REPORT ON PUBLIC CONSULTATION PROCESS ON

ENTSO–E R&D IMPLEMENTATION PLAN 2016 – 2018

ENTSO-E Research and Development Committee
31 March 2015

The consultation on the Implementation Plan 2016-2018 (IP) was carried out between February 3rd and 24th 2015, both through publication on ENTSO-E website and direct contact (addressing e-mail request) to some relevant stakeholders: European Technology Platform (ETP) Smart Grids, European Energy Research Alliance (EERA) Joint Programme (JP) Smart Grids, EWEA (European Wind Association), T&D Europe, Eurelectric, ENTSO-G, Europacable, ESTELA (Concentrated Solar Power Association). This "push" approach proved to be paying as extended and relevant replies were received, in contrast with the previous years.

Furthermore within the Grid+Storage project (service contract to European Commission) the ENTSO-E R&D Implementation Plan 2016-2018 was discussed and endorsed by the project partners: EDSO for Smart Grids (distribution system operators) and EASE (storage community).

Written and detailed replies were received from ETP Smart Grids and EERA JP on Smart Grids / ELECTRA IRP. The contribution of EERA was developed based on the contributions from several research organisations: SINTEF (NO), RSE (IT), TECNALIA (ES), INESC (PT), TNO (NL), USTRATH (UK). Moreover, ENTSO-E considered the informal input provided by ACER gave on ENTSO-E Working Document on regulatory issues for TSOs R&D financing / tariff, dealt with also within the IP.

This report gives a structured overview (see table below) of:
- Comments received, split by subject/nature and gathered in homogeneous clusters for consistency;

- Rationale/background behind the comment;

- ENTSO-E Research Development Committee reaction: acceptance (partial, total or not acceptance) and motivation;

- Consequential actions and follow-up, including modifications, if any, introduced in the Implementation Plan and inputs for future activities and deliverables.

Positive comments of general nature, received by the respondents (about importance of R&D, importance of planning and coordination, etc), are not reported in the table, because they don't generate follow-up actions or modifications in the draft IP. Editing comments have been directly implemented and are also not reported.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

METHODOLOGY & PLANNING PROCESS

Type and source of comment	Issue & rationale	ENTSO-E RDC reaction	Consequences / follow-up
Multiple R&D planning instruments (from all respondents)	Mutual consistency and/or hierarchy among the several others R&D planning instruments for power sector at European level: Strategic Research Agenda of ETP Smart Grids, EEGI Roadmaps, EC Horizon 2020 Work Programs, SET Plan Integrated Roadmap, JRC map, etc.	The issue is real. RDC has already made and is intensifying efforts to liaise and possibly align the different documents, still keeping TSOs' vision on the matter, as per ENTSO-E mandate This is also an input for the on-going Strategy Review within RDC	No draft modification, but issue already considered in the design phase of the IP
ETP Smart Grids Work Program	ETP Smart Grids has submitted its entire Work Program, for reference and alignment, encompassing R&D needs, priorities and challenges / research topics	In next IP, as well as in the upcoming revision of ENTSO-E Roadmap, this Work Program will be consulted	No draft modification, but benchmark with other R&D projects will take place in the execution phase
Prioritisation of topics	Prioritisation of topics is not elaborated enough or there is no wholly consistency among the topics	RDC acknowledges this issue, which is mainly due to the necessity of combining a top-down approach (Clusters from Roadmap, EU indications and funding schemes) with a bottom-up approach (topics proposals coming from TSOs willing to commit as leader or partner)	No draft modification at this stage, but definitely an important point of improvement for next deliverables. This is also an input for the on-going Strategy Review within RDC regarding inter-TSO collaboration. Outcomes from the on-going Grid+Storage support action will be used. Within this project a prioritisation and a ranking of the topics will be carried out (according to flexibility urgency, Technology Readiness Level, cost and environmental impact)
Monitoring of Roadmap	A low advancement status of the clusters of Roadmap has been registered. Therefore this parameter was not used as a driver for selection	RDC fully acknowledges this comment. There are several motivations: the monitoring exercise is referring to year 2013. In 2014, ENTSO-E developed an R&D applications/deployment report. Furthermore the Roadmap concept itself entails the necessity to finalise all its paths (clusters) to attain success,	The upcoming revision of ENTSO-E Roadmap shall re-consider this kind of monitoring activity

