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ELECTRA

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

WP 9.2

Researcher Exchange

Deliverable 9.2

Interim report on exchange programme outputs on the IRP website

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The deliverable D9.2 presents the results from the first two years of the ELECTRA Researcher Exchange Program, a part of the ELECTRA Integrating Research Programme. The document explains in detail all the information concerning the preparation and operation of the Researcher Exchanges.

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Executive summary

The ELECTRA Integrated Research Programme on Smart Grids brings together the partners of the EERA Joint Programme on Smart Grids (JP SG) to reinforce and accelerate Europe's medium to long term research cooperation in this area and to drive a closer integration of the research programmes of the participating organisations and of the related national programmes. ELECTRA's joint research activity and collaborative support actions build on an established track record of collaboration and engagement.

Moreover, the ELECTRA IRP overarching goal is to reinforce the EERA Joint Programme on Smart Grids to strengthen coordinated European research, building support for realizing the European SET Plan objectives. Besides strengthening the framework for coordination of individual research systems in the various Member States established through the EERA JP SG, the ELECTRA IRP is addressing some of the great challenges ahead of the European energy system as a whole.

Together, the JP SG and ELECTRA are establishing significant coherence across national research efforts critical to the stable operation of the EU power system of 2020+. The EU energy strategy sets ambitious goals for the energy systems of the future that foresees a substantial increase in the share of renewable electricity production. ELECTRA addresses this challenge, and are establishing and validate proofs of concept that utilise flexibility from across traditional boundaries in a holistic fashion. The ELECTRA consortium believes that a new control concept is needed and sets out to develop and test radically new control schemes to provide for a dynamic power balance that is closer to its optimal value than that achieved with a conventional central control scheme.

In addition to the joint R&D activities, ELECTRA includes coordination actions that build on existing efforts established through EERA and will significantly escalate these through coordination and collaboration amongst leading EU research infrastructures, researcher exchange across EU and internationally, and actions on international cooperation. This deliverable provides a mid-point report on progress made with the researcher exchange action.

The ELECTRA REX researcher exchange programme has been developed and defined, and a total of three Calls for applications now initiated. The ELECTRA REX approach offers three types of exchange: ELECTRA exchanges, European exchanges, and Global exchanges. Exchanges have been completed for each of these three types, and this deliverable will report on these, reporting on the feedback and improvements adopted from the lessons learned. In order to strongly support the international coordination efforts of ELECTRA, the REX team have organised one call dedicated to global exchanges. The ELECTRA REX opportunities have been disseminated through a number of channels including a range of meetings, moreover the first ELECTRA REX workshop has been held in Vienna in September 2015. These successful activities are reported in this deliverable, and plans and areas for improvement highlighted.

The document includes a number of appendices, including a summary of each ELECTRA work package.

Further information on the ELECTRA IRP, with description of the consortium partners, is available at the Website http://www.electrairp.eu .

Terminologies

Definitions

Exchange Researcher	The person who is participating in a hosted researcher exchange experience.
Exchange Programme Management Committee	The committee of ELECTRA IRP responsible for managing the administration and selection of researcher exchange proposals
Home Organisation	The institute of which the Exchange Researcher is a normal member of staff or PhD student
Host Organisation	The institute at which a researcher exchange experience takes place, responsible for looking after the Exchange Researcher
Strathclyde University	Coordination body for Researcher Exchange Programme
REX Coordinator	Strathclyde University
ELECTRA IRP Coordinator	The person responsible for the whole ELECTRA IRP, Luciano Martini of RSE S.p.A

Abbreviations

EPMC	Exchange Programme Management Committee
ELECTRA	European Liaison on Electricity Committed Towards long-term Research Activity Integrated Research Programme
EES-UETP	Electric Energy Systems – University Enterprise Training Partnership
INCO	International Cooperation
IRP	Integrating Research Programme
MS	Milestone
REX	Researcher Exchange Programme
EERA	European Energy Research Alliance
ISGAN	International Smart Grid Action Network

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1 Introduction

The deliverable D9.2 presents the results from the ELECTRA Researcher Exchange Programme (ELECTRA REX) during the first two years of the four year ELECTRA Integrating Research Programme, from December 2013 until November 2015. The first year of the project was dominated by setting up the rules and structures of the exchange programme, and so this mid-point review is primarily reporting the progress made during the first fifteen months of the programme's operation. The document (1) reports on the experience of the first few REX Calls, (2) reviews the results achieved to date, and (3) proposes some future effort to further improve the effectiveness and value of the remainder of the programme.

ELECTRA REX offers the opportunity for European or International researchers (especially those early in their career) to work closely together with leading smart grid research partners from the ELECTRA project and EERA Joint Programme on Smart Grids through an exchange of staff to reinforce and accelerate Europe's medium to long term research cooperation on smart grids. The scheme is open to high quality applicants from research organizations as well as industry, including SMEs.

This deliverable is based on the preparation and operation of the first three calls for proposals started during the first two years of the project. In particular the deliverable:

- reports the management cycle used for the implementation of the REX Calls;
- reports the implementation experience of the first, second and third REX Calls, the latter being dedicated to global exchanges with extra-European countries;
- reviews the reporting, dissemination and impact results achieved to date, including observations in relation to exchanges operated by other IRPs;
- proposes areas for further effort to improve the coordination impact achieved over the remaining two years of ELECTRA.

The document has thus been structured with key chapters reporting, reviewing, and proposing as above, and is supplemented with a number of relevant appendices of generated materials.

In summary the ELECTRA REX has been given a significant profile that has attracted some good attention, offering value to the individuals involved as well as to the coordination efforts of the ELECTRA IRP and EERA JP. A total of six exchanges have now been completed, with a further five in operation at present. Additionally, a number of applications have already been received for the third Call.

The overall Call schedule is described in Table 1-1 and Table 1-2.

Table 1 shows that the first REX Call for proposals was published in November 2014, the second Call for proposals was published in June 2015, and the third one in October 2015. In each case significant workshops or conferences were used to announce the launch.

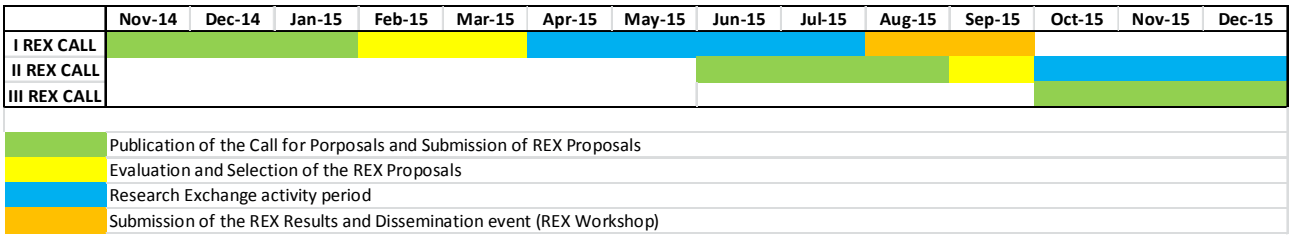

Table 1-1: REX Calls Timetable

A total of six Calls are planned with the schedule shown in Table 1-2.

REX CALL	PUBLICATION	STATE
1	November 2014	Completed
2	June 2015	Completed
3	October 2015	On going
4	May 2016	
5	November 2016	
6	May 2017	

Table 1-2 REX Call Publication dates

2 Reporting: Experience from the management and experience of the first Calls

In this section the key characteristics of the exchange programme and its management are reported first, followed by the experience gained with the first three Calls for proposals under ELECTRA REX.

2.1 Primary features and processes

The primary objectives of the ELECTRA REX remain threefold:

a. The proposed work is relevant to the goals of creating and demonstrating advanced voltage and frequency control as described by the ELECTRA IRP;
b. The Exchange Researcher will be capable of completing a quality body of work from the exchange and will gain useful personal development from it;
c. The value of the exchange is such that the host organisation and key individuals are willing and able to commit to producing valuable outcomes.

In order to achieve these objectives a programme of competitive calls was created supported by high quality publicity materials, and review and monitoring processes established. Project KPIs support the monitoring exercise, however successful outcomes from the exchanges are expected to include elaborated architectures, collaborative demonstrations and pre-standardization activities, as well as the monitored KPIs such as co-authored academic papers. In addition, best efforts are made to ensure that the exchanges offer a valuable and enjoyable experience to the individuals - Figure 2-1 shows some of the researchers enjoying their exchanges.

Figure 2-1 Early career researchers working together across countries and institutes

Deliverable D9.1 “Exchange programme procedures and documentation” provides a detailed account of the management materials, processes, and teams involved in managing the exchange programme. It is unnecessary to repeat the details here, however the methodology of operating multiple REX Calls can best be summarised by the illustration in Figure 2-2. This shows the multiple stages involved in operating the ELECTRA REX programme, and indicates the status of multiple Calls at one snapshot in time: final evaluation and closure of Call 1, operation of commissioned exchanges under Call 2, and encouraging applications to the issued Call 3.

This approach supports effective monitoring that enhances the quality of experience and impact, and aids clear reporting to the project Technical Committee.

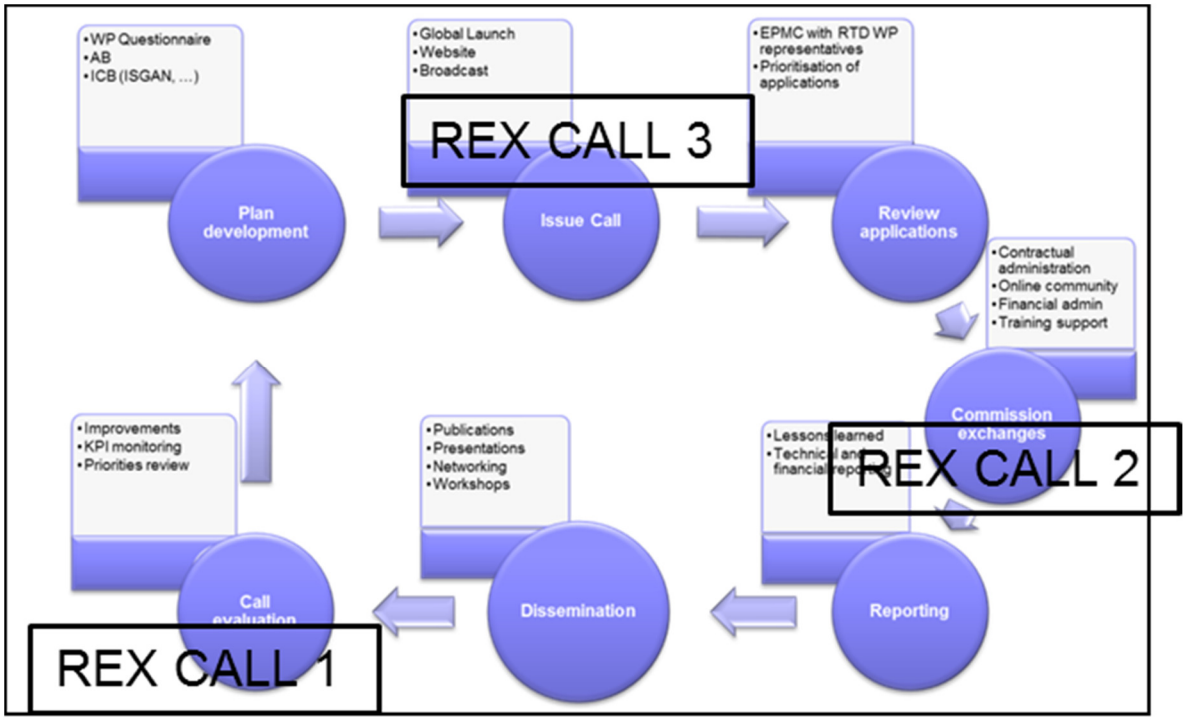

Figure 2-2 Methodology for managing ELECTRA REX, with a snapshot of multiple Call status

The ELECTRA Researcher Exchange Programme provides supports for researchers from ELECTRA partners, from European research or industrial organisations, and from organisations outside Europe, as listed below:

a. A researcher from an ELECTRA partner conducting collaborative work at another partner's site or that of another organisation in another country;
b. A researcher from a European research or industrial organisation out with the ELECTRA partnership conducting collaborative work at an ELECTRA partner's site in another country;
c. A researcher from an organisation outside Europe conducting collaborative work at an ELECTRA partner's site in another country.

The mobility of such individuals is encouraged and supported by three categories of exchange (or exchange "products") as illustrated in Figure 2-3. The host can either be an ELECTRA partner or an organisation recognised by the ELECTRA Exchange Programme Management Committee (EPMC) as suitable for hosting smart grid researchers on exchange. While the first two Calls were 'general' in that they invited proposals for any of these products, the third Call was configured exclusively for global exchanges in order to support the ELECTRA IRP and Joint Programmes agenda of international cooperation.

The Joint Programme is recognised for its international engagement, and the dedicated Call provided an opportunity to further deepen and expand this.

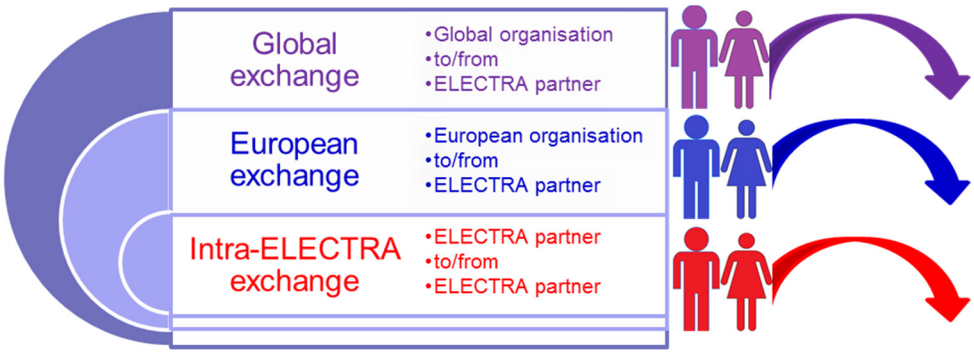

Figure 2-3 Diagram showing the types of possible researcher exchange offered under ELECTRA REX

Indeed, as the EERA JP has successfully expanded, the value of researcher exchanges in deepening this wider collaboration has been recognised. Consequently the three exchange products have recently been modified to permit wider participation of Joint Programme partners and associate partners not directly involved in ELECTRA. This is seen as a positive development, and has been principally stimulated by the attraction of new and motivated JP associates.

The following sections report on the experience of operating the first three Calls.

2.2 The First Researcher Exchange Call

This section describes the implemented steps during Call 1, starting from the development of the call of proposals, until the acceptance and commissioning of the selected exchange projects.

2.2.1 Implementation and publication of the REX 1 Call for proposals

The first call for proposals for researcher exchanges has been developed in collaboration with the research work package leaders of the ELECTRA Project. The WP leaders have been asked to fill out a questionnaire, detailing their priorities for the next period to allow the Call for Proposals to be suitably focused. The questionnaire used for this process is attached as Annex 1.

The topics identified for this Call were (in no particular order):

- Voltage control
- Frequency control
- Experimental demonstration
- Ancillary services provision
- Electro-mobility

The first Call for Proposals was launched by the ELECTRA Exchange Programme Management Committee on November, 2014. The Call was advertised through the dedicated ELECTRA website, under the page “Mobility”, via personal contacts and through conferences and special events. Indeed the global launch of REX Call 1 was made at the conference IRED 2014 on November 17th, 2014, Kyoto, Japan, where a dedicated ELECTRA side event was organized. Publicity for the Call was aided by a range of flyers (see Annex 2). The Call expired on February 5th, 2015.

