EU Commission Task Force for Smart Grids

Expert Group 3: Roles and Responsibilities of Actors involved in the Smart Grids Deployment

EG3 Deliverable

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1 Introduction, Tasks and Scope of Work of Expert Group 3

The tasks and scope of work of the Expert Group 3 (EG3) of the EC Task Force for Smart Grids (TF) are defined on the basis of the Mission Statement of the TF [6] and specified in detail in the Vision document [7], which was presented at the 2nd meeting of the TF Steering Committee on 16. December 2009.

The key elements of the EG3 final deliverable are:

- The **recommendations on the roles and responsibilities** of all involved actors in the implementation of Smart Grids;
- The **definition of criteria and recommendations for the funding** of Smart Grids deployment;
- The **recommendations to the EU Commission regarding the needs for any additional legal framework at the EU level**, in support of the Smart Grids deployment.

The work of EG3 has been organized along the following lines:

i. A questionnaire addressing the issues below was elaborated by the EG3 members and compiled together in a summary document [8]:
   a. Expected benefits from Smart Grids for their own organisation;
   b. Smart Grids features provided by their own organisation;
   c. Smart Grids features needed from other actors[1];
   d. Defined decision criteria for the deployment of specific Smart Grids features;
   e. Roles & responsibilities within their organisation relating to Smart Grids deployment;
   f. Anticipated (or already identified from current/previous Smart Grid deployment) interfaces and interaction with other actors in the electric power supply chain required for Smart Grids deployment.

   The information collected via this questionnaire has been the initial source of information in the development of this EG3 deliverable. In addition, other sources such as the findings and results of the EU TP Smart Grids [1], ERGEG position paper on Smart Grids and related public consultation [2] and the BEUC non-paper on Smart Grids and Smart Metering [3] have also been used.

   An additional questionnaire has been used in elaborating the needs for additional legal framework in support of Smart Grids deployment (Annex I).

ii. A synthesis of the detailed information from (i) above was created and used as a working document in the follow-up discussions of the EG3.

iii. This document contains the final deliverable of the EG3, with elaboration of the three key elements mentioned above, submitted now to the EU Commission and TF for Smart Grids

[1] Coordinated with the other Expert Groups, including in particular the relation of Smart Grids and Smart Metering

2 Roles and Responsibilities – Current Status

For each actor in the electricity supply chain, its role and responsibilities are defined, structuring them according to their functions and responsibilities into 'groups', which are then used in the elaborations of the remainder of this document. Moreover, an overview of current roles and responsibilities within the electric power supply chain is contained also in [4]. Changes to the current roles and responsibilities that will occur as the deployment of Smart Grids proceeds are addressed in Chapter 5 of this document.

2.1 Grid Operators

The term „Grid Operators", refers to the undertakings of operating, building, maintaining and planning of the electric power transmission and distribution networks.

Transmission System Operator (TSO): according to the Article 2.4 of the Electricity Directive 2009/72/EC (Directive): "*a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity*". Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.

Distribution System Operator (DSO): according to the Article 2.6 of the Directive: "*a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity*". Moreover, the DSO is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing[2].

2.2 Grid Users / Customers[3]

Generator: Generating electricity, contributing actively to voltage and reactive power control, required to provide the relevant data (information on outages, forecast, actual production) to the energy marketplace (see also the Articles 2.1 and 2.2 of the Directive).

Electricity Installer / Contractor: Electrical contractors design, install and maintain intelligent systems for all kinds of industrial, commercial and domestic purposes. Alongside the power and lighting applications, they equally install ICT and telecommunications, public street lighting, high medium and low voltage lines, control and energy management systems, access, fire and security control equipment, lightning protection systems, advertising and identification signs, emergency power generating systems and renewable energy systems.

Customer / consumer: Depending on their characteristics, consumers could be classified into one or more of the following categories:

> **Industrial customer:** A large consumer of electricity in an industrial / manufacturing industry. May be involved in contract based Demand/Response.

[2] In some countries this is done by a Balance Responsible Party.

[3] Please refer also to the Articles 2.7 – 2.11 of the Directive.

Transportation customer: A consumer of electricity providing transport systems. May be involved in contract based Demand/Response.

Buildings: A consumer of electricity which is a private or business building, may also be involved in contract-based Demand/Response.

Home customer: A residential consumer of electricity (including also agriculture users) may also be involved in contract-based Demand/Response.

Supplier: A grid user who has a grid connection and access contract with the TSO or DSO (see also the complementary description of supplier in section 2.3). Moreover, suppliers are those actors which will provide new services, real-time information, energy efficiency services and dynamic energy pricing concepts with Time-of-Use (ToU). The suppliers also provide local aggregation of demand and supply, in order to increase the effectiveness and efficiency of the electricity supply at all voltage levels (including low / medium voltage levels).

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.

In addition, multiple combinations of different grid user groups (e.g. those grid users that do both consume and produce electricity) exist. In the remainder of this document, the terms customer/consumer and grid user are used interchangeably where appropriate.

2.3 Energy Market Place

Power Exchange: Provides a market place for trading physical and financial (capacity/energy and derivates) contracts for capacity allocation by implicit auctions within the defined country, region or cross border.

Balance Responsible Party: Ensures that the supply of electricity corresponds to the anticipated consumption of electricity during a given time period and financially regulates for any imbalance that arises.

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.

Trader: A person or entity that buys and sells energy goods and services in an organized electricity market (Power Exchange) or Over the Counter.

Supplier: Has a contractual agreement with end customer relating to the supply of electricity**.**

Aggregator: offers services to aggregate energy production from different sources (generators) and acts towards the grid as one entity, including local aggregation of demand (Demand Response management) and supply (generation management). In cases where the aggregator is not a supplier, it maintains a contract with the supplier.

2.4 Providers of Technologies, Products and Services

The actors listed below provide technology, products and services to the actors mentioned above. They have been classified into the following categories:

- **Electric Power Grid Equipment vendors;**

- **Ancillary Services providers;**

- **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. In case of a specific contractual basis, the contract is mostly with the network operator, or may be with the customer or the supplier. The meter may be rented to, or exceptionally owned by, the customer.

- **Information & Communication Technology (ICT) service providers;**

- **Grid communications network providers** Plan, build and maintain the communications systems that enable the data communication required to maintain grid stability, load balancing and fault protection systems by a TSO or DSO. 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.[4] Grid communications network provider ensures compliance with the agreed service levels (Service Level Agreements including quality of service, data security and privacy) and compliance with any national and/or international regulations as necessary;

- **Home Appliances vendors;**

- **Building Energy Management Systems** (BEMS) providers, delivering the systems which facilitate management and control of building facilities, realizing energy saving and increasing comfortability of users of buildings and making full use of the state-of-the-art Information Technology.[5]**;**

- **Electric Transportation / Vehicle Solutions providers;**

2.5 Influencers

Grid User / Customer / Consumer: Entity or person being delivered electricity. How a customer perceives the value received from other actors in the electricity supply chain has a substantial influence on the economic viability of the grid in general and on the overall acceptance of how the electricity supply chain performs.

Regulator: Independent body responsible for the definition of framework (market rules), for setting up of system charges (tariffs), monitoring of the functioning and performance of energy markets and undertaking any necessary measures to ensure effective and efficient market, non-discriminative treatment of all actors and transparency and involvement of all affected stakeholders.

Standardization bodies: Responsible for standardization of all relevant elements and components within the electricity supply chain, which in turn leads to harmonization of relevant services, support towards removing barriers to trade, creating new market opportunities and reducing manufacturing costs.

EU and national legislation authorities: Entities are in charge of defining legislation and metrics for areas such as environmental policy, social policy, energy policy and economic

[4] An exception is the customers' data which are managed by the grid operator but belong to the customer.

[5] The already defined and broadly used building automation standards (like e.g. bacnet, LON and Konnex) shall be considered in relation to the interfaces between Smart Grids and Smart Metering.

policy. They are also responsible for the authorisation needed to develop the electricity grid infrastructure.

Financial Sector undertakings: Provide capital to other actors or invest themselves into the projects within the electricity supply chain (grid, generation, etc.).

3 Interfaces and Interaction

The present structure of electricity supply chain in Europe is the result of over 100 years of development. The European market liberalization and evolution of the Internal Electricity Market (IEM) is the outcome of implemented policy goals by the EU, but their implementation varies across the Member States. The liberalization process has changed the roles and responsibilities in the electricity supply chain, but many national and regional markets still exist instead of one single European Internal Electricity Market.

The EU 20/20/20 targets aim at further changing the electricity sector and market towards more sustainability and energy efficiency. As a result of political decisions, a large share of variable distributed generation capacities will be installed and connected to the transmission and distribution grids in the years to come. Smart Grids will offer many new opportunities and possible solutions to cope with related challenges.

One key aspect of the Smart Grids concepts is a stronger integration ("convergence") between players that used to operate on more or less distinct markets. The overarching condition for Smart Grids to meet a plethora of expectations is to ensure an overarching effective and efficient deployment. A comparison with other industries shows that this aspect of "building of community of supporters" is not the least challenging among the environments and populations that have different technical and business cultures, different development cycles and often different standardization cultures. Therefore, a pre-requisite for the Smart Grids deployment is that **all the actors in the electricity supply chain are aware of and commit to their future roles and responsibilities**.

3.1 Electricity Supply Chain

Generally, Smart Grids lead to more interaction between the actors in the energy supply chain. In the context of a liberalised market, additional energy can be traded on different platforms such as markets for energy, capacity, or ancillary services. Subsequently this energy can be physically or virtually exchanged between market players. Along with these additional activities, new opportunities and challenges (risks) are introduced into the system operation. The opportunities apply to those who actually make use of the additional functionalities and processes (such as retailers, consumers and/or renewable and conventional generators – grid users in general). The challenges (risks) in the grids are relevant to all participants, need to be managed accordingly by the grid operators, with the support and commitment of other participants.

Large scale **variable generation** from renewable sources (primarily wind) will be connected to the transmission and distribution grids in the future[6]. The three key challenges for the TSOs are (i) to maximize interconnection capacities, (ii) to support the integration of the large wind generation plants and (iii) to keep the grid stable and balanced in cooperation with the DSO´s.

[6] As a consequence of the adoption of the 2009 RES (Renewable Energy Sources) Directive, the European Wind Energy Association (EWEA), in March 2009, increased its 2020 target from 180 GW to

The three key challenges for the DSOs are (i) connecting additional generation from renewables, (ii) enabling active demand/customer side participation in the market (this is also a key challenge for TSOs) and (iii) keeping the distribution grid stable and balanced by handling electric power flows in both directions.

To ensure economically efficient and stable operation taking into account the **importance of the interaction between TSOs and DSOs**, the tasks of economically efficient continuous balancing, monitoring and reporting must be clearly defined and agreed upon by the relevant parties and accordingly implemented by the TSOs and DSOs[7].

In **distribution**, with massive deployment of "conventional" distributed generation and future "in house" micro generation, the DSO role will gradually shift from distributing power on a top-down basis, to a role in which maintaining voltage quality and balance is central while electricity flows in both directions. It follows that the DSO in the future will be **interacting more frequently than today with TSOs, consumers and generators.** The future interfaces required to accomplish this will need to be specified in further detail.

Storage of generated electricity is a subject of intensive R&D and industry effort over many years, including both conventional methods like pumped-hydro-storage and the less conventional ones like compressed air. Future possibilities could possibly extend to batteries of electrical cars connected to the grid. It is therefore possible that electrical cars will play a substantial role in storage in the future, but the realization might be extended until and beyond 2020. The interfaces required between the "storage owners" and the DSOs will require further analysis.

In addition, more detailed work will be needed on the future down stream **interfaces and interaction in relation to Smart Metering** as following the 3rd Electricity Directive, most European customers will be equipped with Smart Metering by 2020. Moreover, interactions of the electricity supply chain with other forms of energy like heating from gas in relation to the use of Smart Metering will further help to increase efficiency and save energy across the EU.

Smart Metering and related "Smart Communication", when implemented in a right way can provide information to different actors (DSOs, Balance Responsible Parties, Retailers, End users, Service-providers and/or Aggregators) – which all should ensure improved service to the customers. This data can be used not only for classical metering & billing but also for introducing new services on the competitive market.

Demand Side Response will gain importance on household level, not only for retailers but also for the grid operators to "get in contact" with customers in times of scarce capacity. Home applications enabling Demand Side Response have to be developed. However, the "smartness" of metering to inform the customers, will only be achieved if relevant add-on information will be distributed for other energy management purposes like e.g.: peak load management, enhanced customer switching, enhanced alarm and fault management by grid operators, etc. Smart Metering will hence be used differently by different actors and might also be of no use at all for some Smart Grids applications and/or services.

Today Smart Metering roll-outs[8] are being implemented in different ways in different Member

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230 GW of which 40 GW would be offshore.

[7] In some countries also a separate Balance Responsible Party

[8] On the contrary to the continuous process of deployment of Smart Grids, Smart Metering as the new metering & billing technology which will enable additional smart services if implemented in an effective and efficient way, will indeed be deployed within a project and rollout plan.

States and different actors are responsible for Smart Metering. Thus a standardized set of services and architecture defined by the EU would be highly beneficial for an efficient implementation throughout Europe.

More flexible products will be needed in the electricity market to support system **balancing**; in this context **intraday trading** will become an important instrument. More transparent and adjusted balancing & reserve power rules agreed between TSOs will be required, also in order to facilitate the development of cross border intraday, balancing and reserve markets. Moreover, all players, including DSOs, generators, Balance Responsible Parties, but also regulators will have to establish an appropriate forecasting framework and system to cope with **higher flexibility and volatility in the electricity supply chain**. In this regards, the application of state-of-the-art forecast tools together with larger balancing areas is the key to integrate large amounts of variable RE generation, e.g. from wind power in a cost-efficient way.

