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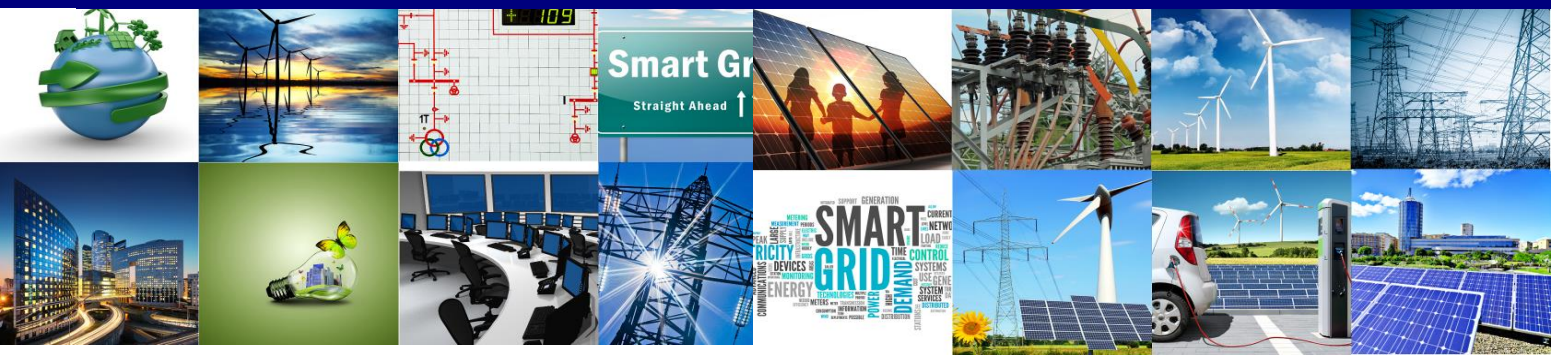
ELECTRA

European Liaison on Electricity Committed Towards long-term Research Activities for Smart Grids



WP 10

Actions on International Cooperation

Deliverable 10.3

List of mutually interesting R&D topics and prioritization by country of R&D topics to be jointly addressed – Final Report

12/06/2016

ID&Title	**D10.3** **List of mutually interesting R&D topics and prioritization by country of R&D topics to be jointly addressed – Final Report**	**Number of pages:**	25

Short description (Max. 50 words):

In this deliverable a prioritized list of R&D topics differentiated by geographical region for INCO is presented. Based on this prioritized list an INCO activity plan is suggested.

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V0.1	18/04/2016	First Draft
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Executive summary

ELECTRA is an Integrated Research Programme IRP that supports networking and R&D activities of the European Energy Research Alliance Joint Programme on Smart Grids (EERA JP SG) and aims at developing radical new control methods for the future renewable energy based electricity system. ELECTRA brings together the partners of the EERA JP SG to reinforce and accelerate Europe's medium to long term research cooperation in the smart grid areas and to contribute to a closer integration of the research programmes of the participating organisations.

The objective of task T10.2 is to identify priorities for the R&D topics of common interest and to set up an International Cooperation Activity Plan, taking into consideration the peculiarities of the different regions involved in the cooperation.

The R&D topics of common interest are collected based on the initial contact and on responses to a questionnaire aligned with the activity areas of ELECTRA and EERA Joint Programme on Smart Grids (JP SG). This deliverable outlines a list of common interesting R&D topics and prioritization by country of R&D topics to be jointly addressed.

Based on the prioritized topics a plan of activities is suggested. The plan of activities also indicates potential interest from B.R.I.C.S. institutions, as presented in D10.2 [4] to obtain maximum impact of the actions. Furthermore, a list of possible actions such as conferences, calls and collaboration is provided.

Deliverable D10.3 is an input for task T10.3, where a selected number of the suggested activities will be launched. However, a joint action has already been initiated: researcher exchanges with extra-European countries have been started within WP9, by a dedicated call launched on October 2015. Seven applications were selected: researchers from USA, Russia and Brazil will visit ELECTRA Partners, while ELECTRA researchers will be hosted by American and Australian institutions.

Terminologies

Definitions

B.R.I.C.S.	Brazil, Russia, India, China, South Africa
INCO	International Cooperation

Abbreviations

D	Deliverable
DMS	Data Management System
DoW	Description of Work
EERA	European Energy Research Alliance
EMS	Energy Management System
EPRI	Electric Power Research Institute
IEC	International Electrotechnical Commission
IRED	Integration of Renewable and Distributed Energy Resources
ISGAN	The International Smart Grid Action Network
JP	Joint Programme
KPI	Key Performance Indicator
MS	Milestone
OPEX	Operational Expenses
R	Internal Report
REX	Researcher Exchange Programme
R&D	Research and Development
SG	Smart Grids
SIRFN	Smart Grid International Research Facility Network
SP	Sub Programme
WP	Work Package
VEN	Virtual end nodes
VTN	Virtual top nodes

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1 Introduction

ELECTRA is an Integrated Research Programme IRP that supports networking and R&D activities of the European Energy Research Alliance Joint Programme on Smart Grids (EERA JP SG) and aims at developing radical new control methods for the future renewable energy based electricity system.