2.2.2 Submission of the REX 1 proposals

The submission of the proposals was conducted electronically following earlier registration at the ELECTRA website, through the assisted tool. The proposal template was available on the ELECTRA website (see Annex 3), along with an online procedure which facilitated the preparation of the proposals and the electronic submission. The proposal template required evidence that the proposers and Host Institute had agreed in advance of the application. The ELECTRA team introduced this requirement at the outset in order to avoid the challenges and delays experienced on other exchange and transnational access projects in the past.

Eleven (11) proposals were submitted:

1. Six (6) Intra-ELECTRA exchange applications, in which a researcher from an ELECTRA Partner proposed undertaking collaborative work at the site of another ELECTRA partner;
2. Four (4) European exchange applications, in which an ELECTRA Partner and other European organization collaborate on an exchange;
3. One (1) Global exchange application, in which a researcher from an ELECTRA Partner proposed undertaking collaborative work at the site of an Extra-EU organization.

2.2.3 Evaluation of the REX 1 proposals

2.2.3.1 The Exchange Programme Management Committee

The evaluation of the submitted proposals has been undertaken by the EPMC, which is composed of representatives of each of the research work packages, along with the leader and deputy leader of WP9, WP9 partners and the coordinator of ELECTRA. The EPMC has been chaired by the leader of WP9.

The evaluation process has been completed in one month and a half from the deadline of the call of proposals.

Each EPMC member has evaluated the proposals following the application assessment, and assigned a score as follows:

- A for Excellent (75+/100)
- B for Good (65-74/100),
- C for Fair (60-64/100)
- D for Poor (55-59/100)
- E for Irrelevant (0-54/100).

The individual scores were collated to give average scores and ranked, and the resulting ordered list and individual scores reviewed by the EPMC. Each application was then considered and a final decision made. The IRP Coordinator did not participate in the voting to be able to adjudicate in the event of a dispute.

2.2.3.2 Evaluation Criteria

The voting has been based on three sets of criteria, the quality of the ambition of the research proposed, the credibility of the team proposing to complete the research, and if the first two are met, a qualitative criteria which is to do with some of the non-technical aspects of the exchanges, as already described in Deliverable D9.1 (paragraph 2.4).

In order to show an overall framework of all the proposal's scores, a simple table with the three sets of criteria (quality of ambition, credibility of impact and qualitative criterion) and the total scores has been prepared, following the Table 2-1.

Application number	Applicant name	Quality of Ambition	Credibility of impact	Qualitative criterion	Final mark

Table 2-1 Table for final scores of REX Call 1

2.2.4 Selection of REX 1 proposals and notification to the exchange researchers

The submitted proposals have received different evaluations, six of them have been positively evaluated (Excellent score - A) and accepted, as summarized in Table 2-2.

N	Home organization			Hosting Institution		
1.1	Fraunhofer IWES	Germany	ELECTRA partner	CSIRO, Energy Centre	Australia	Extra-EU organization
1.2	University of Strathclyde	United Kingdom	ELECTRA partner	TNO	Netherlands	ELECTRA partner
1.3	VITO	Belgium	ELECTRA partner	University of Strathclyde	United Kingdom	ELECTRA partner
1.4	DTU	Denmark	ELECTRA partner	OFFIS	Germany	ELECTRA partner
1.5	DTU	Denmark	ELECTRA partner	University of Strathclyde	United Kingdom	ELECTRA partner
1.6	CENER	Spain	European organization	CRES	Greece	ELECTRA partner

Table 2-2 Accepted proposals following REX Call 1

Several research institutions have been involved in REX Call I, both ELECTRA partners and other organizations from European and extra-European countries, as shown in Figure 2-4 and Figure 2-5.

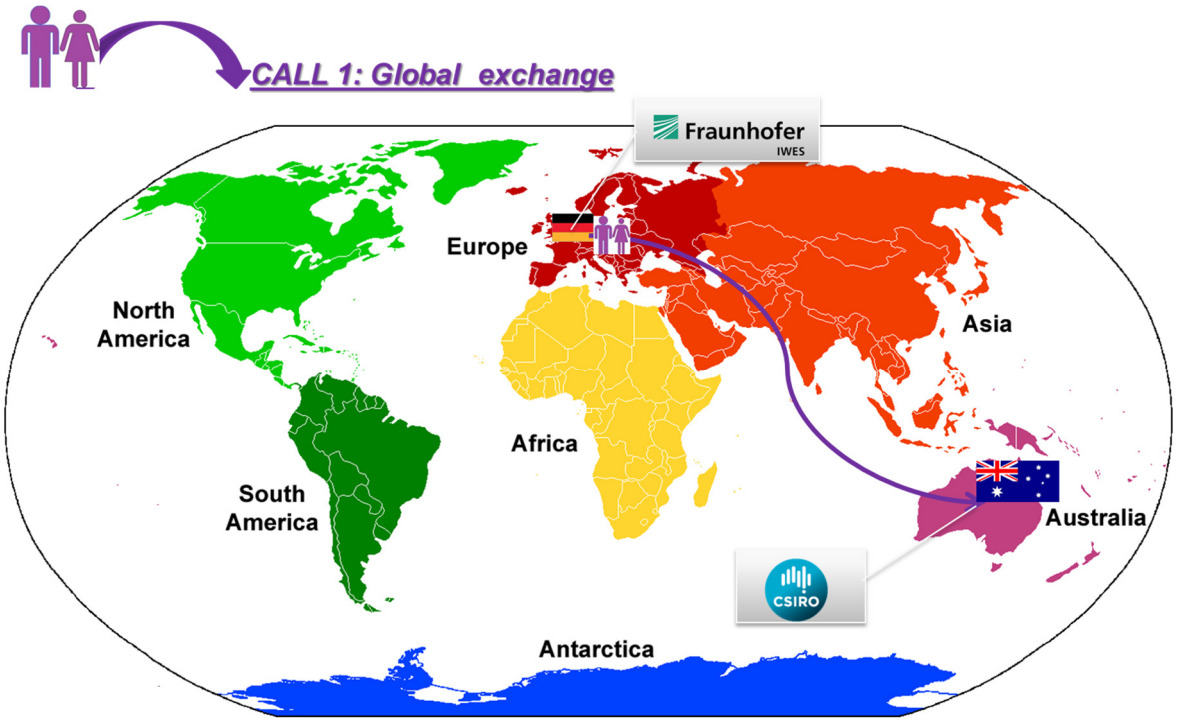

Figure 2-4 Diagram showing the research institutions involved in REX Call 1

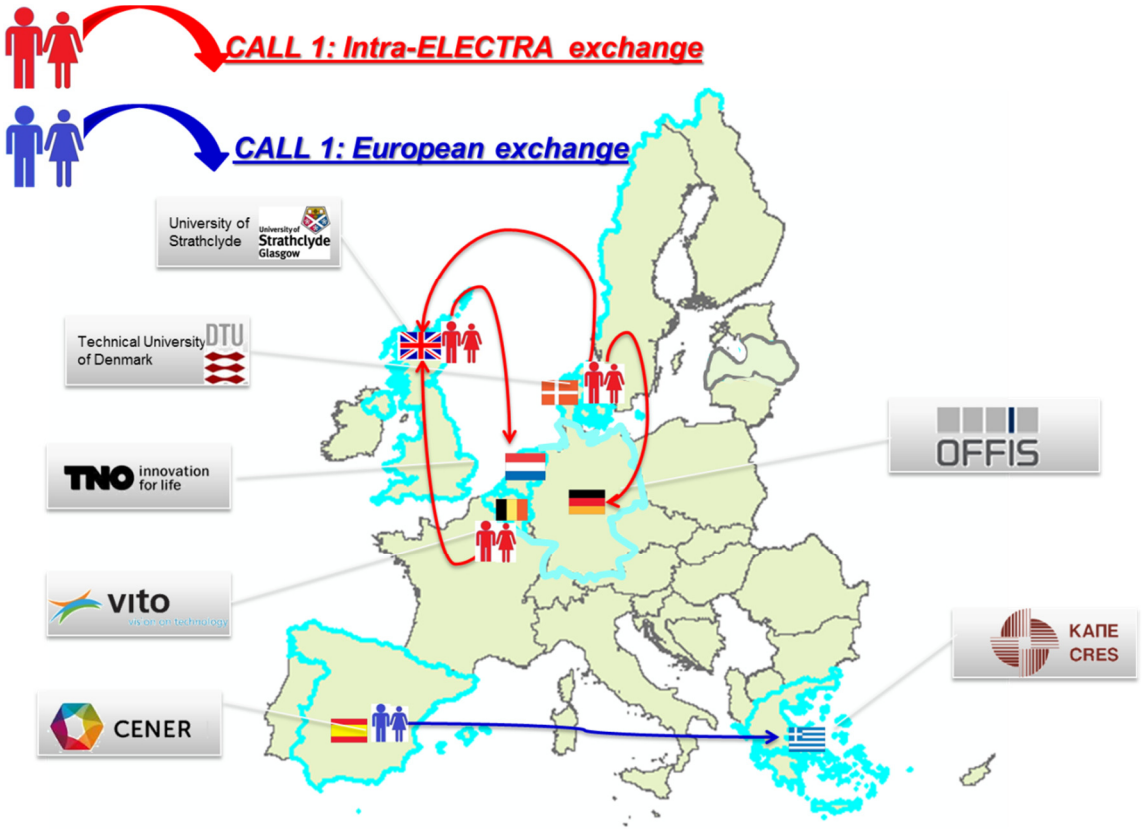

Figure 2-5 Diagram showing the research institutions involved in REX Call 1

The accepted proposals covered different research topics, as shown in Table 2-3 and Table 2-4.

N	Title	Duration	WP
1.1	Novel voltage control schemes and ancillary services provision from DER A comparative assessment for Australia and Germany	12 weeks	WP6, WP2, WP3, WP7,WP5
1.2	A methodology for the validation of Ancillary Service Provision by Demand Side Management through the use of a Real-Time Power Hardware-in-the-Loop Co-simulation Platform	4 weeks	WP6, WP7
1.3	Integrating Sequential Decision Making Bussiness Agents in the PowerMatcher multi-agent communication framework for inter-cell coordination	2 weeks	WP6
1.4	The architectural approach to controller conflict - Part I of Mutual Exchange: Control Case Modelling in SGAM	2 weeks	WP4 ,WP7
1.5	Topology Recognition and Inference Experiments	4 weeks	WP5
1.6	Modelling and simulation of Virtual Inertia for mitigation of frequency fluctuations in microgrids	2 weeks	WP6

Table 2-3 Research topics of REX Call 1

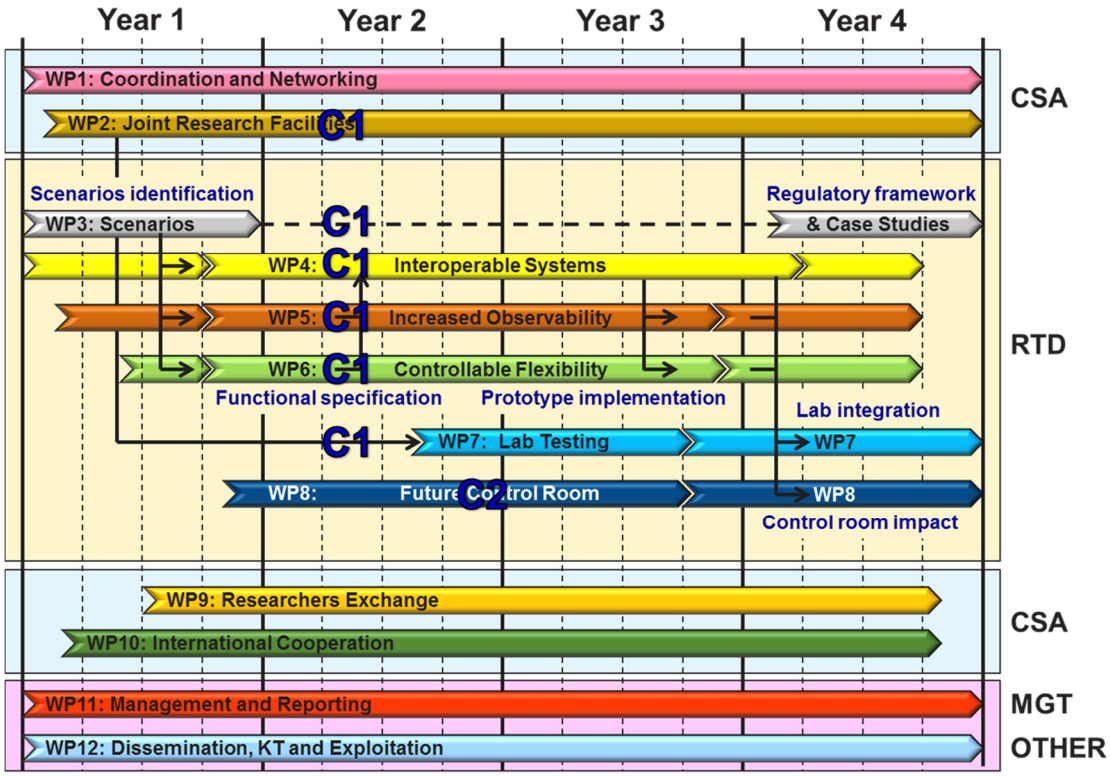

Table 2-4 Research topics of REX Call 1 exchanges related to ELECTRA IRP work plan.

The results of the evaluation process were then notified to the proposing researchers by the ELECTRA WP9 leader.

In each case the notification was accompanied with a short review with comments and suggestions for improvements. Where appropriate, borderline unsuccessful proposals receive suggestions to re-submit the proposal for the next Call. Notification was completed within two months of the call deadline.

2.2.5 Commissioning the REX 1 exchanges

Notification of acceptance launched a process of direct liaison with the exchange researcher and host, together with their contracts teams, was commenced by the REX coordinator. The following activities were conducted:

- Finalising the budgets requested by the successful applicants.
- Establishing three-way contact with contracts and legal teams
- Commencing with the template agreement (as included in deliverable D9.1), a process of negotiation was undertaken in order to reach an agreed exchange contract.
- Dealing with and responding to any queries from the involved parties concerning the exchange, budgets or the required outputs.
- Establishing a commitment to participate in the appropriate REX workshop.

The exchange researcher was instructed to proceed following signature of the exchange agreement.

2.2.6 Exchange activity for REX 1

The REX 1 exchanges were all conducted between April 2015 and August 2015. The operation of exchanges as a cohort is an important feature of the REX programme. Each exchange was completed at the respective host organization, with teams dedicated to the activity objectives.

Each signed contract clearly stated the requirement for dissemination of results by the researchers; the dissemination of results is considered a binding condition for the success of the REX programme. In each case the participants agreed to provide the following not more than 3 months after the end of the exchange period:

- An extended abstract of the research activity, to be published on the ELECTRA web page, submitted for the approval of the EPMC;
- A researcher and host questionnaire concerning the evaluation of the research activity;
- One jointly authored paper;
- Financial summary and invoice to support the review and conclusion of expense payments

At the end of the REX Call 1 exchanges, all the researchers fulfilled their commitment to supply questionnaires for review, abstracts for publication on the ELECTRA website (see Annex 4), and a co-authored paper with the host organization. The papers were prepared and submitted for review to the 2015 International Symposium on Smart Electric Distribution Systems and technologies - EDST'15,– this represents evidence of the soundness of the scientific work performed during the exchange period. EDST'15 was held on 8th-11th September 2015 in Wien, Austria, and provided the venue for both a best practice review workshop and a special papers session for dissemination – these form part of the exchange support experience envisioned for the programme (Figure 2-6).

