data manager setting its own requirements.

Spectrum harmonization is another example where Case II serves interoperability in a realistic way, as opposed to atomization of preferences under each DSO or DAM, where consensus or regulation is rendered slow and difficult.

5. REGULATORY CONTROL

Case I states that “critical information should be controlled by a regulated entity” but, in fact, DSOs should be much more difficult to control than a single independent entity as established under Case II.

Especially in countries where DSOs are very atomized, such as Germany (but even in countries like France or Spain, with higher concentration, small DSOs still exist in high number, according to CULLEN, 2012), control of regulated entities use of information would be much more difficult than control of a single entity, which on top of being sole is independent.

Cost-efficiency lies here again at the core, since regulatory control of n-DSO managing energy information would be a lot more costly and, at the same time, less efficient than controlling the independent single entity created under Case II.

With regards to Case III, the fact of DAMs being new market actors, decentralized and competitive (European Commission, Minutes from the 3rd meeting, 2012) minimize regulatory control by their own nature. Under Case III, the control does not lie within the national regulator, but rather under “either a certification body or industry/standard setting institutions” (EG3, The new role, 2012), possibly not the sufficient level of control for initial smart grid deployment.

Case III goes on to propose IEC “as the front running smart grid standardization body” (EG3, *ibid.*), but that seems to be out of the scope of mandate M/468, which places the European standard organisations CEN, CENELEC and ETSI as front running smart grid standardization bodies for the EU.

6. EXISTING PRECEDENTS

Although the smart grid market models are still under design phase, the previous experiences in smart metering systems already show examples of preliminary independent-central-hub-like experiences.

Not necessarily in chronological or order of importance, Denmark has described its model as that of a DataHub run in an independent fashion by the TSO (European Commission, Minutes from the 3rd meeting, 2012).

The UK and Italy have recently designed central independent models for smart metering. Having different electricity markets and different metering schemes (Cullen International, 2012), both have opted for resting their data management with respectively the DCC and the SII.

On top of that, the German regulator has publicly expressed to be considering a central data hub, (Cullen, *ibid.*).

In favour of Case I there is a similar precedent coming from the telecommunications sector, as pointed out by Miguel Toledano in EG3 (European Commission, Minutes from the 3rd meeting, 2012). Incumbent telecom operators give access to other operators to their networks and also to other users without a network (for example, the so-called “mobile virtual network operators”) and this scheme has successfully enabled broadband deployment during post-liberalization without a need to duplicate networks. However, CEER has expressed that “no other market is as physically interconnected as the electricity system” (CEER, 2012), thereby reducing the importance of considering such a precedent for Case I.

In favour of Case III, SEDC has pointed out that “we can already rely on already available information and standards (BSI)” (European Commission, Minutes from the 3rd meeting, 2012), pointing to the German Federal Office for Information Security.

7. STAKEHOLDERS’ SUPPORT

Case II has already received the support of different stakeholders, notably national energy regulators (NRAs) and network operators alike.

NRA support need not be further quoted; under paragraphs 1 and 4 above, it has been sufficiently alleged in relevant EU member states, namely, Germany (as opposed to Case I), Poland, Estonia, Belgium, Denmark and UK (see paragraph 4 for these three).

Some relevant DSOs have also expressed their views on acceptance of Case II. By way of example, Endesa supports Case I but has pointed out that, while “*Case III (DAM) covers only a part of the required functions... the main benefits for consumers come from Case I and II.*” (ENDESA, 2012).

Other network operators, such as IBERDROLA, implicitly accept Case I by recalling that “only the static data should be stored in an independent data hub managed by a regulated body different than the DSO” (IBERDROLA, 2012). One could argue that not only static data should be stored in the independent data hub, but the fact that this data hub managed by a regulated body different than the DSO remains accepted.

Even those that back Case I in its purest forms, up to considering the DSO as “the link between the market and the end-user”, or the party “to be actively engaged in demand response functions” and rejecting the idea “of other actors having direct access to DSOs meters”, express a concern for Case III, but accept Case II, together with BAU and Case I, when stating: “*GEODE identifies three main approaches for the exchange of information on the market*” (GEODE, 2012).

Therefore, Case II has the advantage of gathering a strong level of consensus, which for consumers ultimately means smoothness and swiftness in deployment.

