ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

WG3: FLEXIBLE GENERATION

TERMS OF REFERENCE

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Working Group established 09/12/2016

HORIZON 2020

Background for all Working Groups

In September 2015, the European Commission issued the SET-Plan Communication[1], addressing innovation in the context of the strategy of the Energy Union. Among the priorities highlighted, of particular interest for the energy networks community is the priority "**Number 4 – Increase the resilience, security, smartness of the energy system**"[2].

The European Technology and Innovation Platform for Smart Networks for the Energy Transition (ETIP SNET) was set-up to reflect the increasing need to consider the smart grids as an integral part of the energy system. The mission of the Platform is to guide research and innovation activities to support Europe's energy transition. The ETIP SNET will elaborate a vision and a Roadmap for R&I activities (and the associated Implementation Plans) for smart networks, storage and other sources of flexibility, and integrated energy systems, engaging all stakeholders. It will also look at customer participation and the impact of digitisation. It will identify innovation barriers, notably related to market design, regulation and financing.

A number of permanent Working Groups and a Member States/Regulators Group were set up in the ETIP SNET to ensure the involvement and contribution of all the stakeholders of the energy system as a whole, providing vision, inputs, guidance and continuous feedback for the development of the integrated R&I Roadmap. The Working Groups are set up to ensure the most adequate balance between the effectiveness of their work on the planned deliverables and the openness towards new subjects and new issues which may appear. The following Working Groups are established:

- WG1: Reliable, economic and efficient smart grid system
- WG2: Storage technologies and sector interfaces
- WG3: Flexible Generation
- WG4: Digitalisation of the electricity system and Customer participation
- WG5: Innovation implementation in the business environment
- WG6: National Stakeholders Coordination Group

WG1 to WG4 are dedicated to the different aspects of development of the energy system along its different main development paths, while WG5 is more focussed on technology transfer, application and market uptake. The WG6 National Stakeholders Coordination Group, involves Governments and Regulators to ensure that the all ETIP outcomes optimally complement national conditions and innovation directions, and to facilitate the uptake of ETIP outcomes into local/national policy. The following figure illustrates the main fields of activities of WG1 to WG4:

<table>
<tr><th>Domain</th><th colspan="4">Working groups</th></tr>
<tr><td>System</td><td rowspan="4">WG1: Reliable, economic and efficient smart grid system</td><td></td><td></td><td></td></tr>
<tr><td>Technology</td><td rowspan="3">WG2: Storage technologies and sector interfaces</td><td rowspan="3">WG3: Flexible Generation</td><td rowspan="3">WG4: Digitalisation of the electricity system and Customer participation</td></tr>
<tr><td>Market</td></tr>
<tr><td>Society</td></tr>
</table>

[1] Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation" (C(2015)6317).

[2] Other priorities, such as priorities one and three for instance, will also impact the energy system transformation.

Mission of the ETIP Working Groups WG1 to WG4

Experts acting in the Working Groups ("WG Members") will aim at providing strategic guidance about RD&I priorities and activities, ensuring the interaction and involvement of the entire expertise needs raised by the integration issues of the electricity system into the wider European energy system.

The Working Groups (WG) will also exchange with the other ETIPs (roadmap and implementation plans) and the other European or International R&I coordination activities (e.g. ERA-Net SG+, GSGF, CEM initiatives, Mission Innovation, IEA TCPs such as ISGAN, DSM, HTS, 4E etc.).

The Working Groups will act in close coordination with the European CSA assisting the ETIP SNET in the development of the RD&I Roadmap and implementation plans (for the period Oct. 2016-Sept. 2020 the CSA is INTENSYS4EU).

The Working Groups are set-up on the principle of avoiding overlaps among their goals and activities carried out. WG1 focuses on both technological and market solutions for the European electricity networks as well as on the integration of generation, consumption, storage, and interfaces to other energy networks. This integration should make the power system sustainable, reliable, secure and affordable. The WGs 2, 3 and 4 focus on providing the main different technological and market solutions to ensure the flexibility of the power system. Through this focus on system integration and flexibility to meet system needs, they support the system approach in WG 1 and of the entire ETIP SNET.

The mapping between the potential scope of each Working Group (WG1 to WG4) and the Functional Objectives of the (existing) Roadmap is presented Annex 1. Additional Functional Objectives provided by other stakeholders than those involved in the development of the present Roadmap will be mapped by the respective Working Groups.

