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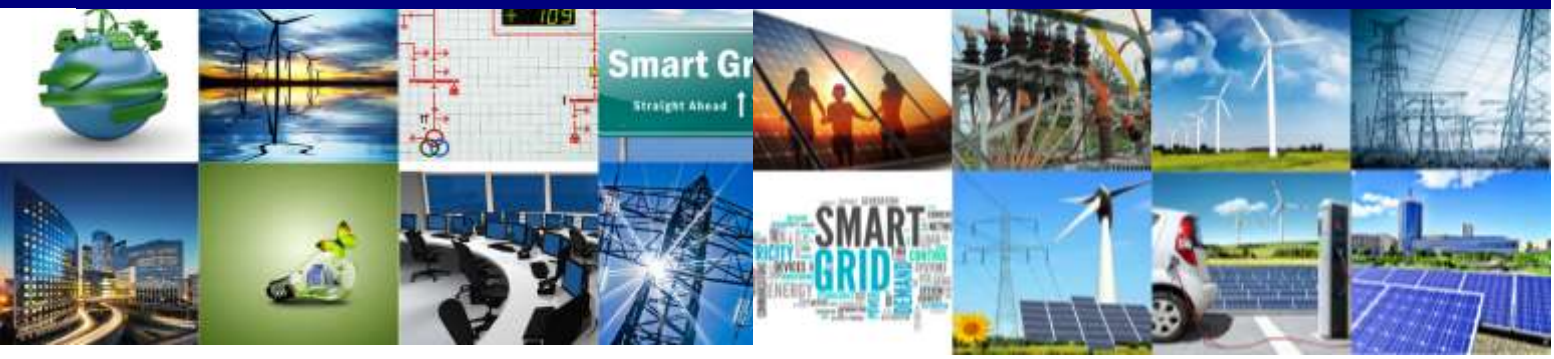
FP7-ENERGY-2013-IRP

ELECTRA

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



ELECTRA final event - proceedings

16/05/2018

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Start	**End**	**Topic**	**Presenter(s)**	**Comment**
9:00	9:20	Registration		
9:20	9:40	**Welcome addresses**	**Stefano Besseghini** RSE CEO **Patrick Van Hove** EC Research Programme Officer	
9:40	10:10	**Keynote speech I** ***"Looking to the future power system: ENTSO-e input"***	**Norela Constantinescu** Team Lead Research & Innovation in ENTSO-E	Grid stakeholder
10:10	10:40	**Keynote speech II** ***C/sells - Showcases for massive Renewable Integration***	**Albrecht Reuter** C/sells Project Manager	National Project
10:40	11:00	**ELECTRA IRP overview**	**Luciano Martini** (RSE)	Coordinator
11:00	11:20	Coffee break		
11:20	13:00	**Presentation of ELECTRA results:** • The Web-of-cells (WoC) concept (25 min) • WoC Experimental validations (40 min) • WoC architectures and cyber security analysis (15 min) • Control room functionalities (20 min)	**Chris Caerts** (VITO) **Thomas Strasser** (AIT) **Giovanna Dondossola** (RSE) **Mattia Marinelli** (DTU)	RTD activity
13:00	14:00	Lunch		
14:00	14:30	**Presentation of ELECTRA results:** • Market design • Regulatory Issues related to WoC	**Irina Oleinikova** (IPE) **Marialaura Di Somma** (ENEA)	RTD activity
14:30	14:45	**Introduction to the round table:** Summary of RTD results	**Helfried Brunner** (AIT)	Technical Coordinator
14:45	16:00	**Round Table I** ***"Grid main challenges and how to bring the WoC concept to maturity"***	Moderator: **Helfried Brunner** (AIT) Participants: **Grid stakeholders**	EU and National stakeholders
16:00	17:45	**Researchers Exchange (REX) Workshop** REX highlights (15 min) REX poster presentation (5 min each) Walking session with coffee and soft drinks	**Graeme Burt** (USTRATH)	Coordination and Support Actions (CSA)
19:30		Gala Dinner at "Osterietta"		

