STARGRID

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D4.2 – INDUSTRY SUMMARY REPORT

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GLOSSARY

Acronym	Explanation
ADV	Advisors including Consumer associations and advisors to authority agencies
AoI	Area of Interest
AT	Austria
BE	Belgium
BULK	Bulk Generators
CBA	Component Based Automation
CIM	Common Information Model
COMM	Communication Operators
CONS	Consulting
CY	Cyprus
CZ	Czech Republic
DE	Germany
DG	Distributed Generators
DSO	Distribution System Operators
EC	European Commission
EU	European Union (wide)
FR	France
GR	Greece
ICT	Information Communication Technology
IT	Italy
LV	Low Voltage
MAN	Manufacturers
MV	Medium Voltage
NC	Network Codes
NO	Norway
OTH	Others
PL	Poland
PLC	Power Line Communication
RES	Researchers

RfG	Requirements for Generators (an ENTSO-E Network Code)
RO	Romania
SE	Sweden
Sl	Slovenia
SME	Small and medium-sized enterprises
SP	Spain
TSO	Transmission System Operators
UK	United Kingdom
UTI	Utilities
WW	worldwide

1 EXECUTIVE SUMMARY

This deliverable of the STARGRID project reports about the survey carried out within the activities of Work Package 4, through questionnaires and interviews, with the aim of gathering the point of view of Industry on the standardization process regarding the Smart Grid evolution.

The report describes the adopted methodology, illustrates the results from questionnaires and interviews and provides a commented synthesis of the findings.

2 INTRODUCTION

2.1 PURPOSE OF WORK

The overall objective of the Work Package 4 of STARGRID: "Analysis of Industry opinion regarding existing standards and drafts" is to carry out an "in-field" survey of opinions, concerns and suggestions from Industry, regarding standardization aspects of the Smart Grid. The term "in-field" means that the methodology to realise the survey should allow reaching the Industry representatives as much directly as possible, especially those representatives who are less involved in the standardization process. The clear reference, even if not exhaustive, is to SMEs, which, while constituting the largest part of the EU Industry, have higher difficulty to approach the standardization world, due to economic end organization hampers.

The survey concurs to the general objectives of STARGRID, aiming to:

- check the awareness level of Industry regarding standardization and standardization-related initiatives on Smart Grids
- assess the importance and the impact of the standardization works against the benefits expected by the Industry
- provide feedbacks to Standardization Committees on the actual use of the Standards
- identify the standardization requirements of the stakeholders and the lacks of existing standards against the selected Areas of Interest of the Project: DER Integration and Grid control; Demand-Response and Customer Energy Management and Smart Metering
- possibly identify good practices, as well as technological and non-technological solutions to take into consideration in the standardization process.

2.2 CONTRIBUTIONS OF PARTNERS

The organization of the survey, format of questionnaire and interviews, dissemination of the initiative, gathering of feedbacks, was discussed and agreed among all partners.

In particular, DERlab cared the setting up of the questionnaire and made it available online through the STARGRID website.

All partners were involved in the distribution of the questionnaire and in the execution of the interviews.

RSE cared the gathering and the analysis of questionnaire results and of reviews feedbacks and their interpretation.

2.4 RELATIONS TO OTHER ACTIVITIES

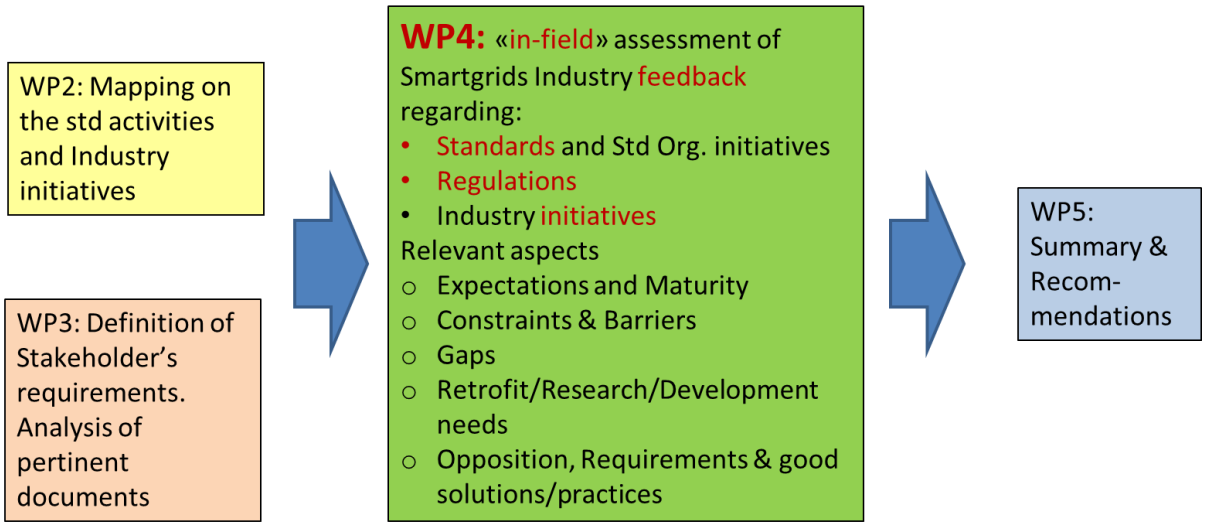
This work bases on some preparatory activities carried out in the Work Packages 2 and 3.

In particular:

- WP2 provided the mapping of the standards and standards-related initiatives, with specific attention to those initiatives directly driven by Industry
- WP3 identified the requirements of the stakeholders and produced the analysis of the standardization-related documents.

Finally, the survey benefited of the Industry ecosystem identification done in the first part of the WP4 activities (Deliverable D4.1).

Clearly, the output of WP4 is functional to the following developments in STARGRID, which will lead to the elaboration of recommendations on the Smart Grid standardization and related issues, both topics of Work Package 5.



Interconnection of STARGRID Work Packages

3 SURVEY METHOD

The survey method is based on two integrated instruments in order to gather the "in-field" position of Industry regarding the Smart Grid Standardization: the Questionnaire and the Interview. In the following paragraphs, criteria and tools of both instruments are explained in some details.

3.1 QUESTIONNAIRE

3.1.1 Structure of the questionnaire

The following figure illustrates the format of the questionnaire:

Questionnaire Format

Section 1	Section 2	Section 3	Section 4	Section 5
General infos on the Organization and its involvement in STD process	Core SG Standards	Priority Topic 1: DER Integration and Grid Control	Priority Topic 2: Demand – Response Management	Priority Topic 3: Smart Metering
		General STD requirements		
		Gaps and specific requirements		
		Standardization initiatives		

Format of the Questionnaire

The Questionnaire is divided into 5 Sections:

3.1.1.1 Section1: Basic information

In the Section 1 the interviewed is requested to provide some basic information about the company he is representing. The below table indicates the nature of the information. The compilation of the questionnaire, in general, is anonymous, to preserve the privacy rights of the Respondent. However, some information on the represented company (Name, Typology, Sector of activity) are obviously necessary, in order to allow the correct interpretation of the given answers. The answer to some questions (type of organization, sector and technology category) is helped and addressed with menu options[1].

Name of company/organisation*		
Contact (Email)*		
		Please indicate if other
Country/Region (for multinational companies, please estimate whether your answers are relevant only to your national branch or the whole company)		
Type of organisation		
Sector (please select the sector most appropriate to your department within the organisation)		
Please indicate the general Smart Grid technology category your company produces/uses		
Do you think that your sector is suitably represented in the standardization process?		
Does your organisation participate in standardization committees or consortia?		

*required field

List of requested information

[1] To help the compilation of the Questionnaire, the compiler may choose to access a version in local language (Italian, Romanian, Spanish and German)

3.1.1.2 Section 2: Core Smart Grid Standards

This Section contains a list of Smart Grid Standards. The list is clearly non-exhaustive in the landscape of relevant standards.

The main objective pursued by this Section is to assess the overall level of involvement and awareness of the responders about existing standards.

With this in mind and without any prejudice against other lists compiled on the same subject (those provided by the Smart Grid Coordination Group and by IEC, *in primis*) the choice of the listed standards responds to the following criteria:

- The list should cover the scope of STARGRID represented by the selected Areas of Interest: DER integration and Grid Control; Demand Response & Customer Energy management; Smart metering.
- The list should be sufficiently "light", i.e. suitable for a compilation of an informative questionnaire
- The list should include the standards most commonly mentioned in the Smart Grid context. i.e. linked to the "hottest" issues of Smart Grid
- The list is complemented by other lists more specifically referred to the STARGRID AoIs and included in the respective sections of the Questionnaire
- The listed Standards should refer to the general and more crucial aspects (we could say: "systemic" aspects) of the Smart Grid. Product standards and specifications are out of the scope of the investigation.

In any case, the possible missing of one particular Standard, does not affect the attainment of the declared objective of the survey.

Finally, the responder is fully and explicitly left free to indicate further Standards of interest, not included in the list.

The respondents are requested to quantitatively express their opinion, possibly commented, on:

a) The relevance of each listed standard to the scope of the organization represented by the respondent
b) An assessment of the importance (increasing,

IEC 60870-5:** Telecontrol equipment and systems - Part 5: Transmission protocols (including parts 101/104)
IEC 60870-6 **- Tase.2: Telecontrol equipment and systems - Part 6: Telecontrol protocols compatible with ISO standards and ITU-T recommendations
IEC 61850* - Power Utility Automation: Communication networks and systems in substations
IEC 61968* - CIM for Distribution: Application integration at electric utilities - System interfaces for distribution management
IEC 61970 *- CIM for Energy Management: Energy management system application program interface (EMS-API)
IEC 62325 - CIM for Market Communication: Framework for energy market communications
IEC 62351* – Security: Power systems management and associated information exchange - Data and communications security
IEC 62056 - DLMS / COSEM:** Electricity metering - Data exchange for meter reading, tariff and load control
IEC/TR 62357 **- Service Oriented Architecture (SOA): Power system control and associated communications - Reference architecture for object models, services and protocols
IEC PAS 62559 – Methodology: IntelliGrid methodology for developing requirements for energy systems
IEC 62488-1 - Power line communication systems for power utility applications - Part 1: Planning of analogue and digital power line carrier systems operating over EHV/HV/MV electricity grids

List of Smart Grid Core Standards (: core std; **: high relevance std according with IEC)*

decreasing, unvaried) that each will assume in
the next short-term future for the organization.

The assessment, in this and in all cases where the respondent is requested to, is quantified through a score ranging from 1 (lowest relevance) to 5 (highest relevance).

3.1.1.3 Sections 3÷5: Specific points referred to the Areas of Interest

The format of the Sections 3-5, respectively referred to the three Areas of Interest, is the same:

Requirements. The first sub-section is dedicated to the Smart Grid Requirements of the stakeholders concerned with the AoI. The listed requirements are derived from the analysis done in WP3. Regarding the requirement aspect, the respondents are requested to assess:

- The priority of the requirement for the represented organization.

Gaps & Required Actions. The second sub-section is dedicated to gather the opinion of Industry on Gaps & Actions-to-implement still to be covered by the existing (or not-existing yet) standards, regarding specific issues of the represented organization. A list of pre-selected gaps is presented, based on the analysis of the previous phases of STARGRID. They do not necessarily correspond to the gaps selection done by the SGCG, although they often coincide. As usual, the respondent may comment and/or add any possible self-assessed gap. Regarding this sub-section, the respondents are requested to express:

- The agreement on the described Gap/Required Action.

Standardization initiatives. This sub-Section lists selected standards (new or in revision) and technical specifications as well as regulation documents, representing in progress initiatives fostered by Smart Grid needs. They will presumably result in new standards and provisions for the industry. Those promoted by the Industry had the priority in the selection. The questionnaire responders were request to express:

a) The level of their knowledge about these initiatives
b) The expected importance for the represented organization

3.1.1.4 Section 3: DER integration & Grid Control

Requirements for DER integration & Grid Control

System
Grid management (Configuration and re-configuration; fault diagnosis, self-healing, island operation)
Safety (of the Grid and of the DER); protection schemes
Safety of the personnel
Seamless communication between control centers, substations and DER installations
EMC compatibility
Operation
Forecasting of power and loads
Electrical Connection of DER to the grid and disconnection
Remote control of DER
Integration into legacy grid control systems
DER Monitoring and Sensors
Service
Support Quality of Supply (Continuity, Voltage and Frequency stability, FRT capability) - Ancillary Services
Provision of flexibility by DERs (control aspects)
Market
Connection procedures
Aggregation of power and loads
Non- discriminatory Power Market access
Services Market (operation/flexibility conditions; revenue of the service)
Data handling
Information and data exchange (definition of the information and data models)
Compliance Testing and certification specifications (incl. e.g. simulation models requirements)?
Objective and non-discriminatory data access rules for service providers (like aggregators).
Access to the electric and energy market (including procurement).
Security of data and protection of the information.
Regulation
Harmonized and stable technical interconnection rules at national and EU level

Gaps & Required Actions for DER integration & Grid Control

Smart Grids request increased automation levels of the distribution grid, to ensure higher efficiency of operation, security, control and quality. Faults detectors will enhance operation and reduce shutdown times.
Electrical connection and operation rules of DERs should be harmonized within Europe.
Too strict connection requirements may have financial impact and slow down the implementation of DERs.
New EMC requirements will arise from the development of the grid, requiring reviewing of the Standards.
Available standards provide a sufficient level of cyber security to protect process control and business.
Installation rules of DER should be adapted to allow for new ways of operating grids, such as microgrid. E.g. safety issues have to be covered for all kind of operation and plant technology.
Ripple control technology offers sufficient means for the grid operator and service providers to control DERs.
Mature communication protocols for the control of distributed energy resources do exist already.
A single communication protocol for the remote control of DERs should be imposed in interconnection rules, to ensure interoperability.
Communication protocols as well as information data models for control center <-> DER communication have to be harmonized.
New connection requirements may impact the design, the life time and the sizing of machines and equipment.
Standards for auxiliary power systems are missing (low voltage DC networks): AC/DC converters, DC management systems, DC protection.
A centralized data access platform is necessary (e.g. containing information on the type of generators, capacity and location).
The current EU electricity wholesale market model (the so-called 'target model') has to be adapted for optimised market integration of DERs.
A capacity market could be an effective way to improve market integration of DERs.
Tender requirements for ancillary grid services should be adapted to allow for participation of DERs (availability, minimum offer sizes, aggregation, etc.).