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

	of next topics : this should be the rationale of a Roadmap	while R&D activities do not necessarily deliver results according to only a "linear" approach	
R&D results' deployment	A coordinated approach to the translation of research to innovation, to demonstration, to deployment of results is missing; indeed this is the correct way of measuring R&D societal and system benefits	The just published Application Report 2014 is addressing this issue	Indications from Application Report will be used as input for next IP and the selection of topics
Coordination among national and EU R&D programmes	Missing indications about strategy, tools and planning processes to realise the desired coordination among national, international and EU R&D programmes	Although this is not strictly in the mandate of ENTSO-E, RDC is currently addressing this issue for the sake of targeting to achieve the best practices and the optimisation of resources	The IP has already a section (for the first time) on the subject, and the issue is deeply under consideration within the on-going Strategy Review

R&D TOPICS - GENERAL

Type and source of comment	Issue & rationale	RDC reaction	Consequences / follow-up
TSO-DSO joint projects (from all respondents)	It was suggested to have more emphasis on TSO-DSO joint projects; on the promotion of an "Integrated Grid" approach; indeed all respondent organisations are stakeholders of the whole power system and are not focused only on transmission, as it is the case for ENTSO-E	RDC has already made and is intensifying efforts to develop cooperation in this field by introducing a specific cluster and some concrete topics regarding TSO-DSO cooperation. RDC sees the importance of stronger interaction between the transmission and distribution networks.	No draft modification at this stage, but RDC shall retain the input of stimulating further collaboration on the issue.
CONSUMERS (AND PRO-SUMER) FOCUS	It was suggested to have more emphasis on demand side, consumer focus & related market developments; indeed most respondent organisations are active in the smart grid field	TSOs have no direct relation with consumers; however they are ready and willing to collaborate and follow R&D projects regarding customers with indirect impact on transmission	No draft modification at this stage, but RDC shall retain the input of prompting TSOs to put more emphasis in next topics proposals

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

ICT	It was suggested to have more emphasis on Information/ ICT tools, cyber security, control instruments	TSOs see themselves as users of such tools/instruments, rather than developers; they are ready and willing to participate to relevant projects to test the solutions in the field or deployment phase	No draft modification at this stage

R&D TOPICS - INDIVIDUAL

Type and source of comment	Issue & rationale	RDC reaction	Consequences / follow-up
Suggestions of item additions and fine-tuning of focus for some topics	The suggestions stem from the comparison with own R&D topics/projects of the respondent organisation. The detailed comments are presented in the Annex.	Individual /specific comments have been addressed to the TSOs proponent of the respective topic for consideration in execution phase. RDC find the suggestions enriching.	No modifications to IP, since it was not compatible with deadline for IP publication

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

ANNEX – Comments on individual Topics/Concepts 2015-2018

Almost all topics of IP have been commented in great detail by the respondents. Most of the comments received refer to the content, others are just referring to the form. Some of the comments are in fact suggestion on how to expand the subjects considered in the Roadmap. EERA is also suggesting two more concepts for the year 2018. RDC appreciated the specific comments on topics which enrich their description and also provide new perspectives on future developments.

Summary of comments on individual topics

Topic/concept	ETP Smart Grid comment	EERA	TSO /RDC reaction
Topic 1 2015 - Inertia, control and protection of large power systems with large share of inverter-based components	The scope of this R&D topic could include investigations for harmonic correction measures, such as filters or real-time current compensation systems to be installed in HVDC substations and decrease harmonic current distortion.	The **specific challenge** of this topic could be enriched by including some of the following : • The integration of HVDC links into the electrical system poses new challenges to analyse and overcome. One key aspect to be analysed is the interactions between the HVDC converters and other parts of the power system as nearby generators and other HVDC converters and FACTS. These analyses require carrying out steady state studies based on load flow simulations, transient stability analysis and dynamic simulations to assess potential interactions between converters of different vendors. In addition, electromagnetic analysis (EMT) for the determination, among other	The received comments will be considered when the topic is implemented (development of project proposals) or in the next Implementation Plan .