Day 2 - 22nd February 2018				
Start	**End**	**Topic**	**Presenter(s)**	**Comment**
9:15	9.30	**Welcome and recap of the first day**	**Luciano Martini** (RSE)	Coordinator
9:30	10:00	**Keynote speech III** ***"Technologies for network digitalization: overview and perspectives"***	**Antonello Monti** RWTH-Aachen ETIP SNET WG4	International expert
10:00	11:30	**CSA activities results:** International Cooperation achievements (40 min) Implementation of a researchers mobility scheme (30 min) Development of joint research facilities (20 min)	**Luciano Martini** (RSE) **Graeme Burt** (USTRATH) **Mihai Calin** (DERlab)	Coordination and Support Actions (CSA)
11:30	11:50	Coffee break		
11:50	13:00	**Round Table II** ***"The way forward: WoC impact on grid evolution"***	Moderator: **ELECTRA WP Leader** Participants: **Grid stakeholders**	EU and National stakeholders
13:00	13:15	**Closing remarks**	**Luciano Martini** (RSE)	Coordinator
13:15	14.30	Lunch		
14:30	16:00	**Steering Committee meeting:** **ELECTRA IRP final steps**	Coordinator, SC members	**ELECTRA Partners only**

ELECTRA IRP final event

The two days ELECTRA IRP final public event, was held on February 21st – 22nd 2018 in San Donato Milanese (Italy) at the presence of the European Commission project officer.
79 people participated to the event representing 47 organizations.
Key experts from the ELECTRA team highlighted the main outcomes of the project, both technical findings, with particular reference to the Web-of-Cells concept, and results of the coordination and support action activity. Moreover, ELECTRA partners had the possibility to hear the point of view on smart grids future development from important keynote speakers. Two round tables with international panellists were also organised. These gave the opportunity to discuss about key topics for the future power systems especially related to the possible deployment of ELECTRA results.
There was also a poster session where the young researchers that participated in the Research Exchange Program described their achievements and their experience to the whole audience.

DAY 1

1.1 Welcome addresses

Stefano Besseghini - *RSE CEO*
Patrick Van Hove - *EC Research Programme Officer*

Stefano Besseghini (RSE CEO)

The event was opened by Mr. Stefano Besseghini (RSE CEO) and Mr. Patrick Van Hove (European Commission project officer). Mr. Besseghini highlighted the importance of the research and development of new concepts, like the ELECTRA *Web-of-Cells* (WoC) while Mr. Van Hove

Patrick Van Hove (EC)

remarked the importance of collaborations between research centres and laboratories to create a solid European research infrastructure network.

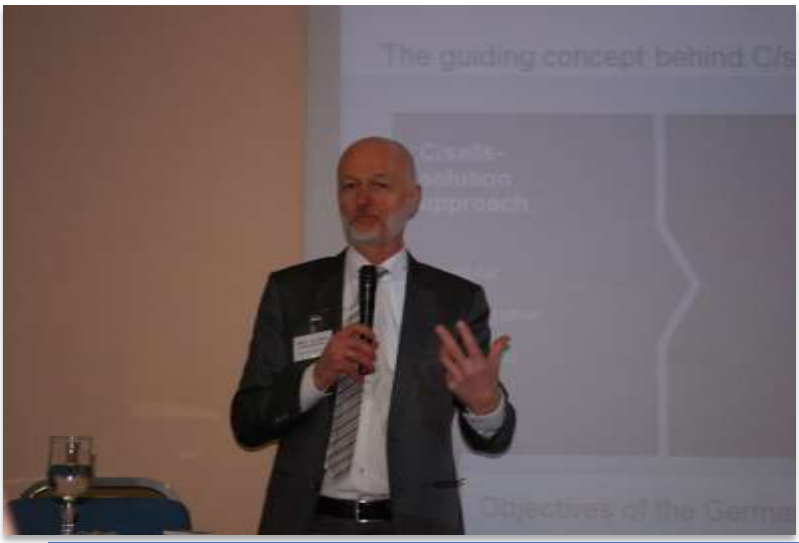
Norela Constantinescu (ENTSO-E)

1.2 **Keynote speech I** *"Looking to the future power system: ENTSO-e input"*

Norela Constantinescu - *ENTSO-E - Team Lead Research & Innovation*

The first keynote speaker, Ms. Norela Constantinescu gave a view about the TYNDP (Ten Year Network Development Plan) of ENTSO-E with special reference to the system evolution toward real time markets, real time operation and a more integrated approach especially with respect to the gas and heating/cooling sectors. Within this scenario system technologies will play an always more crucial role supported by the digitalization of the system. This last is a key aspect for the future and can be the key for enabling the deployment of innovative solutions.