On completion of the exchange outputs, the parties are encouraged to invoice for the exchange costs incurred in keeping with the agreed budgets.

Figure 2-6 Summary of dissemination and publication of exchange results and learning

2.3 The Second Researcher Exchange Call

This section describes the implemented steps during REX Call 2, starting from the development of the call for proposals, until the acceptance and commissioning of the selected exchange projects, following the procedure defined in the Deliverable D9.1.

2.3.1 Implementation and publication of the REX 2 Call for proposals

The second call for researcher exchange proposals has been developed in collaboration with the research work package leaders of the ELECTRA Project. The WP leaders were invited to fill out a questionnaire, detailing their priorities for the next period to allow the Call for Proposals to be suitably focused. The questionnaire used for this process was the same as that used in the earlier Call, as attached in the Annex 1. A number of flyers were created for REX Call 2 and an online announcement prepared – see Annex 5 and Annex 6.

The identified topics for this Call were (in no particular order):

- Coding of distributed control solutions for real time voltage and frequency management
- DER management in support of low voltage network operation
- Detailed (functional) specifications of new smart grid control frameworks, such as microgrids or distributed cells
- Resilience of smart grid controls under disturbance conditions

The REX 2 Call for Proposals was launched by the ELECTRA Exchange Programme Management Committee on June 22nd 2015. The Call was advertised through the dedicated ELECTRA website, under the "Mobility" page, via personal contacts, invited keynote and conference flyer at IEEE POWERENG'15 (Riga), 11th-13th May 2015 [2], the DERLAB e-newsletter, and through an advertisement in the Latvian Journal of Physics & Technical Sciences. A number of improvements were incorporated into the application form and template agreement, reported in an update to Deliverable D9.1. The Call expired on August 22nd 2015.

In additional the team started to use the publicity mechanisms of national hubs to further advertise the exchange opportunities. A view of the example web page on the UK national academic hub for power networks, Hubnet, is shown in Figure 2-7.

Figure 2-7 Hubnet web page to advertise ELECTRA REX and the EERA JP

2.3.2 Submission of the REX 2 proposals

The submission of the proposals has been done only electronically after previous registration at the ELECTRA website, through the assisted tool there available.

Seven (7) proposals were submitted again using the online application process, distributed as follows:

1. Four (4) Intra-ELECTRA exchange applications, in which a researcher from an ELECTRA Partner proposed undertaking collaborative work at the site of another ELECTRA partner;
2. Three (3) European exchange applications, in which an ELECTRA Partner and other European organization collaborate on an exchange;

2.3.3 Evaluation of the REX 2 proposals

The evaluation of the submitted proposals was undertaken by the EPMC, following the set procedure. While the basis of the review and voting procedure was the same, some improvements were introduced. This included adjustments to the weighting of the respective criteria to improve the spread and ranking of proposals. The updated evaluation table is attached as Annex 7.

2.3.4 Selection of REX 2 proposals and notification to the exchange researchers

The submitted proposals received their evaluations, and six of them were positively evaluated and accepted, as shown in Table 2-5.

N	Home organization			Hosting Institution		
2.1	TNO	Netherlands	ELECTRA partner	DTU	Denmark	ELECTRA partner
2.2	National Technical University of Athens	Greece	European organization	SINTEF	Norway	ELECTRA partner
2.3	University of Huelva	Spain	European organization	University of Strathclyde	United Kingdom	ELECTRA partner
2.4	OFFIS	Germany	ELECTRA partner	DTU	Denmark	ELECTRA partner
2.5	DTU	Denmark	ELECTRA partner	VITO	Belgium	ELECTRA partner
2.6	IPE	Latvia	ELECTRA partner	University of Strathclyde	United Kingdom	ELECTRA partner

Table 2-5 Accepted proposals in the II REX Call

Several research institutions have been involved in REX Call 2, both ELECTRA partners and other European organization, as shown in Figure 2-8.

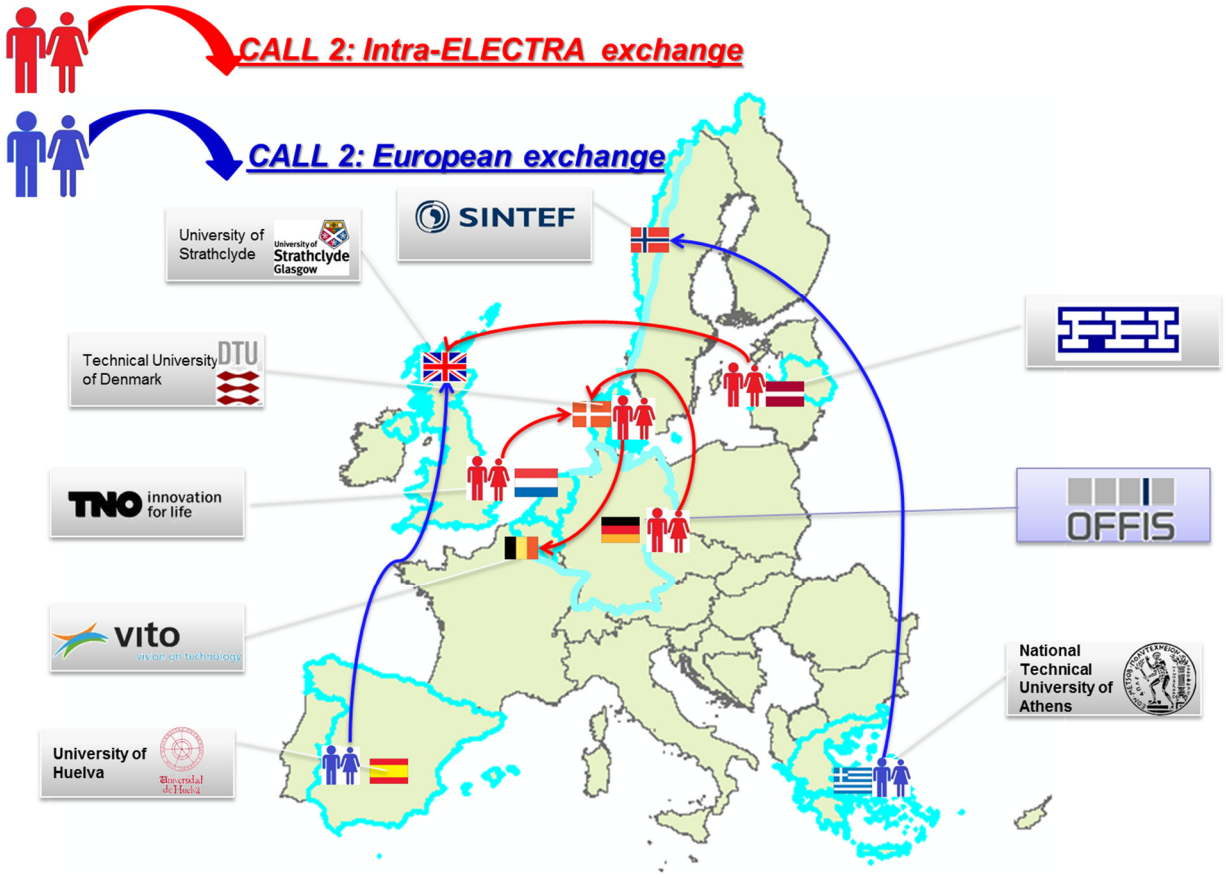

Figure 2-8 Diagram showing the research institutions involved in REX Call 2

The accepted proposals covered different research topics, as shown in Table 2-6 and Table 2-7.

N	Title	Duration	WP
2.1	Aggregation Flexibility Modelling for Balance Restoration Control	4 weeks	WP6
2.2	Coordination of Transmission and Distribution flexibility resources	3 months	WP5, WP6
2.3	Vectorial Control Strategy for a Photovoltaic Active Power Line Conditioner in Photovoltaic Systems (VCS for PV-APLC)	4 weeks	WP7
2.4	Adopting the UCMR and SGAM standards for security analysis for controller conflict analysis	14 days	WP4, WP8
2.5	Transactive Control for Managing Distributed Energy Resources to Support the Use Case of Balance Restoration Control between cell operators and aggregators	4 weeks	WP6
2.6	Smart grid control algorithms, measurement, and instrumentation technologies	2 weeks	WP5

Table 2-6 Research topics of REX Call 2

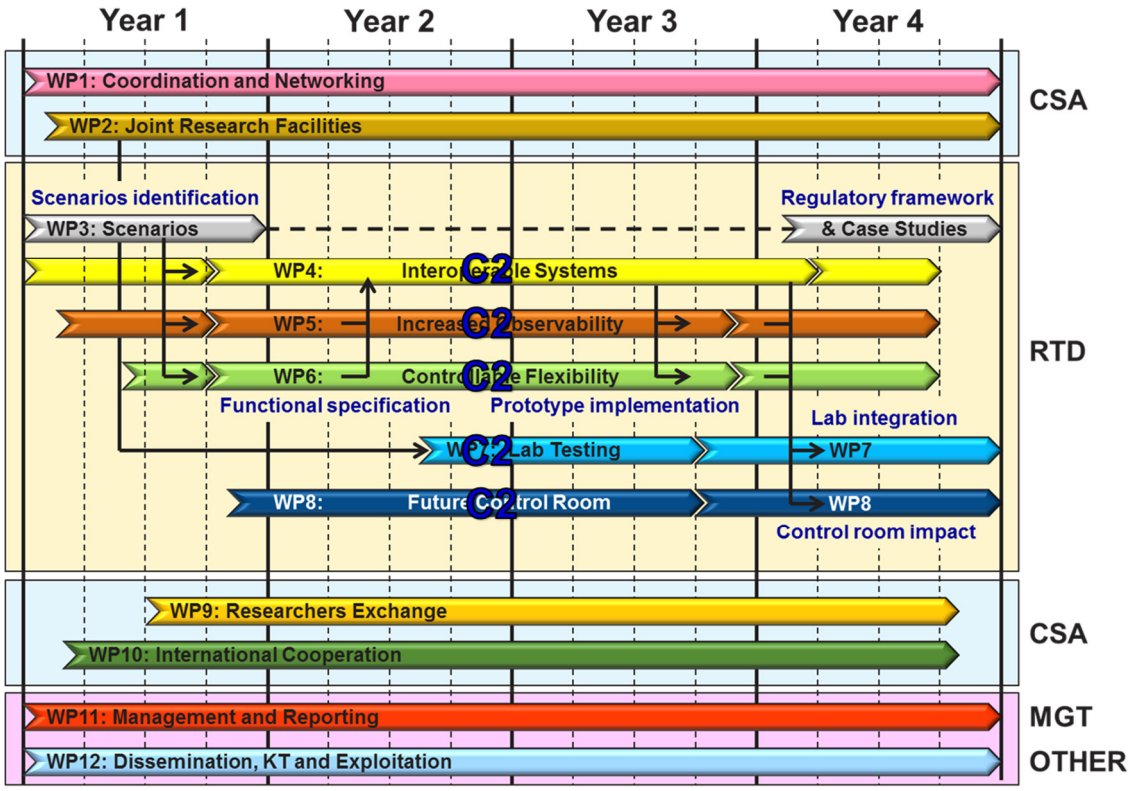

Table 2-7 Research topics of REX 2 related to ELECTRA IRP work plan.

Proposal number 2.3 was subsequently withdrawn due to staff availability challenges at the sending organization and is expected to be resubmitted to REX Call 4.

The results of the evaluation process were notified to the proposing researchers by the ELECTRA WP9 leader, through email. Again, this was accompanied with a short review report with comments and suggestion for improvements.

Notification was completed within one month from the call deadline, a significant improvement on the first Call.

2.3.5 Commissioning the REX 2 exchanges

The improvements to the application form template meant that the process of negotiation of contracts was significantly improved. Nonetheless this still required significant effort by the team at the REX coordinator. Exchange researchers were instructed to proceed as their corresponding agreements were signed. The REX 2 exchanges started in October 2015, some of which have been completed while others are still currently underway.

2.4 The Third Researcher Exchange Call

At project mid-point the third REX Call is still open. This section describes its implemented steps to date. The decision was taken to dedicate this Call to Global Exchanges between overseas organisations & ELECTRA partners, and the Call has been strongly supported by the leader of ELECTRA's International Coordination work package. It is anticipated that this will both deepen and broaden the international collaboration of ELECTRA. To further assist this broadening the Call was extended to allow EERA JP Partners and Associate Partners to participate. This is illustrated

in the updated “product” list, shown in Figure 2-9, and will support stronger integration of the JP with ELECTRA.

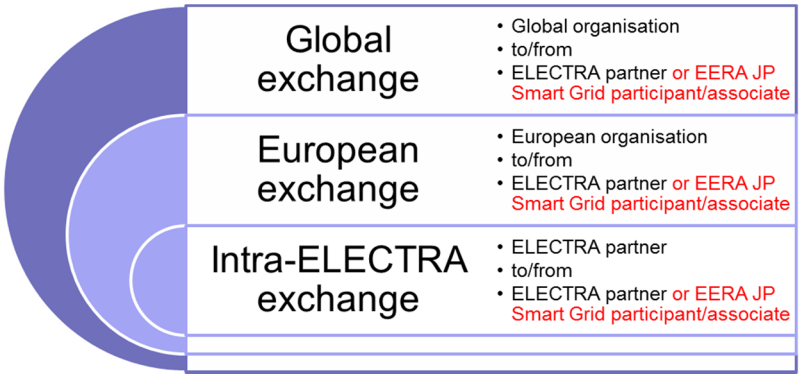

Figure 2-9 Diagram showing the extended exchange offering to include EERA JP Partners and Associate Partners

2.4.1 Implementation and publication of REX 3 Call of proposals

The third call for proposals for researcher exchanges has been developed in collaboration with the research work package leaders of the ELECTRA project. The WP leaders were asked to fill out a questionnaire, detailing their priorities for the next period to allow the Call for Proposals to be suitably focused. The Flyer for REX Call 3 is attached as Annex 8.

Applications were invited in relation to one of the following priority topics that emerged from the questionnaires and discussion:

- Assessment and control of system inertia
- Ancillary services for voltage and frequency regulation
- Power systems supervision & monitoring by considering smart meter data
- ICT & control system Interoperability: power & information flows with grid operators
- Integration of intelligent components such as IEDs and PMUs for wide area control
- Experimental investigation of DER control methodologies
- Definition of reference test networks

The third Call for Proposals was launched by the ELECTRA Exchange Programme Management Committee on October 5th, 2015. The Call was formally launched at an ISGAN workshop (Lecco) 14th-15th September 2015, and further publicized at EDST’15 (Vienna) 08th-11th September 2015, EERA JP Smart Grid General Assembly’15 (Bilbao) 05th October 2015, and the ELECTRA-Brazil conference (Florianopolis) 11-12th November 2015. It was further advertised through the dedicated ELECTRA website under the “Mobility” page, other Web announcements, the DERLAB e-newsletter, and via personal contacts. The Call will expire on January 18th 2016, when the review process will again commence.