The Working Groups (WG1 to WG4) should focus on:

- Delivering a vision (overarching goals and constraints) for the European energy system and respectively of the contribution of various technologies to this system by 2030, 2040 and beyond, guiding the preparation and update of the RD&I Roadmap at the light of the specific priorities of the European Energy Union addressed;
- Assure the large scale integration of Renewables Energy Sources (RES) to the energy system and facilitate and smooth transition to the sustainable future energy system through the development of all the necessary network services based in RES technologies.
- Reviewing the monitoring reports of the implementation of RD&I activities at European, national/regional and industrial levels, produced by on-going research and demonstration activities with the goal to establish the state of the art (e.g.: analysis of recent success stories / innovation actions in the area of expertise of the working group, analysis of the results from the outstanding project's demonstrators, analysis of the potential of scaling up and replication, analysis of the coverage of each functional objective within the scope of the WG by past and ongoing R&I project achievements);
- Reviewing the relevant BRIDGE reports that identify the economic, social, technical, legal, etc. barriers which may slow down business model deployment (impacting scaling, replication, deployment);
- Creating inputs to and reviewing output of the knowledge sharing activities at pan-European level organised by a) INTENSYS4EU through inputs to regional workshops or the production/review of contents for the Knowledge Sharing Platform (KSP) and b) by ERA-NET SG PLUS by its Knowledge Community.

- Preparing a consolidated stakeholder views about the Research and Innovation activities to meet both European and National/Regional Energy Policy orientations, also contributing to the process of development, review and validation of a common RD&I roadmap;
- Contributing to validate, integrate and prioritize the Research and Innovation activities in the updated RD&I roadmap and the related yearly implementation plans;
- Identifying the long term challenges, disruptive technologies , solutions to be addressed by the future R&I activities and the innovation barriers to be removed to favor the deployment of new knowledge in their area of expertise;
- Estimating the financial resources need to carry out the proposed RD&I activities and potential financing mechanisms to be used (EU, National / Regional Funding, financial contributions by project participants).

Organisation of the ETIP Working Groups WG1 to WG4

The WGs gather experts representing the widest community of stakeholders related to their area of expertise. The WG is coordinated by a Chair assisted by one or more vice-chairs. The ETIP SNET Chairs will present to the Governing Board a short list of candidates of WG chairs and vice-chairs taking into account a balanced view of representativeness of different stakeholders in the ETIP Executive Committee. The ETIP Governing board approves the chair and membership of each WG based on their expertise and representativity.

The WG Secretariat function is assured by the INTENSYS4EU project and provides a permanent logistical support to organise meetings, taking minutes and interacting with the Chairs on a permanent basis as well as following-up the execution of decisions taken. WG members are recruited through a call for experts addressed to the entire stakeholder community. Experts contribute to the WG on a voluntary basis and no reimbursement of expenses is foreseen. Decisions in the WG are normally taken by consensus (or through majority vote in cases consensus are not reached) and outcomes from the WG are reported to the ETIP SNET governing board by the Chairs

Specific Objectives – WG3: Flexible Generation

WG3 (Flexible generation) addresses the business and technology trends considering the contribution of generation flexibility from conventional thermal power plants (bulk and distributed), and of the innovative technologies and solutions in thermal-based in high efficiency generation systems(e.g. micro-CHP, industrial co-generation), heat distribution (e.g. district heating), storage and the optimization of the RES capabilities to contribute to reach a secure, clean and reliable energy system network storage to address the needs for flexibility in the framework of an integrated energy system.

Shifting the management of thermal conventional power plants from base-load, a low and limited flexible capability to flexible back-up power generation poses a number of challenges which need to be addressed in terms of efficiency, reliability, life expectancy, operational costs, as well as of environmental performances. Several solutions can be envisaged but need to be validated and demonstrated, ranging from bulk to distributed generation.

In other way the future European energy scenario with very high shares of renewables (up to 100%) in the energy mix, system support functions that are provided today by synchronous generation will need to be provided by renewable generation or procured from third parties. RES should significantly contribute to a more stable operation of the future energy system, allowing growing percentage of renewable sources to substitute traditional dispatchable generation.
WG3 will address the different technologies and solutions of the flexible generation (including conventional power plants, embedded storage and fuel cells) and RES optimisation from a technological, environmental, economic, regulatory and acceptance points of view.