1.3 **Keynote speech II** *"C/sells-Showcases for massive renewable integration" Albrecht Reuter - C/sells Project Manager*



Albrecht Reuter (C/Sells project)

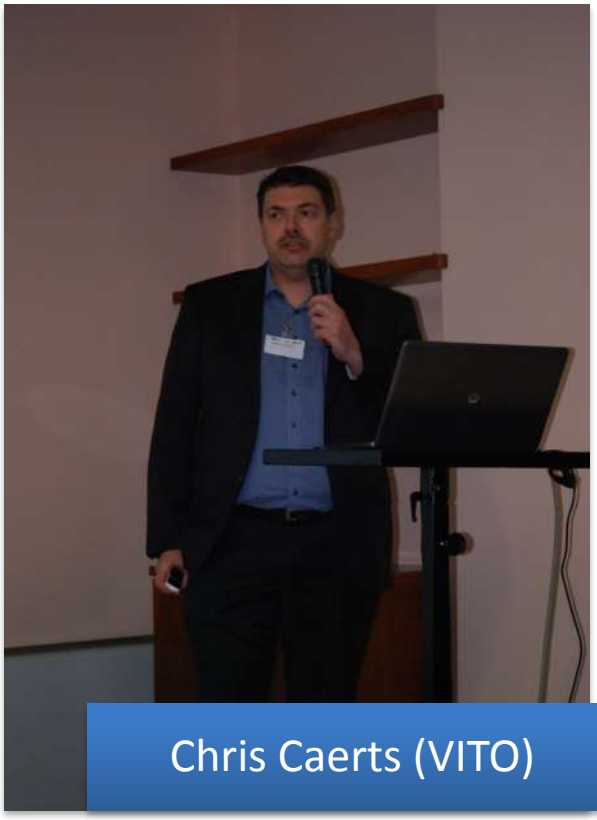
The second keynote speech was given by Mr. Albrecht Reuter, coordinator of the German national project C/Sells, a demonstrator project that aims to develop a cellular approach for the power systems. High similarities are evident between the ELECTRA WoC approach and the C/Sells proposed power system control framework. A cellular approach seems to be a good solution to incorporate high amounts of renewable energy sources. Mr. Albrecht Reuter also highlighted that the engineering challenge in modernising the grid and applying new concepts is high. In fact, the network managed in a traditional

centralised way is an engineering success, so evolving the network while maintaining the same level of service is not easy. Also in this view system technologies such as the information and automation technologies are always more important. The deployment of these technologies is really important to achieve the field deployment of new solutions that are able to manage the increasing amount of uncertainties that the power system will have to face in the future.

1.4 Presentation of ELECTRA results:

1.4.1 The Web-of-Cells (WoC) concept

Chris Caerts (VITO, Belgium), ELECTRA WP4 Leader



Chris Caerts illustrated the Web-of-Cells (WoC) concept, a novel control scheme for real-time frequency/balance and voltage control for the future (2035+) power system. It is expected that it will be very different from the one we have today. Large central dispatchable generation will be replaced by distributed intermittent RES generation, and to deal with this, loads controllability would be very important to manage the power system. There will be far more uncertainty and fluctuations caused by generation and consumption forecast errors, and by the increase of the number of smaller and decentralized generators; moreover, the electricity consumption especially at distribution grid level will increase, due to the electrification of heating and transport, causing grids to be used more closely to their limits. The future grid will have to face, more than today, with congestions, voltage problems, reverse power flows, inefficiencies and losses.

To deal with these problems, a shift from passive '*fit and forget*' distribution grid management to active grid management is mandatory. The electrification of the heating and transport sectors can be part of the solution, as they represent controllable loads that potentially can act fast and can be used for avoiding or solving local problems.

Distribution grid connected resources can also provide system level frequency and balancing services. To ensure that activations of these reserves do not cause problems, grid checks are needed, not just at the location where the resource is connected, but potentially also upstream.

The Web-of-Cells concept proposes to divide the power system in small areas called cells, that are not only responsible for the operational planning and control for solving their own local problems, but also to contribute to solve system level issues (frequency/balance) in a distributed bottom-up manner. Considering this approach, security, effectiveness, optimality and computational tractability will be also addressed.