3.2 Summary and Recommendations on Interfaces and Interactions

3.2.1 Enhanced cooperation of TSOs and DSOs with Focus on Bi-directional Electricity Flows

Massive deployment of distributed generation will not only contribute to displacing local demand but might also result in "injection" towards the transmission grid, influencing the transmission infrastructure. Connection of distributed and micro generation will provide more options for the DSOs[9] to balance their grid areas on the medium and low voltage level, thereby reducing stress on TSO level. At the same time, this will place new requirements on TSOs and DSOs in terms of operational security. The increased efficiency benefits of local generation, in reduction of distribution and network losses should be recognised in planning the local physical network. From an overall energy efficiency respect the more local the balancing of the network the less losses are incurred in overall flow. Hence local balancing is preferable.

Interfaces Recommendation #1: EG3 recommends that DSOs and TSOs implement a two-fold strategy in a coordinated way, including **supply management** and **capacity expansion in regions with high generation potential.**

Growing Distributed Generation also poses operational and control challenges for the traditionally designed and operated distribution grids and is one of the key drivers for Smart Grids. Those challenges include among others voltage and reactive power management, maintaining system stability and operational security. The existing best practices from Member States where considerable distributed generation already exists should be benchmarked in developing new approaches. Therefore **DSOs will have to become much more involved in relation to innovative voltage control, power flow management, dynamic circuit ratings** etc.

Interfaces Recommendation #2: EG3 recommends that the appropriate framework and incentives are introduced for **Distributed Generation (DG) to provide a range of ancillary services** (e.g. voltage-reactive power control, etc) relying on a market based approach.

[9] And/or Balance Responsible Parties, where applicable.

Interfaces Recommendation #3: EG3 considers that the 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.

It is further necessary to ensure that network operators have a good visibility of real time operational limits and the dynamic stability of the interconnected transmission systems.

Interfaces Recommendation #4: **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[10].

Interfaces Recommendation #5: EG3 recommends that the 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 (active or automated). The frequency, handling time and duration for this reporting will depend of the purpose and products being offered on a given market place.

3.2.2 Interfaces between the DSOs, TSOs, Aggregators, Consumers and Generators

The DSOs' responsibility in the future electricity market with massive DG and micro DG is multi-fold and resembles that of the TSOs in the transmission grid of today. These include (i) keeping operational security and quality of supply, (ii) enabling the new operations at the distribution level (including non-discriminatory and effective real-time grid capacity monitoring and management of injections / withdrawals), (iii) market based congestion management, (iv) support energy efficiency and integration of renewables at the producer side by setting harmonized and non-discriminatory rules and codes[11].

Interfaces Recommendation #6: EG3 recommends that 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. This will resemble the way how the "large" market participants and generators participate in the wholesale market and cooperate with the TSOs today. They will have to deliver information on their planned market activities to the DSO and the TSO, depending on their kind of participation.

Some exemptions to the "standard" contractual arrangements might be necessary for the on-site self generation e.g. industrial plants that own generators at their own premises and produce only for their own consumption purposes, thereby not delivering any energy back to the grid.

3.2.3 Interfaces between DSOs, aggregators, BRP and the Storage Owners

Storage refers here to all forms of energy storage (chemical, potential, kinetic, thermal). The energy stored can either be transformed into electricity or be used in the form in which it was originally stored (i.e. as pressure or steam).

[10] The effectiveness of WAMS is conditional on the area covered and this needs to be considered accordingly.

[11] Depending of the national structure parts of this can be handled by the BRPs

Depending on the model chosen for the future electro-mobility and electrical cars deployment within a country or grid area and depending on technical capability of the batteries for the vehicle to grid (V2G), the electrical cars can also be contractually integrated in the future contracts with Storage Owners. Due to the many different models possible, the actual integration of electro-mobility and electrical car owners is left out from the detailed consideration here.

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

In relation to the data from Smart Metering, some of the data will be necessary to suppliers for services around the supply of energy, e.g. the provision of detailed consumption information and billing. Other data may be required with explicit consent to provide additional services. Some data will be only of interest to grid operators and other data will be necessary for meter operators (who – depending on the national market model – may be distribution companies, suppliers or meter companies).

Certain data may be relevant to more than one party. The deployment of smart meters thus prompts decisions at national level about the requirements of the various market participants, the nature of data (individual or aggregated) and how data flows should be managed. Decisions in this area will reflect national market structures and industry systems, but they will also affect the commercial and customer services that smart meters will enable. Data privacy rules and regulations must also be adhered to. **DSOs are responsible for managing some customer and consumption information, DSOs should act as enablers of demand side participation in the form of information hubs.** DSOs should be responsible for gathering consumption data (through meter readings) and dispatch it in a swift, reliable and non-discriminatory way to licensed service providers (suppliers, aggregators, etc.) thereby safeguarding confidentiality of information by restricting the ability of third parties to access confidential information. They should provide historic energy consumption information to customers for free in a format that allows them to make like for like comparisons with tariffs and deals available in the market. The responsibility for administration of verified and validated master data currently lies with the DSO in most European countries. In several countries however, this responsibility is handed over to other actors. Moreover, in some countries e.g. the roll-out of Smart Metering has been assigned to the suppliers, with the introduction of a central data and communications provider. National differences in market models and responsibilities of DSOs, TSOs and retailers are likely to persist in the future, with metering operators or even new entities potentially providing additional services through communication tools to customers.

Some general principles should apply to improve the interface between DSOs and other actors when it comes to metered data provision. It is essential that market actors are able to use a common and standardised communication and data management system. For this purpose, information requirements should be the same and a minimum level of information requirements should be specific: the database format for example should be open and standardized and facilitate data exchange as well as data aggregation. Aggregators, for example, will need ICT with standard interfaces for interacting with customer meters, displays (information) and customer equipment (for automated demand response). Policy makers should assist in promoting harmonisation and standardisation of data exchanges and customer processes at the European Union level as this would facilitate supplier switches and allow economies of scale. DSOs should move towards a unique identification of metering points to facilitate data exchanges.

A strong and coordinated European effort is recommended to develop a new architecture and new standards in the field of security and privacy protection. The market model “around the Smart Meter” will develop differently in different European countries.

Interfaces Recommendation #7: EG3 recommends interfaces to 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 (QoS, security level, privacy, etc.).

Interfaces Recommendation #8: EG3 recommends regulatory authorities to 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. Regarding the interfaces among the actors, EG3 further emphasizes the need of a market role "neutral and transparent information hub" currently mostly performed by DSOs (cf. Final Report of Expert Group 2: point 7.2 Architecture and point 9 Data privacy), for enabling Demand Response strategies. The future implementation of this hub will depend on the national market model and may be further adopted by DSOs or may be newly developed by other neutral actors. In any case the DSO must dispose in a cost efficient way of the information needed to ensure that the DSO is able to fullfill the obligations imposed on DSOs by the 3rd legislative package.

3.2.5 Flexible Energy Pricing and Grid Tariffs' Systems

One of the most important preconditions to establish a market for higher generation and load flexibility is the optimal price signal in energy. As flexibility - both in supply and in demand - often necessitates costly investments, the tariff system has to provide long-term price relations to legitimate the financial expectations of the investors. The energy market itself will support these efforts, this might require further support. An assessment of the actual grid tariff systems reflecting grid load by demand charge on a metered basis and by offering special discounts for interruptible loads could help to find the essential framework to be designed. Considering one of the important aims of Smart Grids is to enable Demand Side Participation, a system of communication, metering, standardised access and interaction between the grid and the consumer (or the retailer) is necessary.

Interfaces Recommendation #9: The manifold components of such a system are expected to give incentives for a wide variety of innovation and products for flexible demand or generation, under the condition that there exists an **economic incentive for generators, consumers and those that do both in terms of flexible energy prices**. Moreover, this might extend towards the flexible grid tariffs with Time of Use (ToU) payments.

In relation to Demand Side Participation and to the growing importance of the grid users who are both, producing and consuming electricity, adequate tariff structures will need to be elaborated taking into account energy (kWh), load (kW) and time of use, so as to ensure fairness towards all grid users and adhering to the principle of causality.

The goal is to achieve optimized use of all generated electricity combined with the optimal use of grid capacity, while limiting financial and environmental impacts. The RES support schemes should be adjusted to take proper account of the financial impact of RES DG, but also other aspects (e.g. overall investment at TSOs vs. DSOs, new services offered as a result of locally connected DG, etc.). The flexibility of generators, consumers and those that do both fostered this way will create liquidity in local market segments at the distribution level.

The services to create a market for load flexibility should follow the assumed **characteristics of such respective demand response products**. This could be load and energy amount, handling time, frequency, duration, etc. Additionally the actual remaining potential of flexibility would be important information to the market. These parameters could also describe standardized and tradable products if the suitable communication tools and information can

be provided by the grid operators. If data protection does not allow permanent analysis of grid load, the required data may be collected on an aggregated level. For some devices providing flexibility it may be necessary to monitor the remaining capacity on an individual basis. It will be necessary to define the procedure and formats on how the grid operators will have to present the information in a 'competition neutral' way and how any incurred costs are recovered.

3.2.6 Further Analysis

Interfaces Recommendation #10: EG3 recommends that the elements requiring further analysis in terms of interfaces and interactions in Smart Grids deployment include:

- The interfaces required between the "storage owners" and the DSOs will require further analysis. (From section 3.1 above)
- Future down stream interfaces and interaction in relation to Smart Grids (From section 3.1 above)
- Flexible energy prices, flexible grid tariffs and their impact on the interfaces between consumers and producers, TSOs, DSOs and suppliers/traders/aggregators
- Clearing & settlement systems interfaces and interaction with data collection, data exchange, and electricity flows
- Products and features fostering producers and consumers' flexibility and their relation to capacity management, communication needs, etc.
- Overview and comparison between flexibility demand and potential on different grid / voltage levels (internal, national market, regional/TSO and local/DSO, medium / low voltage)
- Experiences from existing intraday markets: organisation, triggers for activity, volume, framework, obstacles, etc.
- Study of efficient ways to communicate with customers, such as e-mail, SMS, signals to the meter, In-Home display, digital TV etc.
- A higher contribution of DG to the system stability and operational security.
- Ensuring that consumers receive accurate, timely, understandable and usable information on consumption.

4 Benefits, Criteria and Recommendation for Funding of Smart Grids Deployment

The three complementary objectives of Smart Grids (Economic efficiency, Technology evolution and Environmental policy goals) are summarized in the Annex II, with a specific focus on the trade-offs that may be required between these objectives in order to achieve the 'optimum' Smart Grid deployment. It is against this background that the benefits, criteria and recommendations in this chapter are elaborated.

4.1 Rationale

This section presents **expected benefits**, **criteria** and **recommendations for funding** of Smart Grids deployment. Based on that, a **template for evaluation of the merit for**

deployment of the specific features is elaborated.

The main driver for Smart Grids deployment are **the European environmental policy goals** aiming at CO2 reduction, deployment of renewable energy sources, energy efficiency and the resulting **requirements and needs of grid users**. Moreover, an increased demand for flexibility emerges both in the transmission and in the distribution grids due to the massive deployment of variable generation. Part of the needed flexibility can be offered by Demand Side Response, which will be facilitated by Smart Grids. A key challenge here is to identify and implement first those features that **most efficiently meet grid users' needs resulting from policy goals.**

The related definitions, technology issues and specific Smart Grids features are discussed in the deliverables of EG1 and EG2. It is important to emphasise here, that Smart Grids deployment is about **evolution** (not revolution) of the way how electricity grids should be planned, built, operated and maintained, in order to efficiently support achieving the European 2020 targets and policy goals.

In the future, electric power will be transported and distributed over „copper and iron", with Smart Grids not changing the key principles of physics but instead improving effectiveness, cost- and energy-efficiency. It follows that **there cannot be any "roll-out"** of Smart Grids because "smartening" electricity grids is a continuous process.

Considering the different characteristics and level of "smartness" in the transmission and distribution grids of the EU Member States, it follows that Smart Grids deployment cannot cover 100% of all grids in all Member States at the same time and that **roadmaps for Smart Grids deployment will differ** in the different Member States. The level and need of "smartness" for the grids will also depend on the development of the power generation mix in the different Member States, the regional / national structure of the electricity market and the existing electricity grids' structure.

Finally, while **bi-directionality** – both, of electricity flows in the electricity grid and of exchange of information controlling the grid – is a key feature for Smart Grids deployment, it is not an extra challenge per se. The challenge lies primarily in the interfaces to the grid users' equipment and products, which fall into a wider perception of Smart Grids, the one including grid and grid users. One could also say that "smartening electricity grids" is about achieving "**smart power systems**".

4.2 Benefits and Criteria

A good scheme for promoting enhanced "smartness" of electricity grids requires the quantification through appropriate **criteria and indicators**, of the effects and benefits of this "smartness". These indicators must be identified based on the benefits they deliver and have corresponding metrics defined in order to measure success.

The concept behind defining the criteria to measure the benefits from Smart Grids deployment relies on the following:

- The first and the foremost step is the identification and appropriate elaboration of the **grid user needs and requirements** – this task requires an in-depth discussion and detailed mutual understanding among all relevant stakeholders;
- Definition of **performance targets and measurable output parameters**, as well as the respective "threshold values" which when achieved and / or maintained will ensure the achievement of the needed "smart" grid functionality and features needed to fulfil the requirements above;

- Development and implementation of such a **regulatory framework, that will incentivize TSOs, DSOs and other actors towards achieving the above defined targets**;
- Combining the above elements into a well agreed, committed and transparent **set of rules and measures.**

An initial set of criteria and related indicators, from which a measure of smartness can be extracted and adopted for practical assessment is proposed below, based on [2].