Standardization related initiatives for DER integration & Grid Control

pr IEC 62689 Ed. 1.0 Current and Voltage sensors or detectors, to be used for fault passage indication purposes - Part 1: System aspects; Part 2: General principles and requirements; Part 3: Communication; Part 4: Conformance Testing (IEC TC 38 WG 46)
ENTSO-E Network Codes: RfG: Requirements for Grid Connection; DCC: Demand Connection Code; OS: operational Security; etc.
prEN 50438:2013 (DER operation system) Requirements for the connection of micro-generators to LV distribution networks (CLC TC8X WG3)
FprTS EN 50549:2012 (DER operation system) Requirements for the connection of generators above 16A to LV and MV distribution networks (CLC TC8X WG3)
Pr IEC 61000-X: Electromagnetic Compatibility (EMC) (TC 77)
IEC 62786 Ed. 1.0 Smart Grid User Interface: Demand Side Energy Sources Interconnection with the Grid (TC 8)
IEC/TS 62351-8 Ed. 1.0 Power systems management and associated information exchange - Data and communications security - Part 8: Role-based access control (TC 57 WG 15)
CLC HD 60364-1 Rules for the design, erection, and verification of electrical installations: safety of persons, livestock and property (CLC TC 64)
IEC 61850-90-X Communication networks and systems for power utility automation (e.g. IEC 61850-90-14 for FACTS (Flexible AC Transmission Systems))
IEC 61968 - Common Information Model (CIM) / Distribution Management Application integration at electric utilities - System interfaces for distribution management - Part 8: Interface Standard For Customer Support
IEC 62361-X Harmonization of Quality Codes across TC 57 (TC 57 WG 19)

3.1.1.5 Section 4: Demand Response & Customer Energy Management

Requirements for Demand Response & Customer Energy Management

System architecture
Modular architecture
Scalability
Information Security
Services
Standardized market processes (such as customer or device de-/registration with a service provider)
Fair and non-discriminatory data access for service providers
Ancillary Services
Direct remote load control
Incentives based load control
Baseline definition and service verification
Support for Low Frequency Demand Disconnection and Low Voltage Demand Disconnection (autonomous load disconnection in case of severe underfrequency or undervoltage)
Support for System Frequency Control (autonomous adaption of suitable load/generation devices, e.g. temperature controlled devices, to the system frequency)
Support for Active/Reactive Power Control (load or generation remotely adaptable by the relevant network operator for re-/active power control)
Support for Transmission Constraint Management (load or generation remotely adaptable by the relevant network operator for the purpose of constraint management)
Consumer empowerment
Data privacy
Affordability
Simple handling of devices and software
Opt-out right at any time in Demand Response programs
Data visualisation (e.g. operating schedules, tariff, weather forecasts)
Communication
Standard communication interface: customer energy management system (CEMS) <-> market
Standard communication interface: CEMS <-> grid operator
Standard communication interface: grid operator <-> market
Bidirectional communications, feedback from the customer installation to grid or market operator
Integration of Home Gateways in legacy grid control systems
Interface between customer energy management infrastructure and the advanced metering infrastructure (AMI)

Security: authentication and encryption
Support for multiple and upcoming communication technologies
Home Gateway
Standardized basic services, such as registration, access rights & authentication, data-transfer, time synchronisation, etc.
Standardized protocol translation (gateway functionality)
Standardized runtime environment for applications; accessible to multiple service providers
Transparent forwarding of external control commands to connected devices
Providing status information on capabilities/connected devices to authorised third parties
Decent self-consumption
Specification of basic hardware requirements

Gaps & required actions for Demand Response & Customer Energy Management

The variety of home automation protocols in use hinders the spread of home automation and energy management systems.
The definition of an abstraction layer, i.e. an abstract data model that can be mapped to different information layer standards is a suitable approach to handle the problem of incompatible protocols.
A standardized protocol converter for energy management applications at the customer premises is required
A standardized runtime environment for energy management applications at the customer premises is required
If a Smart Meter Gateway (SMG) is available in a building, the access to controllable loads within the building for external service providers should mandatorily be channelled through the existing (possibly regulated with regard to security measures) connection via the SMG.
The wide-scale introduction of variable tariffs could boost Demand Side measures uptake in Europe
There is an urgent market need (in Europe) for a Demand Response standard, defining the communication between service providers (e.g. utilities or aggregators) and end customers
A Demand Response standard must be compatible with the Common Information Model (IEC 61970, 61968, 62325)
The current EU electricity wholesale market model (the so-called 'target model') has to be adapted to allow for market participation of Demand Response providers
A tailored capacity market would be an effect way to improve the market integration of Demand Response programs.
Aggregation of loads and small generation units should be allowed when bidding into electricity markets.
Tender requirements in ancillary markets, like minimum offer size and minimum durations, should be lowered to allow for Demand Response participation.
Mandatory system frequency control capabilities of temperature controlled devices can be an effective means to ensure grid stability.
Mandatory system frequency control should be imposed on battery chargers and the like (e.g. e-mobility, home energy storage systems).
Mandatory use of technical energy management systems by groups of energy consumers should be imposed when a macroeconomic benefit can be expected.

Standardization related initiatives for Demand Response & Customer Energy Management

IEC 62746 System interfaces and communication protocol profiles relevant for systems connected to the Smart Grid (TC 57 WG 21)
IEC 61850-7-420 ed. 2 [current IEC/TR 61850-90-X] Distributed energy resources logical nodes (TC 57 WG 17) **OpenADR 2.0** Open Automated Demand Response
IEC PC 118 Smart Grid user interface
prEN 50491-12 General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) - Part 12: Smart grid - Application specification - Interface and framework for customer Energy Management (CLC TC 205 WG 18)
Facility Smart Grid Information Model (FSGIM)
ZigBee Smart Energy Profile (SEP) 1.x
ZigBee Smart Energy Profile (SEP) 2.0
ZigBee Home Automation Profile
EEBus
Energy@Home
OGEMA Open Gateway Energy Management Alliance
ENTSO-E Demand Connection Code

3.1.1.6 Section 5: Smart Metering

Requirements for Smart Metering

System architecture and performance
Interoperability
Scalability
Security
Longevity
Modularity
Services
Remote meter reading and management
Remote connection/disconnection
Quality of Supply control
High availability
Load profile data
Usability of AMI for additional services
Provision of data from the AMI for grid control purposes (e.g. voltage and phase measurements)
Allow advanced information, management and control systems for services suppliers and customers
Provision of a variable price signal to customers
Fair and non-discriminatory data access for service providers
Consumer empowerment
Billing based on actual consumption
Data privacy
Affordability
On-demand meter data access
Data visualisation (consumption and billing information)
Seamless change of provider (facilitate switching and moving)
Communications
Standardized interfaces and data exchange formats
Noise limitations ensuring PLC viability
Secure communications (ensuring data integrity & confidentiality)
Bidirectional communications

Support for multiple and upcoming communication technologies
Standardized data profiles
Regulation
Mandatory security provisions (authentication and encryption, data management)
European harmonisation of metering regulations

Gaps & required actions for Smart Metering

The regulatory differences on smart metering between Member States can be barriers for efficient deployment and cost reductions
Many different standards are being used in the smart meter deployments and are deemed to coexist. The current approach of achieving interoperability at the data model level (for example, using DLMS/COSEM) seems to be efficient and sufficient.
Strong security mechanisms (encryption & authentication) should be mandatory for the WAN communication of the SMG
A pragmatic approach to security is to deploy the smart meters and implement security measures progressively, as needed.
Grid operators should get full access to grid related Smart Meter data at the customer connection point, like voltage, current and cos φ.
Smart meters have the potential to be the gateway by which electricity supply can be controlled remotely (entire supply or individual appliances). This possibility must be exploited and become a standard functionality of the smart meter for home devices control
A standardized communication profile for the connection of controllable loads or an energy management system to the Smart Meter Gateway is missing.
Concerning the smart meter certification (non-metrology aspects), the process is still too unclear (lack of harmonised standards/procedures, list of tests, etc.)
In the smart meter certification process it is distinguished between "conformance" (one meter in lab conditions) and "performance" (meter in the entire system, with many meters operating): a) There is a gap in the "conformance" testing
b) There is a gap in the "performance" testing

Standardization related initiatives for Smart Metering

TR 50572 (SMCG) Functional reference architecture for communication in smart metering systems
IEC 62056 Series (incl. DLMS/COSEM) Electricity Metering Data Exchange (TC 13)
ETSI GS OSG 001 Open Smart Grid Protocol (OSGP)
prTS 50568-5 (Meters & More) “Electricity metering data exchange – The Smart Metering Information Tables and Protocols (SMITP) suite" (CLC TC 13)
prTS 50567-1 (PRIME) Meter data exchange over power lines – Part 1: Lower layer profile using OFDM modulation Type 1 (CLC TC 13)
prTS 50567-2 (G3-PLC) Meter exchange over power lines – Part 2: Lower layer profile using OFDM modulation Type 2 (CLC TC 13)
IEC 61334 - DLMS (PLC) Distribution automation using distribution line carrier systems (TC 57 WG 9)
IEC 62056-6-9 Mapping between the Common Information Model CIM (IEC 61968-9) and DLMS/COSEM (IEC 62056) data models and message profiles (TC 13)
ANSI C12 / IEEE 170x Series “Smart Grid Meter Package”
IEC 61968-9 - CIM for Distribution Application integration at electric utilities - System interfaces for distribution management Part 9: Interface Standard for Meter Reading & Control (TC 57 WG14)
M-Bus (EN 13757-2,3), wM-Bus (EN 13757-4)
ETSI M2M Machine to machine communication
SyM^2 specification Synchronous Modular Meter
ZigBee Smart Energy Profile (SEP) 1.x
ZigBee Smart Energy Profile (SEP) 2.0
Energy@Home

3.1.2 Distribution of the questionnaire and Dissemination

The questionnaire was made available on the STARGRID website for the online compilation.

It was also distributed through e-mails to the stakeholders identified in the STARGRID industry ecosystem (Deliverable D4.1).

The announcement of the questionnaire was also realized through the STARGRID newsletter which was sent in October 2013 inviting the 160 recipients to participate in the survey.

Finally, scope and objectives of the questionnaire were disseminated in different workshops and conferences either organized by STARGRID or within other initiatives.

3.2 INTERVIEWS

3.2.1 Format of the interview

The following figure illustrates the format of the interviews, used as a helpful track for the interviewer. Four levels of information are considered. The first level and the third one are strictly complementary to the questionnaire.

Interviews Format

Level	Subject
Level 1	Relevance of the raised technical topics
Level 2	Participation in the STD process
Level 3	Specific requirements for Standards
Level 4	Awareness/Assessment of STARGRID initiatives

In general, interviewed people gave explicitly their voluntary adhesion to the interview through the questionnaire. Other people were separately contacted by the STARGRID Partners among the stakeholders selected in the Industry ecosystem.

4 STATISTICS ON THE QUESTIONNAIRE RESPONDERS

4.1 CATEGORIZATION OF THE RESPONDERS

For the categorization of the Respondents (anonymous) two classes are considered:

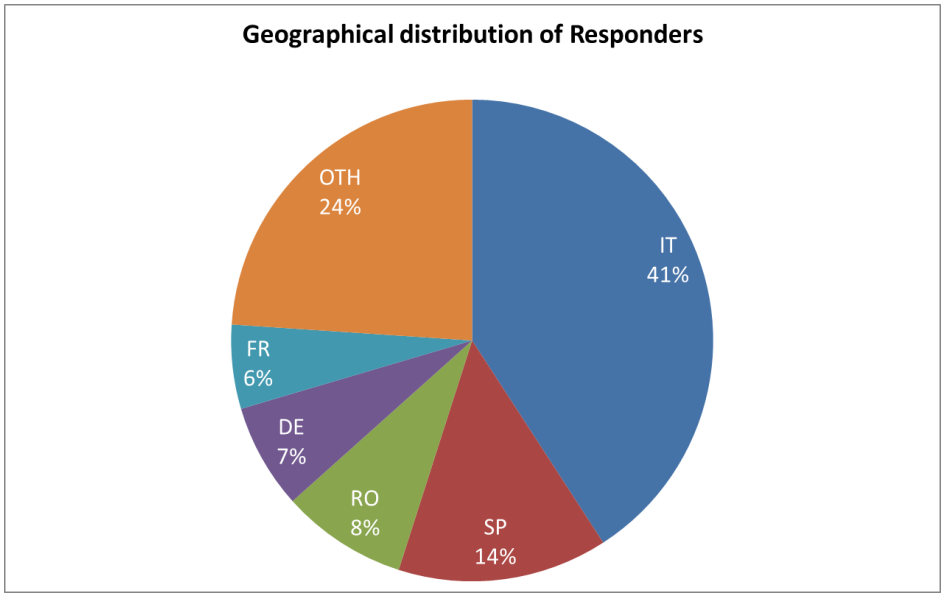
Country of provenance. The intent of this classification is to find out possible macroscopic differences in the answers, caused by peculiar aspects of the concerned country, mainly attributable to the local regulations and energy infrastructure/market organization.

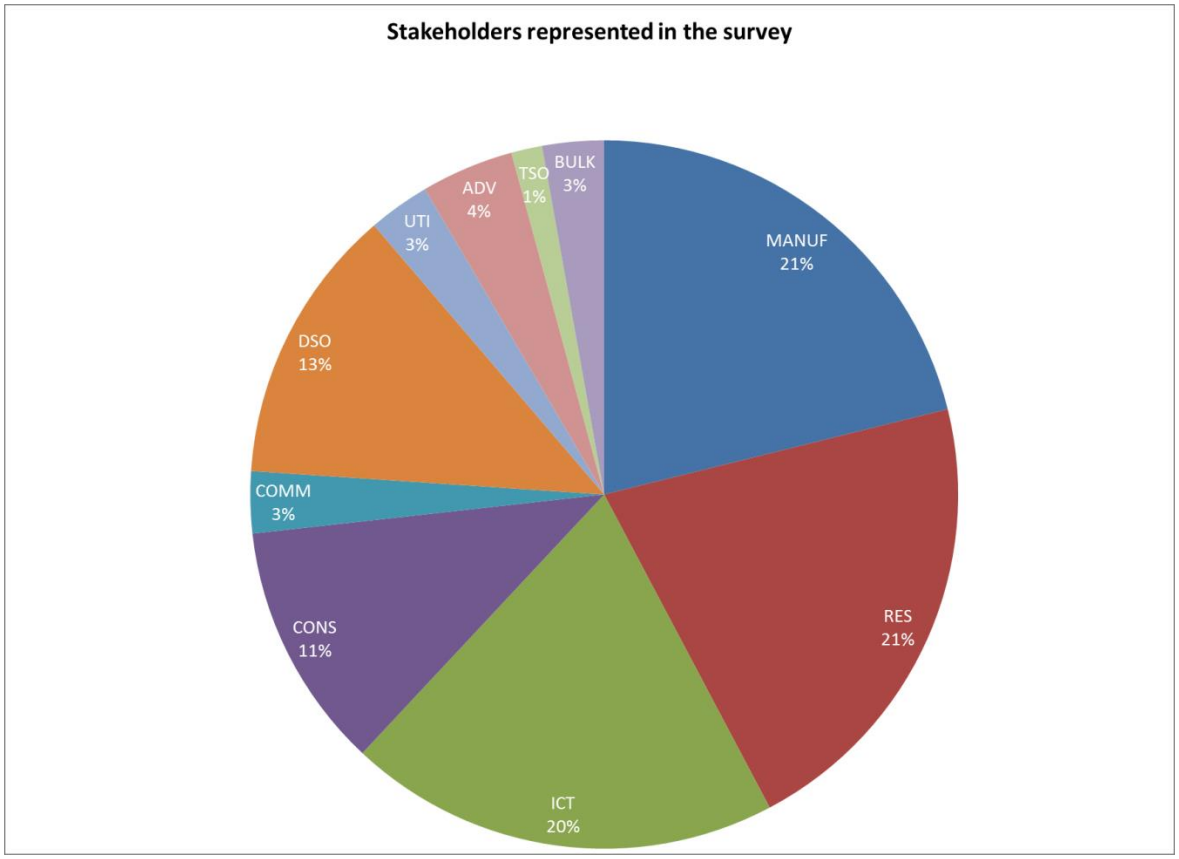
Category of stakeholder. The respondents have been grouped in few categories based on the activity sector of the organization. This is to read possible tendencies and not to disperse the flow of the provided information in too small streams. The following categories are considered:

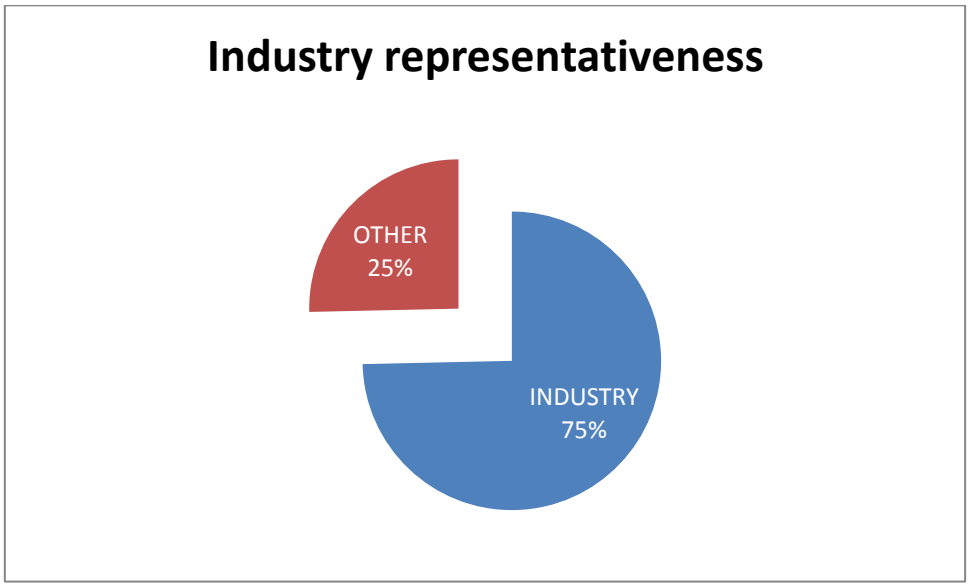
- Industry categories, including all commercial products/services suppliers:
  - Manufacturers (MANUF): including equipment/instruments/hardware constructors
  - Information Communication Technologists (ICT): including control and automation producers and software providers
  - Distribution System Operators (DSO)
  - Transmission System Operators (TSO)
  - Utilities (UTI)
  - Bulk Generators (BULK)
  - Communication Operators (COMM)
  - Consulting (CONS)
- Other
  - Advisors (ADV), including Consumers associations and advisors to Authorities Agencies
  - Researchers (RES), including Academy and Education

4.2 STATISTICS ON THE RESPONDERS

The following graphics summarize the main statistics of the survey:




Stakeholders represented in the survey
MANUF 21%
RES 21%
ICT 20%
CONS 11%
COMM 3%
DSO 13%
UTI 3%
ADV 4%
TSO 1%
BULK 3%


Industry representativeness
OTHER 25%
INDUSTRY 75%

COUNTRY	MANUF		RES		ICT		CONS		COMM		DSO		UTI		ADV		TSO		BULK		TOT
IT	8	53%	6	40%	6	43%	3	38%	2	100%	3	33%	0	0%	0	0%	1	100%	0	0%	29
	28%		21%		21%		10%		7%		10%		0%		0%		3%		0%		41%
SP	3	20%	2	13%	2	14%	0	0%	0	0%	3	33%	0	0%	0	0%	0	0%	0	0%	10
	30%		20%		20%		0%		0%		30%		0%		0%		0%		0%		14%
RO	0	0%	1	7%	1	7%	1	13%	0	0%	0	0%	1	50%	2	67%	0	0%	0	0%	6
	0%		17%		17%		17%		0%		0%		17%		33%		0%		0%		8%
DE	0	0%	1	7%	1	7%	2	25%	0	0%	0	0%	1	50%	0	0%	0	0%	0	0%	5
	0%		20%		20%		40%		0%		0%		20%		0%		0%		0%		7%
FR	1	7%	0	0%	1	7%	0	0%	0	0%	2	22%	0	0%	0	0%	0	0%	0	0%	4
	25%		0%		25%		0%		0%		50%		0%		0%		0%		0%		6%
GR	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1	50%	2
	50%		0%		0%		0%		0%		0%		0%		0%		0%		50%		3%
EU	0	0%	0	0%	1	7%	0	0%	0	0%	0	0%	0	0%	1	33%	0	0%	0	0%	2
	0%		0%		50%		0%		0%		0%		0%		50%		0%		0%		3%
CY	0	0%	0	0%	0	0%	0	0%	0	0%	1	11%	0	0%	0	0%	0	0%	0	0%	1
	0%		0%		0%		0%		0%		100%		0%		0%		0%		0%		1%
BE	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1
	100%		0%		0%		0%		0%		0%		0%		0%		0%		0%		1%
UK	0	0%	0	0%	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1
	0%		0%		100%		0%		0%		0%		0%		0%		0%		0%		1%
SI	0	0%	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1
	0%		100%		0%		0%		0%		0%		0%		0%		0%		0%		1%
USA	0	0%	1	7%	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	2
	0%		50%		50%		0%		0%		0%		0%		0%		0%		0%		3%
PL	0	0%	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1
	0%		100%		0%		0%		0%		0%		0%		0%		0%		0%		1%
NO	0	0%	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1
	0%		100%		0%		0%		0%		0%		0%		0%		0%		0%		1%
CZ	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1	50%	1
	0%		0%		0%		0%		0%		0%		0%		0%		0%		100%		1%
SE	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1
	100%		0%		0%		0%		0%		0%		0%		0%		0%		0%		1%
AT	0	0%	1	7%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1
	0%		100%		0%		0%		0%		0%		0%		0%		0%		0%		1%
WW	0	0%	0	0%	0	0%	2	25%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	2
	0%		0%		0%		100%		0%		0%		0%		0%		0%		0%		3%
TOT	15	100%	15	100%	14	100%	8	100%	2	100%	9	100%	2	100%	3	100%	1	100%	2	100%	71
	21%		21%		20%		11%		3%		13%		3%		4%		1%		3%		100%

The above table represents in details the figures of the survey.

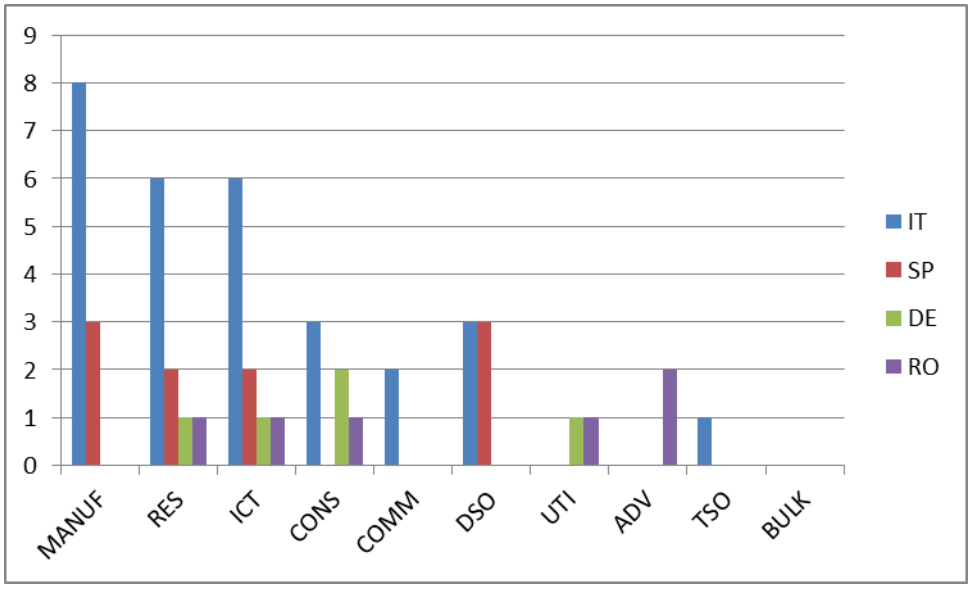
4.3 WARNING ON THE USE OF THE SURVEY RESULTS

The dispersion of the represented categories (both of country and of stakeholder) and the limited number of valid Respondents (a relatively huge number of these latter were eliminated for the scarce reliability/completeness of their answers) force to the following consideration about the interpretation of the results from the survey:

Only the average responses of all the respondents may have sufficient significance as indexes to be analysed.

A more limited significance could be attributed to:

- The average responses of the respondents coming from the most represented countries (IT, SP, DE, RO), corresponding to those also represented in the STARGRID consortium
- The average responses of the respondents belonging to the most represented stakeholders categories (for Industry MANUF, ICT, DSO, CONS, plus RES).



Indications from respondents not sufficiently represented as a group could be case-by-case considered, with due reservation and justification.

5 RESULTS FROM THE QUESTIONNAIRES

The presentation of the survey results is done through commented tables elaborated from the questionnaire data.

Colours of the cells are correlated to the score value and should give more immediate evidence to the figures. In particular, the following convention is adopted:

	score between 4,01 and 5,00
	score between 3,01 and 4,00
	score between 2,01 and 3,00
	score between 1,01 and 2,00
	score between 0,01 and 1,00

Furthermore, the following Legenda is used in the Tables:

LEGEND	
DE	Germany
IT	Italy
RO	Romania
SP	Spain
CONS	Consulting
DSO	Distribution System Operator
ICT	ICT providers
MAN	Manufacturers
RES	Research

5.1 Relevance and future impact of Core Standards

STANDARD	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
IEC 61850 - Power Utility Automation Communication networks and systems in substations	3,54	3,23	3,33	4,00	4,80	3,07	4,17	3,89	3,63	3,00
IEC 62056 - DLMS / COSEM Electricity metering - Data exchange for meter reading, tariff and load control	3,31	2,41	4,56	3,17	2,80	3,25	3,83	4,44	2,50	2,83
IEC 61968 - CIM for Distribution Application integration at electric utilities - System interfaces for distribution management	3,16	2,75	2,44	3,20	4,00	2,58	4,25	3,33	2,63	2,92
IEC 60870-5 Telecontrol equipment and systems Part 5: Transmission protocols (including parts 101/104)	3,14	2,80	4,00	3,67	3,60	2,77	3,33	3,78	2,88	2,46
IEC 61970 - CIM for Energy Management Energy management system application program interface (EMS-API)	3,13	2,92	2,44	3,33	3,60	3,00	3,83	3,33	2,75	2,54
IEC 62351 - Security Power systems management and associated information exchange - Data and communications security	3,11	2,72	2,78	3,33	4,40	2,77	3,67	3,56	3,00	2,54
IEC/TR 62357 - Service Oriented Architecture (SOA) Power system control and associated communications - Reference architecture for object models, services and protocols	3,00	2,91	2,67	3,50	3,40	2,67	3,92	3,11	2,38	2,50
IEC 60870-6 - Tase.2 Telecontrol equipment and systems - Part 6: Telecontrol protocols compatible with ISO standards and ITU-T recommendations	2,81	2,68	2,78	3,83	2,60	2,15	2,92	3,22	3,00	2,08
IEC 62325 - CIM for Market Communication Framework for energy market communications	2,70	2,25	2,11	3,33	3,40	2,33	3,25	2,78	2,63	2,15
IEC 62488-1 - Power line communication systems for power utility applications - Part 1: Planning of analogue and digital power line carrier systems operating over EHV/HV/MV electricity grids	2,60	2,40	3,11	3,33	1,80	2,42	2,50	3,67	2,13	2,38
IEC PAS 62559 - Methodology IntelliGrid methodology for developing requirements for energy systems	2,60	2,54	2,44	3,17	2,25	2,58	3,25	2,67	1,71	2,54
AVERAGE SCORE	**3,01**	2,69	2,97	3,44	3,33	2,69	3,54	3,43	2,66	2,54

Relevance of the selected Core Standards for the represented organizations

STANDARD	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
IEC 61850 - Power Utility Automation Communication networks and systems in substations	2,76	2,54	2,75	3,00	3,00	2,67	2,92	2,33	2,75	2,92
IEC 62351 - Security Power systems management and associated information exchange - Data and communications security	2,75	2,41	2,88	2,83	3,00	2,73	2,75	2,75	2,63	2,83
IEC 61968 - CIM for Distribution Application integration at electric utilities - System interfaces for distribution management	2,64	2,43	2,50	2,80	3,00	2,30	2,83	2,44	2,63	2,82
IEC 61970 - CIM for Energy Management Energy management system application program interface (EMS-API)	2,59	2,45	2,50	2,50	3,00	2,30	2,92	2,50	2,63	2,36
IEC 62056 - DLMS / COSEM Electricity metering - Data exchange for meter reading, tariff and load control	2,54	2,28	2,78	2,17	2,60	2,60	2,64	2,43	2,50	2,50
IEC 62325 - CIM for Market Communication Framework for energy market communications	2,50	2,30	2,50	2,67	3,00	2,20	2,73	2,25	2,50	2,67
IEC/TR 62357 - Service Oriented Architecture (SOA) Power system control and associated communications - Reference architecture for object models, services and protocols	2,44	2,29	2,63	2,80	2,25	2,30	2,67	2,13	2,14	2,67
IEC PAS 62559 - Methodology IntelliGrid methodology for developing requirements for energy systems	2,38	2,19	2,43	2,33	2,20	2,40	2,58	2,29	2,25	2,40
IEC 60870-5 Telecontrol equipment and systems Part 5: Transmission protocols (including parts 101/104)	2,27	2,25	2,56	2,83	1,40	2,50	2,08	2,11	2,00	2,23
IEC 62488-1 - Power line communication systems for power utility applications - Part 1: Planning of analogue and digital power line carrier systems operating over EHV/HV/MV electricity grids	2,24	2,18	2,50	2,00	2,25	2,33	2,36	2,13	2,29	2,33
IEC 60870-6 - Tase.2 Telecontrol equipment and systems - Part 6: Telecontrol protocols compatible with ISO standards and ITU-T recommendations	2,20	2,17	2,50	2,83	1,40	2,55	2,00	1,89	2,13	2,08
AVERAGE SCORE	**2,48**	2,32	2,59	2,62	2,46	2,44	2,59	2,29	2,40	2,53

Future impact of the selected Core Standards

5.1.1 Comments on the survey on Core Standards

The following comments on the rough results of the survey concerning the Core Standards are worth:

- There is a shared agreement among the different Industry categories on the importance of communication network issues (IEC 61850). Their importance in the short-mid time is deemed to decisively increase.
- Data and Information Security (IEC 62351) has probably less overall impact on the represented organizations. However, the respondents recognize almost unanimously that the security problem will assume more and more importance in the next future.

- In general, the respondents acknowledge the greatest importance to all problems related to ICT aspects, either concerning the distribution system (IEC 61968) and the smart metering (IEC 62056).
- It is worth to point out the emphasis assigned to the CIM standardization for all aspects related to the system management and the energy market.
- Telecontrol issues (IEC 60870) have the greatest importance for TSO, not included in the above tables.
- The represented Telecommunication Industries, not included in the above tables, attribute the highest relevance scores to the harmonization of the several standardization initiatives on the Service Oriented Architecture (SOA – IEC/TR 62357).

5.2 DER Integration and Grid Control

5.2.1 Priority of the requirements

The below table ranks the requirements for DER Integration and Grid control according to the priority assigned by the stakeholders through the questionnaire.

REQUIREMENTS	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
Grid management (Configuration and re-configuration; fault diagnosis, self-healing, island operation)	4,10	4,04	4,63	3,80	3,80	4,40	4,09	4,25	4,50	3,87
Electrical Connection of DER to the grid and disconnection	4,03	4,08	3,75	4,00	3,40	4,30	4,09	4,25	3,50	4,07
Security of data and protection of the information	4,02	3,70	3,50	4,00	5,00	3,38	4,17	4,00	4,50	3,80
Safety (of the Grid and of the DER); protection schemes	4,00	3,96	4,13	3,80	3,60	3,70	4,08	4,38	4,38	3,80
Seamless communication between control centers, substations and DER installations	4,00	3,71	4,63	3,80	4,75	4,00	4,08	4,38	4,00	3,73
Remote control of DER	4,00	3,88	3,63	3,80	5,00	4,00	4,25	4,38	3,75	3,80
Forecasting of power and loads	3,87	3,96	3,63	4,00	2,80	3,60	3,82	4,38	3,75	3,93
Harmonized and stable technical interconnection rules at national and EU level	3,87	4,00	3,88	3,75	5,00	4,20	3,67	3,13	4,50	3,80
Information and data exchange (definition of the information and data models)	3,83	3,74	2,75	4,50	4,60	3,00	4,42	3,63	4,25	3,47
Support Quality of Supply (Continuity, Voltage and Frequency stability, FRT capability) - Ancillary Services	3,82	3,73	3,57	4,20	4,25	4,25	3,64	3,63	4,25	3,80
Compliance Testing and certification specifications (incl. e.g. simulation models requirements)	3,78	3,38	3,75	4,00	4,20	3,63	4,18	4,13	3,57	3,43
DER Monitoring and Sensors	3,75	3,38	3,75	4,00	4,40	3,60	4,08	4,13	3,63	3,60
Provision of flexibility by DERs (control aspects)	3,73	3,59	3,13	4,25	4,20	3,00	4,09	4,13	3,75	3,67
Integration into legacy grid control systems	3,66	3,61	3,88	3,80	3,80	4,20	3,73	3,75	4,13	3,07
Aggregation of power and loads	3,60	3,77	2,50	3,75	3,40	3,38	3,82	3,63	4,00	3,40
EMC compatibility	3,49	3,26	4,13	4,20	2,20	3,50	3,70	3,50	3,75	3,20
Safety of the personnel	3,46	3,52	3,88	3,80	2,00	3,40	3,50	4,38	3,88	2,71
Objective and non-discriminatory data access rules for service providers (like aggregators).	3,46	3,61	3,25	3,25	3,20	3,00	3,83	3,50	4,00	3,07
Non- discriminatory Power Market access	3,40	3,57	3,25	3,50	3,25	3,63	3,73	3,63	3,86	2,71
Market Connection procedures	3,33	3,41	2,50	2,75	3,80	3,33	3,82	3,38	4,00	2,73
Services Market (operation/flexibility conditions; revenue of the service)	3,21	3,50	2,38	3,00	3,25	3,00	3,82	3,50	3,50	2,53
Access to the intl electric and energy market (including procurement)	3,18	3,27	3,13	3,50	2,75	3,75	3,18	3,25	3,25	2,73
AVERAGE SCORE	**3,71**	3,67	3,53	3,79	3,76	3,65	3,90	3,88	3,94	3,41

Priority of the Requirements for DER integration and Grid Control

5.2.1.1 Comments on the Priority of the requirements

The following comments are proposed:

- There is a rather significant overall convergence on high priority of the proposed Requirements.
- The highest scores are relevant to grid management issues, as expected: Grid reconfiguration; electric connection of DER; safety of the grid; remote control; forecasting of loads. These topics clearly entail the attention mainly of DSOs and of TSOs.
- DSOs are also highly worried of the problems related to the safety of the personnel involved in the management, showing a great sensitivity to the risks associated with new ways of operating the grid, e.g. considering microgrids.
- Also compliance issues have great relevance for DSOs, as well as for ICT providers.