A cell is defined as a portion of the power system that is able to maintain an agreed power exchange at its boundaries. It is somehow similar to a micro grid, except that there is no need for a cell to be self-sufficient (i.e. a cell can rely on import or export exchanges with other cells), and the fact that it is connected to the main grid while being responsible for its own balance and voltage control.

In order to restore frequency and voltage to the nominal values, different controllers were developed within the ELECTRA project:

- Balance Restoration Control (BRC). It allows cells to collaboratively restore the system balance, which is the aggregated result of all cell balances, where cell balance is defined as 'adhering to a planned and cleared import/export schedule'. This BRC controller is operating at the same timescale as today's primary frequency control and it is responsible for both restoring the balance and the frequency.
- Next to the BRC, there is still a Frequency Containment Control (FCC) that acts globally and collaboratively. In the Web-of-Cells concept, an adaptive variant is proposed, that focuses activations in cells that are causing imbalances, and reduced activations in cells that are in balance. This is viewed as a BRC supporting control.
- Balance Steering Control (BSC) was developed to implement a kind of peer-to-peer/bilateral explicit imbalance netting scheme. Cells can negotiate with their neighbours and agree to change the tie-line power exchange set-point so that all of them can reduce the amount of reserves activations in their own cell.
- Inertia Response Power Control (IRPC): it activates synthetic inertia in each cell, in response to a system level defined set-point, such that not only there is a high enough and relatively constant inertia in the power system as a whole, but also in each of the cells individually.
- For voltage control, a Post Primary Voltage Control (PPVC) was developed, which combines todays secondary and tertiary voltage controls. It involves the periodic proactive recalculation of voltage set-points.

Thomas Strasser (AIT)

1.4.2 WoC Experimental validations

Thomas Strasser (AIT, Austria,) ELECTRA WP7 leader

Thomas Strasser provided a summary of the validation work done in ELECTRA. Selected validation scenarios have been implemented in simulation and in laboratory-bases tests. A structured approach was developed to identify suitable laboratories from partners for implementing these experiments. Moreover, a lot of activities were supported by the ELECTRA REX Programme. As a result, the feasibility of the WoC control approach has been proven. Strasser highlighted also that further work is necessary to define more concrete rules for defining cells and extended lab experiments must be implemented focused ICT issues in order to reach higher TRL levels.

1.4.3 WoC architectures and cyber security analysis

Giovanna Dondossola (RSE, Italy)

Giovanna Dondossola started her presentation providing some examples of cyber-attacks in the energy sector and she summarized the current regulatory and standards initiatives in this field (NIS Directive EU 2016/1148, EECSP Report and NISTIR 7628). Dondossola then introduced the security assessments performed for the WoC


Giovanna Dondossola (RSE)

architecture. She highlighted that the scenarios within this approach could be very various since the cell architecture and communication infrastructure can be very different depending on the cell size (district, city, region). Three different cell topologies have been defined in the accomplished cyber security analysis. For those cells, several attack scenarios have been analysed where different equipment (control room devices, cell controllers, hosts, routers, control data flows, etc.) were compromised. As Giovanna Dondossola explained, *securiCAD* was the tool selected to model the WoC architecture and the attack steps, the "Time to Compromise" (TTC), i.e. the expected time an attacker would take to compromise every single asset of the ICT infrastructure was computed as an indicator for the cyber security assessment. The effectiveness of a few countermeasures was also shown in terms of a reduction of the "attack success rate" along the TTC axis. Dondossola also answered to some questions about the technical and operational countermeasures that could be adopted in order to prevent the cyber-attacks and to meet the cyber security requirements of the WoC communication interfaces.