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		aspects, of the harmonic performance of the HVDC converters is also required in the grid codes. Performing these studies requires the development of accurate models of the HVDC converters and controllers. • Development and integration of converter-level and system-level controllers is another key issue for the proper operation of multi-terminal HVDC links and meshed HVDC grids based on MMC converters. Up to now, most of the studies developing system-level controllers do not include any converter-level controller for the circulating current, thus degrading the dynamic response of the system. Development of system-level and converter-level controllers for the fulfilment of the grid code requirements, both in the onshore and offshore HV and MV networks, and analysis of the interactions between them, are key issues for the development of VSC-HVDC links and future meshed grids. • Development of algorithms for the inverter-based components designed to improve the frequency control and the voltage value of the grid.	
Topic 2 -2015 Methods and tools for optimising asset management	Suggest that topic to be more focused and to consider the text of ETP Smart Grids on the same topic: *"So far, asset management*		The received comments will be considered when the topic is implemented (development of

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

	relies on an average lifespan of equipment as a function of a few critical working parameters (e.g., working temperature, number of switching, etc.). A challenge is to revisit the lifetime prediction modelling based on extended parameters that can be easily monitored (based on a trade-off between the extra cost for monitoring and the expected lifetime expansion). The other challenge is to account for the reliability of the new monitoring system itself." This theme describes the following specific tasks for the identified research work: • Identify the parameters (climate conditions, operating conditions, among others) that impact the lifespan of components. • Establish evaluation/estimation protocols for component statuses that are comparable across TSOs, with in-depth analysis and shared experiences. • Develop a methodology to determine and expand the lifespan of components including conventional components (conductor, insulator, tower, breaker, etc.) and new components such as power electronic and digital devices.		project proposals) or in the next Implementation Plan.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

	• Propose dedicated, intelligent monitoring and analysis of results from equipment operation. If necessary, specify new measurement devices and associated ICT system. • Assess the environmental impact (noise, leakage, etc.) and safety for workers or nearby inhabitants (especially in case of failure), taking into account aging processes and technical obsolescence. • Validate the added value of individual lifetime assessment compared to an average assessment of several similar components based on generic parameters (age of equipment, switching steps, etc.). • Assess the benefits of partially renewing small components (joints, etc.) or adding new protective layers (paint coating) to extend life span. A methodology is to be developed that assesses the capability of each component to be partially repaired or where the coating is to be replaced • develop new ways of detecting component failure based on failure models		

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

	• Define methods and tools to optimize asset management at the system level. The methodology should provide an assessment of risks of different asset management strategy, including interactions between equipment, impacts on security and quality of supply and also environmental and safety constraints. The organization of maintenance work, availability of spare parts (supply chain, quantity of spare parts and location) are part of the global optimization challenge • Provide tools for dynamic management of outage planning & maintenance schedules		
Topic 3-2015: Novel Cross Border Balancing Market Mechanisms and Tools for Ensuring System Reliability		Although "Specific Challenge" section states, in the last sentence of the 1st paragraph, that "It should integrate local balancing resources by finding appropriate **price signals** and increase system reliability and efficiency", no economic assessment is envisaged. It is proposed to include it by adapting the 2nd sentence of 2nd paragraph in the same section: "The optimal allocation of cross-border capacity with respect to security, technical requirements, geographic locations	The received comments will be considered when the topic is implemented (development of project proposals) or in the next Implementation Plan.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		and **economic criteria** are also important areas to examine."	
Topic 1-2016: Fast storage needed by TSOs	The "Specific Challenge" describes the need for fast storage well. It is well known that applications related to voltage control are not new, hence limited required R&D. However, the need could be more specific on the very new emerging problem of frequency fluctuations related to intermittency in generation and the gradual decrease of stabilizing rotating inertia. These frequency instabilities are twofold in nature: • A higher band of frequency fluctuations due to normal small switching actions in normal operation. • A frequency jump at a major event (switching or short circuit).	The description of the topic could be improved by indicating the intermediate use of other energy vectors (i.e. heat) which could be acceptable in terms of improved efficiency, provided that the power to power cycle is always considered as the primary path. Additionally, a couple of issues that could be mentioned : • The need to value the improved performance of energy storage in terms of speed and accuracy when compared to conventional solutions. • The potential for aggregation and centralised management of small distributed service providers (even at residential level).	The received comments will be considered when the topic is implemented (development of project proposals) or in the next Implementation Plan.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