3 Reviewing: performance, feedback and impact

3.1 Summary performance

The outputs achieved at project midpoint are summarized in the WP9 Key Performance Indicators (KPI). These indicators include joint publications and trained young researchers, as well as numbers of exchanges as shown in Table 3-1.

KPI	Project TARGET First 24 months (Nov 2015)	Project TARGET Total 48 months (Nov 2017)	TARGET achieved after 24 months (Nov 2015)
No. of exchange calls	2	6	3
No. of researcher exchanges	6	30	6
No. of researcher-weeks of international exchange	12	75	12
No. of extra-EU partners involved in exchange	2	15	1
No. of trained young researchers	4	21	4
No. of joint publications	6	45	6

Table 3-1 Key Performance Indicators for WP9

As well as the exchanges fully completed (ie. including reported) at project mid-point, a number of exchanges are in train. Other measures of good progress include the success of the first workshop, the quantified feedback received to date. These indicate a healthy start to the ELECTRA REX programme.

3.2 Dissemination and publication of results

In order to share the best practice gained from the researcher exchange, the first ELECTRA REX Workshop on Smart Grid Researcher Exchanges was held in Vienna at the EDST2015 symposium, on September 8th and 9th, 2015. This event provided an opportunity for delegates to hear from the six successful participants in REX Call 1 and to be introduced to the wider work of the EERA Joint Programme in Smart Grids. The workshop took the form of a special papers session at the conference, and the dissemination efforts were significantly assisted by the co-authored papers published in the conference proceedings. Each exchange researcher gave workshop delegates a first-hand account of the value of their exchanges to prestigious smart grid centres.

This dissemination workshop was of recognised value to the exchange researchers themselves. As well as publishing peer-reviewed and internationally co-authors papers, they:

- disseminated the results of their exchanges, their methods and experience;
- shared their experience of exchange working in leading global smart grid organisations;
- were encouraged to network and create a community of early career smart grid researchers.

Figure 3-1 includes some pictures of the workshop, which attracted nearly forty delegates. The agenda for the workshop is included as Table 3-2. Feedback from delegates and exchange researchers was very positive, and this model will be repeated at a future event.


Figure 3-1 Pictures of the first ELECTRA REX dissemination workshop in Vienna

SS05	Experiences from the ELECTRA IRP Researchers Exchange
Wednesday, 9th September 2015, 14:10 - 16:10	
VF-005193	Sizing and grid impact of PV battery systems - a comparative analysis for Australia and Germany
	Jan von Appen, Julio H. Braslavsky, John K. Ward, Martin Braun
VF-005118	Frequency Restoration Reserves: Provision and Activation Using a Multi-Agent Demand Control System
	Reinhilde D'hulst, Jef Verbeeck, Chris Caerts, Mazheruddin Syed, Ammar Zaher, Graeme Burt
VF-005134	A Use Case Methodology to Handle Conflicting Controller Requirements for Future Power Systems
	Kai Heussen, Mathias Uslar, Carlo Tornelli
VF-005142	Implementation of a Fuzzy Logic Controller for Virtual Inertia Emulation
	Konstantina Mentesidi, Evangelos Rikos, Raquel Garde, Monica Aguado
VF-005126	Distributed Framework for Prototyping of Observability Concepts in Smart Grids
	Alexander Prostejovsky, Oliver Gehrke, Anna M. Kosek, Federico Coffele, Ammar S. A. E. Zaher
VF-005169	Demand Side Participation for Frequency Containment in the Web of Cells Architecture
	M. H. Syed, G. M. Burt, J. K. Kok, R. D'Hulst

Table 3-2 Agenda of the first ELECTRA REX dissemination workshop

Again the REX programme made good use of the ELECTRA news feeds to publicise the results of the workshop and to highlight the online posts of the presentations.

3.3 Internal feedback and review workshop

In addition to the dissemination workshop, the REX Call 1 researchers have already participated in an internal feedback and review workshop. Hosted by AIT in Vienna on 8th September 2015, this workshop provided an opportunity for the researchers to meet each other, to share experiences, and to gather lessons learned that might offer improvements for future participants. The REX Call 1 researchers (see Figure 3-2) offered the observations described below.

Figure 3-2 REX Call 1 researchers with REX coordinator and ELECTRA technical coordinator

The exchange researchers offered the following highlights:

- Learning about other facilities and workflows;
- Good networking;
- Following up on previous collaborations;
- Tangible research inputs/outputs;
- Valuable feedback on conducted work.

Some concerns were expressed during a round table at the internal review meeting by the researchers and offered as areas for improvement. These are listed:

- The title of the call was too general and the objectives set were very ambitious;
- Administrative difficulties (mostly legal);
- The time allowed between the results being announced and the start of the exchange is too short (in cases where long term visa needs to be applied);
- Activity not entirely well executed
- Coordination in/between facilities;
- Not enough technical insight.
- Same effort for application of 2 week exchanges and for 12 week exchanges.

The feedback form the experience offered was very positive, and the researchers were happy to recommend the scheme. Video messages were recorder to help communicate this message to a wide audience.

Generally, the exchange provided valuable insight in other new infrastructures and workflows to early career researchers, helping some of them to gain new insights into their working field, and giving them the opportunity to meet open-minded people. Thanks to this experience, some of researchers participating in the REX Program discovered new aspects of international grid integration challenges and identified new research opportunities, had the possibility to discuss and brainstorm with collaborators in person enhances the ideas exchange and mutual understanding also beyond the REX. This opportunity gave them the possibility to get back on issues that come up along the way, and this aspect was very valuable to boost ELECTRA internal collaboration.

3.4 Integrating results into the ELECTRA IRP and EERA Program

A number of key aspects were put in place throughout the program in order to facilitate the integration and output from the REX exchanges within the ELECTRA IRP. This was established via the call design and application process:

- Research topics for each Call were established by Research WP leads to facilitate and further the work being carried out by ELECTRA partners and to ensure they were aligned with work already being undertaken.
- Applicants were asked to specify and detail which WP's their planned work would contribute to as part of the application and its relevance reviewed by the ELECTRA committee
- The compulsory requirement of a joint publication for each and every applicant ensured integration between the works carried out at both the home and host organisations.
- Following the completion of an exchange the message of continued collaboration was portrayed to the applicants through a questionnaire. The questionnaire contained questions and messaging to encourage continued collaboration between the researcher and the host organisation.

3.5 Measurable value and impact from researcher exchange

A number of impacts have been achieved through the exchanges conducted to date. These contribute to the stated objectives and include:

- Value has been brought to the research programme by the intimacy of ELECTRA colleagues working together for a spell in the same office or laboratory;
- Valuable contribution has been made to the web of cells concept, and to researchers' and institutions' shared understanding;
- The exchange has immersed new young PhD researchers into the collaboration and engagement of the ELECTRA IRP and EERA JP. They are now aligning their research studies to continue the engagement and contribution to work package effort;
- Improved understanding of partners' laboratories that will be utilised in the experimental testing planned for the second half of the project.

A more quantified appraisal of exchange researcher and host opinions has been achieved through analysis of the close-out questionnaires solicited from the exchange participants. This gives evidence to the exchanges' positive experience, and is shown in Table 3-3 and Table 3-4.

Question	Results
1. The hosting institution responsible person(s) provided a value adding experience to my research	Strongly agree (4)
	Agree (2)
2. I am satisfied by my overall activity performed at the hosting institution	Strongly agree (2)
	Agree (4)
3. My exchange objectives and activities were performed as planned in my REX proposal	Strongly agree (1)
	Agree (5)
Critical constraints	Technical (2)
	Time (4)
	Economical (0)
	Other (dependency on ELECTRA project progress and administrative issue) (2)
4. The experience I gained throughout my exchange was beneficial	Strongly agree (3)
	Agree (3)
Related benefits	Suggestions for improving laboratory facilities and equipment (1)
	Results sharing and possibilities for scientific publications (5)
	Experience exchange between hosting and hosted researchers (4)
	Collaboration in research activities and projects (5)
5. My exchange has contributed towards my personal development and training	Strongly agree (5)
	No view (1)
6. The work I undertook during my exchange will generate valuable research outputs	Strongly agree (2)
	Agree (4)
7. I intend to continue collaborating with the team at the host organization	Strongly agree (4)
	Agree (2)

Table 3-3 Results from Researcher questionnaires

Question	Results				
1. The REX researcher respected the local rules of my laboratory	Strongly agree (4)	■	■	■	■
2. The REX researcher was well prepared for using the test facilities	Strongly agree (2)	■	■		
	Agree (2)	■	■		
3. How many hours of planning and preparation did you and your team commit prior to the exchange?	1 -10 hours (1)	■			
	11 -20 hours (1)	■			
	21 -30 hours (1)	■			
	31 -40 hours (0)				
	more than 40 hours (1)	■			
4. I'm satisfied by the overall activity performed by the REX researcher	Strongly agree (3)	■	■	■	
	Agree (1)	■			
5. The REX researcher's exchange involved experimental activity	Yes (1)	■			
	No (3)	■	■	■	
6. The experiments carried out by the researcher were performed as planned and correctly	Agree (1)	■			
	No view (3)	■	■	■	
7. Hosting the exchange researcher was beneficial to my research team / institution	Strongly agree (2)	■	■		
	Agree (2)	■	■		
Related benefits	Suggestions for improving laboratory facilities and equipment (0)				
	Results sharing and possibilities for scientific publications (4)	■	■	■	■
	Experience exchange between hosting and hosted researchers (3)	■	■	■	
	Collaboration in research activities and projects (2)	■	■		
8. What value of additional costs did you incur in supporting the exchange?	€ 0-500 (3)	■	■	■	
	€ 5000-7000 (1)	■			

Table 3-4 Results from Hosting Institution questionnaires

The feedback from the exchange researcher questionnaires was very positive, and in particular offered the following highlights:

- The hosting institution provided a value adding experience to the research activity and a unique experience to collaborate with open-minded experts with different background;
- The overall activity performed at the hosting institution was satisfying and gave valuable input from the interaction between different research topics;
- The exchange objectives and activities were performed as planned mostly in all REX proposals, adapting it according to discussion with the hosting institution; some critical constrains are referred to ELETRA project progress;
- The experience gained throughout the REX exchange was beneficial, and in particular the researchers highlighted: good collaboration with the hosting institution responsible person; enough time dedicated to the research activity; good exchange opportunities with other ELECTRA partners; possibility to continue the collaboration with the hosting institution also after the REX experience; additional knowledge gained beyond the project scope; suggestions for improving laboratory facilities and equipment; possibilities to prepare some peer-reviewed publications;
- The exchange contributed towards their personal development and training, developing new competencies and expanded problem comprehension;
- The results of the exchange were directly used for ELECTRA activities and motivated further developments of the proposed approach;
- Good intension to continue collaborating with the team at the host organization.

The feedback from the hosting institution questionnaires was very positive, and in particular offered the following highlights:

- The REX researcher respected the local rules of the hosting laboratory, and in one case the researcher had already been familiar with the rules and regulations governing the hosting organization before her visit, due to previous visits she had paid to the facilities in the frame of other European projects;
- The REX researchers were well prepared for using the test facilities;
- The effort dedicated for the preparation of the exchange was also strongly linked to the ELECTRA research activities;
- Good satisfaction by the overall activity performed by the REX researchers; some critical constrains are referred to the limited visit duration and because of that the test results were limited to some basic scenarios;
- The experiments carried out by the researchers were performed as planned and correctly;
- Good benefits hosting the exchange researchers, above all for results sharing and possibilities for scientific publications, experience exchange between hosting and hosted researchers, and establishment of a good collaboration between the two organizations so as to promote common research activities and project ideas.

The main comments were referred to the future activities, and especially those involving laboratory tests. These activities should be encouraged to last for four rather than two weeks. Otherwise, two week visits should be well organised prior to the exchange so that an optimal exploitation workplan can be achieved.

3.6 Comparison with other approaches from other IRPs

A number of different approaches to researcher exchange are adopted across different projects and initiatives. For example the approach of the IRPWIND is to operate solely within the consortium. No detailed analysis has been conducted to date, however this is planned for year 3 of the programme. A suggested workshop on researcher exchanges has been put forward for the EERA Conference in November 2016.

4 Conclusions and proposed action

This document shares the results of the ELECTRA REX Researcher Exchange Programme as at the mid-point of the project. Key targets have been met, good dissemination experience gained, and important value delivered to the project and Joint Programme. Three Calls for proposals have been launched to date, and some improvements made through the operation of these. The team will continue to learn lessons from each Call, take account of feedback from the participants, and propose to work on the following:

- Earlier introduction of successful applicants to research WP leads within the ELECTRA programme will improve alignment and project pull of the exchange results. This will further contribute to the high level coordination objectives of the EERA Joint Programme.
- The publicity machine for the researcher exchange needs to improve still further in order to increase the number of applications. This will be assisted as awareness of the scheme percolates through the community, but significant effort will accelerate this and attract greater numbers of quality proposals.
- Improvements will continue to be made to the application form to better direct applicants of programme expectations. This will include budgetary information, in order to minimise delays and unnecessary modifications that slow the negotiation process. This will also take account of the need for efficiency, especially in relation to the short duration exchanges.
- Future calls will be shaped to stimulate the participation of industry researchers and innovations engineers.
- Better utilisation of national clusters and contacts of partners will further broaden the participation in the programme and ensure the participation of more countries.
- The later exchanges are likely to include more experimental work in keeping with the focus of the IRP. The EPMC will invest some effort in planning for this, and stimulating the engagement of innovations and prototypes from other projects.

5 References

[1] http://www.electrairp.eu (ELECTRA IRP web site)

[2] http://www.ieei.rtu.lv/POWERENG2015/

6 Disclaimer

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

The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Commission.

The European Commission is not responsible for any use that may be made of the information contained therein.

Annex 1: Questionnaire issued to ELECTRA Work Package leaders to identify the focus of a Call

This questionnaire has been prepared as part of the Researcher Exchange programme within the ELECTRA project (WP9). ELECTRA's Researcher Exchange (REX) programme offers the opportunity for ELECTRA partners and European or International collaborators to work closely together through an exchange of staff. The scheme is open to participants from research organisations and industry, including SMEs. Host organisations are encouraged to offer elements of training, and so this represents an excellent development opportunity, especially for early career researchers.

The following questionnaire is an example of those populated by WP leaders for REX Call2.