8. BRIDGE BETWEEN BAU, CASE I AND CASE III

By its independence, economies of scale, effectiveness for smart grid deployment, regulatory control and stakeholder support, Case II could serve as the first step towards smart grid deployment, without prejudice to a later regulatory evolution towards other models (either by assigning roles to regulated entities or to market players through deregulation at a second step, as commonly known in best-practice sectoral regulation).

In particular, it solves some of the contradictions of other cases, where it is not clear who should be assigned responsibility in smart grid deployment, leading ultimately to deferral of implementation. For instance, Case I seems “to separate the definition of information and processes from the technology used to implement efficient information exchanges” (therefore implying that definition of processes lies within the DSO, while technology used to implement exchanges could lie within a third party responsibility), but at the same time it states that “distribution system operators are in full control of the utility communication services” and that even “communication services for energy generation facilities ... should be covered by owned or majority owned networks” (EG3, 2012).

On the contrary, Case II allows for an independent entity to both define and implement information exchanges, controlling communication services only where strictly necessary and not needing to duplicate n-owned networks that could not only increase costs but also further endanger DSO independence and provoke inter-stakeholder conflict.

9. DISADVANTAGES

Next to the previously mentioned advantages, Case I offers two disadvantages which, for the sake of completeness and neutrality, should be mentioned as well: fears of monopoly creation and need for regulation, or regulatory oversight.

As opposed to Case I and III, it is clear that having an independent data hub managed by a regulated body means creating this regulated body and giving it a monopolistic nature. However, both facts are in reality of no highly negative relevance, since, on the one hand, in several EU member states there is no need to “create” a new body, if it is already created (see under paragraph 6, but even where the body does not exist, its functions could be performed by already existing entities, as for instance is the case in the UK when Elexon bids for the granting of the DCC licence). On the other hand, certainly the setting up of an independent and regulated body does not only mean the setting up of a monopoly, but the setting up of a non regulated agent, operating under the control of an association of electric companies or transmission operator(s), with the oversight by a governmental agency or body. Its responsibilities have to be clearly defined and limited.

Identifying an agent, which could be thought as monopolistic, has a solely a disadvantage to Case III, not to Case I, since under Case I, DSOs are of a monopolistic nature also, in the areas corresponding to each respective grid.

With regards to the need for regulation, surely the creation of an independent data hub managed oversight by a governmental agency or body, means development of regulation, or description of responsibilities, but it has already meant proven how this regulation is more manageable than that pertaining to Case I (see paragraph 5 above). Again, Case I offers a disadvantage vis-à-vis Case III, not to Case I.

In any case, when defending Case I, its representatives have stated that “in order to keep the neutrality of the process an independent body should take the responsibility” (European Commission, Minutes from the 3rd meeting, 2012), so that it means that, in order to achieve independence, Case I would get close to Case II by the creation of a “lesser” independent body, thereby destroying a potential advantage in terms of data duplication avoidance.

Some DSOs, when expressing their preference for Case I, point out to a supposed inefficiency of Case II when “replicating the huge amounts of data the DSO already manages” (IBERDROLA, 2012). However, this is rather a petition of principle, for under Case II, the DSO do not “already” manage all data, but rather the independent data hub.

AS for Case III, its own description recognizes that “the DAM increases initial cost as manufacturers need to implement specific hardware” and ESCO or other service operators need to take cost as well (EG3, The new role, 2012). Decentralization of investments reduces economies of scale and produces duplicities.

SECTION 3. RELATIONS WITH ICT AND TELCO: TECHNOLOGY AND REGULATORY IMPLICATIONS IN ICT / ENERGY SECTOR

Different stakeholder have to deliver services according to their responsibilities, and when planning the infrastructure to implement what regulations mandate, they have the opportunity to consider what not only the need of today what also the roadmap of services that they might have to deliver in the future, as well as looking to improve their operations and new business opportunities.

There are different communication technologies, e.g regarding metering communications. In Europe, different countries or utilities decide based on intrinsic systems features or preferred ones.

There is space to consider coordinated investment in Energy and Telcos, like ESB’s plans to set up a joint venture to build, own and operate a fiber network.

SECTION 4. FINANCIAL IMPLICATIONS AND TIME HORIZON.

The main financial implication of Case II is that it creates a new entity which owns and operates the CDH. Whether this entity is a regulated one or not, it seems clear that it must

perform its duties according to regulated proceedings and prices. Ideally it should be financed through contributions from smart grid market agents, especially those who request information. However, the cost of data needed for regulated processes could be later recovered by the agent through regulated income or passed through on to consumers.