The objective of task T10.2 is to develop of plan of activities for international collaboration (INCO) within the activity areas of ELECTRA and EERA JP SG. Priorities for the topics of common interest are identified and an International Cooperation Activity Plan is set up, taking into consideration the peculiarities of the different regions/countries involved in the cooperation.

This deliverable presents such a plan based on the interaction with a number of INCO partners through a questionnaire that contains a list of mutually interesting R&D topics and prioritization by country of R&D topics and different types of proposed interaction.

This is a final report, and will be used as input for launching task T10.3 activities.

In Chapter 2 the methodology used to complete the suggested action plan is described. The analysis consists of gathering input data, categorization of interesting R&D topics and prioritization per geographical region or country. Furthermore, the methodology used to suggest and select the appropriate types of action is described. For information, it can be mentioned that the same methodology for collecting and prioritizing interesting R&D topics is also applied for countries in B.R.I.C.S. and is separately reported in deliverable D10.2 [4].

In Chapter 3 a list of mutually interesting R&D topics per geographical region/county is outlined while in Chapter 4 each geographical region/country is described in more detail with the corresponding suggestion for type of action.

2 Methodology

2.1 Overall description of the methodology

The process for collecting the interesting R&D topics for countries outside EU and for B.R.I.C.S. countries has been divided into two steps. The same methodology has been applied for INCO and for B.R.I.C.S. and it is fully described in deliverable D10.2 [4].In the first step, information has been collected via first interaction with contacts from countries outside EU. The first interaction was based on international meetings, workshops and conferences and the related results are presented in Deliverable D10.1 [2].

In order to have more information regarding the input data and clearer indications regarding the priorities at geographical level, the second step of the process was initiated: a detailed questionnaire has been prepared and sent out to INCO contacts – see Annex A. This questionnaire was prepared so the R&D topics are easily categorized and the ways of interaction easily identified. The questionnaire was sent out by the partners to their collaboration contacts in extra-EU countries and B.R.I.C.S. countries. Answers from the first interactions from D10.1 [2] have also been mapped into the questionnaire.

Topics of interest are categorized according to the setup in the questionnaire.

2.2 Connection with EERA Joint Programme

As outlined in the Description of Work (DoW), the ELECTRA activity plan should be aligned with the activities of the EERA JP SG. Therefore, the ELECTRA questionnaire includes R&D topics divided into the same categories as for the Sub Programs of the EERA JP SG. The categories are presented in Table 1 where a particular emphasis on the topics researched within ELECTRA is clear.

Table 1 – Sub Programs of EERA JP SG

Sub Program no.	Sub program title
1	Network Operation
2	Power System Management
3	SG ICT and Control Systems Interoperability
4	Electrical Storage Integration
5	Transmission Networks

2.3 Data input from the initial contact

The results of the first interaction for the collection of R&D topics is summarized in D10.1, [1]. The table from D10.1 is repeated in Table 2 for the countries outside EU except the B.R.I.C.S. ones.

Table 2 reports a summary of the R&D topics of interest for specific organizations in different extra-European countries, and an indication about the possible matching with ongoing activities within EERA JP SG sub-programmes and/or ELECTRA work packages. Each topic is identified with the geographical location, the importance level (H stands for “High”, A stands for “Average” and L for “Low”) and the possible links with the ELECTRA and/or EERA JP on Smart Grids activities. This table is taken as a starting point for this analysis.

Table 2 – Preliminary list of Smart Grids R&D topics of interest in specific extra-EU countries

Country	Smart Grids R&D Topics	Importance	Notes / Possible links to EERA JP SG ELECTRA activities
USA	Distribution network reliability and implementation of Distribution Management systems	H	SP2 WP5 - WP6
USA	System efficiency and impact of Information and communication technologies	H	SP3 WP4
USA	OPEX reduction and asset management including the fault and outage management and the service restoration	A	(SP5) (WP6)
Japan	System reliability as seen by the user and building energy management	H	-
Japan	Generation adequacy and its impact on network management (network integration of variable sources)	A	SP2
Japan	Power quality and its impact for the final consumer, with special reference to advanced smart home applications	A	SP2
Korea	Customer services and advanced metering infrastructure	A	SP3
Korea	Energy efficiency and impact of storage	H	SP4 (WP6)
Korea	System efficiency and the potential offered by microgrids	H	SP1 WP6
Australia	System reliability, fault detection and system restoration	A	-
Australia	System efficiency and impacts of the AMI	A	SP3

2.4 Data input to the questionnaire

To expand the level of detail, to be able to enhance the prioritization per geographical region/country and to develop it into a plan of activities, a questionnaire has been prepared.

The questionnaire is based on the same categories as used in the EERA Joint Programme/Sub Program (see Section 2.2). Each of the SP categories is divided into sub-topics. This should make it easier for the respondents to identify their preferences. However, not all relevant R&D topics could be covered by the JP SP categories, and therefore extra categories have been added to the questionnaire, see Table 3.