Work Package Number: XX **Work Package Leader: XXXX**
1. In what topic areas would you particularly welcome exchange applications in REX Call 2 (to be issued June '15) • Control room functionality in particular with respect to visualisation of internal state of cells e.g. amount of inertia, voltage control capabilities and inter cell state of operation e.g. exchange between cells and comparison with schedule. • Topics relating to observability of cells in particular in relation to their responsibilities i.e. exchange and voltage control.
2. Who in industrial organisations would you particularly welcome participating in an exchange to the benefit of the ELECTRA IRP programme? • Researcher/developers from SCADA system providers
3. Can you identify particular SME's that you can recommend participating in an exchange?
4. Which of the work packages should benefit most from the aforementioned topics and industry partners? • WP 8 and WP7
5. If you are a Work Package Leader, which aspect of the programme would particularly benefit from (a) intra-ELECTRA, (b) European, (c) Global exchanges? • a - intra-electra exchanges will be a valuable tool for ensuring coherence between the developed solutions and their implementability/validation; • b - integration of results from other EU-projects; • c - control room operators from US and Japan.
6. REX Call 3 (to be issued September '15) will particularly focus on global exchanges - what topics and global partners would have the greatest impact on the realisation and testing of innovative smart grid controls?
7. What emphasis would you like to be made in the subsequent REX Calls: Call 4 (due early '16), Call 5 (due late '16) and Call 6 (due early '17)? • topics for demonstration of developed topics

8. If you are a Work Package Leader, which of the following calls would you expect to make most use of in your work package:

☐ Call 2 (June'15)

☐ Call 3 (Sep '15)

x Call 4 (early '16)

x Call 5 (late '16)

☐ Call 6 (early '17)

If you are NOT a Work Package Leader, which of the following calls would you expect to be most interested in:

☐ Call 2 (June'15)

☐ Call 3 (Sep '15)

☐ Call 4 (early '16)

☐ Call 5 (late '16)

☐ Call 6 (early '17)

9. List exchanges you expect to apply and complete in each IRP year

	Sending organisation	Receiving laboratory	Description	Value to IRP
Call 2 (June '15)	1. 2. 3.	1. 2. 3.	1. 2. 3.	1. 2. 3.
Call 3 (Sep '15)	1. 2. 3.	1. 2. 3.	1. 2. 3.	1. 2. 3.
Call 4 (early '16)	1. increased observability 2. 3.	1. 2. 3.	1. 2. 3.	1. WP5 2. 3.
Call 5 (late '16)	1. improved visualisation of state of cells 2. 3.	1. 2. 3.	1. 2. 3.	1. WP6 and WP8 2. 3.

Call 6 (early '17)	1. 2. 3.	1. 2. 3.	1. 2. 3.	1. 2. 3.

10. Are you personally aware of any benefit already achieved from an ELECTRA REX exchange? Please describe.

The two exchanges that DTU has participated in have contributed significantly to the progress of Electra. The one involving OFFIS are contributing to the clarification of controller conflicts between the various controllers contributing the safe operation of the cells. The exchange involving Strathclyde has contributed to a more basic part of the system in that some algorithms for dynamic topology detection has been tested on a different grid setup.

Annex 2: Initial flyer of REX Call 1

Call for Researcher Exchanges in the ELECTRA Project

The Exchange Programme Management Committee of the ELECTRA Integrating Research Programme is pleased to announce the first call for applications for Researcher Exchanges between ELECTRA Partners, and between ELECTRA Partners and International organisations.

This Exchange Programme will provide funding (travel and subsistence) for a researcher to work at another recognised research institute to enhance the effectiveness of the ELECTRA research programme.

The research to be conducted during the exchange must be agreed with the Host Institute in advance of the application.

Topics for researcher exchanges during this first call are (in no particular order):

- Voltage control
- Frequency control
- Experimental demonstration
- Ancillary services provision
- Electro-mobility

Applications must be made using the online form available on the ELECTRA website.
www.electrairp.eu .

www.electrairp.eu
An FP7 Integrating Research Programme

2007 - 2013

Annex 3: Template for proposal

Some example screens from the web based form.