The WG must address integrated solutions based on variable renewable energies (solar PV, wind energy and hydro) + energy storage devices + smart technologies focused on the large integration of renewable energies in the network (both, transmission and distribution grids) in a security and reliable mode, assessing the smooth substitution of synchronous generation.

The details of the items addressed are only partly included in the present roadmap (see the items included in Annex 2). New clusters and functional objectives need to be included to address this specific subject.

Key targets and performances Indicators

- *TBD with the WG chair*

Year 1 activities

- *TBD with the WG chair*

Annex 1: Mapping of the Roadmap Functional objectives with the potential scope of each working groups 1-4

The starting point of WG1 to WG4 should be, amongst the Functional Objectives of the R&I roadmap 2016-2025 adopted by the ETIP SNET end of 2016, those relevant to the topic of the working group.

The areas of expertise of the working groups WG1 to WG4 are illustrated by the table below as a function of the functional objectives of the R&I roadmap 2016-2025.

Clusters and functional objectives		WG1	WG2	WG3	WG4
Distribution Cluster C1 -Integration of smart customers and buildings					
D1	Active demand response				X
D2	Energy efficiency from integration with smart homes and buildings				X
Distribution Cluster C2 - Integration of DER and EV, storage, other networks					
D3	DSO integration of small DER	X			
D4	System integration of medium DER	X			
D5	Integration of storage in network management		X		
D6	Infrastructure to host EV/PHEV – Electrification of transport	X			
D7	Integration with other energy networks		X	X	
Distribution Cluster C3 - Network operations					
D8	Monitoring and control of LV network	X			
D9	Automation and control of MV network	X			
D10	Smart metering data processing and other big data applications	X			X
D11	Cyber security (system approach)	X			X
Distribution Cluster C4 -Planning and asset management					
D12	New planning approaches and tools	X	X	X	X
D13	Asset management	X			
Transmission Cluster C1 – Modernization of the network					
T1	Optimal grid design	X	X		
T2	Smart asset management	X			
T3	New materials and technologies	X	X		X
T4	Environmental challenges and stakeholders	X			
Transmission Cluster C2 –Security and system stability					
T5	Grid observability: PMU, WAM, Sensors, DSO information	X			
T6	Grid controllability: frequency and voltage stability, power quality, synthetic inertia	X	X	X	
T7	Expert systems and tools: expert systems, decision-making support tools and advanced automatic control	X			X
T8	Reliability and resilience: defense and restoration plans, probabilistic approach, risk assessment, self-healing	X			

T9	Enhanced ancillary services for network operation	X	X	X	X
Transmission Cluster C3 – Flexibility of power system					
T10	Storage integration, use of storage services		X		
T11	Demand response, tools for using DSR, load profile, EV impact	X			X
T12	Improved RES forecasting and optimal capacity operation	X		X	
T13	Flexible grid use: dynamic rating equipment, power electronic devices, use of interconnectors	X			
T14	Interaction with non-electrical energy networks		X	X	
Transmission Cluster C4 – Economy and efficiency of power system					
T15	Market/grid operation integration	X	X	X	X
T16	Business models	X	X	X	X
T17	Flexible market design	X	X	X	X
Transmission Cluster C5 – ICT and digitalization of power system					
T18	Big data management				X
T19	Standardization, protocols for communication, and data				X
T20	New technologies, Internet of Things				X
T21	Cybersecurity				X

Annex 2: Mapping of the Roadmap Functional objectives with the potential scope of WG 3 (for the start)

The following subjects can be considered for starting the work of WG3:

Increased flexibility of thermal power generation: The main objective is to have a thermal power generation fleet that can react rapidly and contribute to deliver the flexibility needed to allow the integration of an increased share of variable RES, while ensuring the stability of the grid and security of supply and considering possible yearly green-house gas emission limits: this implies the improvement of existing thermal power plants, development of new/innovative technologies/main components/ for large-scale thermal power generation. Activities in this area cover the improvement of operational flexibility (ramp-up/shut-down, load capability, etc.) as well as fuel flexibility and increased robustness of components towards mechanical, electrical, thermal and environmental stresses.