The estimated cost of a CDH depends on how much existing facilities and processes are integrated into the new ones, since in most countries there is already a structure of links for registering and exchanging metering information. The more functions the CDH is entitled to, will mean higher costs but also more complexity. For these reasons, it is convenient to make the most of existing structures and charge Case II only with information that has more than a single end-user.

The most expensive requirements would come from considering the implementation of trading and flexibility energy management and operational processes. Integrating this information into the CDH, in those countries where this could make sense and be possible, would mean a huge amount of data being exchanged so the management costs would rise accordingly:

- It must also be taken into account some kind of information, such as the operational one, needs a specific consideration in order to discriminate responsibilities in case of network emergencies, congestions and so on. The existence of a third party should not introduce an element of uncertainty which could get in the way of clarifying responsibilities. Thus, while it may be possible to offer this kind of data for consultation of aggregators and other agents, grid operation must be controlled exclusively by grid operators. In this respect, security of CDH flows is key.

The same could be said about the time horizon needed to implement the different functionalities. A progressive approach, built on consensus among all agents, would be convenient. We could typically expect a minimum of five years since smart metering becomes widespread until the smart grids market model is fully operational.

SECTION 5. NEEDS FOR REGULATORY INTERVENTION: RECOMMENDATIONS FOR REGULATORY INCENTIVES FOR THEIR IMPLEMENTATION

1. In order to create a regulatory background capable of fostering the implementation of smart grids, it is necessary to remove the main factors hindering the process until now. Thus, if the aim of smart grids is to increase efficiency, the first recommendation would be avoiding regulated tariffs which do not reflect the cost of service.

2. The second recommendations would be setting time of use tariffs. Along with recommendation 1, this would give the correct price signal and incentivize clients to consume in an efficient way.

3. Of course, to allow consumers to benefit from time of use tariffs it is necessary to provide them with accurate information on their consumption, as well as basic information on how to be more energy efficient and make the most of time of use tariffs. This requirement should be tailored to the client's needs since all the clients do not have the same needs of information and / or do not have the same chance to shift their consumption. Action should be taken first

with clients with high consumption rates. Financial aid, such as soft loans, grants or subsidies could be necessary to bring efficiency to the most vulnerable clients with low consumptions but should remain a particular case and not become general. A CBA should be carried out in order to establish the most effective policy of information for each segment, in terms of level and regular updating of information, able to induce positive changes in consumers' load profile and total consumption.

4. To make deployment of smart grids effective, cost-effective measures should be taken according to each segment of the market. This means that measures should focus on segments where bigger efficiency impacts are expected. Agents should have access to aggregated information of client's segments so as to be ready to make suitable offers.

5. The fifth recommendation would be to make a basic design of the CDH and increase its functionalities and complexity as the smart grids market grows. The CDH must rule itself according to the needs of its end-users and whenever there is consensus and CBA results are positive, additional functions and information may be added.

6. The CDH may be a regulated agent or not, but it is clear that its duties must be regulated. Its fees should also be regulated in order to avoid profit making which would mean a new extra cost for agents and induce market distortions. However some specific functions between agents operating in the free market could be out of the regulated scope and subject to agreement between the parties.

Case III: The Data Access-point Manager (DAM)

Section 1- description of the case

MOTIVATION

Smart Grids and Smart Grid consumer oriented programs in particular, require the cooperation and coordination of the entire energy value chain. Any regulatory initiative looking to actualize the Smart Grid in a manner serving consumers will be required to take this fact into consideration. This entails creating a holistic view of the Smart Grid's regulatory principles with the particular focus on developing a framework to manage the generation-, storage- and consumption- resources which in most cases will be owned or operated by private sector third parties (citizens or legal entities).

In particular the increasing share of highly distributed resources and its integration even in critical functions like frequency stabilization is challenging the power systems - especially with regard to system stability. On top of the distributed character of these resources the systems will face a broader variety of functionalities of these resources.

Examples, which are visible already today, are various generations of inverters for solar plants, which originally were passive components, just feeding-in power to the grid, but today are required to provide grid supporting capabilities, for example voltage support or frequency stabilization, and in the future will be very likely required to assume more responsibilities in the grid operation. While now these next generation inverters already hold some communication capabilities, in future these will become more sophisticated.

Another area, in which predicting the actors and service requirements is even more difficult, are all types of solutions supporting demand response.