- Flexibility market, including presumably those related to the aggregation of power and loads seem less interesting to the respondents and this may suggest a less mature knowledge of the related problems or, at least, a lower feeling on the urgency of their solution.
- However, manufacturers show high attention to the potential and related issues of the Ancillary Services in support of the Power Quality. TSO seem also very highly sensible to this topic, as obvious.
- Manufacturers care particularly procurement aspects connected with the energy market access.
- Integration into legacy grid control systems is of high concern especially for manufacturers.
- EMC compatibility issues constitute a transversal problem for all categories.
- Telecommunication industry emphasizes the priority of non-discriminatory rules for the access to the data.

5.2.2 Agreement on and relevance of GAPS & Required Actions

Similarly, the below tables rank the degree of agreement and relevance shown in the questionnaire by the stakeholders on the detected gaps and required actions for DER integration and Grid control.

GAPS & Required Actions	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
Smart Grids request increased automation levels of the distribution grid, to ensure higher efficiency of operation, security, control and quality. Faults detectors will enhance operation and reduce shutdown times	4,46	4,32	4,75	5,00	4,40	4,64	4,45	4,63	4,43	4,14
Electrical connections and operation rules of DERs should be harmonized within Europe.	4,16	4,22	4,25	4,20	4,20	4,55	4,00	4,25	3,71	3,86
Installation rules of DER should be adapted to allow for new ways of operating grids, such as microgrid. E.g. safety issues have to be covered for all kind of operation and plant technology	3,98	4,05	4,00	4,40	3,00	3,67	4,36	3,75	3,86	4,00
Communication protocols as well as information data models for control center <-> DER communication have to be harmonized	3,95	3,88	3,88	4,40	4,40	4,00	3,50	4,25	4,29	3,71
Tender requirements for ancillary grid services should be adapted to allow for participation of DERs (availability, minimum offer sizes, aggregation, etc).	3,76	3,74	3,50	4,00	3,50	3,14	4,00	4,00	3,57	3,73
A single communication protocol for the remote control of DERs should be imposed in interconnection rules, to ensure interoperability.	3,71	3,56	5,00			4,50	2,67		4,50	3,50
New connection requirements may impact the design, the life time and the sizing of machines and equipment	3,71	3,68	3,71	4,60	3,40	3,64	3,64	3,88	3,57	3,92
A centralized data access platform is necessary (e.g. containing information on the type of generators, capacity and location).	3,56	3,90	3,29	4,40	2,60	3,70	3,30	3,75	3,57	3,62
Standards for auxiliary power systems are missing (low voltage DC networks): AC/DC converters, DC management systems, DC protection)	3,54	3,44	3,86	3,80	2,80	3,70	3,10	4,13	3,00	3,67
The current EU electricity wholesale market model (the so-called 'target model') has to be adapted for optimised market integration of DERs.	3,48	3,65	2,86	3,60	3,20	3,60	4,00	3,50	3,71	2,83
New EMC requirements will arise from the development of the grid, requiring reviewing of the Standards	3,43	3,33	4,13	4,00	2,00	3,45	3,40	3,63	3,29	3,50
A capacity mechanism could support the market integration of DERs.	3,38	3,50	3,14	3,60	2,50	3,43	3,80	3,63	3,57	2,92
Too strict connection requirements may have financial impact and slow down the implementation of DER	3,25	3,59	2,88	3,40	2,40	2,91	3,36	3,13	3,57	3,43
Mature communication protocols for the control of distributed energy resources do exist already.	3,24	3,58	3,25	3,40	2,80	3,09	3,33	3,13	3,57	3,21
Ripple control technology offers sufficient means for the grid operator and service providers to control distributed energy resources.	2,92	3,13	3,00	4,00	2,40	3,14	3,11	2,43	2,86	2,92
Available standards provide a sufficient level of cyber security to protect process control and business.	2,56	2,73	2,29	3,40	1,80	2,50	2,80	2,29	1,86	2,57
AVERAGE SCORE	**3,57**	3,64	3,61	3,76	2,84	3,60	3,55	3,40	3,56	3,47

Agreement on the Gaps &Required Actions for DER integration and Grid Control

GAPS & Required Actions	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
Smart Grids request increased automation levels of the distribution grid, to ensure higher efficiency of operation, security, control and quality. Faults detectors will enhance operation and reduce shutdown times	4,26	3,95	4,75	4,60	4,40	4,00	4,27	4,50	4,71	4,21
Electrical connections and operation rules of DERs should be harmonized within Europe.	3,93	4,13	4,38	4,20	3,60	4,18	3,91	4,00	3,43	3,93
Communication protocols as well as information data models for control center <-> DER communication have to be harmonized	3,82	3,83	3,63	4,00	4,20	4,00	3,42	4,13	4,00	3,46
Installation rules of DER should be adapted to allow for new ways of operating grids, such as microgrid. E.g. safety issues have to be covered for all kind of operation and plant technology	3,76	3,71	3,71	4,60	3,20	3,56	3,36	3,63	3,86	4,08
A single communication protocol for the remote control of DERs should be imposed in interconnection rules, to ensure interoperability.	3,62	3,67	3,00			5,00	3,00		4,00	3,33
Mature communication protocols for the control of distributed energy resources do exist already.	3,60	3,57	3,38	4,00	4,50	3,55	3,58	3,75	3,00	3,77
Available standards provide a sufficient level of cyber security to protect process control and business.	3,59	3,38	3,88	3,25	3,80	3,20	4,00	3,75	3,50	3,23
A centralized data access platform is necessary (e.g. containing information on the type of generators, capacity and location).	3,52	3,84	3,57	4,20	2,40	3,67	3,30	3,88	3,29	3,50
New EMC requirements will arise from the development of the grid, requiring reviewing of the Standards	3,48	3,30	4,50	4,20	1,50	3,36	3,40	3,75	3,00	3,62
New connection requirements may impact the design, the life time and the sizing of machines and equipment	3,44	3,52	3,71	3,60	3,20	3,50	3,18	4,13	3,29	3,25
Tender requirements for ancillary grid services should be adapted to allow for participation of DERs (availability, minimum offer sizes, aggregation, etc).	3,35	3,53	3,00	3,60	1,75	3,13	3,45	3,88	2,71	3,09
The current EU electricity wholesale market model (the so-called 'target model') has to be adapted for optimised market integration of DERs.	3,22	3,33	3,00	3,40	2,20	3,33	3,45	3,38	3,14	2,83
Standards for auxiliary power systems are missing (low voltage DC networks): AC/DC converters, DC management systems, DC protection)	3,19	3,30	3,43	3,80	2,00	3,00	2,82	3,86	2,86	3,25
A capacity mechanism could support the market integration of DERs.	3,18	3,21	2,67	3,50	2,50	3,00	3,64	3,43	3,00	2,75
Too strict connection requirements may have financial impact and slow down the implementation of DER	3,16	3,27	3,63	3,20	1,20	3,09	2,91	4,13	2,71	3,21
Ripple control technology offers sufficient means for the grid operator and service providers to control distributed energy resources.	2,98	3,06	2,67	4,00	2,75	2,57	2,60	3,29	3,14	3,00
AVERAGE SCORE	**3,51**	3,54	3,56	3,63	2,70	3,51	3,39	3,59	3,35	3,41

Relevance for the represented organizations of the Requirements for DER integration and Grid Control

5.2.2.1 Comments on the survey on Gaps and Required Actions

- Industry shows a rather homogeneous agreement with the listed gaps to the full exploitation of the Smart Grid paradigm.
- It acknowledges that the Smart Grid is entailing a different way to manage the network, e.g. as far as control, efficient operation, quality of supply and security aspects are concerned.
- Managing integration of DERs also includes new network operation ways, as the microgrid. This entails not only electric aspects related to connection and disconnection, but it also increases the probability of dangerous situations, as the undesired islanding, which may affect the safety of personnel, of the devices and of the network itself.
- The effective monitoring of the network is a priority as well, aiming at the state estimation, to make it possible the effective management, and at the fault diagnosis, to reduce shutdown times.
- Interconnection of networks is assuming more and more importance in the management of the pan-European grid, therefore harmonized electric interconnection rules are still recognized as a strong gap. Industry however considers with concern that rules may impact on design, size, life time of machines and equipment and, in the end, result in higher costs and in slowing down DERs penetration.
- DSOs especially point out the lack of standards on auxiliary devices and the relevance of EMC issues.

- The main challenge is the full automation of the grid, which presupposes the support of a strong communication infrastructure. The development of such an infrastructure is still a gap to be filled with high priority.
- There is a moderate convergence (especially supported by Communication Industry) that mature communication protocols for the control of the grid already exist, although the harmonization of different approaches is still a gap to overcome.
- Industry deems that Market issues are relevant, but the above aspects seem to have higher priority.
- Security aspects are not sufficiently guaranteed by the existing standards and this has high relevance for the responders.

5.2.3 Awareness and Relevance of Standardization related initiatives

Finally, the awareness of the stakeholders on standardization activities was checked in the questionnaire and ranked in the following table. A second table shows also the relevance given to some of the specific DER Integration and Grid control standards.

Standardization related initiatives	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
IEC 61968 - Common Information Model (CIM) / Distribution Management. Part 8: Interface Standard For Customer Support	3,22	2,89	3,00	3,60	4,00	2,56	3,55	3,13	3,29	3,33
IEC 61850-90-X Communication networks and systems for power utility automation (e.g. IEC 61850-90-14 for FACTS (Flexible AC Transmission Systems))	3,17	3,00	3,25	4,00	4,00	3,44	3,40	2,38	3,29	3,08
Pr IEC 61000-X: Electromagnetic Compatibility (EMC) (TC 77)	2,88	2,67	3,00	3,80	1,80	3,67	2,20	2,43	3,14	3,17
ENTSO-E Network Codes: RfG: Requirements for Grid Connection; DCC: Demand Connection Code; OS: operational Security; etc.	2,79	2,47	2,63	3,00	3,80	2,40	2,67	3,00	3,00	2,92
IEC/TS 62351-8 Ed. 1.0 Power systems management and associated information exchange - Data and communications security - Part 8: Role-based access control (TC 57 WG 15)	2,77	2,72	2,50	2,80	3,80	2,89	3,10	2,50	3,14	2,17
National interconnection rules please specify in comments1	2,67	2,83	2,50	3,25	3,00	2,75	2,00	2,57	3,20	2,88
IEC 62786 Ed. 1.0 Smart Grid User Interface: Demand Side Energy Sources Interconnection with the Grid (TC 8)	2,62	2,94	2,25	2,75	2,00	2,44	2,00	2,88	2,86	2,58
IEC 62361-X Harmonization of Quality Codes across TC 57 (TC 57 WG 19)	2,40	1,94	1,86	2,25	3,80	2,00	1,89	2,71	2,57	2,67
prEN 50438:2013 (DER operation system) Requirements for the connection of micro-generators to LV distribution networks (CLC TC8X WG3)	2,38	2,33	2,50	4,00	1,40	2,22	1,67	2,38	2,43	3,00
FprTS EN 50549:2012 (DER operation system) Requirements for the connection of generators above 16A to LV and MV distribution networks (CLC TC8X WG3)	2,22	2,24	2,25	2,50	1,40	2,11	1,50	2,57	2,14	3,00
pr IEC 62689 Ed. 1.0 Current and Voltage sensors or detectors, to be used for fault passage indication purposes - Part 1: System aspects; Part 2: General principles and requirements; Part 3: Communica	2,15	2,26	2,88	2,80	1,00	2,30	2,10	2,25	2,00	2,08
CLC HD 60364-1 Rules for the design, erection, and verification of electrical installations: safety of persons, livestock and property (CLC TC 64)	1,96	1,94	2,14	3,00	1,20	2,38	1,33	1,86	2,00	2,08
AVERAGE SCORE	**2,60**	2,52	2,56	3,15	2,60	2,60	2,28	2,55	2,75	2,75

Awareness on Standardization related initiatives for DER Integration and Grid Control

Standardization related initiatives	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
IEC 61850-90-X Communication networks and systems for power utility automation (e.g. IEC 61850-90-14 for FACTS (Flexible AC Transmission Systems))	3,61	3,59	3,33	3,60	4,60	3,71	4,00	3,29	3,43	3,36
IEC 61968 - Common Information Model (CIM) / Distribution Management. Part 8: Interface Standard For Customer Support	3,59	3,33	3,17	3,25	4,60	2,86	4,10	4,14	3,29	3,36
IEC/TS 62351-8 Ed. 1.0 Power systems management and associated information exchange - Data and communications security - Part 8: Role-based access control (TC 57 WG 15)	3,50	3,24	3,17	3,25	4,40	3,43	3,60	4,29	3,50	2,82
ENTSO-E Network Codes: RfG: Requirements for Grid Connection; DCC: Demand Connection Code; OS: operational Security; etc.	3,45	3,25	3,33	3,75	3,80	3,00	3,67	4,14	2,86	3,50
IEC 62786 Ed. 1.0 Smart Grid User Interface: Demand Side Energy Sources Interconnection with the Grid (TC 8)	3,40	3,44	2,83	3,50	2,80	3,14	3,56	3,86	2,86	3,20
Pr IEC 61000-X: Electromagnetic Compatibility (EMC) (TC 77)	3,31	3,19	3,83	4,20	1,80	3,71	3,20	3,33	2,43	3,55
prEN 50438:2013 (DER operation system) Requirements for the connection of micro-generators to LV distribution networks (CLC TC8X WG3)	3,13	3,33	3,00	3,50	2,20	3,00	3,11	3,33	2,86	3,30
National interconnection rules please specify in comments1	3,13	3,08	3,14	3,25	3,67	2,40	3,00	3,00	3,50	3,11
pr IEC 62689 Ed. 1.0 Current and Voltage sensors or detectors, to be used for fault passage indication purposes - Part 1: System aspects; Part 2: General principles and requirements; Part 3: Communica	3,02	3,19	3,80	3,60	2,00	3,14	3,10	3,17	2,86	2,89
FprTS EN 50549:2012 (DER operation system) Requirements for the connection of generators above 16A to LV and MV distribution networks (CLC TC8X WG3)	3,02	3,25	2,60	3,50	2,40	3,17	2,67	3,29	2,86	3,00
IEC 62361-X Harmonization of Quality Codes across TC 57 (TC 57 WG 19)	2,98	2,50	2,60	3,00	4,20	2,57	2,80	3,80	2,86	2,73
CLC HD 60364-1 Rules for the design, erection, and verification of electrical installations: safety of persons, livestock and property (CLC TC 64)	2,72	2,63	2,80	3,60	2,20	2,86	2,60	3,17	2,43	2,55
AVERAGE SCORE	**3,24**	3,17	3,13	3,50	3,22	3,08	3,28	3,57	2,98	3,11

Relevance of Standardization related initiatives for DER Integration and Grid Control

5.2.3.1 Comments on the survey on standardization related initiatives

- The level of awareness on the standardization related initiatives in progress seems rather low.
- Works on Communication aspects (IEC 61850-90) and information models (IEC 61968) have relatively higher attention and are considered of high relevance.
- Security (IEC 62351) and Network Codes are especially important for DSOs.
- EMC issues (IEC 61000) are especially important to the Manufacturers.
- It could be worth noting that safety of personnel, live stock and property results to have a lower relevance (HD 60364).

5.3 DEMAND RESPONSE AND CUSTOMER ENERGY MANAGEMENT

5.3.1 Priority of the requirements

The below table ranks the Requirements for Demand Response and Customer Energy Management according to the priority assigned by the stakeholders through the questionnaire.