Benefit	Potential key performance indicators[12]
(1) Increased sustainability	Quantified reduction of carbon emissions Environmental impact of electricity grid infrastructure Quantified reduction of accidents and risk associated to generation technologies (during mining, production, installations, etc.)
(2) Adequate capacity of transmission and distribution grids for "collecting" and bringing electricity to the consumers	Hosting capacity for distributed energy resources in distribution grids Allowable maximum injection of power without congestion risks in transmission networks Energy not withdrawn from renewable sources due to congestion and/or security risks An optimized use of capital and assets
(3) Adequate grid connection and access for all kind of grid users	Benefit (3) could be partly assessed by: - first connection charges for generators, consumers and those that do both - grid tariffs for generators, consumers and those that do both - methods adopted to calculate charges and tariffs - time to connect a new user - optimization of new equipment design resulting in best cost/benefit - faster speed of successful innovation against clear standards
(4) Satisfactory levels of security and quality of supply	Ratio of reliably available generation capacity and peak demand Share of electrical energy produced by renewable sources Measured satisfaction of grid users with the "grid" services they receive Power system stability Duration and frequency of interruptions per customer Voltage quality performance of electricity grids (e.g. voltage dips, voltage and frequency deviations)

[12] Some of these indicators are already used today in different EU Member States.

(5) Enhanced efficiency and better service in electricity supply and grid operation	Level of losses in transmission and in distribution networks (absolute or percentage)[13]. Storage induces losses too, but also active flow control increases losses. Ratio between minimum and maximum electricity demand within a defined time period (e.g. one day, one week)[14] Percentage utilisation (i.e. average loading) of electricity grid elements Demand side participation in electricity markets and in energy efficiency measures Availability of network components (related to planned and unplanned maintenance) and its impact on network performances Actual availability of network capacity with respect to its standard value (e.g. net transfer capacity in transmission grids, DER hosting capacity in distribution grids)
(6) Effective support of trans-national electricity markets by load-flow control to alleviate loop-flows and increased interconnection capacities	Ratio between interconnection capacity of one country/region and its electricity demand Exploitation of interconnection capacities (ratio between mono-directional energy transfers and net transfer capacity), particularly related to maximisation of capacities according to the Regulation of electricity cross-border exchanges and the congestion management guidelines Congestion rents across interconnections
(7) Coordinated grid development through common European, regional and local grid planning to optimize transmission grid infrastructure	Benefit (7) could be partly assessed by: - impact of congestion on outcomes and prices of national/regional markets - societal benefit/cost ratio of a proposed infrastructure investment - overall welfare increase, i.e. running always the cheapest generators to supply the actual demand) → this is also an indicator for the benefit (6) above - Time for licensing/authorisation of a new electricity transmission infrastructure. - Time for construction (i.e. after authorisation) of a new electricity transmission infrastructure.
(8) Enhanced consumer awareness and participation in the market by new players	Demand side participation in electricity markets and in energy efficiency measures Percentage of consumers on (opt-in) time-of-use / critical peak / real time dynamic pricing Measured modifications of electricity consumption patterns after new (opt-in) pricing schemes. Percentage of users available to behave as interruptible load. Percentage of load demand participating in market-like schemes for demand flexibility. Percentage participation of users connected to lower voltage levels to ancillary services

The table above is not in a static one that applies to all grids in all Member States – it should rather to be regarded as the summary of most important and wide elements which are applied according to the specific grid and/or country. In addition to the criteria above, EG3 recognizes the following additional benefits and related criteria for Smart Grids deployment:

[13] In case of comparison, the level of losses should be corrected by structural parameters (e.g. by the presence of distributed generation in distribution grids and its production pattern). Moreover a possibly conflicting character of e.g. aiming at higher network elements' utilization (loading) vs. higher losses, should be considered accordingly.

[14] In case of comparison, a structural difference in the indicator should be taken into account due e.g. to electrical heating and weather conditions, shares of industrial and domestic loads.

(9) Benefit: Enable consumers to make **informed decisions related to their energy** to meet the EU Energy Efficiency targets

Criteria:
- Base to peak load ratio
- Relation between power demand and market price for electricity
- Consumers can comprehend their actual energy consumption and receive, understand and act on free information they need / ask for
- Consumers are able to access their historic energy consumption information for free in a format that enables them to make like for like comparisons with deals available on the market.
- Ability to participate in relevant energy market to purchase and/or sell electricity
- Coherent link is established between the energy prices and consumer behaviour

(10) Benefit: Create a **market mechanism for new energy services** such as energy efficiency or energy consulting for customers

Criteria:
- 'Simple' and/or automated changes to consumers' energy consumption in reply to demand/response signals, are enabled
- Data ownership is clearly defined and data processes in place to allow for service providers to be active with customer consent
- Physical grid related data are available in an accessible form
- Transparency of physical connection authorisation, requirements and charges
- Effective consumer complaint handling and redress. This includes clear lines of responsibility should things go wrong

(11) Benefit: Consumer **bills are either** reduced or upward pressure on them is mitigated

Criteria:
- Transparent, robust processes to assess whether the benefits of implementation exceed the costs in each area where roll-out is considered are in place, and a commitment to act on the findings is ensured by all involved parties
- Regulatory mechanisms exist, that ensure that these benefits are appropriately reflected in consumer bills and do not simply result in windfall profits for the industry
- New smart tariffs (energy prices) deliver tangible benefits to consumers or society in a progressive way
- Market design is compatible with the way the consumers use the grid

While selecting and applying the criteria and indicators, it is important to ensure on one hand that they can be impacted by the TSOs and DSOs and on the other hand that they do not create an incentive for the grid operators' involvement in competitive market, what is neither necessary nor possible according to the existing legal framework. Moreover, mutual dependence (and possible exclusivity for some) of the benefits and criteria is an important factor to be taken into account.

A **practical selection of indicators will vary from country to country**, depending on the starting point (the status of the development and "smartness" of the grids) and on the most urgently required and/or the most appropriate features and functionalities for the specific grid(s) under consideration.

The **significance of the indicators will further change over time**. E.g. the maintenance downtimes will be an indicator in the beginning but as the grid becomes more flexible and predictable, planned downtimes can be longer but would influence the grid to a lesser degree. This means that the evaluation of the Smart Grids benefits and its deployment will remain an evolving process.

While practical selection of indicators will vary from country to country (depending on the different maturity level of the national grids) and where significance of the indicators will further change over time, the most important aspect in assessing the benefits (and applying the defined criteria for that), is the **initial evaluation whether and what needs to be done in a different way than it is done today**. This is required because a large number of existing features and functions in the electricity grid today are already supportive of distributed generation, renewables integration, etc. It follows that an appropriate scrutiny and objectivity will be required from grid operators in cooperation with grid users, in assessing the necessity and needs for all "smart" investments and developments in the grids. The key benefit to be achieved is that the economic efficiency of Smart Grids must improve considering overall benefits for the grid users and society when compared with continuing with a "business as usual" approach of today.

Within the context of discussing the criteria above, it is worthwhile recalling the elements which are (by large) already today widely used in the electricity transmission and distribution grids:

- Replacement/refurbishment of power components;
- Increased use of WAMS/WACS;
- Upgrading protection and control devices for communication;
- Installation of power quality devices;
- Increased use of compensation devices;
- Adoption of new technologies and systems for power transmission (all types of HVDC).

4.3 Legal Framework

The new Electricity Directive 2009/72/EC defines a number of general tasks and provisions for the organization of the electricity sector in Articles 3.1, 3.2 and 3.10, which are also relevant for Smart Grids. Moreover, even the "old" Directive 2003/54/EC dealt with issues of importance for Smart Grids in the Articles 3.1, 3.2 and 3.10.

More specific tasks in relation to Smart Grids are defined in the new Electricity Directive, in the Article 12 (a) – (e) for the TSOs and in the Article 25 1-7 for the DSOs. The "old" Directive was also addressing the tasks of TSOs (Article 9) and DSOs (Article 14), related to Smart Grids.

4.4 Regulation

A key principle of good regulation – not just in the electricity sector but also in other regulated businesses – is to **concentrate on outputs of the regulated entity** and effects of a given activity or service, influencing the processes and activities by appropriate regulatory measures, but not directly interfering in management and operations of the grid undertakings / regulated companies.

The **incentive mechanisms** currently adopted to promote other aspects of grid business, like **the quality of supply in electricity distribution** can be used for the promotion of smart grid deployment. In case of incentive regulation, regulated entities can be either rewarded if they improve their performance in the interest of the customers or penalised if they underperform with respect to such targets. This incentives' approach corresponds well to the provisions in the Electricity Directive 2009/72/EC and applies to a number of topics. A complementary approach is the use of a **direct set of minimum requirements** to be fulfilled in the evolution towards Smart Grids, or a **hybrid solution relying on both approaches**. It

is in any case of paramount importance that no regulatory scheme or requirement represents a barrier for the development in technology or application of necessary (new and "smart") solutions in the grid.

In that context, a "**grid-user centric approach**" (in a broader sense) should always be used, so that all players (grid users, suppliers, generators, TSOs and DSOs, system/equipment manufacturers, energy market providers and influences) are involved in the most appropriate way in the deployment process. Making the deployment process economically attractive and efficient will ensure the needed commitment by the participants, while recognizing their different needs.

In order to achieve these important objectives, a well balanced consideration of Smart Grids from the perspective of market, regulation and grid development & innovation is required, where the **interests and needs of all – but most notably grid users and customers** – are taken into account.

Some aspects of the way the interfaces need to function are likely to be covered by regulatory actions, either at national or at European (for cross-border) level. Careful action needs to be taken to ensure clarity of the boundary lines in order to make sure that **the "market platform" can function effectively on the basis of a level playing-field.** Standardization must further provide a clear technical framework for interoperability in conjunction with these regulatory requirements and European level standardization.

Grid codes for example are the fundament of generation product innovation. Unless these are clearly and uniformly defined across Europe, manufacturers cannot develop products which are able to meet a range of proposed standards at minimal costs. Grid codes are also an example for an area where substantial improvements will be achieved through the implementation of the Third Legislative Package.

Besides the incentives and direct regulatory measures for ensuring "smartness" in the grids, another key task for regulation is to **support smooth communication by defining data collection requests, standardised data formats and communication protocols and the access to relevant market information.**

A set of recommendations on regulation is elaborated in [2] based on the initial Position Paper on Smart Grids by the European Energy Regulators and on the results from public consultation:

(1) Ensure, as appropriate, a long-term stable regulatory framework, reasonable rate of return for cost-efficient grid investments and network operators' incentives for increasing efficiency, fostering market integration and security of supply.

(2) Consider and further analyse decoupling between grid operators' profits and volumes of electricity they deliver taking into account the introduction of performance indicators and performance-based incentive regulation;

(3) Pursue regulation of outputs as a mechanism to ensure value for money paid by network users and to investigate metrics for the quantification of the most important output effects and benefits ;

(4) Promote mechanisms favouring an improved consumer awareness of their electricity use and market opportunities through actions of suppliers and other market participants and an improved engagement of network operators with their network users - it is considered further that it would be beneficial if the Governments too were encouraged to pickup this objective;

(5) Encourage the deployment of Smart Grid solutions, where they are a cost-efficient

alternative for existing solutions, and as a first step in this direction, to find ways of incentivizing network companies to pursue innovative solutions where this can be considered beneficial from the viewpoint of the society;

(6) Evaluate the breakdown of costs and benefits of possible demonstration projects for each stakeholder and to take decisions or give advice to decision-makers based on societal cost-benefit assessment which takes into account costs and benefits for each stakeholder and for the society as a whole;

(7) Ensure dissemination of the results and lessons learned from the demonstration projects in case they are (co-)financed by additional grid tariffs or from public funds to all interested parties, including other network operators, market participants, etc.;

(8) Participate in Smart Grids discussions and cooperation activities among stakeholders and especially to consider an active cooperation with European and national standardisation organisations, grid operators and manufacturers, for example on open protocols and standards for information management and data exchange, in order to achieve interoperability of smart grid devices and systems;

(9) Clarify the difference between regulated grid activities and market opportunities for new services under a competitive regime (e.g. aggregation of resources, Electric Vehicle (EV) recharging) and to carefully monitor and prevent the possible presence of cross-subsidies between network activities by TSOs or DSOs and market-based activities;

(10) Continue the exchange of expertise at European level, in order to learn as soon as possible from best regulatory practices.

The principles and recommendations above are the basis for the following considerations and the definition of the template for funding of Smart Grids deployment.

4.5 Recommendations for Funding

In different situations, different funding options for Smart Grids deployment are possible. In general, the investment costs in the electricity grids are covered by grid tariffs. These include among others the use of system charges, access charges, connection charges, metering charges, etc. A precondition for recognition of costs within the grid tariffs is, that the costs relate directly to a real and specific purpose and to a specific solution or service which is deployed in the grid.

This also means that imposing a non-specific tariff component on grid users in an unselective way for grid development, while it can broadly fit into the overall scope of innovation but without a specified goal, service or solution being defined it is not feasible, and is not in line with legal provisions, technical and economic principles.

It follows that the costs in the grid need to be as far as possible attributed to those incurring them and that transparent cost structures on both transmission and distribution level would foster development of Smart Grids. As part of this it follows that regardless of a specific grid cost and tariffs structure, it is essential that grid users understand the system which must be transparent, cost reflective, justifiable and non-discriminatory.