The first added category is: Research infrastructure, lab facilities and testing. The second added category is: Other topics, meant for R&D topics that are not covered by the other suggested categories. In excess of these two added categories the questionnaire also gives possibility for the respondent to suggest new topics, in case their priorities are not fully met in the listed categories. The questionnaire has been extended with the categories listed in Table 3.

Table 3 – Additional categories in the questionnaire

Additional categories in the questionnaire
Research infrastructure, lab facilities and testing
Other Topics
Suggested topics

For each category, specific R&D topics are suggested: for example, for the category ”Research infrastructure, lab facilities and testing” the following topics are indicated: Lab Validation Proof of Concept, Laboratory Testing, Research Infrastructures, Research Facility, Use Case Methodology.

Furthermore, the questionnaire asks the respondents what type of action they prefer for the selected topic. The answer of this will indicate at what level the respondent is willing to interact and collaborate on the specific topics. The types of preferred action are listed in Table 4.

Table 4 – Types of action preferred

Workshops
Conference side events
Researcher exchange
International collaboration fora
Joint proposals
Joint projects
Summer schools
Joint publications
Joint use of international research infrastructures

The answers to the questionnaire are available in the Annex A. From this annex the priorities from the different organisations can be extrapolated while the persons who received the questionnaire are presented in Annex B.

3 List of mutually interesting R&D topics by country

The R&D topics of interest with input from the initial contact [2] and from the questionnaire are summarized in Table 5. The responses to the questionnaire are also outlined in [3]. The ranking is based on 1 as the lowest priority and 5 as the highest priority. The data input are from the initial contact and answers from the questionnaire that was sent out to INCO contacts.

Some of the respondents filled in the questionnaire with five topics prioritized while other respondents choose to prioritize all topics in the questionnaire. In those cases only the top priorities has been included (priority 5 and possibly 4), so the number of prioritized topics is limited to a maximum of fifteen per respondent.

The priorities for INCO activities were received from Singapore (Energy Research Institute and Energy Market Authority), Switzerland (Research Center for Energy Networks / ETH Zurich), USA (EPRI and Reilly Associates, Consultant to U.S. DOE/Office of Electricity), Japan (Fukushima Renewable Energy Institute, AIST), Jordan (Royal Scientific Society/ National Energy Research Centre) and Korea (KEPRI/KEPCO). The initial contacts cover the INCO countries USA, Japan, Korea and Australia. The priorities from the different organisations are detailed in “Annex A”.

The structure of the questionnaire is used to categorize the topics from the initial contact, so they can be mapped into EERA categories; moreover, it also matches the categories used for the B.R.I.C.S. countries as described in Deliverable D10.2 [4].

Table 5 – R&D topics per country

Category	Smart Grid R&D topic	Country	Ranking
Network Operation	Dynamic control schemes	Singapore	5
		Switzerland	5
		Japan	5
	Frequency control	Singapore	4-5
		Switzerland	5
	Grid observability needs	USA	5
	Distribution system planning	USA	5
		Switzerland	5
	Microgrid control	Singapore	4
		USA	5
		Korea	1,5
	System stability	Singapore	5
		Switzerland	5
	Dynamic system resilience	Australia	3
		Singapore	5
	Voltage control	Singapore	5
		Korea	3
	Network automation	Singapore	5

Category	Smart Grid R&D topic	Country	Ranking
Power system management	Scenarios and trends	Singapore	5
	Control room functions	USA	4
	Control concepts	Singapore	4
		USA	4
		Japan	3
	Distributed/decentralized vertical control concepts	Singapore	4
		USA	5
	Distributed/decentralized control requirements	Singapore	4
		USA	5
	TSO - DSO role and interaction	USA	5
	Grid architecture	Singapore	5
	Grid flexibility	Switzerland	5
		Singapore	5
	Supervisory grid observability needs	Singapore	5
	Market design	Switzerland	5
	Distribution and energy management	USA	5
	Energy market and business models	Singapore	5
	Performance verification	Jordan	1
	Power system operation	Korea	2
		Switzerland	4
	Self-healing at distribution system level	USA	5
	Forecasts of generation and consumption	Jordan	4
	Smart grid data mining	Singapore	5
		USA	3
	Demand response	Singapore	4-5
		Switzerland	4
		Japan	3
	Characterization of DER technologies	Jordan	5
		Singapore	5
SG ICT and Control Systems Interoperability	Functional architecture	Singapore	4
		USA	4
	Interoperable systems	Singapore	5
		USA	2x5

Category	Smart Grid R&D topic	Country	Ranking
	Security issues	Korea	5
		USA	4
		Japan	4
		Singapore	5
	Smart grid interface	Singapore	5
		USA	5
	Home energy management gateways	Singapore	4
		Japan	3
		Korea	3
		Australia	3
	Interoperable energy management systems and control	Japan	5
Electrical storage integration	Storage systems integration	Singapore	5
		Switzerland	5
		Jordan	3
	Controllable flexibility achieved by storages in the smart grid applications	Singapore	4
		Switzerland	4
	Economic and technical benefits of incorporating an ESS into network	Korea	5
		Singapore	5
	Integration of EV into grid	Singapore	4
Transmission networks	Energy management	Singapore	4
	Wide area grid observability needs	USA	5
	Transmission grid architecture	Singapore	4
		Switzerland	5
	Transmission system planning	USA	3
		Switzerland	5
	Integrating Control Schemes	USA	5
	Integration control schemes requirements	Singapore	5
	System reliability and self-healing	Singapore	4
Research infrastructure, lab facilities and testing	Lab validation proof of concept	Singapore	4
	Laboratory testing	Korea	4
	Research infrastructures	Singapore	4
		Japan	1