REQUIREMENTS	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
Security: authentication and encryption	4,05	3,73	4,00	4,25	3,75	3,67	4,33	4,60	4,50	3,40
Information Security	4,00	3,59	4,00	4,00	4,00	3,29	4,40	4,20	4,50	3,55
Support for Active/Reactive Power Control (load or generation remotely adaptable by the relevant network operator for re-/active power control)	3,98	4,07	4,00	4,75	3,25	4,00	3,67	3,80	4,17	4,18
Scalability	3,96	4,18	4,67	3,75	4,00	3,86	4,20	4,60	4,50	3,36
Support for multiple and upcoming communication technologies	3,91	3,43	4,33	3,75	5,00	3,17	4,20	4,40	4,33	3,56
Data visualisation (e.g. operating schedules, tariff, weather forecasts)	3,89	4,13	3,33	4,00	3,25	3,83	3,90	4,20	4,33	3,55
Modular architecture	3,86	4,18	4,00	3,75	3,25	3,83	4,30	4,40	4,17	3,18
Simple handling of devices and software	3,77	3,73	4,67	3,75	3,25	3,50	3,89	4,60	4,67	3,27
Standard communication interface: CEMS <-> grid operator	3,77	3,53	3,33	4,50	4,25	3,67	3,70	3,40	4,50	3,90
Bidirectional communications, feedback from the customer installation to grid or market operator	3,74	3,71	3,33	4,00	3,75	3,67	3,78	3,60	4,33	3,60
Interface between customer energy management infrastructure and the advanced metering infrastructure (AMI)	3,74	3,77	4,33	3,50	3,25	3,60	3,67	4,20	4,17	3,30
Incentives based load control	3,72	3,93	4,67	3,25	3,00	3,60	3,78	4,40	4,33	3,18
Data privacy	3,71	3,50	4,00	3,50	2,50	3,33	4,10	4,20	4,00	3,36
Standard communication interface: grid operator <-> market	3,71	3,53	3,67	4,00	3,75	3,67	3,67	3,60	4,33	3,56
Standardised protocol translation (gateway functionality)	3,67	3,50	3,67	3,75	3,75	3,40	4,00	3,40	4,67	3,00
Standard communication interface: customer energy mangement system (CEMS) <-> market	3,67	3,69	3,00	3,50	3,75	3,83	3,80	3,20	4,67	3,27
Direct remote load control	3,64	3,69	4,33	3,75	3,00	3,33	3,50	4,40	4,00	3,64
Affordability	3,64	3,53	3,67	4,00	2,75	3,50	4,11	3,40	4,50	3,18
Standardised basic services, such as registration, access rights & authentication, data-transfer, time synchronisation, etc.	3,58	3,50	3,67	3,25	3,00	3,40	4,20	3,60	4,00	2,90
Support for Transmission Constraint Management (load or generation remotely adaptable by the relevant network operator for the purpose of constraint management)	3,56	3,92	3,00	5,00	3,25	3,60	3,33	3,00	4,00	3,64
Transparent forwarding of external control commands to connected devices	3,51	3,23	3,33	4,67	2,67	3,60	3,33	3,20	4,20	3,30
Fair and non-discriminatory data access for service providers	3,51	3,63	4,33	3,25	2,50	3,67	3,30	4,20	3,83	3,09
Support for System Frequency Control (autonomous adaption of suitable load/generation devices, e.g. temperature controlled devices, to the system frequency)	3,49	3,73	3,33	4,75	3,00	3,67	2,78	3,20	3,83	3,70
Standardised market processes (such as customer or device de-/registration with a service provider)	3,39	3,29	4,33	3,50	2,75	3,71	3,40	4,00	3,33	2,91
Opt-out right at any time in Demand Response programs	3,38	3,69	4,00	3,25	1,75	2,83	3,10	4,20	4,17	3,09
Standardised runtime environment for applications; accessible to multiple service providers	3,35	3,29	3,33	4,00	2,50	3,60	3,20	3,20	3,83	2,90
Support for Low Frequency Demand Disconnection and Low Voltage Demand Disconnection (autonomous load disconnection in case of severe underfrequency or undervoltage)	3,34	3,60	3,67	3,75	2,75	3,29	2,78	3,40	3,67	3,27
Integration of Home Gateways in legacy grid control systems	3,33	3,80	2,67	3,25	2,75	3,67	3,67	2,80	4,17	2,70
Baseline definition and service verification	3,29	3,43	4,00	3,50	2,75	3,20	3,00	3,60	4,00	2,91
Providing status information on capabilities/connected devices to authorised third parties	3,28	3,29	3,50	3,00	3,33	3,40	3,40	3,20	3,50	2,67
Decent self-consumption	3,24	3,42	2,67	3,33	2,00	3,40	3,33	2,80	4,00	2,56
Specification of basic hardware requirements	3,24	3,42	3,33	3,50	2,33	4,00	3,30	3,20	3,00	2,89
AVERAGE SCORE	**3,62**	3,65	3,76	3,80	3,15	3,56	3,66	3,76	4,13	3,27

Priority of the Requirements for Demand Response and Customer Energy Management

5.3.1.1 Comments on the Priority of the requirements

The following statements can be deduced

- All requirements on the list were located averagely in the upper half of the scale (least overall score 3,24 on a scale from 1 to 5)
- The overall highest scores are reached by security requirements. The stakeholders from ICT, DSO and CONS attach the most importance to these requirements.
- Data privacy aspects get a slightly lower score (3,71), but range in the upper zone of the ranked list of requirements. Over average assessment was given from DSO, ICT and CON sector (4,00-4,20). Otherwise MAN and RES give a low score of 3,33 and 3,36 respectively.
- The requirement for an opt-out right from DR programs at any time earns high scores from DSOs (4,20) and CONs (4,17)
- Even higher scores were reached for scalability and simple handling of devices and software each in the DSO and CONS sector
- The same counts for standardised protocol translation (gateway functionality) and standard communication interface CEM <-> market from the CONS stakeholders
- Requirements regarding interfaces (CEMS <-> grid operator, grid operator <-> market, CEMS <-> market) were rated similarly from 3,67 to 3,77
- The assessment of different kind of ancillary services is spread within the narrow range of scores: while the support for remote active/reactive power control is rated highest (3,98), the more seriously needed support on severe underfrequency or undervoltage is rated lowest (3,34). In-between rated are support for system frequency control (3,49) and Transmission Constraint Management (3,56). Probably the rating reflects current debates and market near technologies with higher scores then more future technologies.
- Six out of the nine relatively low rated requirements (< 3,40) are referring to regulatory aspects: Standardised market processes, Opt-out right at any time from DR programs, Integration of home gateways in legacy grid control systems, baseline definition and service verification, providing status information to authorised third parties and decent self-consumption (partly addressed by ecodesign directive 2009/125/EC for similar devices)

5.3.2 Agreement on and relevance of GAPS & Required Actions

Similarly, below table ranks the degree of agreement shown in the questionnaire by the stakeholders on the detected gaps and required actions for Demand Response and Customer Energy Management.

GAPS & Required Actions	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
There is an urgent market need (in Europe) for a Demand Response standard, defining the communication between service providers (e.g. utilities or aggregators) and end customers	4,14	4,20	4,33	4,80	3,25	3,83	4,13	4,75	4,17	4,09
The wide-scale introduction of variable tariffs could boost Demand Side measures uptake in Europe	4,00	4,07	3,67	4,40	3,67	3,80	4,11	4,00	4,17	3,91
A Demand Response standard must be compatible with the Common Information Model (IEC 61970, 61968, 62325)	3,93	3,56	4,67	4,20	4,50	3,80	4,22	4,25	4,00	3,91
The current EU electricity wholesale market model (the so-called 'target model') has to be adapted to allow for market participation of Demand Response providers	3,76	3,60	3,67	4,00	3,75	4,00	4,00	3,25	4,17	3,67
The definition of an abstraction layer, i.e. an abstract data model that can be mapped to different information layer standards is a suitable approach to handle the problem of incompatible protocols.	3,71	3,76	4,00	3,40	4,75	3,67	4,00	3,60	3,50	3,64
Aggregation of loads and small generation units should be allowed when bidding into electricity markets.	3,71	3,71	3,67	3,20	3,75	4,00	3,78	3,25	4,00	3,73
The variety of home automation protocols in use hinders the spread of home automation and energy management systems.	3,63	3,63	4,33	3,00	3,75	3,83	3,50	4,60	3,83	3,09
Tender requirements in ancillary markets, like minimum offer size and minimum durations, should be lowered to allow for Demand Response participation.	3,44	3,58	3,67	3,25	3,00	3,75	3,14	3,50	3,17	3,60
A standardised protocol converter for energy management applications at the customer premises is required	3,42	3,53	3,33	3,60	3,75	3,83	3,70	2,80	3,33	3,27
Mandatory system frequency control should be imposed on battery chargers and the like (e.g. e-mobility, home energy storage systems).	3,39	3,86	3,33	3,75	2,75	4,00	2,88	3,00	3,67	3,13
If a Smart Meter Gateway (SMG) is available in a building, the access to controllable loads within the building for external service providers should mandatorily be channeled through the existing (possibly regulated with regard to security measures) connection via the SMG.	3,37	3,67	3,33	4,00	2,50	4,00	3,38	3,00	3,33	3,18
A standardised runtime environment for energy management applications at the customer premises is required	3,36	3,47	3,33	3,20	3,25	4,17	3,10	3,00	3,50	3,09
A tailored capacity market would be an effect way to improve the market integration of Demand Response programs.	3,34	3,54	3,33	3,40	2,75	3,75	3,50	3,25	3,67	3,00
Mandatory system frequency control capabilities of temperature controlled devices can be an effective means to ensure grid stability.	3,27	3,69	3,67	4,00	2,75	3,75	2,57	3,25	3,50	3,22
Mandatory use of technical energy management systems by groups of energy consumers should be imposed when a macroeconomic benefit can be expected.	3,25	3,43	3,50	4,00	3,33	3,60	3,13	3,00	3,33	3,00
AVERAGE SCORE	**3,58**	3,69	3,72	3,75	3,43	3,85	3,54	3,50	3,69	3,43

Agreement on the Gaps & Required Actions for Demand Response & Customer Energy Management

GAPS & Required Actions	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
There is an urgent market need (in Europe) for a Demand Response standard, defining the communication between service providers (e.g. utilities or aggregators) and end customers	3,78	3,67	3,67	4,40	3,00	3,80	3,71	3,25	3,83	3,91
A Demand Response standard must be compatible with the Common Information Model (IEC 61970, 61968, 62325)	3,60	3,47	4,33	4,00	3,67	3,40	3,25	4,25	3,50	3,64
The wide-scale introduction of variable tariffs could boost Demand Side measures uptake in Europe	3,49	3,40	3,00	3,80	2,67	3,50	3,50	3,50	3,33	3,73
The definition of an abstraction layer, i.e. an abstract data model that can be mapped to different information layer standards is a suitable approach to handle the problem of incompatible protocols.	3,48	3,88	3,33	3,40	2,67	3,40	3,63	3,00	3,33	3,40
The variety of home automation protocols in use hinders the spread of home automation and energy management systems.	3,37	3,88	3,33	3,80	1,33	3,20	3,75	4,00	3,17	3,00
Aggregation of loads and small generation units should be allowed when bidding into electricity markets.	3,33	3,47	3,33	3,20	1,67	3,75	3,50	3,00	3,17	3,55
A standardised runtime environment for energy management applications at the customer premises is required	3,24	3,76	3,00	3,75	1,67	4,20	3,33	3,00	2,80	2,82
A standardised protocol converter for energy management applications at the customer premises is required	3,21	3,65	3,33	3,60	2,00	3,40	3,44	2,75	3,50	2,82
If a Smart Meter Gateway (SMG) is available in a building, the access to controllable loads within the building for external service providers should mandatorily be channeled through the existing (possibly regulated with regard to security measures) connection via the SMG.	3,20	3,44	3,00	4,00	1,33	3,50	3,25	3,25	2,67	3,18
The current EU electricity wholesale market model (the so-called 'target model') has to be adapted to allow for market participation of Demand Response providers	3,18	3,14	3,67	3,40	1,67	3,00	3,43	3,25	3,17	3,20
Tender requirements in ancillary markets, like minimum offer size and minimum durations, should be lowered to allow for Demand Response participation.	3,16	3,29	3,67	3,20	1,50	3,75	3,00	3,33	3,00	3,09
Mandatory system frequency control should be imposed on battery chargers and the like (e.g. e-mobility, home energy storage systems).	3,14	3,62	3,33	3,80	1,33	3,25	3,43	3,00	3,00	2,90
Mandatory use of technical energy management systems by groups of energy consumers should be imposed when a macroeconomic benefit can be expected.	3,09	3,43	3,33	3,00	1,50	3,75	3,50	3,00	2,67	2,56
Mandatory system frequency control capabilities of temperature controlled devices can be an effective means to ensure grid stability.	3,08	3,50	3,33	3,00	1,50	3,25	3,29	3,25	2,50	2,70
A tailored capacity market would be an effect way to improve the market integration of Demand Response programs.	3,08	3,19	3,33	3,20	1,67	3,25	3,33	3,00	2,67	3,20
AVERAGE SCORE	**3,29**	3,52	3,40	3,57	1,94	3,49	3,42	3,26	3,09	3,18

Relevance of the Gaps & Required Actions for Demand Response & Customer Energy Management

5.3.2.1 Comments on the survey on Gaps and Required Actions

The tables allow the following statements

- All the suggested gaps and required actions receive scores in the upper part of the scale (overall score from 3,25 to 4,14 for agreement and 3,29 to 3,78 for relevance on a scale from 1 to 5)
- Essentially, agreement and relevance correspond well on individual as on aggregated level, if both criteria were assessed.
- On individual level in 56% of all cases the ranking offset between agreement and relevance is not more than one point. But for 35% of the cases only one of relevance or agreement was rated. A difference of 3 or 4 points only occurs in 3% of the cases.
- The sequence of the gaps and actions ordered by average score on globally aggregated level is similar for agreement and relevance.
- Two cases make an exception: A standardised runtime environment for energy management applications at the customer premise is ranked on seventh position regarding relevance but only on 12th position expressing lower agreement. The other way round is the ranking for adapt the so called

target model to allow for market participation of DR participants: relevance is low on rank 10, agreement is high on rank 4.

- The highest average score is received by the gap describing an urgent market need (in Europe) for a DR standard. This gap is widely agreed and rewarded with high relevance
- This first rank is followed by actions for a wide-scale introduction of variable tariffs and the claim for compatibility of a DR standard to CIM. Agreement to and relevance assessment for these both gaps are more or less similar from the different categories.
- The three suggested mandatory actions are rated within the last four gaps and required actions (position 12 to 14 of 15) together with a tailored capacity market (last position).
- Following the way up on the ranked list, two further market issues are found on position 10 and 11. Market issues do not generally receive low scores. The top position is occupied by a market relevant issue. Differently from the low scored market issues the top position is also related with technical aspects (defining communication)

5.3.3 Familiarity and Relevance of Standards and related initiatives

Finally, the familiarity of the stakeholders with standardization activities was checked in the questionnaire and ranked in the following table. A second table shows also the relevance given to some of the specific Demand Response and Customer Energy Management standards.

Standardization related initiatives	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
IEC 61850-7-420 ed. 2 [current IEC/TR 61850-90-X] Distributed energy resources logical nodes (TC 57 WG 17)	3,10	2,87	2,67	3,40	4,50	3,20	3,63	2,00	3,67	3,09
ENTSO-E Demand Connection Code	2,71	2,33	3,33	2,75	3,00	2,80	2,57	3,50	2,67	2,44
ZigBee Smart Energy Profile (SEP) 2.0	2,55	2,38	2,33	2,00	2,00	3,00	2,63	3,25	2,50	2,10
ZigBee Home Automation Profile	2,54	2,53	2,33	1,50	2,00	2,80	2,63	3,50	2,50	2,00
ZigBee Smart Energy Profile (SEP) 1.x	2,53	2,38	2,33	2,00	1,75	2,80	2,63	3,25	2,50	2,10
IEC 62746 System interfaces and communication protocol profiles relevant for systems connected to the Smart Grid (TC 57 WG 21)	2,43	2,13	2,33	2,40	1,75	2,40	2,50	2,75	2,50	2,20
IEC PC 118 Smart Grid user interface	2,38	2,20	1,67	2,40	1,50	2,40	2,63	2,50	2,33	1,90
OpenADR 2.0 Open Automated Demand Response	2,37	2,13	2,33	2,40	1,50	2,00	3,00	3,00	2,17	1,73
Energy@Home	2,28	2,94	1,67	1,50	1,25	2,60	2,25	2,75	2,00	1,89
EEBus	2,18	2,40	2,00	1,25	2,25	2,80	2,13	2,50	2,17	1,75
prEN 50491-12 General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) - Part 12: Smart grid - Application specification - Interface and framework for customer Energy Management (CLC TC 205 WG 18)	2,11	2,07	2,50	1,75	1,00	2,80	2,00	2,00	2,50	1,50
OGEMA Open Gateway Energy Management Alliance	2,05	2,36	1,50	2,00	1,75	2,80	1,63	2,00	2,33	1,67
Facility Smart Grid Information Model (FSGIM)	1,64	1,60	1,33	1,75	1,50	2,20	1,14	1,00	2,17	1,50
AVERAGE SCORE	**2,37**	2,33	2,18	2,08	1,98	2,66	2,41	2,62	2,46	1,99

Familiarity of standards and related initiatives for Demand Response & Customer Energy Management