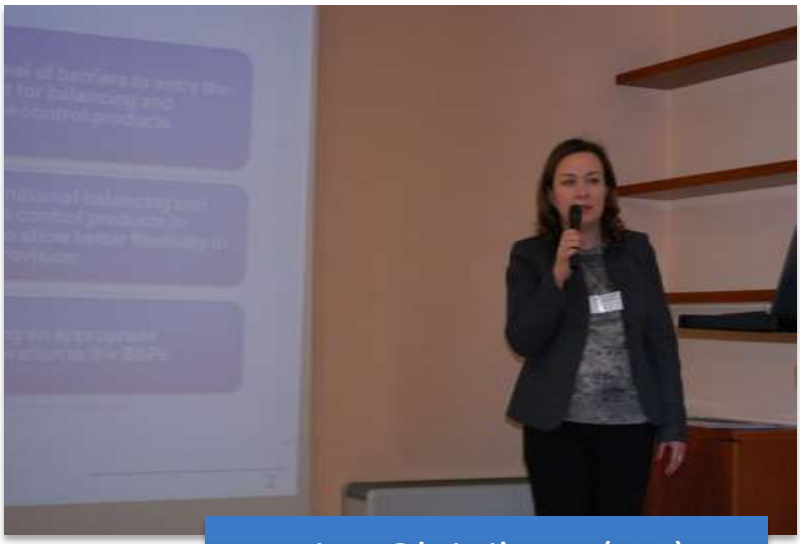
1.4.4 Control room functionalities
Mattia Marinelli (DTU, Denmark)

Mattia Marinelli explained activities performed within ELECTRA about the control room of the future power system. More in detail he explained the decision support system that will be required for the real-time operation of the WoC. The core of this activity has been to ensure that the control room operator is provided with the optimal information of the system state and of the possible control actions to enable the operator to take preventive or corrective actions in order to maintain or return the system in safe state of operation. Key questions were the work focused were:

- Given the high level of automation in future power system, how can the human operator interact with the grid in a meaningful way?
- What is the human operator's role in the decision-making process?
- How can the impact of automation on human cognitive abilities be suppressed or even used to its advantage?

For Mattia Marinelli, the operator's task in the WoC framework is to supervise a highly automated power system where there must be the possibility and the capacity to intervene if necessary. The operator support automatic functions foreseen for the future control rooms could be divided into System Monitoring, Supervisory Control and Interventions (offer input for operators to adjust system state) and Decision Support (help operators identifying the right intervention). Mattia Marinelli ended his presentation showing a short video on how cell information could be displayed and how the WoC operator could zoom for further details depending of the level of interest (inter-cell, intra-cell, device).
In the end a question from the audience gave the chance to state that also in the future human intervention will always be required for supervising the operation of the grids, even if this role will be reduced.

1.4.5 **Market design**



Irina Oleinikova (IPE)

Irina Oleinikova (IPE)

Irina Oleinikova illustrated the results achieved by the analysis of market implications related to the WoC deployment. Within the project a high-level market design in order to support the new proposed control framework was developed. Particular emphasis was given to the analysis of market mechanisms that must be implemented to perform the needed trading for the balancing and voltage control services. In particular the so called "exchange", that is when balancing and voltage control products are traded between the Balance Service Providers (BSP) and the Cell System Operators (CSO) was considered. The results showed that with an increasing volume of intermittent RES integrated into the power markets, new types of the BSPs are requested. With the purpose to increase the size of the BSPs, aggregators play an important role too. An organized marketplace contributing to the improvement of operational efficiency, assuring transparency and level-playing field to all the BSPs and the CSOs is established. It was also highlighted that auction would be an instrument able to promote competition. Where then presented new categories, classes, types and sub-types of balancing and voltage control products and suggested sub-markets for trading these services. Finally, it was highlighted that the link between the quality of balancing products and their price could be established through the implementation of the principle of cascading procurement and by considering the distance to real time of auction.

1.4.6 **Regulatory Issues related to WoC**

Marialaura Di Somma (ENEA, Italy)

Marialaura Di Somma (ENEA)

Marialaura Di Somma illustrated the results of the activities aimed at analysing how the WoC architecture and the new role of the Cell Operator would impact on and which changes shall be introduced in the current regulatory frameworks. The regulatory analysis included the following steps: at first a general overview of the current EU Regulatory framework was performed, (also considering the priorities proposed in the Winter Package, like the Energy

System Integration) aimed at identifying the regulatory aspects that are relevant to the WoC activities. In the second step, a detailed analysis of the impacts of the current regulation (including ENTSO-e network codes. This analysis provided the input for elaborating possible amendments to support/promote the ELECTRA WoC deployment. Roles and responsibilities of new market players were defined, with reference to general aspects related to the WoC. Based on these analyses, ELECTRA team elaborated proposals for a new regulatory schemes needed for a well-functioning market for frequency and voltage control services under the WoC power grid structure.