The costs emerging from the introduction of new services or solutions in the grids (e.g. introduction of new bi-directional protection for massive integration of distributed generation,

optimized grid expansion in support of new gird users' needs, etc.) are today mainly[15] paid by the actor which requires those new services and which is the main beneficiary of them, like new generators, new kinds of consumers, energy management service providers, etc. Therefore particular attention needs to be paid to avoiding that the costs incurred once are charged to the grid users twice or more times, or that the first mover is burdened with the total cost of a change which further users will then access for free. The payment of costs must at any time – today and in the future – remain **fair according to the actual originator of these costs, adhering to the principle of causality.**

Regulation of outputs, by incentives, by minimum requirements or by a combination of both, requires **predefined performance targets and indicators**. Clear and transparent measurement rules are important to make it possible to observe, quantify and verify such targets. Performance targets must be strictly related to the pursued objectives and should therefore be designed so as to avoid external effects which are out of control by the grid operators. Indicators could be benchmarked whenever possible at national or international level before their adoption in order to define the expected performance targets (comparability must be ensured).

Defining **metrics for quantification of the effects and benefits** of Smart Grids – with specific emphasis on the evaluation of efficiency, effectiveness and comparative cost analysis in relation to a conventional "non-smart" approach – is a challenging but necessary task in order to be able to perform the cost / benefit analysis, before cost recovery and possible introduction of incentives for the deployment of Smart Grids. This is a complex and high priority issue which needs to be addressed accordingly by the regulators in close cooperation and coordination with grid users, owners and operators.

In the European context a number of different public funding options are in place ranging from EU funding, national governments funding, both as the sole option or in combination with public-private partnerships. The level of scrutiny given to publicly funded options should be higher than that given to privately funded options to reflect the reduced incentives on the energy industry to make optimal investment decisions where it does not directly bear the risk of these. Public subsidy should only be used where it is clear that industry will not invest otherwise and – most important – where the benefit to society clearly justifies such an approach. In summary, the following funding options / possibilities for deployment of Smart Grids features exist:

1. Private funding by industry, private investors, etc.

2. Public funding and tax incentives at the national and EU (FP's) level,

3. Private-public partnerships,

4. Funding by the European Investment Bank

5. Investment incentives coupled with obligations and reward / penalties in regulation (i.e. incentive & quality regulation) and the grid tariffs.

The type of funding to be used will also depend on the stage when it is needed, e.g. initial R&D phase, pilot demonstration projects, transition phase from first market introduction to a fully-fledged deployment.

[15] Examples exist with some costs being also socialized among all the grid users.

The process and model for elaboration of recommendations are schematically presented in the Figure 1 below, whereas from an economic point of view the "smart" features of the electricity grid need **to be considered as a whole** and need to match the relevant benefits and criteria elaborated in Chapter 4.2.

With respect to all relevant grid features, a categorization into three subgroups appears useful. Furthermore, certain features and functions (described subsequently in 4.5.2 – 4.5.4) will be of different relevance for users according to their needs and requirements and according to the actual situation in the different transmission and distribution grids.

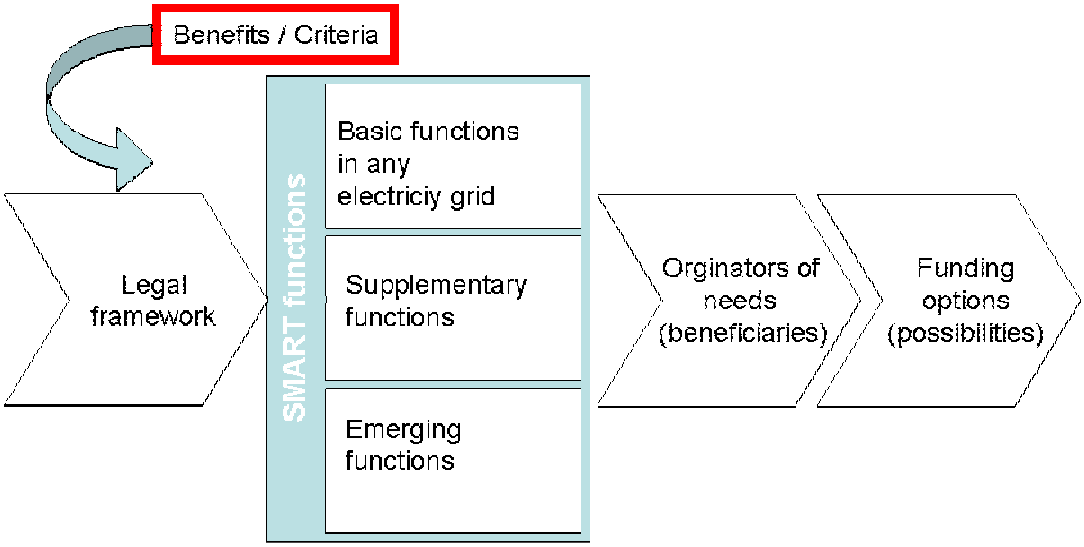

Figure 1: Proposed process for elaboration of recommendations for funding

Furthermore, an underlying common factor in the process above is the need for appropriate **standardization** in all necessary aspects of Smart Grids deployment, as well as taking into account the experiences and lessons learned from the ***different demonstration projects***.

4.5.1 High-Level Smart Grids Services

The EU TP Smart Grids has defined six priorities for the Smart Grids deployment in the Strategic Deployment Document [1]. The EG1 has adopted the key elements of this definition, describing them as the "**high-level Smart Grids services**", including:

A. Enabling the grid to **integrate users with new requirements**

B. Enhancing **efficiency in day-to-day grid operation**

C. Ensuring **grid security, system control and quality of supply**

D. Better **planning of future grid investment**

E. Improving **market functioning and customer service**

F. Enabling and encouraging stronger and more direct **involvement of consumers in their energy usage**

EG1 is conducting detailed analysis of functions, with each of the above high level services being described in terms of different functionalities. Those functions can be conceptually classified in three levels: basic, supplementary and "smart" emerging ones. It's relevant to underline that a practical classification of Smart Grids functions into these three levels can

and will vary according to the voltage level (EHV, HV, MV, LV) as well as according to the starting level of grid functionalities that – especially for distribution network – varies from country to country.

4.5.2 Basic Functions in Any Electricity Grid

Basic features of any electricity grid are required in order to ensure correct functioning, supply and service to the grid users and support of the electricity market, in line with the legal framework (Section 3.3). For instance, within high level service "D. Ensuring grid security, system control and quality of supply" a basic functionality is: "Maintain adequate level of voltage quality (supply voltage variations, rapid voltage changes, dips, swells)". The following recommendations apply for this group of basic grid functions:

Funding Recommendation #1: EG3 recommends that basic functions need to be provided by Transmission or Distribution System Operators within the scope of the applicable regulation and tariffs - considering legal provisions (Section 4.3). In the distribution grids of today, this is often one kind of incentive regulation, combined with quality regulation.

Funding Recommendation #2: EG3 emphasises the importance to avoid cross-subsidizing or double financing. If some additional funding beyond the regulated tariffs is used, this needs to be considered in relation to any regulatory incentives, to avoid any cross subsidies.

4.5.3 Supplementary Functions in Any Electricity Grid

A number of supplementary functions exist, the significance of which is increasing with growing penetration of distributed generation, higher volatility and demand side participation requirements.

For instance, within high level service "C. Ensuring grid security, system control and quality of supply" a supplementary function would be: "Promote tailored contracts between the customers and the network operator for enhanced voltage quality".

Funding Recommendation #3: EG3 recommends that funding for the supplementary functions (depending on each individual case) is also within the scope of the applicable regulation and tariffs - under the conditions that the overall benefits are passed to all customers paying those tariffs and that transparent and economically efficient deployment is ensured. Funding mechanisms must not be regressive, impacting low income households and the fuel poor unfairly.

In the context of the above Funding Recommendation #3, an analysis of the distributional impact of the benefits of Smart Grids should be carried out to ensure that low income and vulnerable consumers are not unfairly carrying the burden of costs and to put in place safeguards. Moreover, a positive discrimination should be considered to ensure a fair and equitable cost allocation if there is a risk that low income households could end up footing the bill when they are the least likely to be able to benefit from it.

4.5.4 Emerging Functions in Transmission and Distribution

On top of the basic and supplementary features, a number of new and emerging ones are more and more widely required and deployed in the electricity grids of today – a trend set to continue even stronger in the next years.

It follows that also for these emerging features, the costs can be clearly attributed to the related grid users / beneficiaries within the foreseen tariffication components.

The recommendations #1 to #3 above apply therefore to the funding recommendations in this section too.

Funding Recommendation #4: In relation to the listed (and possible new, or presently yet unknown) emerging features in combination with the supplementary and basic ones, EG3 recommends to establish a multi-dimensional mapping where the area "spanned" as illustrated in Figure 2 is maximized in terms of Smart Grids benefits and criteria elaborated in Section 4.2.

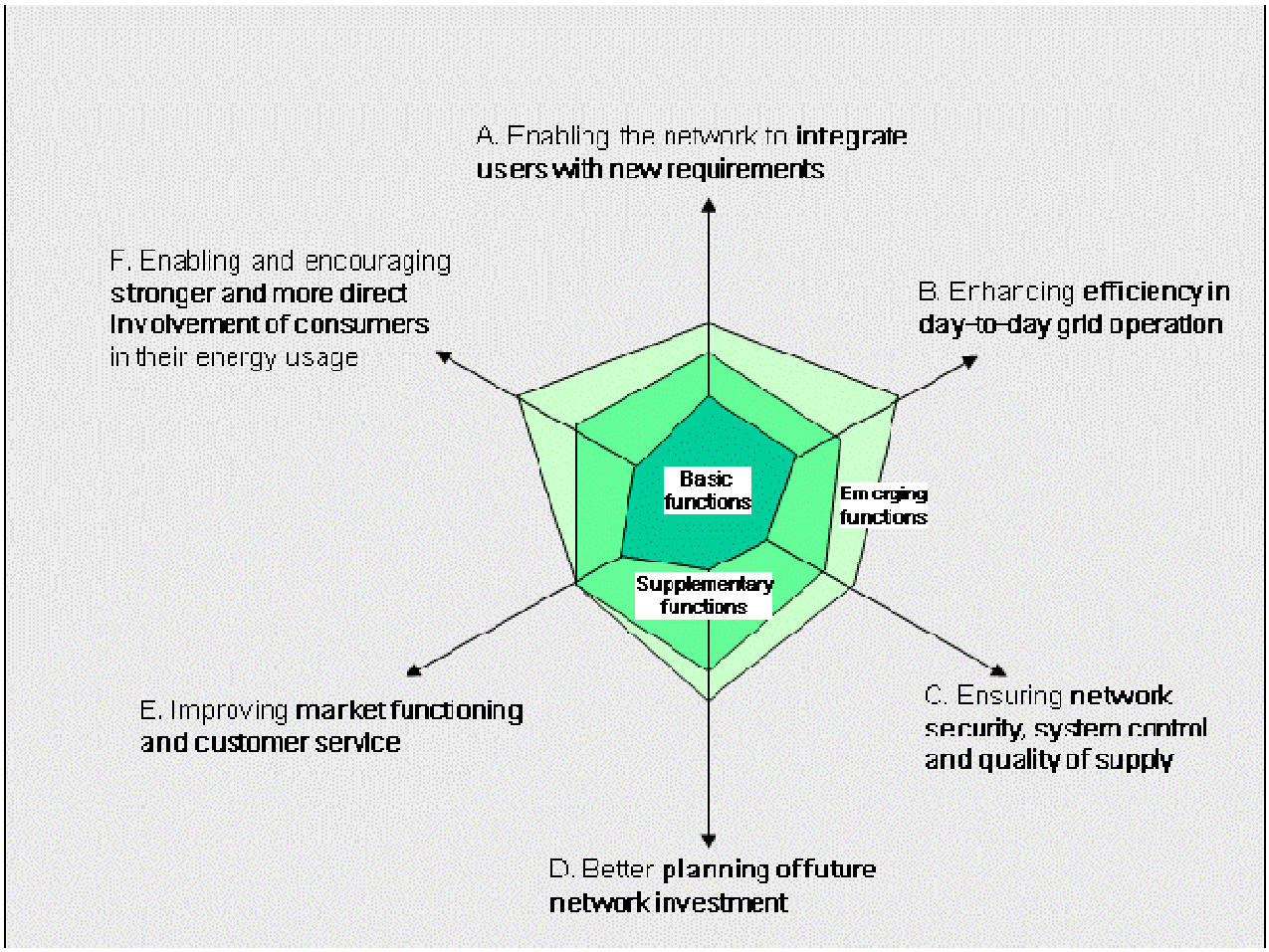

Figure 2: Mapping between the three levels of grid features, the grid users / beneficiaries and the funding options

The following examples illustrate the possible contents and key issues within the given high level services:

- Within the high level service "D. Ensuring grid security, system control and quality of supply" a basic functionality is: "Maintain adequate level of voltage quality (supply voltage variations, rapid voltage changes, dips, swells)", or "Foster proactive system stability assessment and management at distribution level (including future load and feeder state assessment, exceptional weather events, etc., also by increasingly intelligent post-fault actions)"

- Within the high level service "C. Ensuring network security, system control and quality of supply" a basic function is to "safeguard system stability, system security, continuity of supply and voltage quality"

- Within the high level service "C. Ensuring grid security, system control and quality of supply" a supplementary function would be: "Promote tailored contracts between the customers and the network operator for enhanced voltage quality".

Within the high level service "C. Ensuring network security, system control and quality of supply" a supplementary function would be "the introduction of tailored contracts (curtailment, quality of supply) between the users or their suppliers and the network operator".