Traditionally the functional model of power systems has been rather static and automation systems have been designed and deployed for a particular, well known purpose. Only a limited number of components, all within the system of bulk power generation and the grids, haven been automated. This approach is obviously not feasible any more in an environment with millions or even tens or hundreds of millions of distributed devices. In fact the bottleneck created when the system cannot incorporate new devices will slow or threaten the very development of the Smart Grid.

As a consequence, a suitable method for handling information on devices connected to the grid and their functionalities is required. This must allow the localization, connection, update or disconnection of devices offering functions, which are even unknown today, without requiring other parts of the system to be adapted. This is a key issue to innovate technologies and services which can securely and dynamically be integrated into the Smart Grid without a fundamental upgrade of the entire system or without developing single purpose regulatory frameworks.

THE PARADIGM

In recognition of this, the Case III Data Access Manager team has gathered a list of principles which created a wider framework of principles we see as essential to robust long term Smart Grid development.

Reaching a cost neutral integration of intermittent renewable generation and demand side systems as well as activating consumers (resp. Citizens) to become part of the energy markets are major challenges on the path to a post-fossil energy age.

Case III therefore focuses on offering a methodology which anticipates a certain dynamics in the smart grid deployment and encourages:

- *citizens participation as investor in resources and as active user of services (e.g. demand side management, energy supply, microtrading etc.)*
- *access of the DNO and TSO to all - by regulation defined – required technical data and access to functionalities in order to keep the highest level of grid stability and security of supply*
- *fair allocation of grid investment and business relations according to local resource situations*
- *flexibility in commercial relations between various actors (incl. DNO, TSO and energy service companies)*
- *highest security standards to protect malware injection, to avoid hacking, to prevent fraud and to respect privacy and ownership rights for citizens*
- *freedom of choice on energy supply, energy service providers and other demand side oriented smart grid related services*
- *transparency for the resource owner on all retrieved data and remotely executed functionalities by any actor*
- *encourage innovation through a non-discrimination access for service providers to data and functionalities (on resource owner allowance and potentially needed licence to operate from DNO/TSO)*

THE DATA ACCESS POINT MANAGER (DAM)

Case III therefore introduces the Data Access Point Manager (title of Case = DAM): A new role designed to handle in a fair, open and secure manner the access to the ever increasing volumes of data and functionalities needed to create value added programs within the Smart Grid. This role enforces trust between market actors and facilitates service innovation and implementation during operations. The DAM does not hold the data.

The DAM is a role who is

- *...provisioning and prioritizing rights...*
- *...of any regulated and non regulated market actor (service providers)...*
- *...via any implemented communication network...*
- *...over the whole lifetime of a relevant smart grid resource (energy generating/measuring/consuming device)...*

- ...by implementing and managing secure and independent access to the functionalities of the smart grid resources according to dynamic regulatory and contractual situations over lifetime.

The DAM furthermore:

- enables the management of dedicated functionalities and data of a smart grid asset for all stakeholders (DSO, Retail, ESCO, Manufacturer, Maintenance Services, other innovative Service Providers (e.g. HEM-brokerage))
- is under control (licensed/certified) of either a certification body or industry/standard setting institutions (like Global Platform or GSMA in other industries – an alike institution could be installed as result of EG 1-4)
- guarantees authentication of interventions (who effected what and when) according to the rights granted either by regulation (for the DNO) or by allowance (from consumer/asset owner)
- facilitates the relation between the asset manufacturer, the asset owner, the asset operator, the grid operator and service companies by being an independent third party
- requires standardized access point architecture (which most likely needs to be implemented as a result of Data security and privacy → e.g. DAM role could be built based on a smart meter gateway architecture like demanded by BSI in Germany)
- increases total benefit of the asset owner but also increases initial cost as manufacturers need to implement specific hardware (allowing standardized secure access → key handling secure execution environment) and ESCO or other service operators need to take cost of provisioning into consideration

The DAM will not:

- collect, manage and distribute consumption/generation data centrally (→ no central database)
- operate any core functionalities on the smart grid asset (→ evtl. credentials*¹⁹)
- provide lock-in of a consumer to stick to a dedicated service provider
- operate communication networks
- be a monopolistic actor
- be chosen by the consumer (→ but by the market player who implements a smart grid asset or wants to have access to data/functionalities of the device/ it is a B2B-role)
- Remote control of functionalities is meant for all grid relevant devices, not individual domestic appliances. Although they also can contribute to grid stability, their interaction with the grid is managed in a different way with no direct control from third parties