Category	Smart Grid R&D topic	Country	Ranking
	Research facility	Singapore	4
	Use cases methodology	Japan	2
Other topics	KPI identification	Singapore	4-5
	Researcher exchange	Singapore	5
		Jordan	2
Suggested topics	Sharing of related open source software related to R&D topics	USA	2
	End to end interoperability demonstration and use of open field message bus (OpenFMB) across multiple labs and utilities	USA	1
	DMS/uGrid EMS operational interfaces	USA	Not specified
	DMS functions	USA	Not specified

The priorities are listed country wise. It is worth mentioning that the responses to the questionnaire reflect the opinions of the organizations and not necessarily the opinions for the whole country. It can be observed that the research priorities differ for each organization. However, topics within all categories are broadly prioritized. Almost all the represented topics in the questionnaire are prioritized by one or more of the organizations who replied. Looking at the prioritization per country or geographical region the trend within each category is:

Network Operation:
Singapore is prioritizing almost all aspects and Switzerland a majority of the topics in this category. USA prioritize grid observability needs, distribution grid planning and microgrid control. Korea prioritizes microgrid control and voltage control. Australia prioritizes Dynamic System resilience. Dynamic control schemes are top priority for Japan.

Power system management:
Both USA and Singapore in general prioritize almost all topics within power system management. Grid flexibility and market design are priority of Switzerland. Japan has selected control concepts. Japan, Switzerland and Singapore also prioritize demand response. For Jordan Performance verification, Forecasts of generation and consumption as well as Characterization of DER technologies are prioritized. Both Australia and Korea are not prioritizing topics in this category.

SG ICT and Control Systems Interoperability:
All topics within this category are prioritized by one or more country. Singapore and USA are interested in a majority of the topics. Security issues are prioritized by Japan, Korea. Home energy management gateways are medium interest of Japan, Korea and Australia. Japan also prioritizes interoperable energy management systems and control within this category. Switzerland and Jordan are not prioritizing topics in this category.

Electrical storage integration:

All topics within this category are prioritized by one or more country. Singapore is again prioritizing almost all topics. Switzerland and Jordan prioritize Storage Systems Integration, Switzerland also prioritizes controllable flexibility achieved by storages, Korea also prioritizes economic and technical benefits of incorporating an ESS into network. USA, Japan, Australia are not prioritizing topics in this category.

Transmission networks:
Almost all topics are prioritized by one or more of the countries Singapore, Switzerland or USA, while Japan, Korea, Jordan and Australia are not prioritizing topics in this category.

Research infrastructure, lab facilities and testing:
Singapore, Japan and Korea are prioritizing various topics within this category. On the other side, Switzerland, USA, Australia and Jordan are not prioritizing topics in this category.

Other topics:
Singapore prioritizes KPI identification while Singapore and Jordan prioritize researcher exchange.

Suggested topics:
Different entities in USA have suggested new topics of interest:

- Sharing of related Open Source Software related to R&D Topics;
- DMS/uGrid EMS Operational Interfaces;
- DMS Functions;
- End to End Interoperability Demonstration and use of Open Field Message Bus (OpenFMB) across multiple labs and utilities.

4 Selected action types

For each of the prioritized R&D categories the potential for activities with suggested topics is proposed in Table 6. This activity plan serves as input to task T10.3 for launching some of the activities. The countries represented in this survey are Switzerland, USA, Jordan, Singapore, Korea, Japan and Australia.

Table 6 – Selected actions

Category	Region	Action Types preferred									Suggested topics
		Workshops	Conference side events	Researcher exchange	International collaboration	Joint proposals	Joint projects	Summer schools	Joint publications	Joint use of international research infrastructures	
Network Operation	Singapore, Korea, Japan, Jordan, might be most interesting for countries with power systems relying on connection to other regions or island networks	x	x	x	x	x	x	x	x	x	Workshops or other actions covering the topics: • Potential for microgrids • Frequency control • Voltage control • Demand response (see also Power system management) • Network automation
	All regions	x			x	x	x		x	x	Workshops covering network operation topics in general might lead to common projects of interest and eventually joint use of international laboratory infrastructure where relevant. Selected topics could be: • Dynamic control schemes • Distribution system planning • Distribution system resilience and reliability • System stability
Power system management	USA, Singapore, Korea, Japan, Jordan	x	x	x	x	x	x		x	x	• Distribution management systems • Distribution network reliability • Impact on network management with variable generation • Control room functions • Control concepts • Scenarios and trends • requirements and concepts for decentralized control • grid architecture • Supervisory grid observability