Funding Recommendation #5: EG3 is of the opinion that in terms of benefits from section 4.2 the key criteria in deciding on possible funding through the additional socialization within grid tariffs, shall be based on the optimized (maximized) area in the Figure 2

Funding Recommendation #6: EG3 recommends that the evaluation of applicable and recommended funding options for the given features in Smart Grids deployment shall be based on completing the template for evaluation which is described in the following Section 4.6

4.6 Template for Evaluation of the Merit for the Deployment

The grid users' needs could develop the needed dynamics if all the relevant players are involved in an appropriate way: including consumers, generators, TSOs and DSOs, equipment vendors etc.. An important condition for this is an adequate legal and regulatory environment, ensuring attractiveness and economic efficiency of Smart Grids deployment.

Based on the expected benefits and criteria in Section 4.2, taking into account the legal provisions and tasks of the DSOs and TSOs and with mapping between the grid functions in Sections 4.5, a **template for evaluation of the merit for the deployment** is proposed in the spreadsheet below – it is intended to ensure consideration of all the different interests in evaluation of the merit for the deployment of specific Smart Grids functions (defined by EG1).

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The way to use this template is a rather simple and straight forward one:

- First the different benefits and related criteria should be evaluated in terms of their contribution to the specific grid features; a proposed metric is to use 0 for no contribution, 1 for the highest contribution and a value between 0 and 1 for some degree of contribution; this way a weighted sum of contributions for a given feature, in terms of the applicable benefits / criteria can be obtained.

- Second, the weighted sums should be calculated for the specific grid features (only an example is listed in the spreadsheet above) and for the benefits / criteria.

- Third and final step would be to elaborate on those grid functions to be deployed, which have the highest contribution to delivering the desired benefits and meeting the most criteria.

The process and template here are the initial tool for evaluation and consideration for the deployment, the next step should be a cost/benefit analysis as the basis for the concrete business plan with all the necessary elements to justify the selected Smart Grids function for the deployment – this however needs to be done on a case-by-case basis and will have to involve, besides the grid operator, all the relevant and affected grid users and stakeholders.

The primary users of this template should therefore be the DSOs, TSOs and responsible

authorities, in cooperation with grid users who should be consulted and sufficiently involved in elaborating the specific relations in the template.

Thus, the funding should then be recommended only for those functions / features, where highest benefits for all grid users are ensured – in line with the optimization approach from Figure 2 above.

5 Roles and Responsibilities – Recommendations on Scope, Policy and Regulatory Directions

In Chapter 2, the current roles and responsibilities of the actors in the electricity supply chain were presented. In this chapter the changes in current actors' roles and responsibilities and the new roles of the new actors are presented, along with the proposed policy and regulatory changes that may be required or may evolve in the coming years.

The political goal to reduce greenhouse gas emissions and to increase generation from decentralized and/or renewable energy sources has already changed and in the future will further change the energy mix in Europe. This development will continue due to the improved economics of distributed and renewable generation. To exploit the full potential of the increasing output from centralized and decentralized renewables, network structures and operations will become more sophisticated, "intelligent". This will require changes in the planning, operation, maintenance and expansion of the transmission and distribution grids. This can further lead to a shortening of investment cycles of grid operators due to the massive integration of ICT (Information and Communication Technology) components. All actors will ultimately benefit from this development as the increased smartness should result in potentially overall lower costs, higher quality of supply, enhanced competition and more flexible tariff options compared to situation where no Smart Grids deployment is made.

That said, for the successful deployment of Smart Gird, a number of challenges that need to be resolved include:

- **Technical issues,** including standardization activities, where ways to make the transmission and distribution grids smarter and stronger are proven at appropriate scales for replication in Europe
- **Market design issues,** where variable energy sources and active demand side management are integrated into new market rules, incentivizing consumers and (small) producers to actively participate in the energy market
- **Necessary changes** that allow grid operators, retailers, small generators and customers to make use of state-of-the-art communication technologies to improve data transparency and actively participate at the energy market
- **Regulatory measures allowing** the development of smarter grids and more active participation of small players by e.g. giving proper incentives to grid and energy providers and users to contribute to an efficient system
- **Customer engagement with Smart Grid issues,** especially focusing on public acceptance of and engagement with Smart Metering and reassuring consumers on privacy and/or security, and other issues that may arise. In order to build consumer trust there needs to be a systematic review of consumer protections and a strategy to deliver tangible benefits to consumers.
- **Societal issues,** such as acceptance and engagement with technological changes, ensuring that all consumers including vulnerable and low income consumers can access the benefits of Smart Grids. The way forward is to inform grid users, especially

households, which in turn is a responsibility for all actors: "watchdogs" services, regulators, suppliers, distribution networks and manufactures. At the same time, national communication campaigns must acknowledge that it is not possible to engage all audiences on the same level: consideration must be given on how best to segment and approach the respective consumer groups. Furthermore, educational messages do not deliver behavioural shifts. To achieve the desired outcomes campaigns must comprise a call(s) for action that is fun, easy and popular. In addition, another key aspect is the **position and needs of consumers** which must be addressed appropriately and contained in any strategy for overcoming the challenges above. These include;

- The national economic assessments must address the potential social benefits and risks;
- Consumers must be protected from financial risks and from unfair, new and confusing tariffs;
- Low income and/or vulnerable consumers must be protected.

Finally, it is essential to assist consumers to understand and value the environmental benefits related to the deployment of Smart Grids.

5.1 Grid Operators

DSOs' related issues will be treated mostly on national level but will require some elements of harmonization at the European level. Further investment and innovation will be required by both TSOs and DSOs. However, it appears that it is the DSOs who will have to face the biggest challenges so that Smart Grids will become a reality. The reasons include;

- Growing distributed generation, active management of demand, local storage and electric vehicles (EV) will impact the DSO infrastructure. Thus the DSO will have to be an active participant in all such projects along with the actors implementing these projects as these projects will fundamentally change today's relatively static distribution system to a much more dynamic distribution system.
- As more fluctuating distributed generation will feed into the distribution system, gathering and handling the data about the state of the distribution system will be one key issue for the DSO.
- Attention will need to be paid to ensure that all privacy and system security recommendations (in line with the provisions defined by EG2) will be adhered to. Ownership of the data, length of time data is stored etc will all need to be addressed in an appropriate way.
- The data collected will enable the DSOs to fulfil their duty in relation to the overall grid stability and operational security, given that more and more distributed generation will be connected to the distribution grid.

In order to resolve the above challenges, the DSOs will have to continue upgrading their grid infrastructure, control centres and educating their employees accordingly.

The TSOs will have to provide more support & communication of data to the DSOs, but will also require more specific information from the DSOs, especially with more distributed generation coming from the distribution grids. In order to achieve this, both TSOs and DSOs need to ensure that the standards they implement for communication and data exchange are compatible. It also follows that the TSOs will have to gradually redesign **power system control** as well as **market information management** relating to forecasting the overall

system load in conjunction with the DSOs. At the same time, the DSOs will have to strengthen their role in providing the required data relating to the distributed generation, local storage and electric vehicles within the distribution grid.

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.** Following the analysis about funding in Chapter 4, these mechanisms should include the ability to interfere with the planned market activities in case of disturbed or emergency operational conditions, without "automatic" socialization of the related costs to other grid users.

Finally, the role of grid communications will significantly increase as much more data will have to be gathered and exchanged frequently, which will be in turn used for different purposes by the grid operators and other service providers. As stated above, **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. The security of the grid and supply systems as well as the **privacy of customer data** must remain the top priority.

5.2 Grid Users

Generators

Today, large generators are responsible for supplying the major share of the load, for supplying ancillary services and reserve capacity, as well as for contributing to voltage control. This role will not change in general, but with an increasing share of distributed generation, the responsibility of distributed generation in contributing to grid stability and operational security will progressively increase, hand in hand with the technology progress which will enable that in a cost/effective manner.

Consumers

Consumers will become more engaged in Demand Side Response (DSR) and DSR will become increasingly important to enhance the overall system efficiency and effectiveness. DSR has also significant implications for the DSOs as well as equipment suppliers and electricity retailers.

Moreover, based on the increased information on consumption, consumers can make more informed decisions on how & when they can save energy, either by changing their behaviour or by engaging with an energy efficiency service provider.

Suppliers

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. It is also important that by collecting and communicating such data, all consumers will become more aware of their overall consumption of energy and how they actually use that energy. This will result in equipment suppliers, energy retailers and new actors such as 'aggregators' to offer new energy efficiency services. The ultimate result will be more competitive and market driven products being offered to consumers.

To make Demand Side Responsible possible, standard load profiles used by suppliers for customers will have to be replaced by 'dynamic' load profiles in case of flexible energy prices and / or grid tariffs. Moreover, this information will need to be complemented with the actual information about market activities of consumers, producers and those that do both, to the DSOs/TSOs.

5.3 Energy Market Place

With the deployment of Smart Grids, more and more consumers and new actors such as aggregators will participate in the energy market place. This will result in new opportunities and challenges that will need to be dealt with in a structured manner. Based on the discussions of EG3, the following have been identified as priority areas[16]:

- With the increase in distributed generation, **new energy market places will have to be promoted, contributing to a further optimization of the system**. These market places might require additional rules than the ones which are in place today in the wholesale market. The structures in the markets will start to reflect more and more the increasing decentralized character of the power system and balancing, clearing and settlement will have to react to this development by opening to smaller participants. It can be expected that an increasingly flexible formation of energy prices and ancillary services (both on the time scale and in the spatial extension) as well as increasingly flexible grid tariffs will ultimately be required to deliver the full potential of Smart Grids.

- The trading activities are responsible for the **economic optimization of the European generation "portfolio"** since the first market openings in Europe. 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 and to incentivise TSOs to further develop and harmonise the capacity calculation systems. Beyond that, the demand side response framework and implementation should be developed, that will allow the best use of the most effective measures at the customers' side also to contribute managing the intermittency of e.g. wind power.

- The emergence of more dynamic energy pricing being offered by suppliers/retailers to consumers is expected. These products may vary the price offered based on time-of-day or day-of-week related to the cost of electricity on the marketplace at that time. This would bring many benefits, but also a higher complexity for the supply of standard customers both with regard to making an adequate offer for supply and with regard to billing. Steps should also be taken to ensure that low income and vulnerable consumers are not adversely affected by the new tariff structures. Retail suppliers will be more and more confronted with **supplying customers that produce some of their electricity as well**. The management of such customers will be a challenge but at the same time an opportunity for retail suppliers or other service providers. As stated above, a change of standard load profiles will be needed for customers that actively manage their demand. These **new load profiles / flexibility measures should help retail suppliers to optimize their procurement from the energy market**.

5.4 Providers of Technologies, Products and Services

Electric Power Grid Equipment supplied to grid users will continue to evolve as suppliers innovate to integrate more and more 'smartness' into their products and solutions. Further technology developments in conjunction with advances in modern ICT will result in more sophisticated and intelligent equipment being used in the Smart Grid. An open **standards based approach** will be key for market development with standards set at the European level, through a transparent process, to create market size and through a process involving

[16] Whereas the considerations on energy market place are intended to remain as universally applicable as possible, further cost-benefit and demand analysis taking into account local and regional conditions might be advantageous for effectiveness of the Smart Grids deployment.

the full range of the new and different stakeholders in Smart Grid with distributed generation**.** Moreover, new primary technologies will be able to fulfil functionalities that had not been available in the past (e.g. relying on power electronics).

In particular, as Smart Metering does provide important functionality in support of active demand side participation, whoever is responsible for the roll-out of Smart Metering (i.e. DSOs, retail suppliers, others) it must be ensured that all relevant actors, market participants and stakeholders are be able to use the benefits of Smart Metering. Thus, the actors specifying the requirements for Smart Meters and the manufacturers of such devices must be aware that they are developing products for a regulated market environment in which European integration, consumer privacy, security of supply and regulated returns on investment are important and need to be understood.

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. The ability of actors to better understand their customers' needs, their usage behaviours towards electricity, where efficiencies can be gained within the system etc., will all enable new innovative business models and thus services offerings to be delivered to consumers. These in turn will fuel further development in new technologies, products and services from suppliers to further capitalise on these new opportunities. Consumers must have the choice whether other parties than the DSO should have access to their specific data. In this context both the kind and amount of data shared should be controlled by the consumer. Moreover, the 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 in order to benefit from the choice that competition offers in the market in terms of price, products and services. If there is a competitive advantage for the incumbent energy supplier from data access, this must be neutralized to ensure third parties have equal chance to compete in the energy supply, products and services markets. Control must sit with the consumer. To that matter, all legal provisions for data protection and privacy must be complied in full.

Examples of new services range from data mining systems for identification of new customer opportunities, infrastructure management products for distribution systems, home automation devices and home energy management class of devices and services, contract based products to consumers based on their individual usage pattern of energy, etc.

Compatibility of in home technology including appliances, communications networks and meters is key for consumers. Consumers should be able to switch energy company without having to change their display or other in-home smart products or services. Failure to address this would result in increased inconvenience to consumers, barriers to competition, additional cost of purchasing new equipment and environmental waste from obsolete technology which is thrown away.

The services related to Electric Vehicles will induce further innovation both in terms of technology and business models. While feasible business models are still being formulated, the physical impact of millions of electric vehicles participating both as 'consumers' and 'storage' actors in the grid needs to be fully understood and may further add to the complexity of maintaining overall grid stability and security of supply especially within the distribution system. It is not 100% clear at this time if new grid infrastructure will need to be built to meet electric vehicles needs, and who will actually invest in this build out. It may be the traditional TSO & DSO that do this investment or it may fall to the current 'fuel station' providers to develop this infrastructure. Regardless of who implements this infrastructure, new energy supply models and services will emerge, like e.g. 'mobile' energy consumers, pre-paid energy cards, etc.