¹⁹ Credentials in the context of digital security establish the identity of a party to communication. Usually they take the form of machine-readable cryptographic keys. Cryptographic credentials may be self-issued, or issued by a trusted third party

Prerequisite of an effective impact of the DAM would be a highly standardized methodology/systematic to have a non-disputable identification of all resources (type, actors, functionalities and data types in order to

- register a resource and its attributes
- identify the resource and its attributes in the network
- authorize actors to allow data retrieval
- authenticate activities from authorized actors
- use the existing communication connection and remunerate the communication service provider
- being able to provide remote security and firmware upgrades

The device makers and the other market players can ask the DAM to provision services on the device and to authenticate transactions. Once the access point is standardized, innovative Service providers can ask the customer whether they want the service which then is provisioned by the DAM onto the device

DAM USE CASES – INFORMATION PROCESSES

Assumption: set of minimum functionalities in resources (as defined in M490) is available and accessible connection is established.

CUSTOMER ISSUES

Metering:

The DAM role will enable the activation of different actors to retrieve data directly from the meter without asking a (regulated) third party to deliver the data.

Once provisioned, the actors reading demand (e.g. hourly values) will be read out and encrypted in the way that only the actor could decrypt the data.

Only the consumer but no third party (apart from the DAM) will ever know about the type of data the actors retrieve.

The DSO and the metering operator are provisioned from the day of activation with their dedicated rights and keys on the smart metering system.

Depending on the meter capability, the consumer can demand to provision and deprovision different actors on the device by simply signing a contract with a service provider allowing or withdrawing the rights to read out data or access functionalities.

The cost for the use of the existing communication infrastructure could be anonymously cleared between the DAM and the meter operator.

This easy way of service provisioning could add additional revenue stream and income to re-finance the investment in smart metering rollouts.

All other relevant resources could be connected and managed with this methodology.

Supply switch

As discussed above, a supply switch can in the long run be executed by a provisioning process on the meter. The same way it is thinkable to switch a mobile operator by changing the subscription of the operator on a SIM card, a supplier switch could be provisioned without changing one single piece of the metering system.

The DAM could then be responsible for notifying the supplier of the metering point to the DSO. The clearing between suppliers and DSO would then be facilitated and flexibilized.

TRADING and FLEXIBILITY:

The DAM offers providers of flexibility direct access to resources data and depending on regulatory situation direct access to functionalities. Each owner of a resource could then choose between different service providers.

At a given lifetime of most resources exceeding 10 years, the impact on grid management as well as the commercial relations of the owner with service providers might be subject to change. Also the owner or the location of the installed resource could vary.

The DAM-role would enrol the owner- or regulation-driven access keys to the different actors.

Virtual Power Networks, Aggregated Buying, Ancillary Services, Storage Management , electro vehicles would through the DAM quickly and securely provisioned to the grid operators and service providers environment.

With the decentralized DAM approach, local generation can be managed and marketed separate on local markets. It is thinkable that solar generation and home energy management systems are interacting in way that one could sell the share of production to the neighbour who changes his behaviour according to the production of a dedicated asset.

The DAM would provision these kinds of services and application securely into the system while communication and application providers as well as grid operators could be incentivized accordingly and based on true and certified data provided by the generation and consumption devices.

The seamless use of resources for active Demand Side Management and Demand Response transactions can be enabled with the DAM approach which implicitly contains a high level of data integrity and standardization in authentication processes.

From a grid operator perspective, all data needed for Forecasting, Programming, real time Operation in order to comply to regulators mandate shall be provisioned on the connected resources.

One major requirement to lift the DAM potential would be to extend the scope of the Mandate 490 to define the minimum functionalities per resource and a standardized secure access point to data and functionalities to ensure the identical basic set-up of the access point per device within Europe. Ideally, one could provision a resource and its related potential service contributions into the smart grid system seamlessly.

Once provisioned the grid operator receives a notification from the device which activates his data retrieval and potential access to functionalities.

Section 2 - Specific advantages/issues for consumers: indications of potential for consumer benefits

The decentralized DAM approach reflects on the main requirements consumer are expected to have. The consumer is more seen as active contributors and participants to the smart grid.

Case III shows a good performance empowering consumers to actively participate in the energy system through demand response, enabling differentiated offerings for electricity consumers.