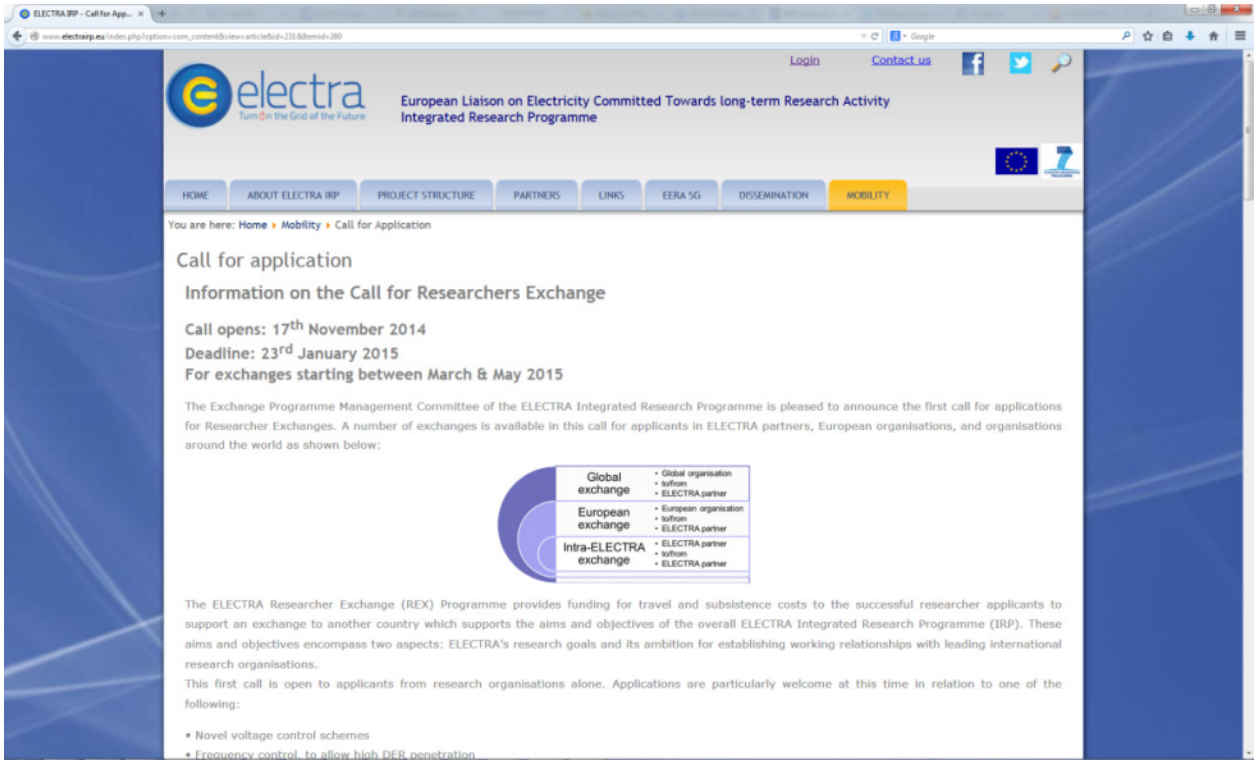

Figure A- 1 Website capture of call for exchanges details

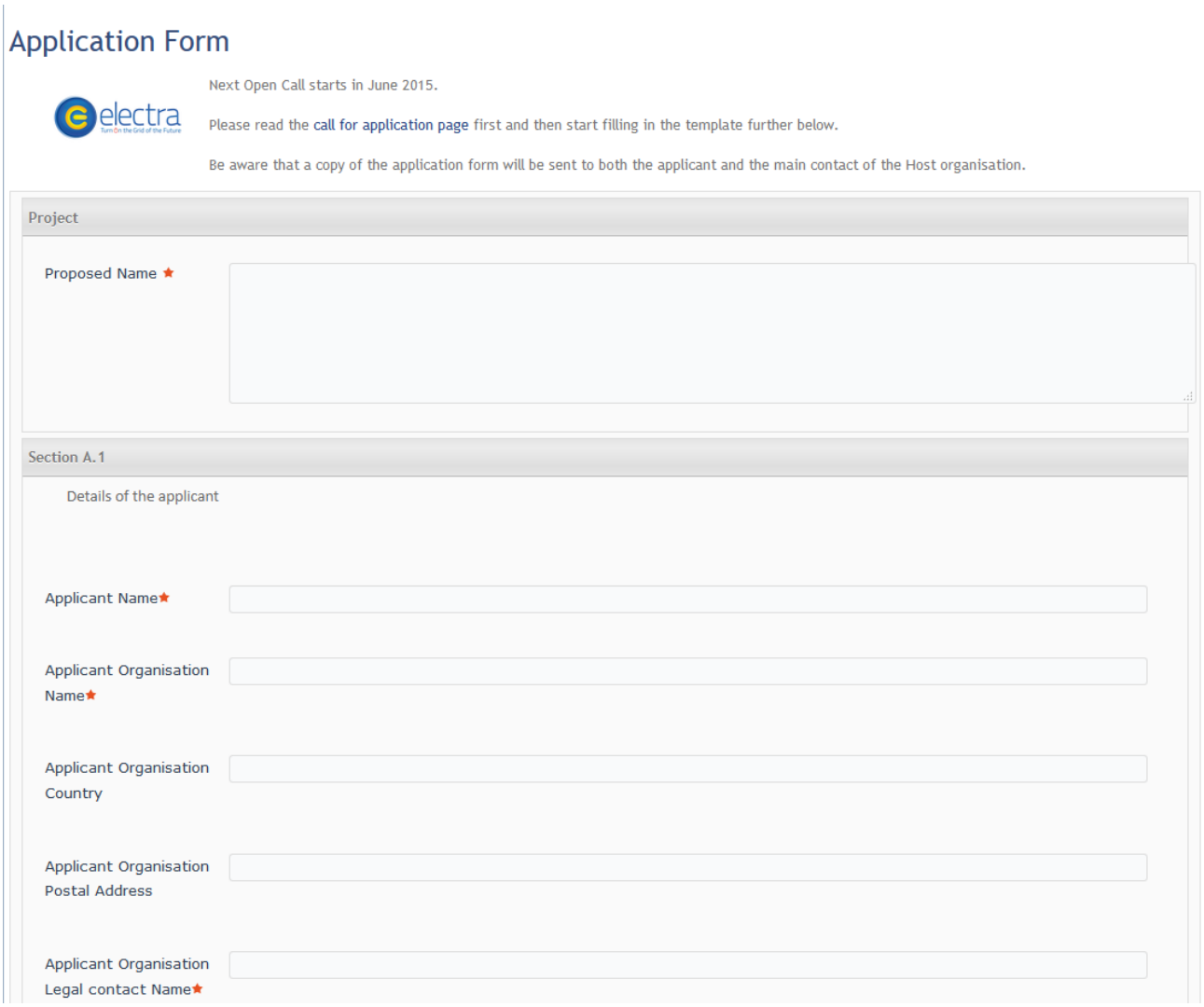

Figure A- 2 Part 1 of online application form

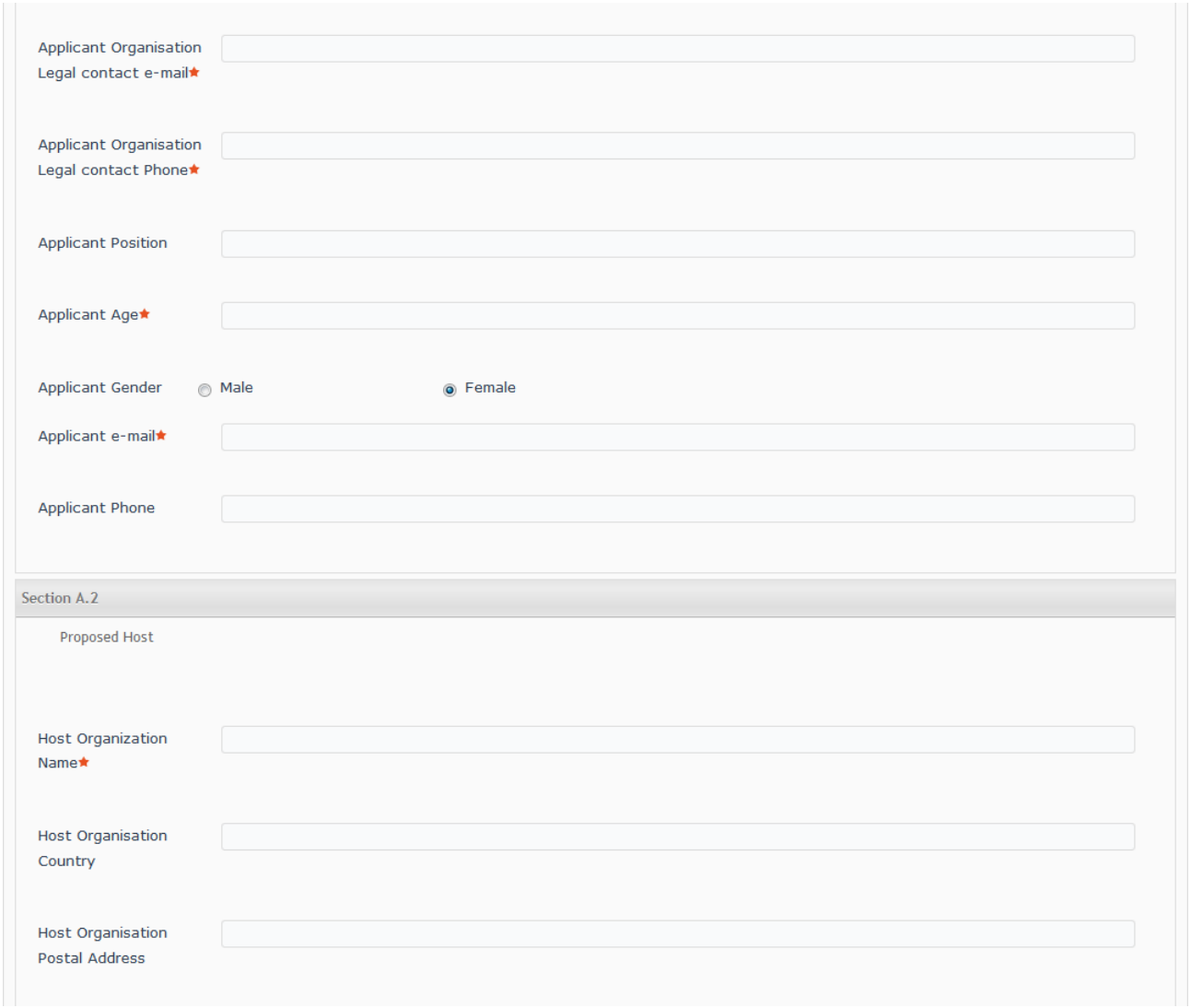

Figure A- 3 Part 1 cont. and 2 of application form

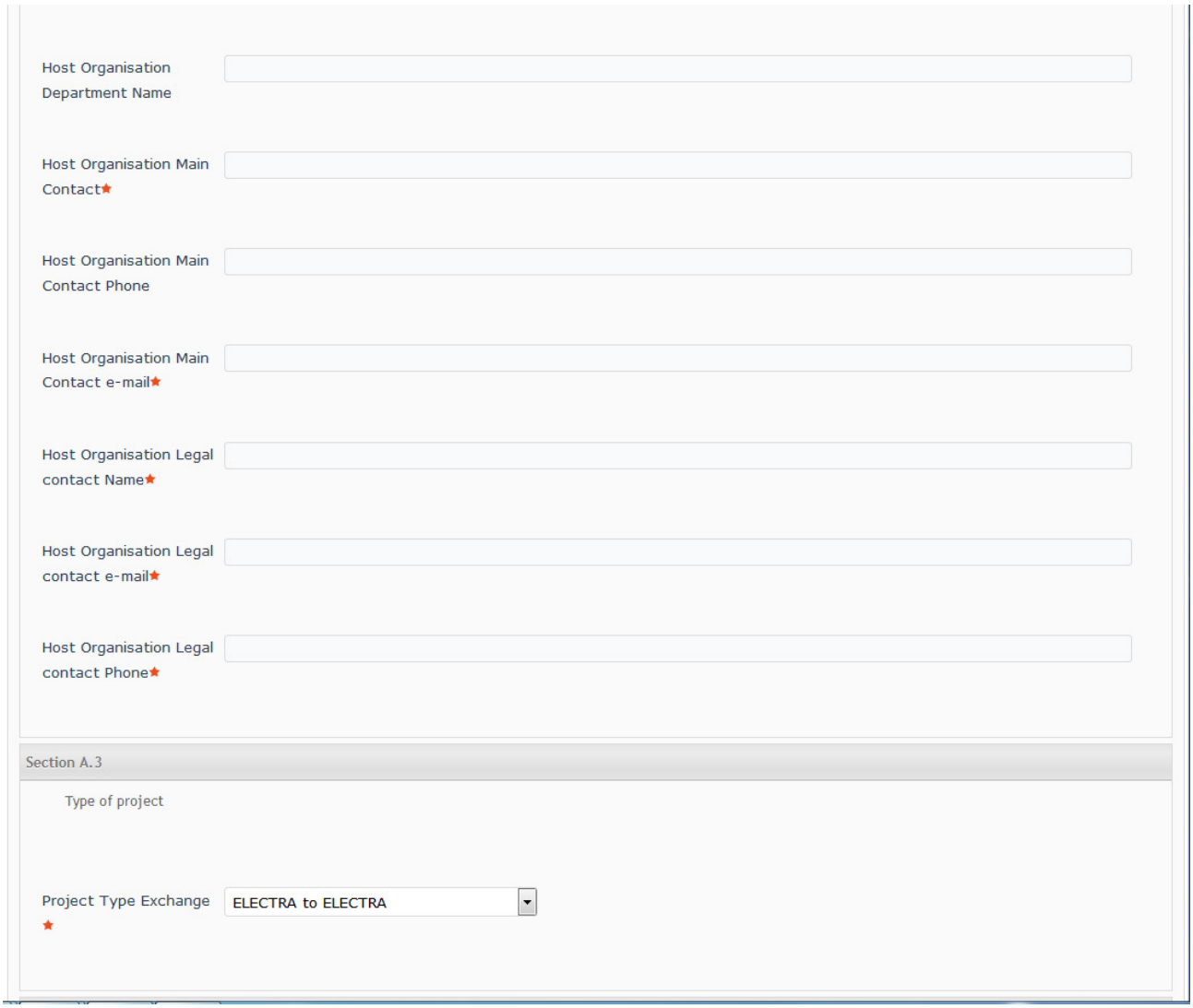

Figure A- 4 Parts 2 cont. and 3 of application form

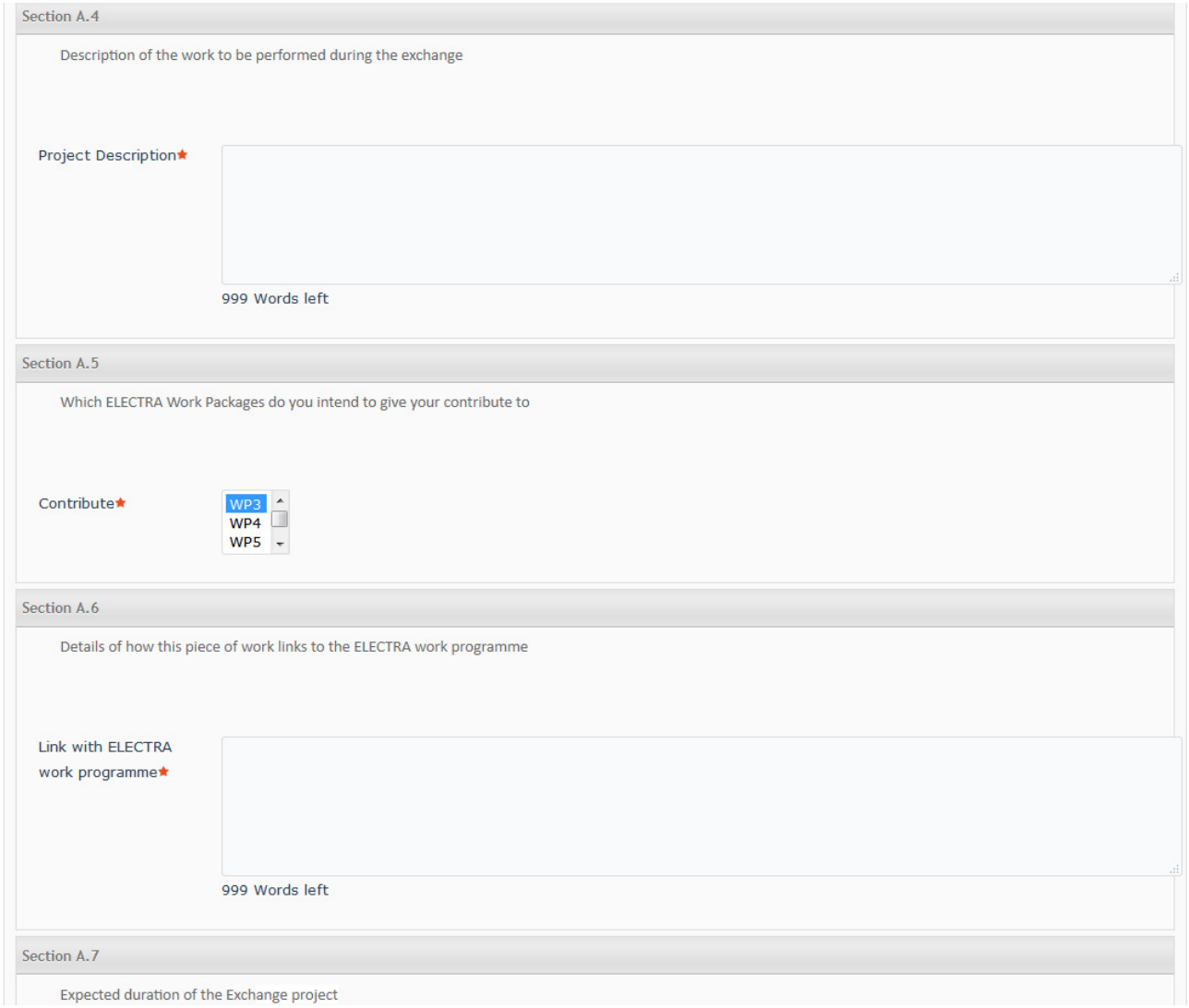

Figure A- 5 Parts 4 to 6 of application form

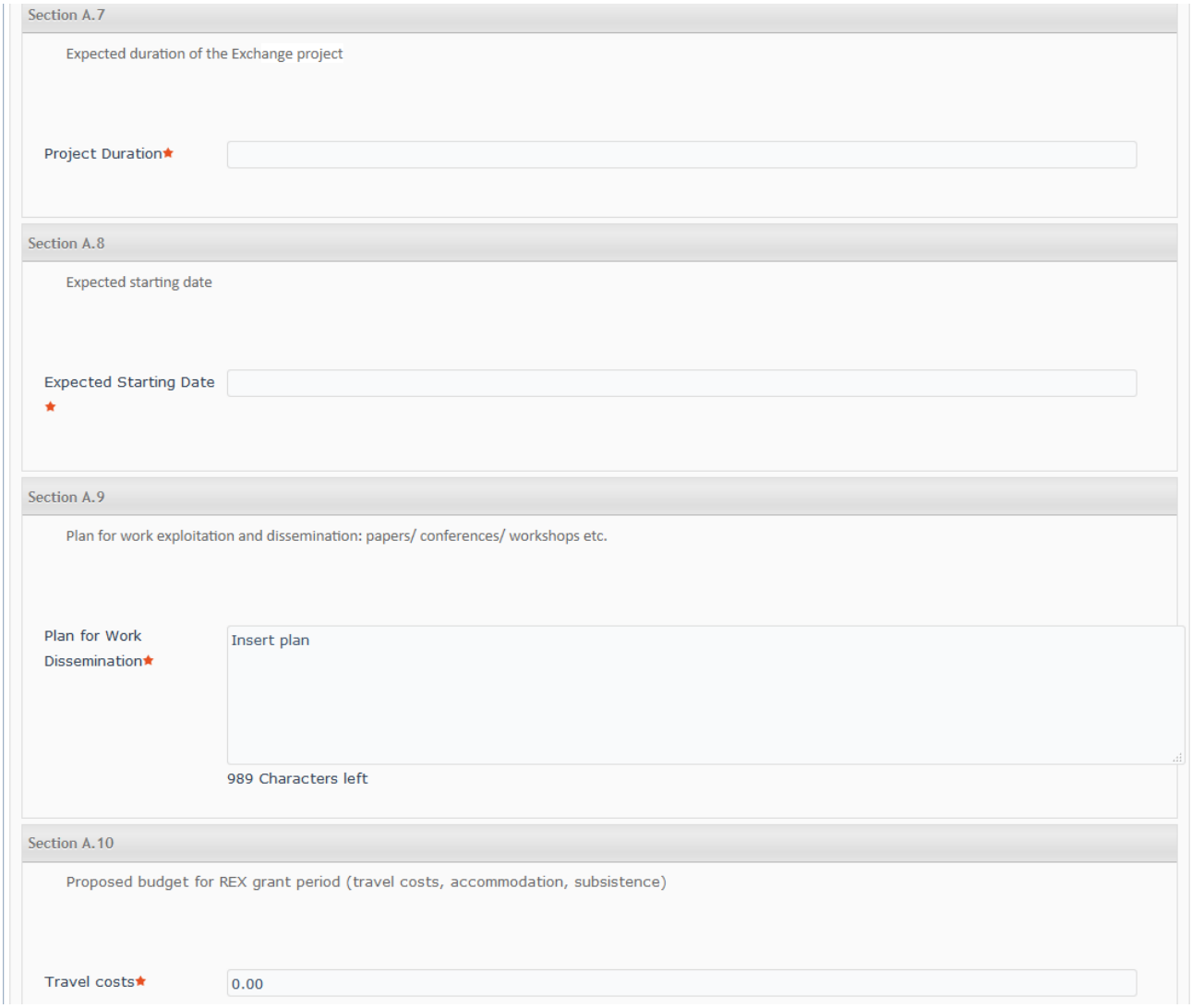

Figure A- 6 Parts 7 to 10 of application form

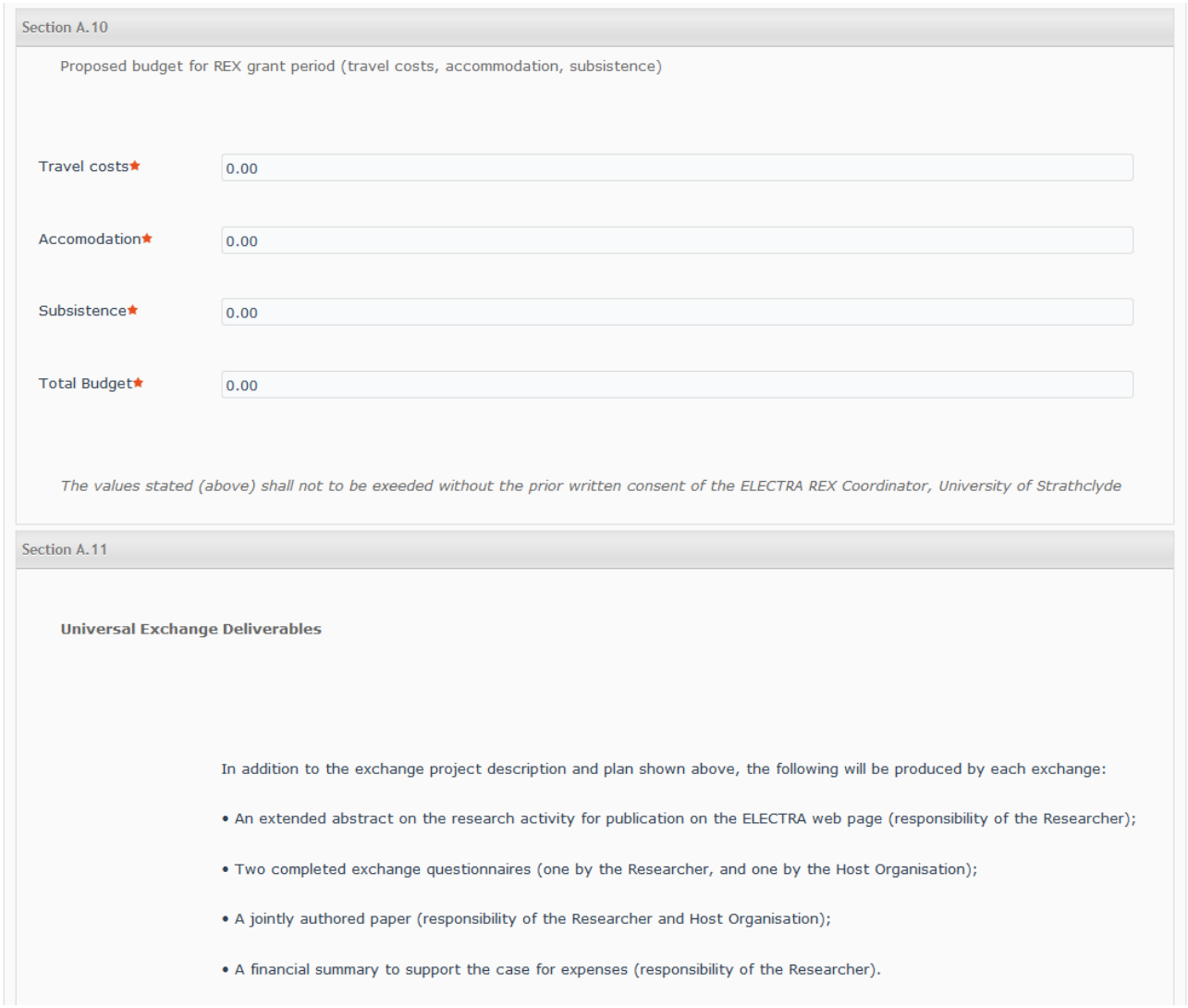

Figure A- 7 Parts 10 and 11 of application form

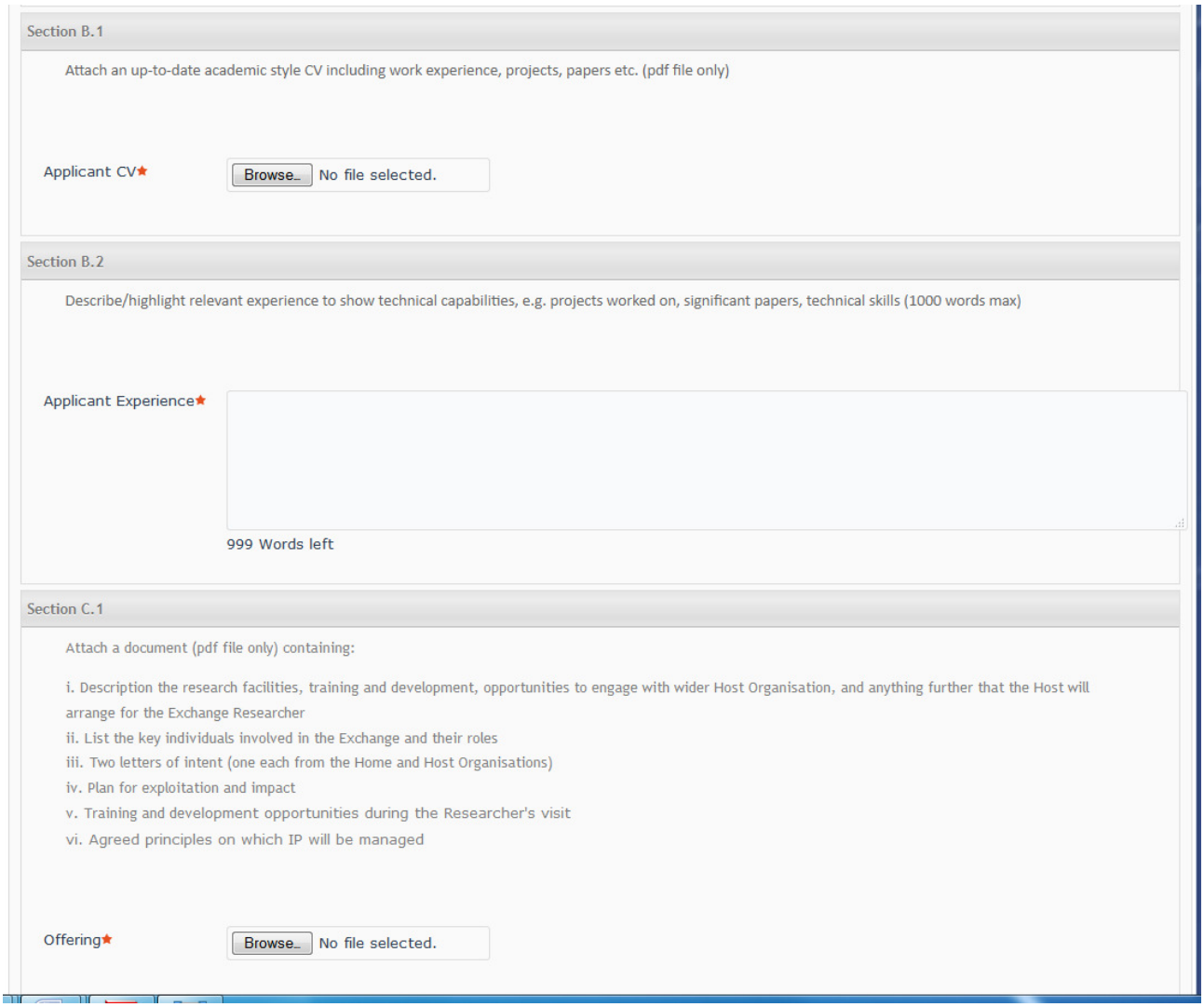

Figure A- 8 Final parts of application form

Annex 4: Extended abstracts resulting from REX Call 1 exchanges

ELECTRA REX

A Researcher Exchange Programme for Smart Grids

European Liaison on Electricity Committed Towards long-term Research Activity Integrated Research Programme

GRID IMPACT AND SIZING OF PV STORAGE SYSTEMS - A COMPARATIVE ANALYSIS FOR AUSTRALIA AND GERMANY

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The traditional business case for rooftop PV systems has evolved over the last years in Australia and in Germany. Since the feed-in tariff has dropped below the electricity price for households, PV self-consumption drives the installation of rooftop PV systems and a business opportunity for small scaled storage systems emerges. Such systems are also discussed as a solution for facilitating PV grid integration by increasing active and reactive power control flexibilities. However, the impact of different pricing schemes and grid integration approaches on the sizing and operation of such systems and on distribution grids has not been evaluated

Within this Electra REX project these challenges are addressed and several aspects of the grid integration of PV storage systems are analyzed:

- Development and adaption of an integrated sizing and control for PV storage systems under different economic and regulatory circumstances to assess their impact on distribution systems
- Voltage control possibilities using PV storage systems exploiting voltage dependent active and reactive power control possibilities (including stability aspects)
- Control of thermal storage systems to increase demand flexibilities for distribution systems with high amounts of PV generation

Results of a comparative case study to assess the interactions between sizing and control of PV storage systems and grid integration are published in [1].

ACKNOWLEDGMENT

This research has been supported by the European Commission, under the FP7 project ELECTRA (grant no: 609687). The work has also been supported by the German for Economic Affairs and Energy through the projects "INE-VES" and "HiPePV2" (FKZ: 0325561A, 0325785) and by ARENA, the Australian Renewable Energy Agency, through the VPS2 Project. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect those of the funding parties.

Fig. 1: Jan von Appen at the CSIRO site in Newcastle, Australia.

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[1] J. von Appen, J. H. Braslavsky, J. K. Ward, and M. Braun, "Sizing and grid impact of PV battery systems - a comparative case study for Australia and Germany," in 2015 International Symposium on Smart Electric Distribution Systems and Technologies (EDST), Sep. 2015

ELECTRA REX

A Researcher Exchange Programme for Smart Grids

European Liaison on Electricity Committed Towards long-term Research Activity Integrated Research Programme

A USE CASE METHODOLOGY TO HANDLE CONFLICTING CONTROLLER REQUIREMENTS FOR FUTURE POWER SYSTEMS

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This research exchange aimed to propose a standards-based requirements elicitation and analysis strategy tailored for smart grid control structure development. Control structures in electric power systems often span across several systems and stakeholders. Requirements elicitation for such control systems therefore requires coordination across many stakeholders and it is challenging to achieve a consistent design. To enable an iterative and distributed development we suggest a conflict management approach as a modular element of the design strategy, focusing on conflict identification and tracing. The idea is to describe a process starting from a tailored IEC 62559 template amended for recording controller conflicts and adapting the underlying use case management repository for collaborative work. Conflict identification is supported by Multilevel Flow Modeling providing abstracted conflict patterns. Based on this work a modified Use Case template has been published [5].

ACKNOWLEDGMENT

This research has been supported by the European Commission, under the FP7 project ELECTRA (grant no: 609687). Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect those of the European Commission.

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ELECTRA REX

A Researcher Exchange Programme for Smart Grids

European Liaison on Electricity Committed Towards long-term Research Activity Integrated Research Programme

DEMAND SIDE PARTICIPATION FOR FREQUENCY CONTAINMENT IN THE WEB OF CELLS ARCHITECTURE

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The ELECTRA IRP Researcher Exchange Programme has given the opportunity to bring together the expertise of TNO in multi-agent systems, PowerMatcher [1] and secure communications, and that of Strathclyde University researchers in Real-Time Power Hardware-In-the-Loop (RT-PHIL) based testing, power system operation and control, wide area monitoring and adaptive protection techniques [2].

The exchange builds upon the ongoing project, "Testing and Validation of Time Critical Ancillary Service Provision by Demand Side Management" between University of Strathclyde and TNO. In this work, demand side management (DSM) is implemented within the ELECTRA web of cells architecture (EWOC). A large number of demand side management schemes have been proposed in literature for provision of frequency control ancillary services to the network. However, it is assumed that all the flexible devices within the network are managed and controlled under one DSM scheme. In this work, two independent demand side management schemes control the portfolio of flexible devices within EWOC. A methodology and scenarios for analysis of the performance of more than one DSM scheme within the same network have been realized using a real-time power hardware-in-the-loop co-simulation platform, and the paper presents this as a basis for investigations into the validation of such DSM schemes.

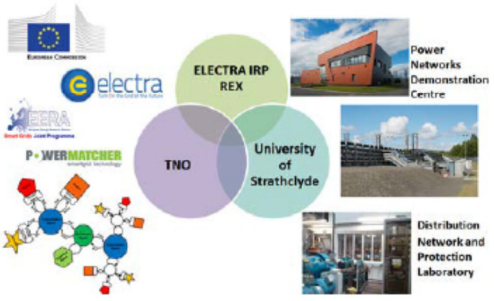

Fig. 1. The collaboration.

ACKNOWLEDGMENT

The research leading to these results has received funding from the European Union Seventh Framework Programme ([FP7/2007-2013] under grant agreement n°609687, as part of the ELECTRA REX researcher exchange programme. The work has also been supported TNO under ERP Program "Energy Storage and Conversion"