In addition, communication service providers will offer services addressing the electricity industry needs. Given the critical role of the electricity supply, those communication services must deliver the necessary quality of service, security of information and privacy. This is particularly important under the disturbed or emergency conditions in the grid.

5.5 Influencers

Consumers and Smart Metering

While the dependencies between Smart Metering and Smart Grids have been explained, Consumers (especially residential) acceptance of Smart Metering, specifically on the perceived benefits and particularly on the perceived implications to the cost of bills, privacy and security will be key.

As outlined in Chapter 2, Smart Metering in itself is not the critical element to ensure Smart Grid deployment, it will play an important part in the success of Smart Grid deployments Thus it is important to bear in mind that consumer acceptance of Smart Metering is a critical element to the successful deployment of Smart Grids in the EU.

Regulators

It is important that national regulatory authorities and European institutions (CEER, ERGEG and ACER in the future) ensure a **long-term-predictable and stable regulatory framework**, including adequate incentives for investments, taking account of: 1) economic and technical efficiency, 2) quality of supply, 3) “smartness” of the electricity grids and 4) energy efficiency. As explained in Chapter 4, the payment of costs must at any time – today and in the future – remain **fair according to the actual originator of these costs, adhering to the principle of causality.** It follows that a well balanced and sustainable approach is needed between the appropriate rate-of return for the regulated grid operators and the respective requirements and benefits for the grid users.

Given that more actors will participate in the marketplace, Regulators will also need to further support designing and implementing the **direct regulatory measures and market rules** required for the market place of the future and for ensuring utilization of all the new services and opportunities to the benefit of all actors.

Finally and as outlined in 5.4, the emergence of electric vehicles is expected to become an important factor in the electricity supply chain, with the emergence of multiple new business models for ‘mobile‘ consumers. This may in turn result in the need for increased regulatory oversight, similar to the recent developments in the telecommunications industry.

Regulators should also be assigned the responsibility for systematically reviewing customer protection to ensure that they are fit for purpose in a smart world. For example, new safeguards will need to be put in place to protect customers from misuse of remote disconnection, remote switching, mis-selling of complex new tariffs alongside new data protection and privacy rules. They have a particular responsibility to protect the interests of low income and vulnerable consumers to ensure that all customers are able to access the benefits of smart grids.

Standardization Bodies

Open, standards based approach is crucial for the deployment of Smart Grids. The recognized European Standardization Organizations (ESOs), CEN, CENELEC and ETSI are

traditionally closely linked to regulation at European level, providing the technical specifications that are needed to implement regulation. These links are explicit in the context of EU Directives including those for EMC (Electro-Magnetic Compatibility), low-voltage and (in relation to Smart Metering) measuring instruments. The ESOs maintain formal links with global standardization bodies ISO, IEC and ITU-T (and also with UN-ECE, which is relevant for electronic business process standards) and those links should be utilized to avoid duplication of activities and possibly conflicting standards at the European or a wider level. Whereas some issues can only be standardized at European level, in other cases the necessary standards should be provided globally but the ESOs should ensure these global standards meet European requirements. In the ICT standardization, there is a plethora of different industry consortia providing sometimes competing standards solutions, and care needs to be taken to avoid inter-operability problems or issues related to intellectual property rights.

Standardization should play a role also in other areas where technical enforcement for market decisions by regulators or private sector actors is needed. Moreover, Standardization Organisations have to provide the needed flexibility to accommodate with the increasing variety of business models. These needs must be based on an agreed set of use-cases to be developed and maintained over time. All of those use-cases should be based on the described actors and roles.

One of the particularly important areas of ICT standardization concerns market communication standards like EDIFACT, etc. and their capability of fulfilling the services and functionalities. Besides general interest for standardization bodies and all other stakeholders, this issue is of utmost interest for all market players (suppliers, generators, traders, etc.) but also network operators, as it ensures a uniform and efficient exchange of data and information in the market. It is the standardization bodies for electricity and ICT sector together, who will need to review and identify all the required improvements and further development in this area.

EU and National Legislation Authorities

Policy makers should ensure active support for market and competitive business activities – including innovative approaches where these benefit their citizens. They must put in place the appropriate regulatory framework to protect consumers and enable them to access the full benefits of Smart Grids and Metering. At the same time, they should avoid interfering where this is not necessary to preserve the competitive environment, ensuring, unless it is for fairness reasons and guaranteeing proper functioning of all markets in a sustainable way to the benefit of all actors and society as a whole.

It should also be recognized that some EU, national or regional initiatives related to energy policy, economic policy, environmental policy etc may actually be counterproductive to meeting all the benefits of Smart Grids but consumer and citizen concerns must be put at the hear of the decision making process. Where such issues arise, then the framework and template defined in Chapter 4 should be used to assess all potential implications, to limit unintended consequences. Work will also need to be done around the accreditation of new technologies, products and services to ensure that customers can have the peace of mind that they deliver their proposed benefits e.g. around micro-generation.

Within the discussions and work of EG3, the following areas have been identified as priority areas to be addressed;

- Given that the marketplace will expand with new actors and services offered, the required legal framework needs to exist and be enforced to ensure all relevant market rules and regulations are in place between TSOs, DSOs and other market participants.

- Policy makers will be required to create a framework and guidance for the Smart Metering rollout especially to deal with issues relating to customer data privacy, data protection, tariffs, remote management and disconnection. Necessary legislation for imposing cross-industry standardization (energy and ICT) and imposing the Calibration Directive implementation in a uniform way throughout the member states will be required.

- The TEN Guidelines have set clear priorities for the development of transmission grid infrastructure for the EU and the Infrastructure Package announced by the EU Commission at the end of 2010 set similar priorities. Policy makers will be required to ensure the required legal framework exists to support this.

- As distributed generation will further grow, DSOs will have to rely on it to contribute to the stability of the overall grid and the associated regulatory framework to both incentivize and enforce these changes will need to be created.

- Defined and enforceable legal provisions for education and certification of DSOs and TSOs staff as well as training of other market participants will need to be developed. (E.g. comparable to provisions in air-traffic control today). The goal will be to ensure an efficient and secure operation of the grids in the highly meshed grids of Europe.

6 Conclusions

The current roles and responsibilities of the actors in the electricity supply chain have been summarized in Chapter 3.

A number of specific and directly applicable recommendations have been proposed by EG3 in relation to Interfaces (Chapter 3) and Recommendations for Funding (Chapter 4). Chapter 4 also presents the criteria, benefits and a template (tool) for assessment and elaboration of the most useful Smart Grids functions / features.

The future roles and responsibilities for the deployment of Smart Grids, have been elaborated in Chapter 5 for all kinds of actors in the electricity supply chain.

Recalling the tasks and scope of work of EG3, it should be stated at the conclusion of this document that is not a final and static answer to all questions in relation to the Smart Grids deployment – it should be envisaged as a practical toolset for use by grid operators and grid users and also as a toolset that will be further developed as the deployment of Smart Grids across the EU become a reality.

7 Glossary and Abbreviations

BRP ..... Balance Responsible Party

CEN ..... European Committee for Standardization

CENELEC ..... European Committee for Electrotechnical Standardization

DER ..... Distributed Energy Resources

DG ..... Distributed Generation

DSO ..... Distribution System Operator

DSP ..... Demand Side Participation

DSR ..... Demand Side Response

EC ..... European Community

EHV ..... Extra-high voltage, above 230 kV, ref IEC

ESO ..... European Standardization Organizations

ETSI ..... European Telecommunications Standards Institute

EV ..... Electric Vehicles

HV ..... High Voltage, above 35 kV up to and including 230 kV, ref IEC

IEC ..... International Electrotechnical Commission

ISO ..... International organization for Standardization

ITU-T ..... International Telecommunication Union

LV ..... Low Voltage, up to and including 1 kV, ref IEC

MV ..... Medium Voltage, above 1 kV up to and including 35 kV, ref IEC

MS ..... Member State

RES ..... Renewable Energy Sources

SG ..... Smart Grids

SM ..... Smart Metering

TSO ..... Transmission System Operator

ToU ..... Time of Use, pricing of energy depending on the time of its usage

UoS ..... Use of System

V2G ..... Vehicle to Grid

Ancillary services (from FERC order 888-A, April 1996): Those services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the Transmission Service Provider's transmission system in accordance with good utility practice. FERC Order 888 identified the following six ancillary services to be included in an open access transmission tariff:

- Scheduling, System Control and Dispatch Service;
- Reactive Supply and Voltage Control from Generation Sources Service;
- Regulation and Frequency Response Service;
- Energy Imbalance Service;
- Operating Reserve - Spinning Reserve Service;
- Operating Reserve - Supplemental Reserve Service.

FERC Order 888 does not preclude the transmission provider from offering voluntarily to provide other interconnected operations services to the transmission customer along with the supply of basic transmission service and ancillary services. During the consultation process towards Order 888, NERC proposed interconnected operations services were 12 as follows:

- system control and dispatch services;
- accounting;
- regulation service;
- energy imbalance service;
- frequency response service;
- backup supply service;
- operating reserve service: spinning reserve and supplemental reserve services;
- real power loss service;
- reactive supply (from generation resources) and voltage control service;
- restoration service;
- facilities use;
- reactive supply (from transmission resources).

Demand Side Response (by FERC): Changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.

Demand Side Management (from EIA DOE): The planning, implementation, and monitoring of utility activities designed to encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand. It refers to only energy and load-shape modifying activities that are undertaken in response to utility-administered programs. It does not refer to energy and load-shaped changes arising from the normal operation of the marketplace or from government-mandated energy-efficiency standards. Demand Side Management covers the complete range of load-shape objectives, including strategic conservation and load management, as well as strategic load growth.

8 List of References

[1] Documents, information, results of work and the three General Assembly meetings of the EU Technology Platform Smart Grids 2005-2009, www.smartgrids.eu

[2] ERGEG Position Paper on Smart Grids – Consultation Paper and Conclusions Paper (after public consultation), ERGEG, May 2010, www.energy-regulators.eu

[3] BEUC Non-Paper on Smart Grids and Smart Metering, delivered to the TF and EG3 in Spring 2010

[4] ETSO, EFET, eBix: The Harmonised electric market role model, January 2010

[5] T&D Europe – University of Genoa & others Universities in EU: Study on Criteria for the Quantification of how modern T&D-systems help accomplish the EU 20/20/20 targets, October 2009

[6] Mission Statement of the EU Commission TF for Smart Grids

[7] Vision of the EU Commission TF for Smart Grids

[8] Summary of answers to the EG3 Questionnaire

[9] Smart Grids: a vision and recommendations from technology providers, Orgalime, 09. July 2010

Annex I: Possible Needs for Additional EU Legislation in Support of the Smart Grids Deployment

The following questions have been answered by the EG3 members, in relation to the need of any new framework for Smart Grids:

1. Do you consider any new EU framework for Smart Grids deployment necessary? Y / N
2. If you answered Yes to the question 1. please explain:
    a. Why there is such a need?
    b. Which specific issues it needs to address?
    c. How those issues shall be addressed?
3. Do you consider any framework for standardization in relation to Smart Grids deployment necessary?
    Y / N
4. If you answered Yes to the question 2. please explain:
    a. Which issues need to be addressed?
    b. What kind of framework (e.g. EU regulation, standardisation bodies' framework, etc.)

A summary of the answers and recommendations by the EG3 to the EU Commission are presented below:

1. There is a need for standardized, harmonized approach to all issues (technical, privacy / data protection, organisational, cross-issues between energy and ICT, etc); very important: issue is **interoperability**.

2. There is **no need for new Directives or Regulation** but there is a need for a harmonized and effective implementation of the 3rd Package

3. A range of **consumer related issues** need to be addressed related to:

    (i) Adapting the implementation of the consumer protection in the 3rd Legislative Package to the rapid technological changes being introduced through Smart Grids and Smart Metering;

    (ii) Ensuring that the principle of privacy by is implemented in European Law (e.g. minimizing the amount of data to the only necessary ones, deadlines and timeframes for storage of the data, procedures for removing / deleting the data, anonymous approach, etc.);

    (iii) Extending the monitoring provisions to include indicators related to the evolution towards Smart Grids which relate to benefits for end-users, society and the environment. Moreover:

    - Consumer protection - including issues related to standards - need to take into account technological changes – such as the potential for remote disconnection/interruption of supply. Interoperability standards are a key to ensure that customers do not face compatibility problems when switching suppliers, displays or some smart in home appliances.

    - Appropriate market instruments and tools are needed to help all consumers, including vulnerable consumers switch to the best energy deal for their needs in what will become an increasingly complex energy services market.

    - As a minimum, energy customers should be entitled to their energy consumption and bill history for free in a common format, via a medium of their choice, that

allows for like for like comparisons of deals available on the market.

- The relevant national bodies need to monitor the steps taken to deliver both social and environment benefits from Smart Grids and Smart Metering through extending the appropriate legal instruments available on monitoring.

- The relevant national bodies must further take steps to pre-empt risks induced by the technological change, not just respond to risks after detriment has been incurred. This should include mitigating against the financial risks as well as protections against unfair, new and potentially confusing tariff / price information, unclear advice and energy efficiency products and service.

- Particular consideration must be given to the needs of low income and vulnerable consumers. It is essential that all consumers are able to access the benefits of Smart Grids in its broadest sense (smart homes, smart appliances, Smart Metering, transport, cheaper prices). Extending this monitoring obligation needs to be done through the appropriate legal instrument available.

4. Strengthen Support for **right and smart** investment and ensure adequate return

5. Need to **legally enable TSOs and DSOs** to fulfil their duties (also relying on the implementation of the 3rd legislative package and, if necessary correcting a national framework).