Privacy and Security are implicitly designed in the system. No party but the owner of the data will possess the full range of data. The minimum data rule is reflected in the way the DAM provisions applications securely on the resources interfaces.

The consumer himself will have access to all data produced in his personal environment.

In addition consumers will decide actively, which resources e.g. they will provide to which commercial partner. Business models for service providers are not limited to artificial constraints in availability of data. Furthermore an intelligent implementation of the DAM role could foster both – innovation and competition.

The DAM case would provide smooth path of consumers (step-by-step approach) into the smart grid world. Starting with smart metering and savings, optimization of use of captive energy or micro trading of energy generated by own property – the citizen decides at what point in time he starts to adopt these technologies and services.

Section 3 - Relations with ICT and Telco: Technology and regulatory implications in ICT/Energy sector

The DAM case implicates for each relevant resource

- a physical connection to the electricity grid and
- a communication connection to a head-end system

The DAM case shall encourage

- steady increase in smart grid related service deployment,
- more managed resources connected over time
- accurate billing of services based on reliable data
- further development of smart grid industry based on equal opportunities to access information and devices

While the challenge of the electricity system is to find mechanisms applying and combining technologies to minimize the additional investment on the physical and the control layer of the smart grid, TelCos must ensure the accessibility of the resources on communication layer. Both infrastructures adopt and grow in parallel. While the electricity grid operator acts on regulatory mandate, the communications provider must find ways to re-finance the investments in connectivity.

One promising model could be the definition of a standardized communications hub where all resources could be connected to in order to use a shared wide area network connection.

The SMETS 2 Consultation in UK contains some items which encourage the development of additional services and a citizen- and community driven initiation of the smart grid.

Telecoms can leverage on their existing network to take the role as certified DAM. Most mechanisms and methodologies to identify, authenticate and certify access to data and resources could be adopted from the proven standard approach in cellular mobile markets and developed into the energy ecosystem.

As broadband coverage grows, the number of connected resources especially in the sector of electric vehicles, distributed solar generation and others shall rise in parallel. There is room for leveraging on the seamless connection of these resources and add additional services like remote maintenance or warranty supervision. The capital cost for the initial connection and communication of relevant resources in a smart grid ecosystem could be reduced when the communication infrastructure could be “rented” by service providers. The DAM could play a facilitation and clearing role in this ecosystem. In order to investigate the synergies between ICT and energy sector caused by the DAM model, further research is required.

Section 4 - Financial implications and time horizon

The DAM model aims to avoid a one-time investment in centralized IC-Technologies but allows the consecutive and sustainable growth of ICT systems according to the services and requirements for grid and service operations.

The cost as well as the benefits could be allocated in a fair way over a longer transition period.

The risk of ending up in a deployment in which investments in resources and in grid equipment are paid by rate- or taxpayers and profits end up at a few monopolistic actors will be reduced with implementing a decentralized model like the DAM.

As the smart grid needs to grow and evolve with the contribution of flexible demand or volatile generation of energy, more and more investors have to have a clear reason to invest in such resources. Case III offers an innovation driven approach to incentivize these investments. The innovation area goes beyond the currently known revenue streams in the energy markets which are mainly based on the aggregated use of energy independent from place and time of generation.

The cost for initially connecting resources could be incorporated in the standardized communication interface, while the operational cost could be recovered on the one hand from the utilization of data from grid operators based on regulation and on the other hand from additional service operations which are managed by commercial service providers. The DAM facilitates the clearance of these money streams.

Further investigation and research on the financial implication of a DAM model needs to be done.

Section 5 - Needs for regulatory intervention: recommendations for regulatory incentives for their implementation

The DAM model requires a regulation which incentivizes grid operators to buy aggregation services and energy from distributed renewable resources. The DAM model requires a regulation which allows the implementation of local markets with a fair compensation of the grid operators for the partial use of grid assets.

In addition, standardization and security requirements need to be clearly defined in order to be treated in M490 and related mandates (M441 and M468). The European data protection directive as well as the initiatives to protect critical infrastructures shall be integrated in this regulatory environment.

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For establishing the DAM Model, grid operators' natural monopoly and mandate for smart grid operations needs to be clearly defined. For contributions to stabilize the grid as well as for injection of captive generation, a framework which is considering local infrastructures and structures is needed.

Especially in market communication and incentives for demand side management, the DAM offers potential to encourage more and less costly transactions.