1.5 Round Table 1 "*Grid main challenges and how to bring the WoC concept to maturity*"

1.5.1 Introduction

Luciano Martini (RSE. Italy), ELECTRA IRP coordinator

Electricity system is facing significant changes driven by: the shift from dispatchable units towards intermittent renewables; the replacement of large generation units connected to transmission systems to decentralized power plants, the increasing electricity consumption for different purposes like heating and cooling. These transformations are increasing the challenges that network operators are facing in order to maintain a safe operation of the grids (e.g.: increasing congestions, reverse power flow and local voltage problems, activation of central reserves might not be sufficient any more to solve problems, etc.).

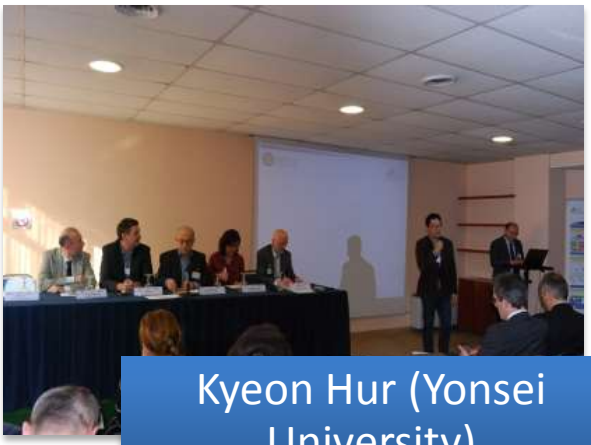
Network operators are developing, in cooperation with research centres, innovative solutions to address these challenges. Few technologies are already emerging: ubiquitous sensors and advanced ICT will vastly increase the power system's observability; fast-reacting distributed resources could offer ancillary services and reserve capacity; recent developments in ICT will support the pathway towards more decentralized power systems control.

The ELECTRA project, with the development of the WoC concept, investigated how to integrate these innovations proposing a way to address the above mentioned challenges.

1.5.2 Panel discussion

***Panellists**: Norela Constantinescu (ENTSO-e), Albrecht Reuter (C/sells project), Venizelos Efthymiou, (EURELECTRIC, ETIP SNET, SET Plan SG), Kyeon Hur (Yonsei University, Korea), Gianluigi Migliavacca (SmartNET coordinator), Chris Caerts (VITO)*

Panellists before the round table gave short presentations:



Kyeon Hur (Yonsei University)

Gianluigi Migliavacca (SmartNet)

Round table 1

Kyeon Hur, from the School of Electrical and Electronic Engineering of Yonsei University, Seoul, illustrated how South Korea is handling the above recalled changes of the electricity systems:

- Local utilities are developing new methodologies for integrated grid planning that incorporate locational signals and account for solutions for grid flexibility services offered by network users;
- Research centres are developing advanced modelling of distributed energy resources, for grid analysis able to simulate the dynamic behaviour of the system and to account for forecasting of load and intermittent generators, etc.
- Research efforts are dedicated to the challenge of dealing with the increased computational complexity derived by the innovative simulations models that can guarantee the level of accuracy needed to manage the grids.
- Research is also focusing on understanding how to bridge the gap between existing transmission and distribution planning and study practice while improve the current practices for asset utilization.

Gianluigi Migliavacca (RSE and coordinator of the H2020 project SmartNet) highlighted the fact that some ideas investigated in the SmartNet project have points of contact with the Web-of-Cells concept. One coordination scheme between the TSO and the DSO implemented in simulation within SmartNet presents similarities with the WoC concept. In this way, said Migliavacca, some results of SmartNet will also be useful as a complement to what developed by ELECTRA. Migliavacca also presented ISGAN Annex VI, giving a hint of the work that is presently under way and foreseen to be completed within the current year.

Venizelos Efthymiou, member of, EURELECTRIC, ETIP SNET, and of SET Plan steering group, highlighted that ELECTRA project provided a significant contribution for designing the architecture of the future electricity grids, thanks to the development of WoC, that allows to:

- Integrate flexible and adaptive set of active grid components capable of efficiently delivering the quality of supply specified by grid rules and codes,
- Develop an integrated grid for global optimisation that can also respond to local specificities for flexibility, while remaining technology neutral.
- Offer the required grid services of the connected users with implied cost optimisation embedded in the system architecture.