Standardization related initiatives	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
IEC 61850-7-420 ed. 2 [current IEC/TR 61850-90-X] Distributed energy resources logical nodes (TC 57 WG 17)	3,39	3,60	3,33	3,00	4,00	3,80	3,88	3,50	2,67	3,18
IEC 62746 System interfaces and communication protocol profiles relevant for systems connected to the Smart Grid (TC 57 WG 21)	3,18	3,43	2,67	3,00	2,50	3,40	3,88	3,50	2,33	3,00
IEC PC 118 Smart Grid user interface	2,94	3,36	2,00	2,75	2,00	2,80	3,00	3,33	2,17	3,13
OpenADR 2.0 Open Automated Demand Response	2,93	3,13	1,50	2,40	2,25	3,20	3,63	3,00	2,00	2,64
ENTSO-E Demand Connection Code	2,82	2,83	3,67	3,50	2,25	3,40	2,00	4,00	2,17	2,75
prEN 50491-12 General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) - Part 12: Smart grid - Application specification - Interface and framework for customer Energy Management (CLC TC 205 WG 18)	2,74	3,07	2,00	2,50	1,67	3,80	3,17	2,00	2,50	2,13
ZigBee Smart Energy Profile (SEP) 2.0	2,64	2,71	2,00	2,33	2,25	2,80	3,00	2,75	2,00	2,22
Energy@Home	2,56	3,14	1,50	2,75	1,50	3,20	1,86	3,33	2,00	2,33
ZigBee Home Automation Profile	2,55	2,79	2,00	2,00	2,00	2,80	2,67	3,25	2,17	2,00
ZigBee Smart Energy Profile (SEP) 1.x	2,53	2,71	2,00	2,25	1,75	2,60	3,17	2,50	2,00	2,10
OGEMA Open Gateway Energy Management Alliance	2,43	2,77	1,50	2,80	1,50	3,60	2,00	2,00	2,00	2,33
Facility Smart Grid Information Model (FSGIM)	2,39	2,50	1,50	2,67	1,33	3,00	2,60	2,00	2,17	2,00
EEBus	2,25	2,46	2,33	2,00	1,50	3,20	1,67	2,00	2,00	2,11
AVERAGE SCORE	**2,72**	2,96	2,15	2,61	2,04	3,20	2,81	2,86	2,17	2,46

Relevance of standards and related initiatives for Demand Response & Customer Energy Management

5.3.3.1 Comments on the survey on standardization related initiatives

The above representation of the received data leads to the following comments

- The given scores regarding familiarity and relevance of standards are filling a broader part of the possible scale (1-5) as the scores regarding requirements, gaps and required actions. The difference between highest and lowest overall aggregated scores is 1,46 (requirements: 0,81; agreement on gaps and required actions: 0,89; relevance of gaps and required actions 0,70)
- IEC 61850-7-420 is leading the ranked lists for familiarity as for relevance with clear distance. Familiarity throughout the industry categories is quite homogeneous (3,09 – 3,67), except the significant lower score from DSOs (2,0). The assessment for familiarity and relevance from Germany for this standard is even above the high ratings from other countries.
- Familiarity of the ZigBee initiatives and especially the ENTSO-E Demand Connection Code are rated higher by DSOs than from other sectors.
- Generally, the listed standards and initiatives are less familiar to RES.
- FSGIM is clearly trailing the familiarity list
- Familiarity and relevance ratings do not correspond but exceptions are IEC 61850-7-420, Energy@Home, OGEMA, FSGIM and EEBus
- Generally, standards are higher rated then industry initiatives. Exceptions are ZigBee and prEN 50491-12 regarding familiarity, OpenADR regarding relevance
- MAN give significant higher, CONS significant lower relevance scores compared to the average.

5.4 SMART METERING

5.4.1 Priority of the requirements

The below table ranks the Requirements for smart metering according to the priority assigned by the stakeholders through the questionnaire.

REQUIREMENTS	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
Interoperability	4,60	4,50	5,00	4,60	5,00	4,40	4,90	5,00	4,80	4,36
Security	4,49	4,31	4,60	4,40	5,00	4,60	4,44	4,60	5,00	4,00
Remote meter reading and management	4,44	4,38	4,80	4,20	4,25	4,00	4,67	4,60	4,20	4,55
High availability	4,30	4,09	4,60	4,40	4,50	4,40	4,33	4,40	4,80	4,18
Mandatory security provisions (authentication and encryption, data management)	4,29	3,93	4,80	4,67	4,50	4,40	4,33	4,40	4,60	4,11
Standardised interfaces and data exchange formats	4,26	3,85	5,00	4,40	4,00	4,20	4,44	4,40	4,60	4,00
Load profile data	4,21	3,92	4,60	4,40	4,50	4,40	4,11	4,40	4,20	4,27
Secure communications (ensuring data integrity & confidentiality)	4,21	3,85	4,80	3,80	4,75	3,80	4,44	4,40	4,40	4,00
Remote connection/disconnection	4,16	4,08	4,80	4,20	4,00	4,00	4,56	4,20	3,80	3,91
Bidirectional communications	4,16	4,15	4,40	4,20	3,75	4,20	4,44	4,20	3,80	4,18
Data privacy	4,16	3,71	4,60	4,20	4,25	3,80	4,20	4,40	4,60	4,18
Scalability	4,14	4,31	4,40	4,40	4,25	4,40	4,20	4,40	4,40	3,73
Billing based on actual consumption	4,14	4,08	4,40	4,00	3,25	4,20	4,22	4,20	4,40	4,00
Support for multiple and upcoming communication technologies	4,14	4,00	4,60	4,20	4,67	4,00	4,60	4,20	4,40	3,73
On-demand meter data access	4,12	4,15	4,60	4,00	4,00	4,00	4,22	4,40	3,60	4,27
Quality of Supply control	4,07	4,00	4,20	4,60	3,50	4,40	4,11	4,40	3,60	4,00
Standardised data profiles	4,07	3,79	4,40	4,60	4,25	3,80	4,20	4,60	4,00	3,91
Provision of data from the AMI for grid control purposes (e.g. voltage and phase measurements)	4,05	4,00	4,00	4,20	4,25	4,20	3,89	4,40	3,80	4,18
Data visualisation (consumption and billing information)	4,05	4,14	4,60	3,80	4,00	4,00	3,80	4,40	4,00	4,00
Provision of a variable price signal to customers	4,00	4,23	4,20	4,00	3,25	4,40	4,22	4,60	3,80	3,55
European harmonisation of metering regulations	3,98	4,08	4,40	4,67	4,25	4,40	3,75	3,60	4,40	4,00
Modularity	3,95	4,14	4,00	4,60	3,50	4,20	3,90	4,80	3,80	3,64
Allow advanced information, management and control systems for services suppliers and customers	3,95	4,08	4,40	4,20	3,50	3,80	4,00	4,20	3,80	4,00
Affordability	3,93	3,77	4,00	4,00	3,75	4,00	3,90	4,00	4,40	3,82
Usability of AMI for additional services	3,86	3,77	4,60	4,50	3,25	3,20	3,67	4,20	4,25	4,00
Longevity	3,74	3,93	4,00	4,20	3,75	3,20	3,30	4,60	4,60	3,55
Fair and non-discriminatory data access for service providers	3,74	3,69	3,60	4,00	3,50	3,80	3,78	3,80	3,60	3,73
Seamless change of provider (facilitate switching and moving)	3,74	3,85	4,20	4,20	3,25	4,00	3,67	3,60	3,40	3,82
Noise limitations ensuring PLC viability	3,62	3,62	4,80	3,80	2,00	3,00	4,00	4,40	3,80	3,64
AVERAGE SCORE	**4,09**	4,01	4,46	4,26	3,95	4,04	4,15	4,34	4,17	3,98

Priority of the Requirements for Smart Metring

5.4.1.1 Comments on the Priority of the requirements

The following comments can be extracted:

- The extensive red colour on the table (quantified through an average score of 4.09) indicates a remarkable convergence on the high priority of the proposed requirements not only for all the sectors considered but also geographically.
- As expected interoperability ("interoperability" as a general requirement, "standardised interfaces and data exchange formats", "support for multiple and upcoming technologies" and "standardised data profiles") and security are the issues with highest scores.

- Remote management of meters and practical implementation issues like modularity have great relevance also for DSO.
- In addition to interoperability, ICT emphasizes the priority of remote operations: remote reading, remote management, remote connection/disconnection, etc.
- Lowest priority is for a specific technical problem dealing with noise in PLC communications, with the logical exceptions of DSO who are the main affected stakeholder, and Spain where all smart metering systems use PLC technologies.

5.4.2 Agreement on and relevance of GAPS & Required Actions

Similarly, below tables rank the degree of agreement and relevance shown in the questionnaire by the stakeholders on the detected gaps and required actions for smart metering.

GAPS & Required Actions	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
Strong security mechanisms (encryption & authentication) should be mandatory for the WAN communication of the SMG	4,13	3,87	4,00	4,20	4,75	4,00	4,40	4,00	4,80	3,73
Grid operators should get full access to grid related Smart Meter data at the customer connection point, like voltage, current and cos ϕ.	4,07	4,29	4,40	4,60	4,00	4,67	4,13	4,80	3,20	3,91
Smart meters have the potential to be the gateway by which electricity supply can be controlled remotely (entire supply or individual appliances). This possibility must be exploited and become a standard functionality of the smart meter for home devices control	3,93	4,14	4,00	4,40	3,50	4,33	4,33	4,60	3,40	3,45
The regulatory differences on smart metering between Member States can be barriers for efficient deployment and cost reductions	3,82	4,00	4,00	4,40	4,00	4,33	3,50	3,60	4,40	3,36
Concerning the smart meter certification (non-metrology aspects), the process is still too unclear (lack of harmonised standards/procedures, list of tests, etc.)	3,78	3,75	3,80	3,80	4,50	3,83	3,75	3,40	3,00	4,18
A standardised communication profile for the connection of controllable loads or an energy management system to the Smart Meter Gateway is missing.	3,77	4,00	3,80	3,60	3,75	4,17	4,22	3,80	3,40	3,36
A pragmatic approach to security is to deploy the smart meters and implement security measures progressively, as needed.	3,38	3,40	3,80	4,40	2,75	3,33	3,70	4,00	2,80	3,00
In the smart meter certification process it is distinguished between "conformance" (one meter in lab conditions) and "performance" (meter in the entire system, with many meters operating): a) There is a gap in the "conformance" testing	3,31	3,55	3,20	4,00	3,50	3,20	3,33	3,40	2,80	3,40
b) There is a gap in the "performance" testing	3,40	3,40	4,00	4,00	3,00	3,00	3,00	3,00	3,20	4,00
Many different standards are being used in the smart meter deployments and are deemed to coexist. The current approach of achieving interoperability at the data model level (for example, using DLMS/COSEM) seems to be efficient and sufficient.	3,20	3,13	3,40	4,00	2,50	3,17	3,20	2,80	2,80	3,45
AVERAGE SCORE	**3,68**	3,75	3,84	4,14	3,63	3,80	3,76	3,74	3,38	3,59

Agreement on the Gaps & Required Actions for Smart Metering

GAPS & Required Actions	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
Strong security mechanisms (encryption & authentication) should be mandatory for the WAN communication of the SMG	3,87	3,47	3,60	4,40	3,00	3,67	4,30	4,40	4,00	3,27
Grid operators should get full access to grid related Smart Meter data at the customer connection point, like voltage, current and cos ϕ.	3,74	3,71	3,40	4,60	3,33	4,17	4,13	4,00	3,00	3,82
A pragmatic approach to security is to deploy the smart meters and implement security measures progressively, as needed.	3,62	3,73	3,40	3,80	3,00	4,00	4,10	3,60	3,00	3,00
Smart meters have the potential to be the gateway by which electricity supply can be controlled remotely (entire supply or individual appliances). This possibility must be exploited and become a standard functionality of the smart meter for home devices control	3,59	4,07	3,40	4,00	2,25	3,83	3,78	4,60	2,60	3,09
Concerning the smart meter certification (non-metrology aspects), the process is still too unclear (lack of harmonised standards/procedures, list of tests, etc.)	3,43	3,25	3,60	4,20	3,00	3,50	3,50	3,20	2,80	4,00
The regulatory differences on smart metering between Member States can be barriers for efficient deployment and cost reductions	3,42	3,73	2,40	4,20	3,00	4,17	3,33	3,00	3,60	3,00
Many different standards are being used in the smart meter deployments and are deemed to coexist. The current approach of achieving interoperability at the data model level (for example, using DLMS/COSEM) seems to be efficient and sufficient.	3,39	3,47	3,40	3,80	3,25	4,00	3,40	3,00	3,00	3,27
A standardised communication profile for the connection of controllable loads or an energy management system to the Smart Meter Gateway is missing.	3,23	3,57	3,00	3,60	3,25	3,50	3,44	3,40	2,60	2,91
In the smart meter certification process it is distinguished between "conformance" (one meter in lab conditions) and "performance" (meter in the entire system, with many meters operating): a) There is a gap in the "conformance" testing	3,00	2,55	3,40	4,00	3,00	2,60	2,67	3,40	2,60	3,56
b) There is a gap in the "performance" testing	3,03	2,75	3,60	3,75	3,00	2,60	2,83	3,40	2,60	3,50
AVERAGE SCORE	**3,43**	3,43	3,32	4,04	3,01	3,60	3,55	3,60	2,98	3,34

Relevance of the Gaps & Required Actions for Smart Metering

5.4.2.1 Comments on the survey on Gaps and Required Actions

The following comments can be extracted:

- The responses acknowledge security mechanisms as the main gap in this field, specially recognized by the ICT and consulting sectors, and in a country (Germany).
- Homogeneous agreement is found for the gap on the use of smart meter data for grid operation purposes. The use of smart meters only for billing means that the system is clearly underused.
- Manufacturers, ICT and DSO also point out a lack of standardization on the possibility of connection/disconnection of loads through the smart meter, as a standard functionality of the device.
- Certification of smart meters seems to have lower priority than the mention gaps.
- In the final position of the agreement list appears the interoperability gap. However, due to the text formulation, this means that interoperability reached at the higher communication layers (DLMS/COSEM) might not be sufficient.
- In general, the relevance given by the stakeholders to the gaps and required actions follow the same priority level than the agreement on these issues.
- In this case, a flat score is provided around an average value of 3.43, indicating that no clear preferences or priorities exist for dealing with the detected gaps and possible required actions.
- Again, security and low voltage grid operation based on smart meter data are listed as the most relevant for ICT, DSO and manufacturers.

- Analogously, the certification process has the lowest relevance and therefore priority for taking actions to solve it.

5.4.3 Awareness and Relevance of Standardization related initiatives

Finally, the awareness of the stakeholders on standardization activities was checked in the questionnaire and ranked in the following table. A second table shows also the relevance given to some of the specific smart metering standards, mainly dealing with the involved communications.