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ELECTRA REX

A Researcher Exchange Programme for Smart Grids

European Liaison on Electricity Committed Towards long-term Research Activity Integrated Research Programme

INTEGRATING SMART OBJECTIVE AGENTS IN THE POWERMATCHER FRAMEWORK FOR BALANCE RESTORATION CONTROL

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This exchange relates to the coordination and optimization of reserves activation in the Balance Restoration Control in the proposed web-of-cells architecture by ELECTRA IRP. In this web-of-cells architecture, the Control Cell Operator is responsible for correcting real-time imbalances (i.e. real-time deviations from the market determined setpoint) within his cell. To correct the cell imbalance, restoration reserves, provided by an aggregator, are activated.

The objective of the exchange project is to prepare the detailed functional architecture and specification of a multi-agent control system for such reserve provision based on the TNO PowerMatcher framework. This well-known open-source framework that has been used in various field-tests, is being used by multiple ELECTRA partners like Strathclyde in their smart grid test labs.

VITO has developed Sequential Decision Making Business Agent technology that distinguishes from more common Myopic Agents in that their decision making optimization takes into account forecast information, resulting in a decision plan or schedule rather than a decision point. Such forward looking Business Agents are essential assets for an effective stable multi-agent control system that is required for reserve provision.

During the research exchange it was investigated how such Business Agents can be integrated in the Powermatcher based multi-agent framework that is being used and evaluated in the Strathclyde smart grid test lab to extend the framework's capabilities from Myopic Decision making to Sequential Decision making. The two-week exchange was intended to kick of this work by learning about the Strathclyde PowerMatcher setup and related labo infrastructure and capabilities, and to agree on the best way to integrate the Business Agents in the Strathclyde validation and demonstration environment.

Figure 1: The Technology & Innovation Centre at the University of Strathclyde.

ACKNOWLEDGMENT

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ELECTRA REX

A Researcher Exchange Programme for Smart Grids

European Liaison on Electricity Committed Towards long-term Research Activity Integrated Research Programme

SMS-VIR (STUDY, MODELING & SIMULATION OF VIRTUAL INERTIAL RESPONSE)

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(*Athens, Greece*)

I. SUMMARY OF THE PROJECT

This project investigated the frequency stability in power systems, which is highly correlated to the inertial response of the system since any inequality in system´s power balance causes a variation in the kinetic energy of the rotating masses and thus a change in frequency.

In this framework, the main objective of this project was the general implementation of emulated inertia response and fuzzy logic controllers with virtual inertia in power systems for the stabilization of the frequency by diminishing fast deviations under step load changes or during continuous fluctuations in the electrical grid.

II. MAIN ACHIEVEMENTS

The following figures (Fig. 1 & 2) illustrate the contribution of fuzzy controller with virtual inertia and simply the virtual inertia response against classical frequency control. The disturbances being considered are for a step load changes of 1% and the implementation of a continuous fluctuation onto the system respectively. As it was anticipated, fuzzy logic control and emulated inertia improve the system´s dynamic response during the aforementioned disturbances when the system´s total inertia is reduced by half.

III. DISSEMINATION PLANNING

1) Special Session at EDST Conference- Experiences from the ELECTRA IRP Researchers Exchange
2) Paper Submission to a peer reviewed journal

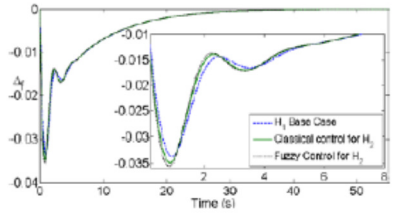

Fig. 1. Fuzzy and classical control strategies´ contribution to frequency support (1% step load change).

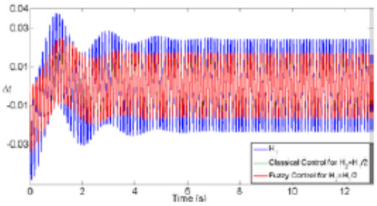

Fig. 2. Fuzzy anc classical control strategies´ contribution to frequency stability (continuous fluctuation).

ACKNOWLEDGMENT

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ELECTRA REX

A Researcher Exchange Programme for Smart Grids

European Liaison on Electricity Committed Towards long-term Research Activity Integrated Research Programme

DISTRIBUTED FRAMEWORK FOR PROTOTYPING OF OBSERVABILITY CONCEPTS IN SMART GRIDS

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**Power Networks Demonstration Centre, University of Strathclyde, United Kingdom.
***Department of Electronic And Electrical Engineering, University of Strathclyde, United Kingdom.

The ELECTRA Web-of-Cells (WoC) concept [1] defines cells as autonomous balancing and control areas within the grid to which distributed data acquisition and aggregation approaches are applied. Development and testing of according distributed monitoring, visualisation, and decision support concepts for future power systems require appropriate modelling tools that represent both the electrical side of the grid, as well as the communication and logical relations between the acting entities.

The goal of this research exchange was the development of an "Observability Framework" (see Fig. 1) that facilitates the development of these concepts by providing high-level application interfaces and flexible low-level data acquisition mechanisms. A Multi-Agent System [2] platform was chosen for implementation, where agents represent the different electrical and logical grid elements and perform data acquisition, processing, and exchange. The underlying data model represents general grid components (buses, branches, devices), which can be refined on demand.

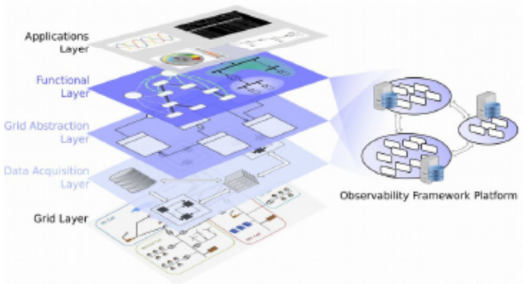

Fig. 1: General framework architecture.

Development and testing of the framework took place at University of Strathclyde and the Power Networks Demonstration Centre (PNDC). PNDC's MV and LV grid was used for deriving the information model requirements based on its grid topology. The implemented test case using a PNDC simulation model verified the framework's data acquisition, processing and communication abilities. Furthermore, the test case also demonstrated the framework's purpose as a prototyping platform for distributed concepts by means of an exemplary grid topology and state visualisation that is generated without any central topology storage.

I. ACKNOWLEDGMENT

This research has been supported by the European Commission, under the FP7 project ELECTRA (grant no: 609687). Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect those of the European Commission.