The Web of Cells is also compliant with the Smart Grid Architecture Model adopted by European standards thus it can offer simplicity and flexibility in managing the emerging grid components and uses. Moreover, he explained that the ETIP SNET platform is elaborating the roadmap for future evolution of European electricity systems, some of the most relevant priority identified in the document are represented by the necessity to ensure coordination among market players and stakeholders and to support the digital transition of the electricity system. The WoC represent a key solution that can enable the achievement of these priorities.

The panellists were then engaged in answering to questions from the audience, more in detail the following points were addressed:

- *Which are the requirements that shall be fulfilled to develop mathematical models adequate to simulate the network observability?*

Kyeon Hur said that we need to develop mathematical models able to simulate the interactions among cells and able to account for the effects of uncertainties of load and renewable sources. Moreover, the new simulation models shall also simulate the participation of grid users to the provision of flexibility services (with market mechanisms).

Venizelos Efthymiou highlights that in the ETIP SNET roadmap, the need to increase system observability is also considered.

- *Will the introduction of cell operator remove the need of human intervention?*

I was said that human intervention will always be required for supervising the operation of the grids, even if this role will be reduced

- *Are computational capability and data management a barrier for the development of the C/Sells approach?*

Albrecht Reuter states that the data requirements are limited with respect to other sectors.

- *Which are the research and innovation priorities related to the integration of energy networks?*

Venizelos Efthymiou said that the priorities are related to the development of solutions for handling big data and for enhancing grid flexibility. The energy system is moving from a “generation following load” approach towards a “load following generation” approach. The future energy system shall enable system operators to see all devices connected to the grid and shall enable each end user to actively participate to the markets.

- *How do you deal with uncertainties in the WoC approach?*

Chris Caerts said that two alternative approaches could be followed: get rid of all uncertainties by relying on stakeholders to auto-correct them, or elaborate an algorithm that deals with uncertainties. The WoC approach is an example of the first approach, where a cell is made responsible for correcting its own deviations.

- *The future energy system shall enable each user to actively participate to the functioning of the system but, at the same time, the system must remain connected and the overall safety must be guaranteed. How to cope with these two different requirements?*

Gianluigi Migliavacca said that standardization is a key element. Moreover, the interactions with the system shall be decoupled from the daily life, the development of new market players like aggregators, that can be an interface between users and system operators could be also a key solution.

Graeme Burt (University of Strathclyde)

Chris Caerts added that the automated equipment that are connected to the grid must be certified and interoperable.

- *Different congestions can occur in European energy networks and they can be treated by using different technologies. Did you estimate the congestion costs? Which are the main causes of congestions? Thermal limits, renewable integration?*

Norela Constantinescu said that MIGRATE project is analysing and classifying the main congestion causes. ENTSO-E research and demonstration committee had mapped the different technologies in order to identify the optimal technology to be used. It was then highlighted that within the transmission networks, the voltage stability is the main source of congestions while within the distribution grids the most critical concern is the quality of supply.

1.5.3 Researchers Exchange (REX) Workshop

Graeme Burt (University of Strathclyde, United Kingdom), ELECTRA WP9 leader

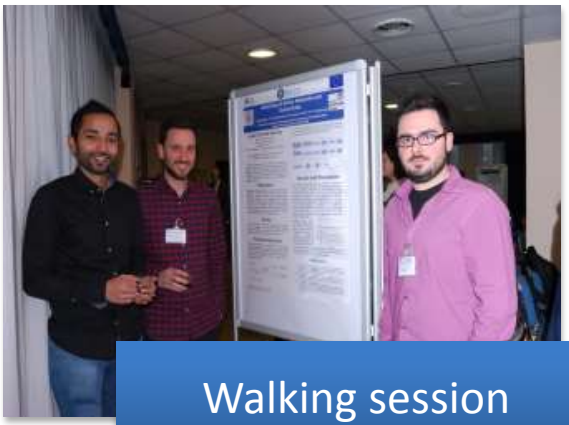
Graeme Burt, illustrated the ELECTRA Researcher Exchange (REX) programme. Through this it was offered assistance to international researcher exchanges to or from ELECTRA and EERA JP SG partners. This successful scheme enhanced the project results by giving the possibility to the ELECTRA involved researchers to work close together on the project tasks.