Standardization related initiatives	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
IEC 62056 Series (incl. DLMS/COSEM) Electricity Metering Data Exchange (TC 13)	3,02	2,36	4,40	2,60	2,50	3,00	4,11	3,40	2,60	2,45
IEC 61334 - DLMS (PLC) Distribution automation using distribution line carrier systems (TC 57 WG 9)	2,88	2,14	4,40	2,40	2,75	2,40	3,78	3,40	2,60	2,64
IEC 61968-9 - CIM for Distribution Application integration at electric utilities - System interfaces for distribution management Part 9: Interface Standard for Meter Reading & Control (TC 57 WG 14)	2,71	2,14	2,20	2,80	3,50	2,40	3,56	2,60	2,80	2,55
IEC 62056-6-9 Mapping between the Common Information Model CIM (IEC 61968-9) and DLMS/COSEM (IEC 62056) data models and message profiles (TC 13)	2,68	2,07	3,40	2,25	3,00	2,80	3,38	2,80	2,60	2,18
ZigBee Smart Energy Profile (SEP) 2.0	2,59	2,50	2,00	1,50	2,00	2,80	3,38	3,40	2,20	1,91
prTS 50567-1 (PRIME) Meter data exchange over power lines – Part 1: Lower layer profile using OFDM modulation Type 1 (CLC TC 13)	2,52	2,14	4,80	2,80	1,00	2,20	3,33	2,80	2,00	2,36
ZigBee Smart Energy Profile (SEP) 1.x	2,46	2,50	2,00	1,50	1,75	2,60	2,88	3,40	2,20	1,91
M-Bus (EN 13757-2,3), wM-Bus (EN 13757-4)	2,44	2,14	2,25	2,00	2,00	2,40	3,00	2,50	2,40	2,00
prTS 50567-2 (G3-PLC) Meter exchange over power lines – Part 2: Lower layer profile using OFDM modulation Type 2 (CLC TC 13)	2,43	2,29	3,00	2,50	1,00	2,20	3,00	2,40	2,00	2,50
ETSI M2M Machine to machine communication	2,41	2,29	3,00	2,20	1,25	3,20	2,44	2,75	2,20	1,91
TR 50572 (SMCG) Functional reference architecture for communication in smart metering systems	2,40	2,00	2,60	2,80	1,50	2,40	2,44	2,40	3,00	2,09
Energy@Home	2,35	2,80	2,20	2,00	1,00	2,80	2,33	3,00	1,80	1,89
ETSI GS OSG 001 Open Smart Grid Protocol (OSGP)	2,27	2,07	2,20	2,75	1,75	2,20	2,38	1,80	2,40	2,18
prTS 50568-5 (Meters & More) "Electricity metering data exchange – The Smart Metering Information Tables and Protocols (SMITP) suite" (CLC TC 13)	2,17	2,00	2,80	2,50	1,25	2,00	2,38	1,80	2,00	2,09
ANSI C12 / IEEE 170x Series "Smart Grid Meter Package"	1,90	1,86	1,75	2,00	1,50	2,00	2,13	1,25	2,20	1,82
SyM^2 specification Synchronous Modular Meter	1,63	1,62	1,75	1,75	1,50	1,60	1,57	1,00	2,00	1,60
AVERAGE SCORE	**2,43**	2,18	2,80	2,27	1,83	2,44	2,88	2,54	2,31	2,13

Standardization related initiatives	OVERALL	IT	SP	RO	DE	MAN	ICT	DSO	CONS	RES
IEC 62056 Series (incl. DLMS/COSEM) Electricity Metering Data Exchange (TC 13)	3,55	3,36	4,60	3,60	2,50	3,80	4,00	4,00	2,40	3,60
IEC 61968-9 - CIM for Distribution Application integration at electric utilities - System interfaces for distribution management Part 9: Interface Standard for Meter Reading & Control (TC 57 WG 14)	3,25	2,79	2,75	3,40	3,75	2,60	3,67	3,60	2,40	3,56
IEC 62056-6-9 Mapping between the Common Information Model CIM (IEC 61968-9) and DLMS/COSEM (IEC 62056) data models and message profiles (TC 13)	3,15	2,86	3,50	3,40	2,75	3,00	3,56	3,60	2,40	3,22
IEC 61334 - DLMS (PLC) Distribution automation using distribution line carrier systems (TC 57 WG 9)	3,13	2,92	4,00	3,50	2,00	3,00	3,33	3,80	2,40	3,40
prTS 50567-1 (PRIME) Meter data exchange over power lines – Part 1: Lower layer profile using OFDM modulation Type 1 (CLC TC 13)	3,13	3,21	4,75	3,60	1,67	3,00	3,38	3,25	2,60	3,40
TR 50572 (SMCG) Functional reference architecture for communication in smart metering systems	3,10	3,21	3,00	3,20	2,00	3,00	3,50	3,50	2,60	2,90
ETSI GS OSG 001 Open Smart Grid Protocol (OSGP)	3,08	3,43	3,00	3,50	2,00	3,20	3,50	2,75	2,20	3,20
prTS 50567-2 (G3-PLC) Meter exchange over power lines – Part 2: Lower layer profile using OFDM modulation Type 2 (CLC TC 13)	3,03	3,36	2,50	3,75	1,67	3,00	3,14	3,25	2,60	3,20
ETSI M2M Machine to machine communication	2,89	3,00	3,25	2,50	1,00	3,20	2,57	4,00	2,00	2,67
prTS 50568-5 (Meters & More) "Electricity metering data exchange – The Smart Metering Information Tables and Protocols (SMITP) suite" (CLC TC 13)	2,87	3,29	2,20	3,50	1,67	3,60	2,86	2,20	2,20	3,20
ZigBee Smart Energy Profile (SEP) 2.0	2,73	2,93	2,00	2,75	1,00	2,80	2,43	3,75	2,00	2,67
M-Bus (EN 13757-2,3), wM-Bus (EN 13757-4)	2,70	2,86	2,67	2,50	1,00	2,60	3,00	3,00	1,80	2,56
Energy@Home	2,65	3,29	1,67	3,00	1,00	3,20	2,00	3,33	1,80	2,57
ZigBee Smart Energy Profile (SEP) 1.x	2,60	2,92	2,00	2,25	1,00	2,75	2,29	3,75	2,00	2,25
ANSI C12 / IEEE 170x Series "Smart Grid Meter Package"	2,46	2,57	2,33	2,40	2,00	2,20	2,25	2,50	2,00	3,00
SyM^2 specification Synchronous Modular Meter	2,38	2,38	2,33	2,75	1,00	2,75	1,86	2,75	1,80	2,63
AVERAGE SCORE	**2,92**	3,02	2,91	3,10	1,75	2,98	2,96	3,31	2,20	3,00

5.4.3.1 Comments on the survey on standardization related initiatives

The following comments can be extracted:

- The level of awareness on the standardization related initiatives in progress seems rather low.
- In general, more awareness is found and relevance is given to higher communication layers (information models) than lower communication layers protocols. This seems to be logical since standards like DLMS/COSEM and CIM are becoming extensively used and imply a harmonized solution, while the high number of low communication layer standards contribute to a much more fragmented and spread scenario.
- SyM^2 appears as the less known initiative, even in Germany. Also ANSI standards have low relevance in Europe.
- Surprisingly, TR 50572 is located in the middle of the table, which means that the work of the SMCG do not have the stakeholders attention that certainly it deserves, and more efforts are needed for disseminating this standardization work.

6 RESULTS FROM THE INTERVIEWS

The following paragraphs report on the outcomes of the interviews to stakeholders done within the STARGRID activities, either by means of telephone conversations or with direct colloquia during workshops. In some cases reference is done to technical documents, which have been indicated by the same interviewed person as representative of his points of view.

Whenever relevant, the issues raised by the interviewed have been associated to the STARGRID Areas of Interest and Gaps/Standards/Requirements referred to in the questionnaires survey. A coloured cell on the left side indicates the overall criticality level assessed through the questionnaire.

6.1 DER Integration and Grid Control

6.1.1 Regulation and Standard issues

Raised issues:

a) Reliability of the system is the problem and therefore strong regulations and codes are necessary, as to guarantee effective flexibility to the system.
b) Some technical capabilities set in the Network Codes (NC) can have a general negative impact on DER deployment as they can lead to increased equipment costs and to lengthier connection procedures. Fulfilling some technical requirements included in the NC RfG could imply over-sizing and could be difficult and costly. In case prescribed capabilities are not technically implementable in a short time period, the NC may give rise to delays in the erection of DERs.
c) Communication devices to be installed on generators can have a positive impact on DER integration in distribution grids provided that DSO has access rights to the communication devices. The rollout of communication devices could lead to a significant cost increase for small generators.
d) Compliance procedures should be defined with a European standardization approach, in order to avoid additional burden especially with low-size generators (third party product certificates should be allowed).
e) About Technical Specifications (prTS50549-1/2): requirements not compatible with current technologies; requirements beyond current standard values and beyond ENTSO-E RfG current and future; requirements unjustified (not supported by a CBA); operations not required leading to oversize components; missing compliance procedures and security aspects may hamper the use of some standard elements.
f) The use of European standards will be crucial in providing guidance for a progressive alignment of the national legal frameworks avoiding product variance and facilitating further deployment of DER by a better use/understanding of DER capabilities. The evolution of these technical specifications into EU standards should be speeded up as it will trigger harmonization and will facilitate further DG deployment.
g) Could Technical Specifications be transposed into Harmonization Documents?
h) These documents recognize the existence and must comply with national standards and network codes. The requirements specified in these technical specifications can consequently only be applied in the absence of a national framework (standards and codes) for the connection of the LV and MV generators.
i) National Codes for DER integration are still missing in several EU countries.
j) Tendency to national standardization before consolidating the EU interconnection rules may create in a next future country-by-country discrepancies and confusion, which may impact on the industry competitiveness.

Main Source:

MAN

Associated Requirements:

DIGC-R7: Electrical Connection of DER to the grid and disconnection

DIGC-R22: Harmonized and stable technical interconnection rules at national and EU level

DIGC-R18: Compliance Testing and certification specifications (incl. e.g. simulation models requirements)

Main Concerned GAPs:

DIGC-G2: Electrical connections and operation rules of DERs should be harmonized within Europe.

DIGC-G11: New connection requirements may impact the design, the life time and the sizing of machines and equipment

DIGC-G12: Standards for auxiliary power systems are missing (low voltage DC networks): AC/DC converters, DC management systems, DC protection)

DIGC-G3: Too strict connection requirements may have financial impact and slow down the implementation of DER

Impact:

- Speed up the regulation and standardization process at EU and National level.
- Market access and CBA to address regulation and standardization, especially for low-size equipment manufacturers.

Main impacting stakeholders:

MAN-DSO

Main concerned Core Standards

EN 50438:2013 (DER operation system) Requirements for the connection of micro-generators to LV distribution networks (CLC TC8X WG3)

Related Standardization initiatives:

ENTSO-E Network Codes: RfG: Requirements for Grid Connection; DCC: Demand Connection Code; OS: operational Security; etc.

prTS EN 50549:2012 (DER operation system) Requirements for the connection of generators above 16A to LV and MV distribution networks (CLC TC8X WG3)

IEC 62361-X Harmonization of Quality Codes across TC 57 (TC 57 WG 19)

6.1.2 Interoperability and Conformance Testing

Raised issues:

a) DSOs cannot invest in systems, which are not fully interoperable. The system should be interoperable and open to new demands (EVs, dynamic tariffs, DSM). The Network system should be fully automated.
b) Interoperability is the pre-requisite for the full automation of the electric system. To demonstrate the interoperability of any device (DER included) integrated in the Smart Grid, specific interoperability tests are necessary. Conformance tests required by product-standards demonstrate the compliance with the specific standard specifications, but they are not enough to guarantee the interoperability in the system.
c) Interoperability tests methods need to be developed, based on the Use Cases requirements. Procedures for interoperability testing should be standardized.
d) Interoperability is a "systemic issue" and has to be demonstrated in a systemic environment. Auto-certification by the component manufacturers cannot replace this demonstration.
e) Open standards is a basic condition for the interoperability, but they are not sufficient. They should cover all functionalities included in the Use Case.
f) Interoperability conditions should not limit the potential for innovation and differentiation of products.
g) Interoperability requirements may impact on the costs of equipment and on the market penetration capacity.

Main Source:

DSO - MAN

Associated Requirements:

- DIGC-R4: Seamless communication between control centres, substations and DER installations
- DIGC-R17: Information and data exchange (definition of the information and data models)
- DIGC-R18: Compliance Testing and certification specifications (incl. e.g. simulation models requirements)
- DIGC-R9: Integration into legacy grid control systems

Main Concerned GAPs:

- DIGC-G1: Smart Grids request increased automation levels of the distribution grid, to ensure higher efficiency of operation, security, control and quality.
- DIGC-G10: Communication protocols as well as information data models for control centre - DER communication have to be harmonized
- DIGC-G16: A single communication protocol for the remote control of DERs should be imposed in interconnection rules, to ensure interoperability.

Impact:

- Identification and description of concerned Use Cases
- Development of Standards for interoperability testing
- Set up of demonstration environments
- Agreed rules for the interoperability performance of devices in the Smart Grid system
- Agreement on communication protocols and exchange data models

Main impacting stakeholders:

ICT-MAN

Main concerned Core Standards:

IEC 61850

IEC 61968

Related Standardization initiatives:

IEC 61850-90-X Communication networks and systems for power utility automation

IEC 61850-7-420 ed. 2 [current IEC/TR 61850-90-X]

IEC 62746 System interfaces and communication protocol profiles relevant for systems connected to the Smart Grid (TC 57 WG 21)

6.1.3 Security, Privacy and Data Protection

Raised issues:

a) Security and security standards is the challenge due to the complexity of the Smart Grid system. Traditional security systems are ineffective against aimed attacks. A new scheme is necessary based on the anti-intrusion rules i.e. the same approach as for critical infrastructures should be adopted, including: asset identification; security control; perimeters security; physical security; personnel & training; recovery management models adapted to the energy chain.
b) Pre-requisite is the solution of interoperability issues in the different domains. Standardization/harmonization of protocols for security/privacy and unified information models are needed.
c) Requirements on security/privacy and information models are not clear and agreed enough
d) Consumer/customer data protection is the pre-requisite for his participation in the business and the realisation of forecast benefits.
e) Measures for smart meters personal data protection should be harmonized. Standards for use of sensible energy data are still missing in EU.
f) Remote control of supply should only be possible with express consent of the consumer.

Main Source:

ICT (Automation industry)

Associated Requirements:

DIGC-R21: Security of data and protection of the information.

Main Concerned GAPs:

DIGC-G5: Available standards provide a sufficient level of cyber security to protect process control and business.

Impact:

- New standards security architecture.
- Agreed rules for data protection and use.

Main impacting stakeholders:

DSO-ICT

Main concerned Core Standards:

IEC 62351

Related Standardization initiatives:

IEC/TS 62351-8 Ed. 1.0 Power systems management and associated information exchange - Data and communications security - Part 8: Role-based access control (TC 57 WG 15)

6.1.4 Safety of personnel and devices

Raised issues:

a) The enlargement of the frequency bandwidth with which generators should stay connected increases the probability of uncontrolled islanding and the risk of damages in equipment and personnel.
b) Anti-islanding defence actions may differ according to the operational criteria and protection schemes. A scrutiny of present prescription set by each national regulatory authority at national level might be appropriate.

Main Source:

MAN

Associated Requirements:

DICG-R1: Grid management (Configuration and re-configuration; fault diagnosis, self-healing, island operation)

DICG-R2: Safety (of the Grid and of the DER); protection schemes

DICG-R8: Remote control of DER

DICG-R3: Safety of the personnel

Main Concerned GAPs:

DICG-G6: Installation rules of DER should be adapted to allow for new ways of operating grids, such as microgrid.

Impact:

- Adaptation of protection schemes/systems for devices and personnel needed.

Main impacting stakeholders:

DSO-MAN

Main concerned Core Standards:

NA

Related Standardization initiatives:

CLC HD 60364-1 Rules for the design, erection, and verification of electrical installations: safety of persons, livestock and property (CLC TC 64)

6.1.5 Communication – Information & Data Exchange

Raised issues:

a) Inter-domain info and data exchange is now an urgent priority for industries. Information flows coming from different domains should be treated and this means that there should be an agreement on common models.
b) Requirements of appropriate communication infrastructures haven't been fixed yet for different applications, e.g. for the remote control of DER (especially at LV). Internet and PLC are not reliable enough, fibre glass is unavailable and expensive. GSM/GPRS solution (as, for instance, requested in Italy by standard CEI 0-16 for the participation of active users to the Defence Plans) is a compromise, its reliability depending on the communication infrastructure coverage.
c) IEC 60870 and IEC 61850 are mature sets, able to cover the most communication aspects between devices. However semantic interoperability (CIM) should be guaranteed to allow devices to be really automatically connected
d) Communication solutions should cover the more pressing monitoring requirements. Technology is on the shelf, in general. However, some components (e.g. sensors like Fault Passage Indicators) request non-conventional solutions to be standardized
e) Self-consumption rules and standards have still to be suitably developed

Main Source:

ICT - COMM

Associated Requirements:

DIGC-R4: Seamless communication between control centres, substations and DER installations

DIGC-R17: Information and data exchange (definition of the information and data models)

DIGC-R10: DER Monitoring and Sensors

Main Concerned GAPs:

DIGC-G10: Communication protocols as well as information data models for control center <-> DER communication have to be harmonized

DIGC-G9: A single communication protocol for the remote control of DERs should be imposed in interconnection rules, to ensure interoperability

DIGC-G8: Mature communication protocols for the control of distributed energy resources do exist already

Impact:

- Requirements of communication infrastructures to be established for different applications.
- Standards of monitoring devices to be developed
- Semantic interoperability (CIM) to be included in the existing set of standards

Main impacting stakeholders:

COMM - ICT

Main concerned Core Standards:

IEC 61850

IEC 61968

IEC 60870

IEC 62488-1

Related Standardization initiatives:

IEC 61850-90-X Communication networks and systems for power utility automation (e.g. IEC 61850-90-14 for FACTS (Flexible AC Transmission Systems))

pr IEC 62689 Ed. 1.0 Current and Voltage sensors or detectors, to be used for fault passage indication purposes - Parts 1-3

6.2 Demand Response and Customer Energy Management

6.2.1 Participation to the Market

Raised issues:

a) Participation in DR programs has to be voluntary, and the compensation of customers is important. Mandatory measures are incompatible with free market.
b) DERs have to appear to the market as customary subjects. The complexity of the operation should not affect modalities of market participation.
c) Capacity Markets revealed very effective in US. Good balance between heavy regulation (to avoid extreme prices in energy only markets) and free markets. Boosting DR programs.

d) There are many solutions to deploy Smart Grid in EU. They are ready and cover everything. Utility are reactive but the problem is with the Business models, which are inadequate to invest. The complexity is increased but not the payback perspective. Standards are ok, as well the process which is already launched. They are not the prior issue that hampers the participation in Smart Grids.
e) Standardized connection/measurement schemes are necessary, compatible with incentives, supporting transparent methods for the analysis and the quantification of the trade-off and, in general, sustaining the new business models. The whole storage topic needs to be addressed in regulatory terms, defining the economic framework for storage use. Technical conditions and standard connections/measurements schemes needed in order to ensure storage use compatibility with incentives must be also defined.
f) Curtailment. The costs may roughly be estimated by the value of the lost energy, i.e. by compensating the installation owner for lost power sales. However, to analyse this trade-off (the savings for the avoided grid reinforcement vs. the reimbursements paid), a standardized and clearly quantifiable calculation method is needed.
g) Remote Control: In real time and geographically spread over large areas. However, the control algorithms are not fixed yet.
h) The whole storage topic needs to be addressed in regulatory terms, defining the economic framework for storage use. Technical conditions and standard connections/measurements schemes needed in order to ensure storage use compatibility with incentives must be also defined.

i) Personal data protection; Non repudiation and liability for actions; Trust model establishment between all stakeholders, supporting flexible market models.