Annex II: Objectives, Dependencies and Smartening of Grid Operation

Actors, Objectives and Trade-offs

The actors of the electric power supply chain and other actors described in Chapters 2 & 3, aim at fulfilling different objectives: economic, technical and social / environmental. A common, optimized scenario requires a compromise approach and trade-offs between these objectives, in order to achieve the optimum. This is illustrated symbolically in the Figure 3 below.

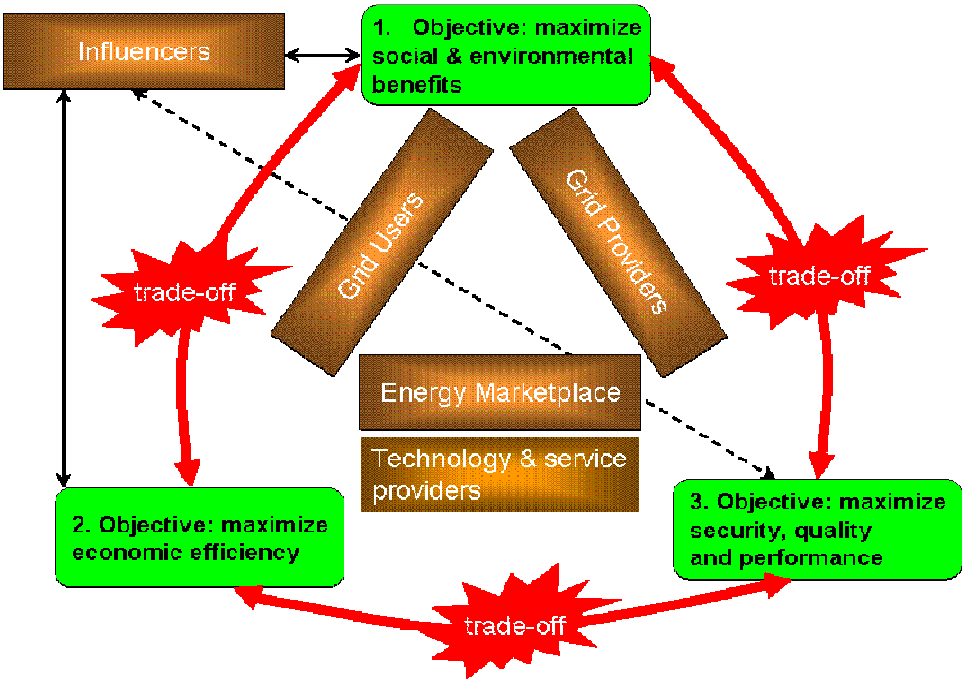

Figure 3: A view on the three different objectives and their interaction

„Smartening“ the Grid Operation

While seeking this “optimum” end state and ensuring the sharing of the necessary information required for grid operation, different actors may reconsider their planning and operation schedules in order to improve the overall grid merit. A grid is considered to be operated at its optimum when a predefined and adequate mix of quality of supply, operational security, minimizing impact on the environment and maximizing economic benefits to all actors (most notably users / consumers) metrics are achieved.

It follows that to “smarten” the operation of the grid (both transmission and distribution) it is required to reconsider the actor’s behaviour, under the necessary control, in order to meet the three objectives.

In addition, the electric power grids can undergo dynamic changes and volatile “pressure” depending on varying injections and withdrawals at any given time, which could lead to reducing the optimum state outlined above. With increased volatility and potential magnitude of this volatility (e.g. by massive wind power deployment), additional interaction and information from the grid users will be required, in conjunction with well structured control loops that will be deployed both at transmission and distribution level.

Annex III: Needs for Additional Legislation in Relation to Customer Benefits, Competition and Market

1 Preamble

At the 7th Steering Committee meeting of the EU Task Force for Smart Grids on 27th October 2010, it has been emphasized that all necessary measures need to be undertaken in order to maximize the contribution of Smart Grids to the benefits and protection of customers' interests, competition and development of the European electricity market. In particular, Smart Grids technologies and solutions shall not foreclose any part of the market or market participant, ensuring that the scope for new services remains open to all new entrants. It was decided by the Steering Committee, to request the Expert Group 3 to analise by the end of this year, whether there is a need for an additional framework at the EU level, in order to ensure the Smart Grids contribution mentioned above and, if necessary, provide support and guidance to Member States and national authorities involved in Smart Grids deployment.

2 Background Information

The needs and benefits of electricity customers are in the core of Smart Grids deployment and meeting those needs is the driving force behind both, "visible" and "invisible" features of Smart Grids. Indeed, the Strategic Deployment Document [2] of the EU Technology Platform puts the customer into the focus of the electric power supply chain and market, Fig.1.

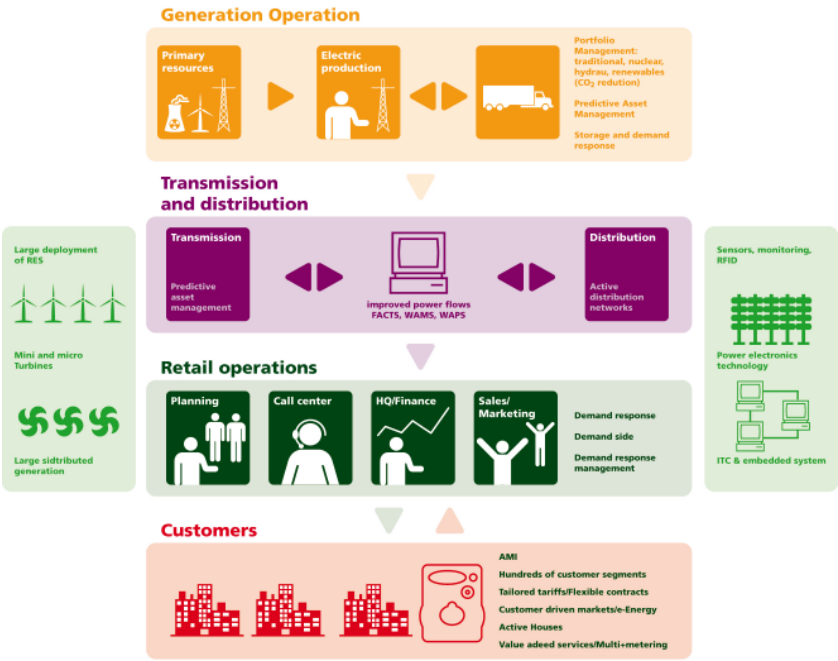

Figure 1: Customer focus of the electric power supply chain and market

(Deployment Priority No. 6 in [2])

Moreover, the need for active involvement and participation of customer throughout the different phases of Smart Grids deployment is particularly emphasized in [2], Fig. 2.

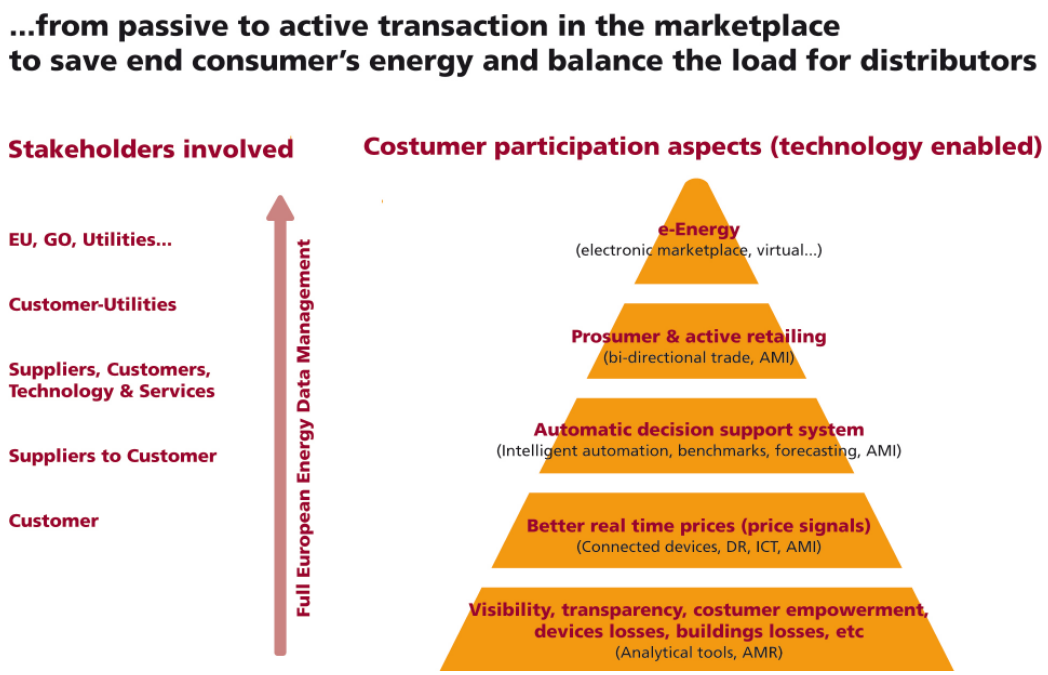

Figure 2: Customer involvement and active participation in Smart Grids deployment (Figure 15 in [2])

Strengthening customer position, supporting the innovation required for that – including Smart Grids and Smart Metering – and ensuring the necessary framework, are also among the key elements of the Third Legislative Package for European Energy Market, which is currently under implementation.

3 Key Relations and Objectives

The roles, responsibilities and relations of actors involved in Smart Grids deployment are described in detail in the EG3 deliverable document, [1]. In terms of Smart Grids contribution to the issues mentioned in the Preamble above, the relations of particular interest are the relations and interaction between the customers, Distribution System Operators (DSOs) and suppliers / aggregators / new service providers.

Against this background and bearing in mind the Background Information above, the key objectives of Smart Grids in relation to customers, market and competitions are:

1. Maximizing the customer benefits from the deployment of Smart Grids and from roll-out of Smart Metering, in particular the benefits described in detail in points (8) – (11) in chapter 4.2 in this document.

2. Ensuring that there is no discriminatory treatment of customer and supplier (or aggregator, or in the future, provider of new energy services) by the DSO or by any other actor in the Smart Grids deployment.

3. Protection of customer interests in general and in particular:

    a. Customer privacy;

b. Access to the own data of relevance (e.g. energy consumption) for any customer free of charge and under the secure conditions which prevent fraud or abuse;

c. User-friendly and secure usage of all relevant applications and elements provided by the Information and Communication Technology

4. Enhancing competition through an active support of the suppliers, aggregators and new service providers in serving the customer and promoting market development at all levels, including energy and service exchanges also at the retail (low voltage) level.

4 The Questionnaire

In response to the request of the Steering Committee mentioned in Preamble and in relation to the Background Information and Objectives presented above, the EG3 members have answered the following questions (completing the discussion on 26. January 2011)

QUESTION I

Do you consider that reaching the objectives 1.-4. above is appropriately provided for and secured within the existing legal framework in the EU, including the Third Legislative Package?

QUESTION II

In case you answered NO to the question I, please explain and answer the following:

Why do you consider that the objectives 1.-4. cannot be reached within the present EU framework?

Do you think there is a need for an EU Directive in support of achieving the objectives 1.-4. above and if yes, please specify:

(i) What it would need to address?

(ii) How it would be related to the existing EU framework?

(iii) What would be the added value?

Do you think there is a need for an EU Regulation in support of achieving the objectives 1.-4. above and if yes, please specify:

(i) What it would need to address?

(ii) How it would be related to the existing EU framework?

(iii) What would be the added value?

QUESTION III

If you have answered NO to the question I but did not make use of any of the options / answers in question II, please specify what other measure would be needed in support of achieving the objectives 1.-4.

QUESTION IV

The general question of whether an additional framework for the deployment of Smart Grids is necessary has been the subject of the first EG3 questionnaire from May 2010. The summary of answers and the result of that questionnaire are presented in the Annex 1 of this document.

Based on the specific, customer related issues from the first questionnaire (especially the point 3. of Annex I), on the follow-up discussions and the request of the SC mentioned in the Preamble, the specific questions I – III have been raised, addressing the Smart Grids contribution to the customers' benefits, competition and market.

If there are any other issues which in your view need to be addressed beyond the current EU framework, in order to ensure proper treatment and addressing of Smart Grids deployment by all actors and stakeholders, please explain such issue(s) below:

(i) What is the particular issue which needs to be addressed?

(ii) Why this issue should be addressed and why it is not sufficiently addressed within the scope of the existing EU framework?

(iii) How should this issue be addressed and how is this related to the existing EU framework?

5 Results of Answers, Discussions and Recommendations of EG3

5.1 Executive Summary

The answers of the EG3 members to the second questionnaire have been discussed at the EG3 meeting on 26. January 2011. The outcome of the discussion is summarized below, structured as follows:

- **EG3 common view with recommendations for new EU legislation** for the issues relevant for Smart Grids deployment, <u>within the scope of the second questionnaire</u> (i.e. the scope of the four objectives which were the subject of the second questionnaire: (i) maximizing customer benefits from Smart Grids deployment; (ii) ensuring non-discriminatory treatment of all customers; (iii) protection of customer interests; (iv) enhancing competition).

  Within that scope, the EG3 recommends new legislation on the following issues: (a) Time of Use (ToU) and Demand Response (DR); (b) data security, privacy and communication; (c) permissions for new grid infrastructure; (d) Information and guidance of customers; (e) Commitment of Member States towards national models for Smart Grids deployment.

- **EG3 common additional remarks** <u>within the scope of the second EG3 questionnaire</u>

- **Specific views of the EG3 members (stakeholders) with recommendations for new EU legislation** <u>within the scope of the second EG3 questionnaire.</u>

  Within that scope: (a) AIE proposes measures for customers' empowerment; (b) T&D Europe addresses the need for a harmonized approach focusing on energy efficiency, renewable energy and Key Performance Indicators (KPI); (c) BEUC proposes a number of measures in relation to customer benefits, customer protection and participation.