Increased RES capabilities to support network services: In the future energy scenario the conventional power plants will be substitute by new and improved performance Renewable energy generation plants, that must support the same services and capabilities than those offered actualy by the convetional systems. This improvements will facilitate and acelerate this energy transition reducing cost and promoting a sutanaible energy system respecting the EC climate change objectives.

Increased efficiency of thermal power generation: The main objective is to have a thermal power generation fleet that can increase its efficiency under greater flexibility conditions (e.g. partial load operation or operation close to the technical minimum permitted for the plant, in combined heat and power units); this implies the improvement of currently used thermal power plants, the development of new/innovative technologies/main components for large-scale thermal power generation.

Improved environmental performance of thermal power generation: The main objective is to have a thermal power generation fleet that can, sustainably, deliver when needed, allowing the integration of an increased share of variable RES, while ensuring the stability of the grid and security of supply. Other aspects, such as manufacturing and lifetime should also be addressed. These objectives can be achieved through the improvement of existing thermal power plants, development of new/innovative technologies/main components/, for large-scale thermal generation.

Increased flexibility and integration of decentralized thermal power generation: The main objective is to address non-variable distributed generation (DG) technologies in order to allow a higher share of RES feeding into the (distribution) grid and ensure a high security of energy supply. This objective can be reached by the improvement of non-variable DG technologies, development and demonstration of hybrid systems (e.g. micro-turbine-fuel cells, solar hybrid, hybrid micro-CHP systems), fuel flexibility, improvement of flexibility of decentralized energy systems, integration into energy systems with specific focus on different demand pattern of electricity and heat.

District Heating and Cooling: The main objective is to decouple the use of heat & power (e.g. via buffers, storage, power-to-heat, power-to-fuel) and to better integrate existing and future large-scale centralised and distributed combined heat and power District Heating applications/plants in the grid/energy system.

Industrial cogeneration: The main objective is to decouple the use of heat & power and to better integrate existing and future large-scale centralised and distributed combined heat and power

industrial applications/plants in the grid/energy system and to develop technologies with high electrical efficiency that can use hydrogen, biomass and biofuels.

Small- and micro-CHP: As part of a future 'smart grid', small and micro-CHP units can be aggregated with other low carbon technologies as a 'virtual power plant' which can be dispatched when the intermittent renewables are not generating. Projects should aim to demonstrate the potential of small scale and micro-CHP as part of virtual power plant configurations. Small- and micro-CHP technologies can be complementary to renewable technologies (e.g. PV) and electric heating solutions (heat pumps), as they produce electricity at times of peak electricity demand. In combination with storage (heat or electric) and by applying demand response, the flexibility potential of small and micro-CHP can be further realized.

Integration of storage into thermal power plants: Thermal power plants can improve their efficiency and flexibility by storing excess energy on site in case of demand variations and using this at times of peak demand. Similarly also excess energy from variable RES could be stored at thermal power plants or transformed into a syngas, chemical products etc., as support and/or possible alternative to fossil fuels.

Development of hybrid solutions: The objective is to better integrate RES via hybrid plants, for example by enabling rapid switches between and/or the combination of RES and conventional thermal power generation sources, such as thermal solar plants or allowing the use of CO_2 neutral biomass or hydrogen to increase electricity supply stability while reducing plants' carbon emissions.

Hybrid systems with Fuel Cells: Fuel cells and combined heat and power (CHP) are well understood technologies and will play a critical role in Europe's energy transition toward distributed sustainable electricity generation and control. In particular, fuel cells will enable the highest levels of intermittent renewables, while offering central power plant efficiencies at a distributed scale. In a CHP configuration, the electrochemical, non-combustion fuel cells offer the greatest potential for clean, efficient, firm, dispatchable and decentralized power generation. Fuel flexibility, Clean energy, Power density, Electric ramp rates.

Annex 3: Key input documents

- Strategic Energy Technology Plan - Towards an Integrated Roadmap: Research and Innovation challenges and needs of the EU energy system [https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap_0.pdf]
- Communications of the EC COM(2015) 80 final: A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy [http://www.eea.europa.eu/policy-documents/com-2015-80-final]
- Communications of the EC C(2015) 6317 final: Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation [https://setis.ec.europa.eu/system/files/Communication_SET-Plan_15_Sept_2015.pdf]
- SET Plan – Declaration on Strategic Targets in the context of an Initiative on Energy Systems [draft]