Main Source:

ICT-CONS-ADV

Associated Requirements:

DR-R29/15/16: Transparent/simplified rules of participation of Consumers to DR programs

DR- R26/5/7/8: Business models for participation to Services-to-grid

DR-R24/13/3: Privacy and Security

Main Concerned GAPs:

DR-G11: Aggregation of loads and small generation units should be allowed when bidding into electricity markets.

DR-G12: Tender requirements in ancillary markets, like minimum offer size and minimum durations, should be lowered to allow for Demand Response participation.

DR-G10: A tailored capacity market would be an effect way to improve the market integration of Demand Response programs.

Impact:

- Rules for participation to DR programs to be adapted
- Business models for DR Services to be defined and modalities standardized

Main impacting stakeholders:

MAN

Main concerned Core Standards:

IEC 62351

IEC/TR 62357

Related Standardization initiatives:

IEC 61850-7-420 ed. 2: Distributed energy resources logical nodes (TC 57 WG 17)

ENTSO-E Demand Connection Code

6.2.2 Communication & Information exchange

Raised issues:

a) OpenADR is a mature protocol, Europe is lagging behind (also regarding implementation of DR measures)
b) CIM is a solution sufficiently mature for an agreed semantic model. Already considered in the evolution of OpenADR
c) Standardization of protocols is necessary: any attempt to closed solutions is negative for the market.
d) Standardization is the key of open competition: Market cannot destroy the quality.
e) In many cases patents are useless. A different attitude is necessary: “the progress of the other is mine”. Open Source is an example.
f) Need for a Customer Energy Management (CEM) as protocol converter confirmed. Standardized application runtime environment not as clear, but has many proponents as well (“Smartness concentrator”).

g) Integration of CEM in legacy grid control systems is irrelevant as this problem has to be solved at the Aggregation/Service provider level
h) Communication via Internet broad band could be the solution, considered reliable enough by some respondents, others call for guaranteed connectivity as a service.

Main Source:

ICT-COMM

Associated Requirements:

- DR-R20: Support for multiple and upcoming communication technologies
- DR-R25/19/22/18: Integration of Customer Energy Management (CEM) into the Grid and Market
- DR-R27/28: Gateway functionalities

Main Concerned GAPs:

- DR-G8: A Demand Response standard must be compatible with the Common Information Model (IEC 61970, 61968, 62325)
- DR-G2: The definition of an abstraction layer, i.e. an abstract data model that can be mapped to different information layer standards is a suitable approach to handle the problem of incompatible protocols.
- DR-G1: The variety of home automation protocols in use hinders the spread of home automation and energy management systems.
- DR-G3: A standardized protocol converter for energy management applications at the customer premises is required
- DR-G4: A standardized runtime environment for energy management applications at the customer premises is required

Impact:

- Functionalities/interfaces/protocols of CEM to be defined and standardized

Main impacting stakeholders:

ICT

Main concerned Core Standards:

IEC 61970

IEC 61968

IEC 62325

Related Standardization initiatives:

IEC 62746: System interfaces and communication protocol profiles relevant for systems connected to the Smart Grid (TC 57 WG 21)

IEC PC 118: Smart Grid user interface

OpenADR 2.0: Open Automated Demand Response

6.3 SMART METERING

6.3.1 Participation of the Consumer

Raised issues:

a) The customer should be deeply involved and that is not the case in the current deployments. The customer does not understand the benefits. Provided information should be more understandable and useful. The customer information should be uniform regardless of who provides it. Consumer opt-out option can foster participation.
b) Remote control of supply should only be possible with the express consent of the consumer.

c) Customer is the owner of the data. Data which is not required for billing or statutory purposes should only be provided with the express consent of the consumer. Standards for use of sensible data of the consumer are still missing in EU. Failure to adequately address consumer concerns about privacy will limit active consumer involvement and make it difficult to realise forecast benefits.
d) Harmonization of security assurance for smart meters measures to preserve privacy/personal data protection, while providing control and access to data subjects: this requires a flexible model to perform local processing at the meter level (data minimization and less exposure), i.e. an interoperable framework for secure applications accessing and processing meter data.

e) High consumption alert for consumers. Frequent update of real time information on current consumption.
f) Visualization - This needs to take into account ergonomic issues with meters and displays, including measures to ensure that consumers with sensory impairments are not disadvantaged.
g) Energy efficiency aspects (e.g. in Smart meters and in appliances stand by) have still to be suitably developed and considered in standards.

Main Source:

ICT-ADV (Consumers Association)

Associated Requirements:

SM-R6/27/14/7: Deep involvement of Consumers

SM-R17/24: Preservation of privacy

SM-R16/19/20: Clear visualization of consumption

Main Concerned GAPs:

SM-G1: The regulatory differences on smart metering between Member States can be barriers for efficient deployment and cost reductions

SM-G3: Strong security mechanisms (encryption and authentication) should be mandatory for the WAN communication of the SMG

Impact:

- Clear/harmonised rules to encourage the participation of consumers needed
- Make uniform/useful information to consumers
- Data use and protection and privacy to be standardized at EU level
- Care of consumers with sensory impairments

Main impacting stakeholders:

ICT-UTI-MAN

Main concerned Core Standards:

IEC 62351

Related Standardization initiatives:

TR 50572 (SMCG): Functional reference architecture for communication in smart metering systems

prEN 50491-11: General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) - Part 11: Smart Metering - Application Specifications - Simple External Consumer Display

prEN 50491-12: General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) - Part 12: Smart grid - Application specification - Interface and framework for customer

6.3.2 Technical issues

Raised issues:

a) The problem is that requirements (for example, security and information models) are not agreed and clear enough. Once that is solved, the implementation should not be a problem: the technology already exists in other areas (cryptography, ontology, etc.).

b) Smart metering harmonization is impossible: even complying with DLMS, final data models are different per country (different functionalities and requirements).
c) Complying with open standards is a basic condition but not sufficient to reach real interoperability (additional specifications needed to cover the free options of the base standards: specification of the complete functionality).
d) Standardization for interoperability must not limit the potential for innovation and differentiation.
e) Necessary to fill the gap between the smart meter and the rest of players.
f) No need for a global smart metering standard, utilities define interface themselves.

g) Smart meters can have a part in the management of distribution networks (e.g. by supplying information for state estimation of the grid), thus contributing to enhance its ability to host more DG: they need to be complemented with other equipment and new business models that turn available data into business opportunities.
h) Frequencies from 150 kHz to 500 kHz should be available for smart metering communications (less noisy and higher bandwidth).
i) Limit the noise emission (below 150 kHz) in power networks on acceptable levels that would not result in problems for PLC smart meters and mains signalling systems.

Main Source:

ICT

Associated Requirements:

SM-R1/22/26/27: Interoperability

SM-R3/28/24/17: Security

SM-R12: Provision of data from the AMI for grid control purposes (e.g. voltage and phase measurements)

SM-R23: Noise limitation ensuring PLC viability

Main Concerned GAPs:

SM-G3: Strong security mechanisms (encryption & authentication) should be mandatory for the WAN communication of the SMG

SM-G2: Many different standards are being used in the smart meter deployments and are deemed to coexist. The current approach of achieving interoperability at the data model level (for example, using DLMS/COSEM) seems to be efficient and sufficient.

SM-G7: A standardized communication profile for the connection of controllable loads or an energy management system to the Smart Meter Gateway is missing.

SM-G8: Concerning the smart meter certification (non-metrology aspects), the process is still too unclear (lack of harmonised standards/procedures, list of tests, etc.)

SM-G5: Grid operators should get full access to grid related Smart Meter data at the customer connection point, like voltage, current and cos ϕ.

SM-G6: Smart meters have the potential to be the gateway by which electricity supply can be controlled remotely (entire supply or individual appliances). This possibility must be exploited and become a standard functionality of the smart meter for home devices control

Impact:

- Building a strong security architecture
- Develop effective interaction between network and smart meters: low voltage distribution network becomes visible for grid operator
- Formulation of EMC emission limits below 150 kHz

Main impacting stakeholders:

ICT-COMM-UTI

Main concerned Core Standards:

IEC 62351

IEC 62056

Related Standardization initiatives:

IEC 62056 Series (incl. DLMS/COSEM)

IEC 61968-9 - CIM for Distribution - Application integration at electric utilities - System interfaces for distribution management Part 9: Interface Standard for Meter Reading & Control (TC 57 WG 14)

prTS 50567-1 (PRIME) - Meter data exchange over power lines – Part 1: Lower layer profile using OFDM modulation Type 1 (CLC TC 13)

6.4 Other issues

6.4.1 Costs & Benefits

Raised issues:

- Spending a bit more for the quality at the point of connection will pay back in the overall cost of the system. Following strict requirements we can allow high penetration since the system's response in the overall management will be better.
- The higher costs for development and adjustment of technologies are not a problem, if compared with the costs of possible blackouts (as per Germany and Switzerland recently). This is the bill to pay to get reliability and to attain the 20-20-20 objectives. And to have a payback on the overall system.
- Big investments should be addressed to the Grid Management.
- Standards should assist and facilitate investment decisions.
- The lack of harmonization implies great adaptation costs for the manufacturers, for the need of different solutions to different markets.
- ICT and automation are not the only keywords. Actually, fitting the architecture with the good functioning of the system and minimum cost/maximum benefit, is what counts
- Provisions of standards should be modulated in relation to the functionality requirements; these latter should be related to the plant power, to guarantee scale economy.

Major concerned topic:

☑ DER Integration and Grid Control (DIGC)
☑ Demand Response and Customer Energy Management (DRCEM)
☑ Smart Metering (SM)

6.4.2 International approach in Standardization

Raised issues:

a) To lower costs of the standardization and its impact, it would be preferable referring to international Standards, rather than new European solutions
b) We should look at the developments outside Europe and especially in US. Here the need to replace/improve the too old electric infrastructure led to an innovation process quicker than in Europe.
c) IEC-IEEE. The pair would represent the best strategy to extend the USA market to the World (China excluded). However harmonization of technical rules is the most critical point at the level of IEC and IEEE.

d) IEC and EU standards: IEC in Europe. EU Standards could be a limitation of the export capacity of the industry. The transpose of IEC standards into EN is the right approach to reduce costs of standards generation and to generalize the use of IEC in EU.
e) Harmonized and stable technical interconnection rules at national and EU level are not enough. Smart Grid standards should be rolled out by IEC IEEE for worldwide market: Energy is a matter that involves the whole world.
f) At the moment, only EU West industry is really involved in standardization. EU East is rather reluctant (Poland, Czech Rep, Romania) are poorly represented (with some exceptions). Participation should be pushed as much as possible

Major concerned topic:

☑ DER Integration and Grid Control (DIGC)
☑ Demand Response and Customer Energy Management (DRCEM)
☑ Smart Metering (SM)

6.4.3 Regulations and Standards

Raised issues:

a) Too high complexity of standards may kill the market.
b) Rules cannot replace standards. Airplane industry is the example. It is ruled by technical standards (for safety and security motivations). Standards should be mainly issued by technicians for the use of technicians.
c) When taking decisions all factors should be considered: e.g. in Italy the big subsidies have generated the explosion of the PV plants market were partially compensated by the consequent reduction of costs of the oil.
d) Standards and codes should support the interests of the single and of the overall system (not only of a sector). Standardization bodies should bear this duty, whilst sector associations tend to sponsor different policies.

Major concerned topic:

☑ DER Integration and Grid Control (DIGC)
☑ Demand Response and Customer Energy Management (DRCEM)
☑ Smart Metering (SM)

7 SUMMARY AND CONCLUSIONS

This document is a public Deliverable (D4.2) of the project STARGRID and presents the results of the survey carried out, in the period December 2013-March 2014, within the activities of Work Package 4 “Analysis of Industry opinion” of the project.
General subject of the survey was the standardization in progress to support the evolution of the EU energy system towards the Smart Grid paradigm.
The main objective of the survey was to catch first hand opinions, remarks and concerns from the energy sector industry on the adequacy of the current standards against the requirements of industry, with specific attention to the Areas of Interest selected by STARGRID, i.e. DER integration and DER control; Demand Response and Customer Energy Management and Smart Metering.
The survey was conducted by the STARGRID Partners through both a specific questionnaire and face-to-face interviews. The questionnaire was made accessible on the STARGRID website and disseminated with different initiatives (e-mails, workshops, conferences, etc.) to a recipient group mainly constituted by Industry representatives (75%). The recipients were identified in previously works of WP4 leading to the compilation of the Deliverable D4.1 Smart Grid Industry Ecosystem. Although mainly addressed to Industry, also feedbacks from complementary sectors (e.g. Research, Academy) were taken into consideration.
More than 1000 targets were reached.
Interviews have been conducted on voluntaries among the questionnaire respondents and other stakeholders.
Questionnaire and interviews covered the key issues of the Smart Grid industry system associated to the above mentioned Areas of Interest:

- Smart Grid Core Standards relevance
- Requirements priority
- Gaps and required actions, identification and priority
- Awareness and importance of the in progress standardization initiatives.

The actual responses basis, at the end of the survey campaign, was in fact rather limited in number, especially after a reliability filter on the received feedbacks. 71 questionnaires were analysed from respondents coming from 10 different countries, even with a few cases extra-EU and covering the most pertinent industry categories: Manufacturers, ICT technologists; grid operators, industry engineers and consultants.
The limited number of the respondents associated with the large industry categories dispersion, limits the significance of the investigation to the overall trends, although in some cases some drawbacks from specific sectors were possible.
This document shows the survey results, for each of the indicated AoIs, through tables reproducing the structure of the questionnaire: for each topic the relevance score deducted from the indications of the respondents is indicated, highlighted by correspondent colours. This kind of representation puts in clear evidence the ranking, in the industry opinion, of the considered item: comments on the table, pointing out the main evidences from the tables, are provided for the discussion.
The structure of the Tables is such as to point out the overall trends country-by-country, at least for those ones mainly represented in STARGRID. Also in this case, obviously, the above mentioned analysis limits have to be considered.
As a general comment, the responses show a rather solid coherence, close to the expectancies, e.g. stating that:

- electric aspects and associated connection rules represent the most concerned topic of industry involved in DER integration;
- communication issues (protocols harmonization and implications on the market developments) touch mainly the Demand Response Industry, although the theme of the interoperability equally affects all sectors;

- the same consideration of transversal importance can be strongly extended to the hot topics of the security of the system and of the single devices and of the data privacy protection;
- more specific issues, e.g. those related to the EMC, deserve due attention as standardization problems.

It is also worth to underline, as a result of the survey analysis, the rather scarce awareness by the industry representatives on the in progress standardization initiatives, although they attribute high relevance to the discussions on the specific problems within the standardization bodies and the other initiatives promoters. This evidence should be taken into due consideration by the concerned institutions, indicating lack in the information and perhaps in the active participation of stakeholders (especially SMEs, we suspect).
Also the outcomes from interviews give interesting hints to the discussion on the standardization. The chapter 6 of the document reports about that, correlating the industry representative's remarks to the most critical gaps raised by the questionnaires and to the concerned standards and standardization related initiatives.
Critical positions concern different items correlated with the three Areas of Interest, but also more transversal issues, including the standardization process as implemented by the EU bodies.
Indications on the possible impact deriving from the reported critical aspects have also been attempted.
All the above aspects will be matter of discussion within the STARGRID activities and specifically within those of the WP5, where further dedicated interviews will be carried out with experts, so as to draw the final achievements of the Project.