Category	Region	Action Types preferred								Suggested topics
										needs • distribution and energy management • energy markets and business models • smart grid data mining. Action types could be many. Collaboration may initiated by a workshop or conference side event, where other types of activities can be agreed and developed.
	USA	x				x	x		x		Interest in TSO - DSO Role
	Switzerland, Singapore	x				x	x		x		Grid flexibility
	Switzerland and Korea	x	x	x	x	x	x	x	x	x	Prioritize topic power system operation
	Switzerland, Singapore, Japan, Jordan	x	x	x	x	x	x	x	x	x	Demand response covering • Characterization of DER technologies • Forecasts of generation and consumption • Performance verification • Impact on end user for advanced smart home applications Action types could be many. Collaboration may be initiated by a workshop or conference side event, where other types of activities can be agreed and developed.
SG ICT and Control Systems Interoperability	All regions are interested except Switzerland and Jordan	x	x	x	x	x	x		x	x	Main topics of interest are system efficiency and impact of Information and communication technologies • Functional architecture • Interoperable systems • Home energy management gateways • Interoperable Energy Management Systems and Control • Security issues • Standards • Smart grid interfaces (Expand of OpenADR and related IEC standards - evaluate current standard and identify gaps. Leverage EPRI's open source VTN and VEN in demonstrations. Software architecture principle -

Category	Region	Action Types preferred									Suggested topics
											at the interface, keeping it simple)
Electrical storage integration	Switzerland, Singapore, Jordan, Korea	x	x	x	x	x	x	x	x	x	General topic on storage systems with focus on: • Storage systems integration • Controllable flexibility achieved by storages in the smart grid applications • Economic and technical benefits of incorporating an ESS into network
	Singapore		x			x	x		x		Integration of EV into grid
Transmission networks	Singapore, Switzerland, USA					x	x		x		• Transmission system planning • Transmission grid architecture including OPEX reduction and asset management including the fault and outage management
	Singapore	x	x		x	x	x		x	x	• Energy management • System reliability and self-healing • Integration control schemes requirements
	USA										• Wide area grid observability needs • Integration control schemes (no action types indicated)
Research infrastructure, lab facilities and testing	Singapore, Japan, Korea	x	x	x	x	x	x		x	x	In general all topics in Research Infrastructure is prioritized by one or more of the four countries
Other topics	Singapore		x			x	x		x	x	KPI identification to check grid performance and project contributions
	Singapore, Jordan	x	x	x	x	x	x	x	x	x	Researcher exchange
Suggested topics	USA										• Sharing of open source software • DMS /uGrid EMS operational interfaces • DMS functions • End to end interoperability demonstrations and use of open field message bus

5 Suggested activity plan

Based on the collected answers from the initial contacts and from the questionnaire, the suggested activities are proposed in Table 7. Furthermore, the potential interest for B.R.I.C.S. is indicated so the maximum impact of the activities may be obtained.

Table 7 – Suggested activity plan

Region or countries	Category	Topic	Activity suggested	B.R.I.C.S. interest indicated
All represented countries	Network operation	Focus on the topics: system stability, distribution system planning and system resilience, control concepts	Joint proposals/projects or researcher exchange starting with a workshop	B.R.I.C.S.
Singapore, Korea		Microgrids, demand response, network automation, frequency and voltage control	Workshop or conference side event	C.
USA, Singapore, Korea,Japan	Power system management	Distribution and energy management systems, various aspects in control concepts incl. self-healing networks	Joint proposals/projects or researcher exchange starting with a workshop	B.R.I.C.S.
Switzerland, Singapore, Japan, Jordan		Demand response, characterization, performance verification etc.	Workshop or as conference side event, might lead to researcher exchange or joint projects	C.
Singapore, Korea, Japan, USA, Australia	SG ICT and Control Systems Interoperability	All topics are of interest	All types of action	Low interest, C. only interested in standards
Singapore, Korea, Jordan	Electrical storage integration	Storage systems	Side Event	C
Singapore		EV integration into the grid	Side Event	C
Singapore, USA, Switzerland	Transmission networks	System planning and transmission grid architecture incl. OPEX	Side event leading to joint projects/publications	B.I.C.S

Region or countries	Category	Topic	Activity suggested	B.R.I.C.S. interest indicated
		reduction and asset management		
Singapore, Korea, Japan	Research infrastructure, lab facilities and testing	Lab validation, testing and research infrastructures	All types of action are preferred, however researcher exchange and joint proposals/projects are suggested	B.I.C.
	Suggested topic by USA	Sharing of open source software		

Some of the activities in the above mentioned activity plan are supposed to be launched in task T10.3. In Table 8 potential actions that might be relevant for the launch of activities are listed.

Table 8 – Potential action possibilities

Potential actions	Location	Date
Conference	IRED, Niagara Falls	October 2016
Researcher exchange	Call REX	Summer 2016, Autumn 2016
'Workshop/International collaboration fora	ISGAN SIRFN	

As stated in [3], a joint action has already been initiated. Researcher exchanges with extra-European countries have already been started within WP9 by a dedicated call launched on October 2015. Seven applications were selected: researchers from USA, Russia and Brazil will visit ELECTRA Partners, while ELECTRA researchers will be hosted by American and Australian institutions.