II. REFERENCES

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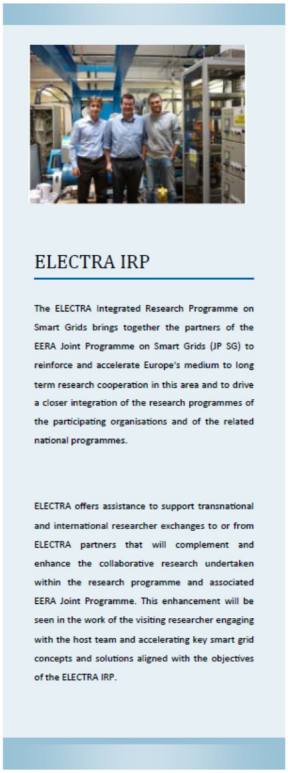
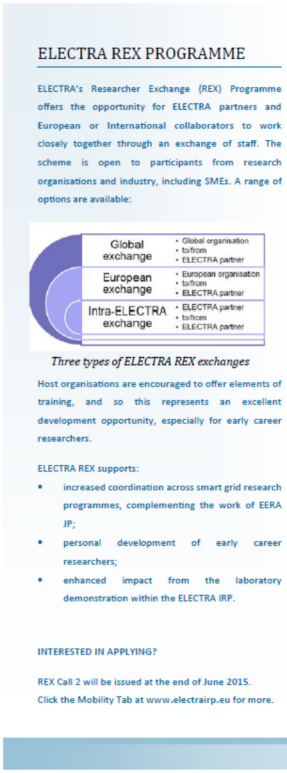
Annex 5: Flyer for REX Call 2



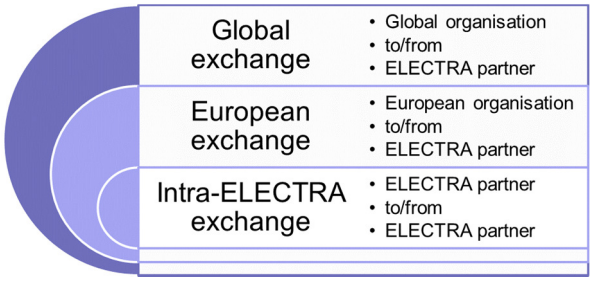


Annex 6: Announcement of REX Call 2

Second REX Call

Call opens: 22th June 2015
Deadline: 22th August 2015
For exchanges starting by October 2015

The Exchange Programme Management Committee of the ELECTRA Integrated Research Programme is pleased to announce the second call for applications for Researcher Exchanges. A number of exchanges is available in this call for applicants in ELECTRA partners, European organisations, and organisations around the world as shown below:



The ELECTRA Researcher Exchange (REX) Programme provides funding for travel and subsistence costs to the successful researcher applicants to support an exchange to another country which supports the aims and objectives of the overall ELECTRA Integrated Research Programme (IRP). These aims and objectives encompass two aspects: ELECTRA's research goals and its ambition for establishing working relationships with leading international research organisations.

This Call is open to applicants from research organisations alone. Applications are particularly welcome at this time in relation to one of the following:

- Coding of distributed control solutions for real time voltage and frequency management
- DER management in support of low voltage network operation
- Detailed (functional) specifications of new smart grid control frameworks, such as microgrids or distributed cells
- Resilience of smart grid controls under disturbance conditions

It is important to note that the proposed exchange must be agreed with the Host Organisation in advance of submission. By working together, the proposed Host Organisation and Home Organisation should demonstrate that they are supporting the threefold objectives of the ELECTRA REX Programme:

a) The proposed work is relevant to the goals of creating and demonstrating advanced voltage and frequency control as described by the ELECTRA IRP.
b) The Exchange Researcher will be capable of completing a quality body of work from the exchange and will gain useful personal development from it.
c) The value of the exchange is such that the host organization and key individuals are willing and able to commit to producing valuable outcomes.

ELECTRA IRP

The ELECTRA Integrated Research Programme on Smart Grids brings together the partners of the EERA Joint Programme on Smart Grids (JP SG) to reinforce and accelerate Europe's medium to long term research cooperation in this area and to drive a closer integration of the research programmes of the participating organisations and of the related national programmes.

ELECTRA offers assistance to support transnational and international researcher exchanges to or from ELECTRA partners that will complement and enhance the collaborative research undertaken within the research programme and associated EERA Joint Programme. This enhancement will be seen in the work of the visiting researcher engaging with the host team and accelerating key smart grid concepts and solutions aligned with the objectives of the ELECTRA IRP.

ELECTRA REX PROGRAMME

ELECTRA's Researcher Exchange (REX) Programme offers the opportunity for ELECTRA partners and European or International collaborators to work closely together through an exchange of staff. The scheme is open to participants from research organisations and industry, including SMEs. A range of options are available:

Three types of ELECTRA REX exchanges

Host organisations are encouraged to offer elements of training, and so this represents an excellent development opportunity, especially for early career researchers.

ELECTRA REX supports:

- increased coordination across smart grid research programmes, complementing the work of EERA JP;
- personal development of early career researchers;
- enhanced impact from the laboratory demonstration within the ELECTRA IRP.

For more info: www.electrairp.eu

INTERESTED IN APPLYING?

REX Call 2 is currently open, and has a closing of 22nd August 2015. The exchanges will start in October.

REX Call 3 will open in early October, and is dedicated to Global Exchanges between overseas organisations & ELECTRA partners. For more info: click the "Mobility" Tab at www.electrairp.eu.

ELECTRA REX WORKSHOP

The six researchers who were successful in REX Call 1 will be presenting their results in the "First ELECTRA REX Workshop on Smart Grid Exchanges" on 9th September as part of the EDST2015 symposium, Vienna. Come along to hear first hand the researchers:

- disseminate the results of their exchanges
- share their experience of exchange working in leading smart grid organisations.

Annex 7: Application assessment for REX Call 2

Quantitative Criterion	Quality of Ambition	Credibility of impact
A. The proposed work is aligned with the goals of creating and demonstrating advanced voltage and frequency as described by the ELECTRA IRP. I.e. is the proposal technically feasible and value adding for the ELECTRA IRP	(…/15)	(…/15)
B. Based on the applicant's résumé they are capable of completing a quality body of work from the exchange and will gain useful personal development from it	(…/10)	(…/10)
C. Does the host organization provide a value adding experience to the proposed research, i.e. will the research be better because of the facilities/experience at the Host Organization	(…/10)	(…/10)
TOTALS (out of 35)		
Overall score (out of 70)		

Qualitative criterion	
Is the application from an ELECTRA partner?	Yes (5 points)/ No (0 points)
Is the application from a European organisation involved in the EERA JP Smart Grids but not in ELECTRA?	Yes (5 points)/ No (0 points)
Is the application from a European or an international organisation that ELECTRA is developing a partnership with?	Yes (5 points)/ No (0 points)
Is this the first REX submission from the researcher's institution?	Yes (3 points)/ No (0 points)
Is this the first REX submission from the researcher's country?	Yes (3 points)/ No (0 points)
Is the researcher an 'early career researcher'?	Yes (6 points)/ No (0 points)
Is the researcher female?	Yes (3 points)/ No (0 points)
Overall score	(…/30)
Final comments	

Annex 8: Announcement of REX Call 3

Third Call for Applications dedicated to exchanges between ELECTRA Partners and extra-EU Organizations

Call opens: 5th October 2015
Deadline: 5th December 2015
For exchanges starting from February/March 2016

The Exchange Programme Management Committee of the ELECTRA Integrated Research Programme is pleased to announce the third call for applications for Researcher Exchanges.

The ELECTRA Researcher Exchange (REX) Programme provides funding for travel and subsistence costs to the successful researcher applicants to support an exchange to another country which supports the aims and objectives of the overall ELECTRA Integrated Research Programme (IRP).
These aims and objectives encompass two aspects: ELECTRA's research goals and its ambition for establishing working relationships with leading international research organisations.

Applications are particularly welcome at this time in relation to one of the following priority topics:

- Assessment and control of system inertia
- Ancillary services for voltage and frequency regulation
- Power systems supervision & monitoring by considering smart meter data
- ICT & control system Interoperability: power & information flows with grid operators
- Integration of intelligent components such as IEDs and PMUs for wide area control
- Experimental investigation of DER control methodologies
- Definition of reference test networks

It is important to note that the proposed exchange must be agreed with the Host Organisation in advance of submission. By working together, the proposed Host Organisation and Home Organisation should demonstrate that they are supporting the threefold objectives of the ELECTRA REX Programme:

a) The proposed work is relevant to the goals of creating and demonstrating advanced voltage and frequency control as described by the ELECTRA IRP.
b) The Exchange Researcher will be capable of completing a quality body of work from the exchange and will gain useful personal development from it.
c) The value of the exchange is such that the host organization and key individuals are willing and able to commit to producing valuable outcomes.

Annex 9 Summary of ELECTRA Programme Research and International Coordination Work Packages

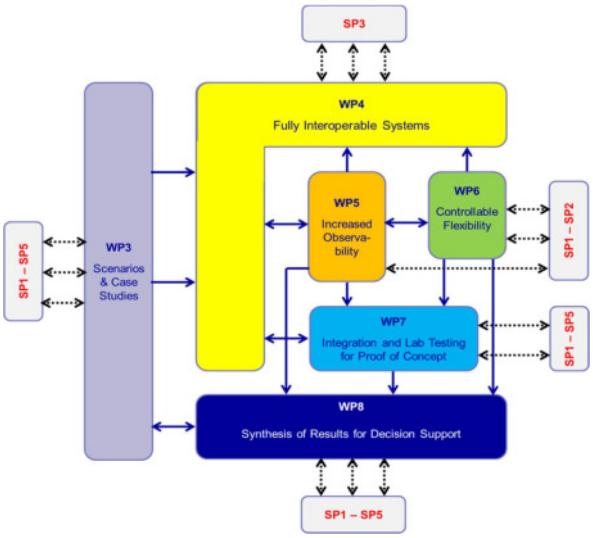


Figure A- 9 Interlinks of the ELECTRA work programmes

WP3 Scenarios and case studies for future power system operation

The main goal of WP3 is to provide a detailed problem description of the voltage and frequency control problem that we target to solve and to describe the concepts of the solutions that will be further specified, implemented and tested in WP4 – WP8.

The work to be performed within the work package will be divided in four main blocks:

- The first one will be gathering of requirements for future (2030) frequency and voltage control for system operation;
- The second one will focus on the SGAM business layer specification of Smart Grid functionalities to fulfil the identified requirements;
- The third one will be drafting electricity market designs able to cope with the above created requirements and functions, and
- The fourth one will gather the necessary information to provide inputs for a future regulatory framework for T&D businesses.

WP4 Fully Interoperable Systems

The role of WP4 is to translate the concepts (business layer specification) of the overall voltage and frequency control in WP3 as well as the concepts of the monitoring system (WP5) and the control system (WP6) into detailed technical specifications encompassing all layers of the SGAM model such that WP5 and WP6 are able to make the required implementations and WP7 is able to make the integration and testing of the overall solution.

The main objectives of this work package are:

- Create the detailed specifications of fully interoperable monitoring and control systems for future Smart Grids

- Participate in standardization activities to ensure that the proposed solutions of ELECTRA are aligned with existing standards and ongoing work in standardization organisations

WP5 Increased Observability

The main objective of the present work package is to develop and implement adequate concepts and methods for sufficiently observing the state of the future power system for the three axes identified before:

- Pan-European
- Vertically integrated
- Local (Horizontal/ Distributed).

The suggested observability schemes will be implemented in a generic lab platform programmable in an advanced language (MATLAB, SciLab or similar). The concrete programming environment will be defined and harmonized among the partners in course of the IRP.

WP6 Control Schemes for the use of flexibility

The main objective of this work package is to design and develop control functions for the three axes of operation as described before (distributed control, vertical control, and pan-European control). The main focus is in the frequency and voltage control in the transmission level but also the other control objectives in distribution level, among other reactive power, load control etc. will be taken into account in order to avoid congestions, security margins and minimizing losses.

This includes the following items:

- To describe the inherent and controllable flexibility across multiple resources and control boundaries.
- To design and develop robust coordination function modules for multiple controllers across different control boundaries.
- To design and develop new control function modules for emergency situations exploiting the flexibility of adaptive protection and inherent controllability of network assets.
- To design economically optimal coordinating control between system operators at European level in order to share flexibility resources via transmission system interconnections.

The purpose of this whole project is to research radical control solutions for the real time operation of the 2030 power system. The control solutions utilize the flexibility from across traditional boundaries (of voltage level, stakeholders, license areas, etc.) in a holistic fashion and build ubiquitous sensing and dynamic and autonomous control functions under normal and disturbed conditions

WP7 Integration and lab testing for the proof of concept

The objective of the WP is to conduct experimental testing for proof of concept evaluation of ELECTRA controllable flexibility solutions for voltage and frequency control, incorporating system modelling and simulation tools in order to prove the system performance across numerous devices distributed across the power system at laboratory scale level, since live tests are not in scope of ELECTRA. In summary:

- Definition of the requirements for evaluation and validation of future integrated frequency and voltage control algorithms
- To design and build an ELECTRA experimental proof-of-concept set-up including simulations, testing infrastructure and related interfaces in selected EERA research facilities
- To evaluate and validate the ELECTRA controllable flexibility concepts across a range of challenging system conditions
- Definition of key findings, lessons learned and recommendations for testing and validation of 2030 frequency and voltage control approaches

Beside the focus on control algorithms WP7 will implement and test the proposed communication interfaces from WP4 and work towards facilitating easy transfer of controller implementations across the different lab facilities and interfacing between simulation tools and lab facilities. The WP will take the results from WP5 and WP6 and integrate them in proof of concept implementations. Based on detailed scenarios and use cases specifications from WP4 along with the models of observability and flexible components from WP5 and WP6, lab scale implementations of the technologies and solutions will be designed and integrated. It is planned to use the models developed in the other work packages and consolidate them in to a coherent set of models creating tools that are more generically applicable thus ensuring that lab tests are rigorous and support quantified evaluation and validation. Within the simulation environment it will be possible to characterize the interaction of different controls. From a research infrastructure perspective the interaction between laboratory facilities (hardware) and system simulation tools will be particularly considered (e.g. software-in-the-loop, hardware-in-the-loop tests with focus on controller-in-the-loop).

WP 8 - Future control room functionality

The main objective of this work package is to develop and demonstrate the control room decision support that will be required for the real time operation of the 2030 power systems, utilizing the visualization and control features being investigated in WP5 and WP6 respectively to ensure that the control room operator is provided with the optimal information of the state of the system and of the possible control actions to enable taking preventive or corrective actions, in order to maintain or return the system in safe state of operation. With the increased flexibility within the power system, system-wide adoption of dynamic ratings, pervasive control and automation, increasing market influence, etc., it is recognized that significantly improved information and visualization is essential for future control rooms. It will remain essential to have control engineers aware of system state and of potential threats, and informed of the suitability of potential interventions to emerging critical situations. This work package will demonstrate the means to achieving this and will be supported by direct interaction with end users such as TSOs and DSOs on the development of measures/analytics/quantities that provide the information needed for operators to quickly and easily assess the system state and make safe/informed control actions to mitigate critical situations. It includes:

- Interaction with (Transmission System Operators) TSOs, (Distribution System Operators) DSOs and (Balancing Responsible Parties) BRPs to identify relevant measures/analytics/quantities for preventive and corrective actions
- Develop prototype visualizations of the measures/analytics/quantities

- Development of decision support tools for control operators at TSO, DSO, BRPs control rooms
- Integration of the results with other systems being used by those congestion management, market and trading systems

WP8 will interact strongly with WP7 for proof of concept implementations, data and models. It furthermore builds on the planned activities within the EERA JP with regard to the integration of new primary control cycles (SP1), new network monitoring (SP1), new disturbance management schemes (SP1), modelling platforms and system operation (SP2), and appropriate ICT architectures (SP3).

WP10 Actions on International Cooperation (INCO)

The main objectives of WP10 are:

- To identify promising International Cooperation (INCO) partner programmes, partner organisations, activities and lab-to-lab collaborations in the field of smart grids for teaming up of the ELECTRA IRP and the EERA JP Smart Grids with activities outside Europe.
- To establish an intense collaboration and effective interactions through the members of the International Coordination Board (ICB) with leading international organizations involved in defining the R&D strategy and/or the execution of R&D activities on smart grids in their own country.
- To define, in agreement with the inputs received by ICB members, the R&D topics of mutual interest for International Cooperation activities with respect to some of the most active countries worldwide in the field of smart grids and to coordinate these with the programmes of work of the IRP and the JP.
- To contribute through the ELECTRA INCO activity to the already ongoing work of the major worldwide initiatives such as ISGAN and the GSGF (Global Smart Grids Federation), highlighting the leadership of European research in the smart grids field.