	For this reason R&D should be targeted to solutions to the problem by providing the missing inertial response through. Technologies are available but further work is required to validate optimal solutions for different operating conditions.	A specific mention could be done for the integration of energy storage in planning tools for both electric infrastructures and markets The role of energy storage in the path towards an integrated European electricity market is also important for the third technical objective The description could be more specific on the very new emerging problem of frequency instabilities due to lack of inertial response power in the system. These frequency instabilities are twofold in nature: • A higher band of frequency fluctuations due to normal small switching actions in normal operation. • A frequency jump at a major event (switching or short circuit) that may be become too fast for protections measures to respond adequately. As the percentage of renewable generation in the power system varies during the day, also	

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		the severity of frequency instabilities will depend on the time of the day. This could for example for a system with a lot of solar power range from a stable system at night to a completely uncontrollable system at noon that would blackout at any disturbance. For a system with a high penetration of wind power this could have the same result of a stable system during wind still situation and calm winds, and an uncontrollable system at high winds and maximum wind turbine power. Solutions to the problem provide the missing inertial response power by e.g.: • applying appropriate control algorithms to the power electronic interfaces of devices like fast storage devices (non-synchronous flywheel, MES (Super conducting Magnetic Energy Storage), large loads or the DC-bus of HVDC connections • Install synchronous machines with appropriate rotating inertia that operate at zero net load. These may be synchronous condensers fitted with extra	

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		synchronous rotational mass (inertia) as a fast storage device.	
Topic 2-2016: Control system of the future: real time tools for control centres		When referring to the size of the system to be controlled, it could be more accurate to consider the data (amount, type) to be managed.	
Topic 3-2016 Monitoring and observation tools for power network infrastructure	As sensors and monitoring equipment on the grid grow, this can easily lead to flooding of information that cannot be effectively handled by operators. For this reason the R& D topics should be extended to cover work in developing efficient means for handling the generated data on the principle of “what I need to know" of the provided observables and the selected observables to be presented in a meaningful way to the operators in the control rooms. In the noted Content/Scope section, it would be useful to add the need for “Monitoring information provided by forecasts for observation and control of generation and demand”.	New monitoring methods at many places in the power system can easily lead to a flood of information that cannot be handled by the TSOs anymore. Information gathering should be restricted to "need to know" observables that are presented in a meaningful way to the operators in the control rooms. Hence, in order to ease the monitoring in control rooms, it would be advisable to develop appropriate aggregated observables for the cases where still many single observations are needed to describe a needed type of information.	The received comments will be considered when the topic is implemented (development of project proposals) or in the next Implementation Plan.
Topic 4 -2016 Demand Side Response : load control mechanisms and ancillary services at TSO and DSO level		ENTSO –E forgot to mention the row regarding Content /scope. It suggested to have as scope/content the following: • Novel ways of providing ancillary services through loads and their impact on transmission networks; the highly	The received comments will be considered when the topic is implemented (development of project proposals) or in the next Implementation Plan.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		variable and unpredictable nature of DER and RES places new constraints on these ancillary services. • Technologies and tools for active and reactive power control of DER, TSO/DSO coordination to provide extra power flow control, load management and islanding.	
Topic 1-2017: Advanced tools for new market models		Suggested change in the bold letters: "Pan-European power flows within a free energy market plus massive integration of variable RES resulting in local and regional bottlenecks, necessitating a fair charging mechanism for **transmission network** capacity use." Suggested change in bold letters : "The aim is to develop new capacity calculation methods for medium to long-term horizons (week, month, year, multi-year ahead) and congestion management approaches in accordance with a new comprehensive and reliable methodology **being developed** for the pan-European transmission network" and of paragraph 2 "Stakeholders such as TSOs, market operators, regulators and market players **have cooperated in establishing the broad lines** of a target model for the European Electricity market".	