6 Conclusions

ELECTRA is an Integrated Research Programme that supports networking and R&D activities of the European Energy Research Alliance Joint Programme on Smart Grids (EERA JP SG) and aims at developing radical new control methods for the future renewable energy based electricity system.

The objective of task T10.2 is to identify priorities for the topics of common interest and to set up an International Cooperation Activity Plan, taking into consideration the peculiarities of the different regions involved in the cooperation.

The topics of common interest are collected based on the initial contact and on responses to a questionnaire aligned with the activity areas of ELECTRA and EERA JP SG. ELECTRA brings together the partners of the EERA JP SG to reinforce and accelerate Europe's mid-long term research cooperation in the smart grid areas and to contribute to a closer integration of the research programmes of the participating organisations.

This deliverable outlines a list of common interesting R&D topics and prioritization by country of R&D topics to be jointly addressed.

Based on the prioritized topics a plan of activities is suggested. The plan of activities also indicates potential interest from the B.R.I.C.S. countries, as outlined in D10.2 [4], to obtain maximum impact of the actions. Furthermore, a list of possible actions like conferences, calls and collaboration is also presented.

D10.3 will be input for task T10.3, where a selected number of the suggested activities will be launched. However, a joint action has already been initiated: researcher exchanges with extra-European countries have already been started in WP9 by a dedicated call launched on October 2015. Seven applications were selected: researchers from USA, Russia and Brazil will visit ELECTRA Partners, while ELECTRA researchers will be hosted by American and Australian institutions.

7 References

[1] http://www.electrairp.eu (ELECTRA IRP web site)
[2] ELECTRA D10.1 “List of mutually interesting R&D topics and prioritization by country of R&D topics to be jointly addressed – Phase I”
[3] ELECTRA Internal Report R10.3, “List of mutually interesting R&D topics for INCO activities by country – Final Report”
[4] ELECTRA D10.2 “Report on common interesting R&D topics for INCO with BRICS countries”

8 Disclaimer

The ELECTRA project is co-funded by the European Commission under the 7th Framework Programme 2013.

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Annex A. Questionnaire responses from external contacts and initial contacts

Category	Term / R&D Topic	Examples of potential joint R&D activities	Rankings, 5 highest…1 lowest												Action Types preferred									Comments
			Singapore University	Switzerland	USA (EPRI)	USA (Verizon)	Japan AIST	USA (D10.1)	Japan (D10.1)	Korea KEPCO	Korea (D10.1)	Australia (D10.1)	Jordan	Singapore EMA			Workshops	Conference side events	Researcher exchange	International collaboration	Joint proposals	Joint projects	Summer schools	Joint publications	Joint use of international research infrastructures	
Network operation	Dynamic Control Schemes	Control Systems for Increasing Penetration of Variable Generation e.g. integration of DER and RE in the system control, coordination with large hydro power		5			5							5			x							x	x	
	Frequency control	New frequency control schemes to accommodate DERs, storage and load demand management, incl. Low inertia systems	4	5										5			x			x	x	x		x		
	Grid observability needs	Grid observables requirements, PMU and WAMS applications, integration with new control schemes				5																				At medium and low voltage levels
	Local Control Schemes	Analysis methods for decentralized systems in a market based system for assessing performance and stability, web-of-cells, exploitation of local measurements and control capabilities																								

	Distribution system planning	Planning methods that include active grid control, DER, RE and addresses reliability		5				5																				USA: distribution network reliability and impl. of Distribution Management systems(SP2)
	Microgrid control	Microgrids control, microgrids interactions	4			5				1	5						x	x	x		x	x	x	x	x			Korea: System efficiency and the potential offered by microgrids (SP1) USA Verizon: Energy management systems for microgrids, interactive with DMS (across the PCC)
	System stability	Analysis methods for systems with DER and RE		5										5			x							x				
	Dynamic System resilience	Ability to withstand large disturbances, continuity of supply after catastrophic events										3		5			x				x	x		x				Australia: System reliability, fault detection and system restoration
	Voltage control	Voltage control in the presence of high RES and DER penetration								3				5			x	x	x				x	x				
	Network automation	Use of automation devices to ensure automatic system control												5			x											
Power System Management	Common case studies	Definition of common case studies for results comparison and related discussion, preparation of openly available consolidated data sets																										
	Scenarios and trends	Generation and load forecast for the future grid												5			x	x	x									
	Control room functions	New functionalities and available data in control rooms for real-time grid management						4									x	x	x						x			USA: distribution network reliability and impl. of Distribution Management systems(SP2)USA Verizon: TSO, DSO, uGrid Operations - cooperative control