- **Specific views of the EG3 members (stakeholders) with recommendations** <u>out of the scope of the second EG3 questionnaire</u> addressing the issues which were already covered in the first questionnaire.

Within that scope: (a) GEODE, Eurelectric and T&D Europe call for a change of incentive regulation because they consider that it does not facilitate the deployment of Smart Grids; (b) ESMIG calls for a new legislation for Smart Grids investments; (c) ENTSO-E, COGEN Europe and CEDEC consider that there is no need for additional legislation on issues outside of the scope of the second questionnaire, but there shall be strengthening of the existing framework and priority on implementation within the scope of the 3rd Legislative Package – COGEN Europe and CEDEC call for Guidelines of Good Practice with a role for ACER and CEER.

- **Additional remarks of the EG3 members** out of the scope of the second EG3 questionnaire.

Whereas the issues presented thereafter are reflecting the discussion on the second EG3 questionnaire, they need to be considered also within the scope of the whole EG3 deliverable document and in relation to the other two EGs deliverables.

5.2 EG3 Common View with Recommendations for New EU Legislation

Within the scope of the second questionnaire (i.e. the scope of the four objectives which were the subject of the second questionnaire: (i) maximizing customer benefits from Smart Grids deployment; (ii) ensuring non-discriminatory treatment of all customers; (iii) protection of customer interests; (iv) enhancing competition), the EG3 recommends new legislation at the EU level for the following issues:

a. **(ToU) and Demand Response (DR)** → new legislation is needed in order to obtain full benefits for the customers. There is no preference on whether Directive(s) or Regulation(s) would be better[17].

   Moreover, the market design mechanisms and pricing supporting ToU and DR should be envisaged and the impact of new tariffs on low income and vulnerable customers needs to be considered accordingly too.

b. **Data security, privacy and communication to third parties** → new legislation is needed with a preferred approach being a revision of the Data Protection Directive including privacy and security by design standards, enforcement and customer education mechanisms. A final recommendation needs to be aligned with the relevant findings of the EG2.

c. **Permitting procedures for constructing of new grid infrastructure** → new legislation is needed not just for the TSOs, but also for the DSOs, in order to speed-up the realization of the new infrastructure projects which are crucial for the development of the grids. There is no preference on whether Directive(s) or Regulation(s) would be better voiced by the EG3, however recalling previous discussions and works of the European Regulators, ENTSO-E (ETSO), EU Commission and other stakeholders (most notably the ERGEG Workshop on electricity infrastructure on 13. February 2007, http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_WORKSHOP/CEER-ERGEG%20EVENTS/Electricity/WS-04_ELEC

[17] The TOU prices reflect the variability of the market value of electricity and take into account possible grid constraints, while incentivizing end users to optimize their consumption (peak load management, etc.). Therefore any kind of price regulation should be abolished.

Policy makers should focus their attention also on utilizing the present regulatory framework and removing barriers like e.g. regulated prices.

TRICITY%20INFRASTRUCTURE), a Regulation complementing the present Environmental Assessment Impact Directive would by an appropriate solution.

d. **Informing and neutral guidance of customers** → new legislation is needed to ensure that customers have choice in whether or not to share their data, gain all information and knowledge on data used free of charge, benefit of that and are empowered to decide which services are beneficial. No preference on whether Directive(s) or Regulation(s) would be better.

e. **Commitment of Member States towards national models for deployment of Smart Grids** → new legislation is needed in order to ensure that EU Member States define national models and / or platforms towards deployment of Smart Grids, in line with the provisions of the 3rd Package (Point (27) in the Preamble and Article 3 (1) of the Directive 2009/72/EC), ensuring in particular dissemination and exchange of experiences.

5.3 EG3 Common Additional Remarks

Beyond the recommendations in Chapter 2, EG3 has the following relevant remarks in relation to the customers and Smart Grids deployment:

f. Higher involvement of customers (e.g. by Demand Response) shall not lead to a reduction in system state or load predictability or to reduced reliability of the distribution and transmission grids as compared to today's levels. Whereas more data and information on customer behaviour could help to improve predictability as such, the increasing amount of distributed generation and Demand Response could eventually lead to lower predictability.

g. Energy efficiency of the full supply chain is among the key benefits to be delivered by Smart Grids.

h. There is a wide support for the work of European Standardization Organizations which are expected to receive from the EU Commission a mandate for standardization in the area of Smart Grids.

i. For consumers it is important that they get delivered what they expect and understand the benefits for them and for society as a whole and the potential risks;

5.4 Specific Views of the EG3 Members within the 2nd Questionnaire Scope

In this part the recommendations are presented, where either more specific views of EG3 members and stakeholders exist in separate works listed in References [2,3,5,9], or where only some EG3 members have a certain position which was not shared by the whole EG3. The issues addressed are within the scope of the second questionnaire

a. ***AIE:*** **Ensuring that customer receives information, neutral guidance on Smart Grids and that customer is** in **charge of which services she/he uses** → moreover, it is important that customer gains all the knowledge about their own collected data and what happens with that data free of charge; customer shall be empowered to decide on used services.

b. ***T&D Europe, University of Genoa***: **Harmonizing the approach with clear targets in energy efficiency, CO2 reduction and integration of renewable energy**

together with quantitative KPIs → to spread the benefits across the value chain and to identify customer services and advantages, because at the moment the EU framework is more qualitative than quantitative and thus prone to misinterpretation.

c. ***BEUC*: The following issues of relevance to customers require new legislation:**

- **Complaint handling and redress** in relation to the bundling of technologies (addressing the risk that the overlap of regulators' responsibilities and of liability for the respective goods and services will leave a consumer turning in circles when seeking redress/assistance)
- **Customer switching** process shall be as comfortable and simple as possible, free of charge and realized in high quality. Switching shall be possible within 24 hours with Smart Metering[18]
- **Assurance on provision of energy consumption information to consumers** in comparable formats, appropriate level of detail and free of charge
- **Encourage Member States to ensure that energy suppliers' tariffs are not complicated or confusing** and that customers can easily find the best deal for them.
- **Resolution of situations with long term and roll over contracts** (if suppliers chose to differentiate on high quality displays or energy efficiency packages this is one possible consequence for which consumer safeguards would be needed)
- **Transparent and robust processes for assessment of whether the benefits of implementation exceed the cost** → regulatory mechanisms are needed to ensure that benefits are appropriately reflected in consumer bills and do not result in increased detriment to low income households.
- **Stronger protection of vulnerable and low income consumers** (in relation to remote switching and disconnection, time of use tariffs and the potential use of load limiting by suppliers as a debt management tool).
- Informing and addressing **appropriately the customers' concerns on health**
- **Consumers producing energy** should be considered accordingly (e.g. grid tariffs, etc.)
- **Consumer choice should remain a key principle** and consumers should have the opportunity to refuse Smart Meters
- **A deadline for review should be set** whether the consumer protection provisions in the 3rd Package remain fit for purpose in a "smart world" (BEUC)
- **As recommended in the European Parliament Resolution of 15 December 2010**, Member States should develop and publish a strategy to deliver the potential benefit of Smart Metering to all consumers, including vulnerable and low income people.
- **In order to achieve reassurance to consumers on health impact,** the Commission should examine the (internationally) reported fears related to the health impact of Smart Meters.

[18] GEODE comments that the switching process is much more than gathering an accurate metering value remotely through a Smart Metering system. Besides, contractual arrangements (duration, cancellation period, etc.) must be taken into account, which is why GEODE considers that a switching period of 24 hours is unrealistic and not necessary for a well functioning electricity market.

d. ***CEER / ERGEG***: **European Energy Regulators see no need for any additional EU legal framework** beyond the issues listed in chapter 6.2 of this Annex III (EG3 Common View with Recommendations).

Moreover, it is important to reference here some key findings from the regulators' position and conclusion paper [2] which are relevant also for the EG3 work:

- A European **coordinated approach and knowledge sharing** in TSO or DSO led R&D&D public funded projects is a basic requirement and is important for fast progress, dissemination of the demonstration project results
- The electricity undertakings are well-informed but **consumer awareness is needed** to succeed in the full utilisation of the smart grids. **Consumers and all network users should be more in the focus. This could be incentivized** e.g. by introducing user satisfaction (e.g. in the form of commercial quality indicators) as one indicator for network operators' performance in the area of smart grids.
- The workshop [2] also recognised the **importance of standardisation** for the full and efficient utilisation of smart grids. Stakeholder discussions have already been organised and standardisation is also addressed in the Commission Smart Grids Task Force and its Expert Groups as well as in the relevant standardisation organisations and their stakeholder groups.

e. ***DIGITALEUROPE*** **refers to consumer protection, privacy and trust in using new services as a continuous regulation lifecycle management managed by a Global Database**

- **Other services industries** like Telecommunications and e-Banking are considered at least as critical as Utilities in terms of data handling, security and customer's protection.
- It is recommended to **investigate and to implement the regulations developed for the other critical services industries** as much as possible at a global level.
- Since regulations will continuously evolve to fill in the security and privacy gaps, ICT industry represented by DIGITALEUROPE can help creating a National, European and Global Database for handling continuous regulations lifecycle management, to manage exceptions and to take semi-automatic decisions for improvements.

DIGITALEUROPE also refers on the roles and responsibilities of each stakeholder, addressing in particular the responsibilities of Suppliers and Retailers:

- The 3rd energy package mentions **roles and responsibilities at a high European level while the unbundling structure in Europe has been in majority left to the countries to decide on their local unbundling framework**.
- Therefore, 3rd energy package must be enhanced to **harmonize at least the roles and responsibilities of Suppliers and Retailers, that are infrastructure "independent" with the objective to create a pan-European marketplace for Demand and Customer Services** focusing on Energy Efficiency Innovative programs.
- ICT industry represented by DIGITALEUROPE can help building a pan-European Retail market, starting by a group of 10 different countries.

5.5 Specific Views of the EG3 Members Out of the 2nd Questionnaire Scope

In this Chapter, specific views of the EG3 members (stakeholders) are presented which are out of the scope of the second EG3 questionnaire, addressing the issues which were largely covered in the first questionnaire.

a. ***GEODE, Eurelectric, T&D Europe:*** **Evolution of present incentive regulation framework** → since these stakeholders consider that it does not facilitate deployment of Smart Grids; Preferred approach for Iberdrola would be a Directive. Preferred approach for GEODE would be an Annex to Directive 2009/72/EC.

   Eurelectric: **Additional EU guidance is needed to keep the momentum on Smart Grids, help stimulate their development and enable DSOs to invest in Smart Grids[19],** whereas existing legislation which is already calling for intelligent networks (3rd market directive, RES Directive) might have to be reinforced.

   Eurelectric: is in favour an EC communication giving assistance to Member States and supports the assessment of legislative measures like annex to the existing Directives or precise Directives on Smart Grids along with national roadmaps/action plans (based on local needs) which would also confirm the role of DSOs as network operators and market facilitators.;

b. ***ESMIG:*** **New legislation in order to bring forth the necessary Smart Grids investments**

c. ***ENTSO-E, COGEN, CEDEC, Electrabel*****: There shall be no changes or amendment to the 3rd Package** since the package (and related codes) is not yet implemented and the existing legal framework needs rather to be strengthened accordingly.[20]

   CEDEC, COGEN Europe and Electrabel consider Guidelines of Good Practice with a role for CEER and ACER preferable over new legislation.

5.6 Additional Remarks of the EG3 Members Out of the 2nd Questionnaire Scope

a. ***Cullen International***: There is a need for binding timetable (and other, such as costs) targets as soon as possible (before 2015) for meeting 2020 targets.

b. ***EVN***: The challenge of demand response according to increased variable generation needs to be addressed by Smart Grids and Smart Metering, but there are no appropriate appliances for the customers yet. There is a need for harmonization of preconditions of regulatory practices in the EU. There is a need also for the convincing base for communication towards customers.

[19] As pointed out in the EG3 paper

[20] Nevertheless, there is a room to foresee amendments in Article 8 of the Regulation (EC) 714/2009, within the Framework Guidelines and respective Codes, if necessary in relation to customer aspects.

c. ***Eurelectric***: As more and more generation capacity will be connected to distribution grids, DSOs need to be more involved in the development of regulations for grid connection of generators and regulations for balancing energy.

d. ***BEUC***: Member States need to develop and implement a strategy to deliver the consumer benefits of Smart Grids and Smart Metering including energy efficiency; Member States should review consumer protections to ensure that customer interests are safeguarded; Smart Metering rollout must be efficient and cost effective; Mechanisms must be put in place to ensure that the consumer costs and benefits are transparent and there is accountability; EU Commission should review and offer assurances to consumers regarding the alleged health impacts of Smart Meters.

e. ***DIGITALEUROPE***: proposes, considering scalable "minimum" requirements of Smart Grids per category of connected generators and demand, the minimal Smart Grids functionalities and technologies involved:

   - available technologies,
   - needed R&D,
   - standards,
   - regulations,
   - time to market,
   - affordable costs/benefits.

   Moreover, DIGITALEUROPE considers that Smart Grids minimum functionalities should be defined as scalable categories of services that have a specific cost of deployment and ROI associated, recommending to have the following categories:

   1. Smart Grids category 1 : for today's consumers,
   2. Smart Grids category 2 : for tomorrow's consumers,
   3. Smart Grids category 3 : connecting the world of Renewable and Electrical Vehicles,
   4. Smart Grids category 4 : connecting a whole member State country,
   5. Smart Grids category 5 : connecting Europe

   ICT industry represented by DIGITALEUROPE can help packaging each of the categories in well-defined infrastructures and services to end customers as well as calculating semi-automatically the ROI generated by each category.

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