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		Suggested change in bold letters: “Advanced congestion management principles, methods and tools will correctly indicate to the market where true network congestions physically exist and should therefore minimise losses **(non-supplied energy, technical losses)** due to limited network capacity.”	
Topic 3-2017: Market modelling and system adequacy assessment for long-term planning		The impact of Demand Response, electric vehicles and storage must be taken into account when planning the grid, but not only from the market functions point of view. EERA suggests to add the following tasks of the Roadmap 2013-2022 • To develop long-term planning methods to combine electricity market analyses, production capacities (all types including RES) and infrastructure in view of strengthening expected weak points on the grid • To provide coordinated grid design involving new network architectures, power flow control devices, storage and other technologies to achieve sustainable and efficient networks • To develop planning software to optimize location, coordination, control and integration of technologies within existing and	The received comments will be considered when the topic is implemented (development of project proposals) or in the next Implementation Plan.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		future system architecture and operation	
New Addition from EERA Concept 3-2018: Innovative tool and method for coordinated operation		CONTENT Challenges: The expanding share of RES is affecting power system operations by rais-ing the volatility of flows in the grid. This increases the complexity of managing balancing and congestion problems while still maintaining security of supply. Moreover, dynamic aspects must be monitored in real-time (or as closely as possible) and planning must be performed on a daily basis. Guidance is needed so that appropriate decisions can be made quickly. Once the worst-case scenario has been iden-tified, an elaborate defence plan must be defined. Objectives: New tools will be developed to facilitate the harmonization and coordination of operational procedures between TSOs so that electricity is delivered at the level of quality customers require. Specific tasks: To develop approaches for optimal provisioning, dimensioning and sourcing of reserves to maintain security of supply; To implement stochastic approaches to manage the operational planning by the optimization of critical variables (larger dispersions around the determin-istic values	The received comments will be considered when the topic is implemented (development of project proposals) or in the next Implementation Plan.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		obtained from the current steady state simulation tools) to cope adequately with uncertainties; To facilitate converging policies for operational planning and to support the harmonization of operating rules across Europe; To identify optimal control actions that deliver the right level of reliability while facing uncertainties from the large-scale deployment of RES and market integration; to identify critical multiple contingencies and to assess residual risks while taking into account effectiveness and availability of new approaches to coordinate protection and defence. Expected outcome: The system will be operated in a coordinated and reliable manner through the use of new tools, methods and expertise, according to a new European reliability doctrine (see FO T9). It will also support the creation of coordinated defence and restoration plans based on a new set of principles and methods which account for uncertainties. Expected impact: Maintain security of supply at the level requested by the end users. Main contributors: TSOs Research institutes	

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		Additional information: To consider the results of AFTER, GARPUR, iTesla, Umbrella Timeline 2016 – 2018/19	
New addition from EERA Concept 4-2018: Innovative tools and approaches for planning and operation of the transmission grid		CONTENT Challenges: Operation and Operational planning are the most challenging tasks for TSOs. The integration of renewable energy sources such as wind- and solar power has considerably changed and will continue to change the way transmission systems are planned and operated. In addition, the presence of both AC and DC links will make operation of the pan-European system even more challenging. Objectives: In this perspective it is relevant to define new method for planning and operating transmission grids considering the new security doctrine to take into account the variability of RES and demand. Specific tasks: To provide an optimal approach for expansion and operational planning taking into account the new security doctrine. In alternative to define optimal way to verify the efficient operability of a proposed grid expansion plan. To provide an appropriate approach to risk assessment and	The received comments will be considered when the topic is implemented (development of project proposals) or in the next Implementation Plan.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu

		control for the evaluated criteria based on probabilistic analy-ses which takes into account correlations in the power system .To develop indicators for the evaluated criteria for network operators to help them make decisions for preven-tive and curative actions. Expected outcome: New methods and tools to allow TSOs to integrate new technologies in system planning and operation procedures to maintain or increase today's system security and reliability levels. Expected impact: An optimized use of the European transmission system which allows integration of RES without decreasing today's system security considering social welfare.	

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 info@entsoe.eu • www.entsoe.eu