	Control Concepts	Control Systems for Increasing Penetration of Variable Generation focus of interaction between ICT and control performance, control and market	4					4	3												x	x		x		(SP2) USA: distribution network reliability and impl. of Distribution Management systems USA Verizon: Secure ICT infrastructure (SP2)Japan: Generation adequacy and its impact on network management (network integration of variable sources).
	Distributed/decentralized Vertical Control Concepts	Architecture of distributed/decentralized control integrating TSO/DSO resources for voltage control	4			5														x					x	
	Distributed/decentralised control requirements	Requirements of distributed/decentralized control	4			5															x	x		x		USA Verizon: Basis for standards/rules for interaction between DSO and uGrid operations
	TSO - DSO Role and interaction	Re-definition of interaction between TSO and DSO				5										x					x	x		x		USA Verizon: Definition of basic requirements for visibility and eventual control
	Grid architecture	New grid architectures and grid operation, power system modelling											5			x										USA Verizon: modeling of interaction between distribution system and microgrid and aggregated DER
	Grid flexibility	Optimal power flow, Flexibility resources requirements, technology, load demand management		5									5			x					x	x		x		
	Supervisory Grid observability needs	Grid congestion management											5			x										
	Microgrid operation	Microgrid requirements, microgrids control, microgrids interactions																								
	Market design	New market structure to integrate DERs and flexibility resources, business models		5																						
	Distribution and Energy management	Develop a Software Tool for Economic Benefits of Energy Storage for the Integrated Transmission and Distribution System				5																				USA Verizon: Consider alternatives to energy storage for balancing and compensation for variability of local generation.

	Energy market and Business models	Development of new business models, financial impact of DERs, flexibility and storage											5			x										
	Power system operation	Simulation of Smart Grid Operations, Markets and Benefits, Loss minimization		4						2						x	x	x	x	x	x	x	x	x		
	Performance verification	Methodologies for quantification and verification of service delivery from system with DER										1				x	x	x	x	x	x		x	x		
	Forecasts of generation and consumption	RES forecasts, forecast of flexibility from DER										4				x	x	x	x	x	x		x	x		
	Self-healing at distribution system level	Power system feature to recover its functionalities automatically						5																	USA: distribution network reliability and impl. of Distribution Management systems(SP2)	
	Smart grid data mining	Data management for real-time analysis, roll out of smart meters and PMUs, utilization of data for system operation optimization, data fusion			3								5										x			
	Demand response	Demand response refers to the capability of smart grid technologies to allow for reductions in electricity use targeted at times when demand is highest.	4	4					3				5			x		x				x			Japan: Power quality and its impact for the final consumer, with special reference to advanced smart home applications.(SP2)	
	Characterization of DER technologies	Characterization of DER technologies in terms of consumption patterns, flexibility										5	5			x	x	x	x	x	x		x	x		
SG ICT and Control Systems Interoperability	Functional architeture	Relation with Smart Grid Architecture Model (SGAM) and conceptual architecture definition, description of power systems functions incl. Ancillary services	4					4									x							x	USA: System efficiency and impact of Information and communication technologies	
	Interoperable Systems	Use of world-wide accepted standards for ICT technologies to grant full compatibility among system devices	5			5		5					5			x	x		x	x	x		x		USA: System efficiency and impact of Information and communication technologies USA Verizon: IEEE and IEC joint efforts and WG	

	Security issues	Cyber-security issues in the ICT architecture for smart grids				4		4			5				5			x	x	x	x	x	x		x	x	USA(EPRI)Emphasis on identification of attacks and isolation. EPRI is currently launching a new project on this to develop an associated framework. Correlating attack vectors from IT/ OT/Physical, Operations,, etc. There is a gap event correlation to more rapidly detect attacks.
	Smart grid interface	Definition of the power and the information flow exchanged by the grid operator and the client				5									5				x									USA(EPRI)Expand of OpenADR and related IEC standards - evaluate current standard and identify gaps. Leverage EPRI's open source VTN and VEN in demonstrations. This is important software architecture principle - at the interface, keeping it simple (separation of concerns, single responsibility principle, etc.) and relates to the bottom two R&D topics in this category (having a simple and appropriate interface from the Grid operator TO the Client (HEMS, Aggregator, Device, Appliance, Vehicle, Storage, Inverter, Microgrid, Building, etc.). The grid operator does not need to know "How" a device is managing energy, but needs to understand the physics (production & consumption in the form of energy parameters (kW, kWh, Volt, Var, Duration, etc.).
	Standards	Communication standards (IEC 61850) and interoperability issues																x				x	x		x		

	Home Energy Management Gateways	Standards for interfacing at the HEMS level to ensure interoperability between aggregators	4				3				3	3				x	x		x	x	x		x	x	Australia: System efficiency and impacts of the AMI (SP3)USA (EPRI)I'm not clear how this is differentiated from "Smart Grid Interface" and Interoperable Energy Management Systems and Control. So I just selected Smart Grid Interface and added my comments in that section. Korea:Customer services and advanced metering infrastructure (SP3)
	Interoperable Energy Management Systems and Control	Definition of control functionality for HEMS systems, standard interfaces between power system actors included aggregators, BRPs and DSOs							5																Japan: System reliability as seen by the user and building energy management.
Electrical Storage Integration	Storage systems integration	Local storage, long duration storage, technology, estimation to accommodate DERs integration, economic benefits	5	5								3				x	x	2 x	x	x	x		x	x	
	Controllable flexibility achieved by storages in the smart grid applications	Grid impact of ESS, tools for analysis of energy storage integration	4	4												x						x		x	
	Economic and technical benefits of incorporating an ESS into network	Methods and tools for analysis of ESS at system and business level									5			5			x								Korea: Energy efficiency and impact of storage (SP4)
	Integration of EV into grid	EV integration, fleet energy management	4														x			x	x		x		
Transmission Networks	Wide area grid observability needs	Grid observables requirements, PMU and WAMS applications, focus on Transmission system level				5																			USA Verizon: Actional schemes using PMU capabilities, rather than simple observability for studies.

	Interarea Control Schemes	Architecture that enables simultaneous vertical and horizontal integration of TSO/DSO resources for voltage control																								
	Energy management	Develop a Software Tool for Economic Benefits of Energy Storage for the Integrated Transmission and Distribution System	4													x			x	x	x		x	x	
	Transmission Grid architecture	New grid architectures, power system modelling, multiterminal HVDC	4	5												x		x		x	x			x	
	Transmission Network automation	Use of automation devices to ensure automatic system control																								
	Transmission system planning	Optimal planning methodologies taking RE and cross country/region aspects into account and new extended control concepts		5				3												x	x		x		USA: OPEX reduction and asset management including the fault and outage management and the service restoration (SP5, WP6)
	System reliability and Self-healing	Power system feature to recover its functionalities automatically	4																	x	x				
	Integrating Control Schemes	Architecture that enables simultaneous vertical and horizontal integration of TSO/DSO resources for voltage control				5																				
	Integration control schemes requirements	Requirements for simultaneous vertical and horizontal integration of TSO/DSO resources for voltage control											5				x									
Research infrastructure, lab facilities and testing	Lab Validation Proof of Concept	Specific CHIL, PHIL, … testing	4															x		x	x		x			
	Laboratory Testing	Conformance Testing, Energy Storage Performance Metrics and Testing Procedures, demand response, distributed control schemes, signal communication							4							x		x					x	x		
	Reseach infrastructures	Research facilities for lab testing, system studies, software testing and demonstrations, simulation	4				1									x		x	x	x	x		x	x		
	Research Facility	Mapping, effective use, testing protocols, …	4																	x	x			x		

	Use cases methodology	Review/discussion of use cases for the frequency/voltage control schemes					2									x		x		x			x	x	
Other topics	KPIs identification	Key Performance Indicators to check grid performances and project contributions	4										5				x			x	x		x	x	
	Researcher Exchange	Definition of procedures, scope, objectives	5									2				x	x	x	x	x	2 x		x	x	
Suggested other topics (max. 2 topics)	Sharing of related Open Source Software related to R&D Topics	Raise awareness and use of open source software being used for many of these R&D projects that are identified to accelerate testing and adoption of standards leading towards commercialized projects. EPRI has numerous open source software products and we are doing more. We would also like to learn and leverage similar products across the industry.			2																				
	DMS/uGrid EMS Operational Interfaces	DMS and uGrid EMS functional specifications				x																			Standards for mirogrid controllers
	DMS Functions	Requirements for full DMS functionality				x																			18 identifiable DMS functions; Guidelines.
	End to End Interoperability Demonstration and use of Open Field Message Bus (OpenFMB) across multiple labs and utilities	Accelerate R&D with coordinated lab efforts. Interconnect labs and use of open source solutions. Having interoperable exchanges based on use cases (many of the use cases we are working on are listed in the above R&D topic areas and include multiple architecture domains (Enterprise, Communications, Open Applications Platform, Cyber Security, OpenFMB). EPRI is coordinating a new initiative on this with NREL, SGIP, Duke Energy, CPS Energy, Southern California Edison and multiple vendors.			1																				

Annex B. Contact list

Partner		Contact external		
Organization	Name	Country	Name of contact person	Institution
VTT Ltd	Seppo Hänninen	Singapore	Dr Anshuman Tripathi	Energy Research Institute @ NTU (ERI@N), Nanyang Technological University
RSE	Luciano Martini	Singapore	Eugene Toh	Energy Market Authority (EMA)
RSE	Luciano Martini	Switzerland	Dr. Turhan Hilmi Demiray	Research Center for Energy Networks / ETH Zurich
VTT Ltd	Seppo Hänninen	South Korea	Dr Jintae Cho	KEPCO/KEPRI
RSE	Luciano Martini	USA	Matt Wakefield	EPRI
RSE	Luciano Martini	USA	Jim Reilly	Reilly Associates, Consultant to U.S. DOE/Office of Electricity on microgrids and resilient power delivery systems
RSE	Luciano Martini	Japan	Kenji Otani	Fukushima Renewable Energy Institute, AIST (FREA)
CRES	Stathis Tselepis	Jordan	Diala Haddad	RSS(Royal Scientific Society), PV Division
CRES	Stathis Tselepis	Jordan	Firas Alawneh	RSS and NERC (National Energy Research Center)
Institute of Physical Energetics, Latvia	Irina Oleinikova	Latvia		
TECNALIA	Rodríguez Seco, Jose Emilio	Mexico		Universidad Nacional Autónoma de México (UNAM)
TECNALIA	Rodríguez Seco, Jose Emilio	Mexico		Instituto de Investigaciones Eléctricas (IIE)
IEN	Michał Kosmecki	Brazil	Wo Wei Ping	Electrical Energy Research Center (Cepel)