Thanks to the REX programme, 40 exchanges from different countries, covering four continents (Europe, Asia, North America, South America, Australia) were financed during the 7 calls. 5 international workshops were organized for disseminating the results achieved by researchers.

Moreover, the REX give the possibility to assess the development of a methodology for managing the call for applications to the mobility scheme and the development of a standardized exchange products. This experience and scheme could also be exploited within EERA.

1.5.4 REX poster presentation & Walking session

REX poster presentation



Walking session

REX poster presentation

DAY 2

1.6 Keynote speech III - *"Technologies for network digitalization: overview and perspectives" Antonello Monti RWTH-Aachen, ETIP SNET WG4*

Antonello Monti, professor from the RWTH Aachen University and expert of the ETIP SNET working group 4 (WG4), gave a key note speech on the second day of the ELECTRA final event about the importance of energy network digitalization. This is becoming a key innovation issue and could be seen as similar to the transition that is happening in several industrial sectors. Digitalization is the process of moving to a digital business, that includes digital technologies with the aim to change business models and to provide new revenue streams and value. The digital energy network paradigm is a broader concept than Smart Grid with significant social components, and focused on services.

The changes that the electricity system must undergo to enable the digitalization process can be described by means of a common reference architecture, represented by the Smart Grid Architecture Model (SGAM). In the framework of ETIP-SNET the 5 layers have been compacted to 3: business layer, architecture layer and physical layer.

At the physical layer the always growing presence of converter coupled generators, is transforming the traditional electromechanical systems, characterized by high amount of mechanical inertia, into a system based on static generators that exploits distributed and renewable energy resources. These new fast resources provide the system operators with new challenges and opportunities. In the future 100% renewable sources scenario, hydro power plants are expected to be the only source of traditional inertia, therefore current control techniques will have to be enhanced. A possible solution could be emulation of the traditional inertia behaviour exploiting the capabilities of power converters. In doing this, we can not only emulate the behaviour of the traditional power plants, but also enhance the system response through controlling the power electronics converters in order to avoid unwanted behaviour of traditional power plants. Digital solutions could support these aims, but could also be exploited for system oriented new solutions. Intelligent Electronic Devices (IED) can be fully virtualized by defining proper interfaces with the field. Substation intelligent hardware becomes simpler dedicated to digitalization and data transfer. This architecture fits very well with the new standards for sensor interfaces and the concept of Data Aggregator in a substation.
System flexibility can be improved by dividing the current control areas into smaller areas. Moreover, portion of the network could be decoupled from the main grid by mean of power electronics converters allowing the deployment of mixed DC/AC distribution grids. This feature could also allow deeper frequency deviations than today and could also allow that some portions of the network offer services to the rest of the system.

Monti also reported about the IDE4L project has demonstrated the functioning of a complete set of services for substation automation in a single low-cost machine. It is structured with a distributed intelligence

approach to support scalability in distribution networks. The demo developed in the project is currently running in the grid of the Italian DSO Unareti.

Thanks to the deployment of digital technologies, new approaches can be developed. They require new testing concepts given that a full test in the grid cannot be performed. These include:

- Real-Time simulation as intermediate verification before real deployment
- Development of open sources real-time simulators to support the creation
- Applying dynamic phasors as a tool to support the new real-time solver able to run in standard computer
- Providing tools to link laboratories in real time creating a unique computing infrastructure

These approaches were already experimented some virtual laboratories like VILLAS (Virtually Integrated Laboratory for Large System Simulation) and can pave the way for the development of a future "SUPERLAB scenario" in which several laboratories in different countries can be interconnected and perform parallel simulations

1.7 CSA activities results:

1.7.1 International Cooperation achievements

Luciano Martini (RSE, Italy), ELECTRA coordinator

Luciano Martini, ELECTRA project coordinator, illustrated the achievements obtained in the International Cooperation activities. ELECTRA IRP project dedicated several efforts to the International Cooperation (INCO) activities, with the aims to:

- Identify extra-EU organizations to be potentially engaged in smart grids INCO activities;
- Establish a collaboration with leading organizations in the smart grids field;
- Define the R&D topics of mutual interest for smart grids INCO activities and coordinate them with the EERA JP SG;
- Contribute, through the INCO activities, to promote the leadership of Europe in the smart grids field

In order to achieve these targets, a step by step approach was adopted by the project. In the first stages, information about ongoing smart grids programs and project, national visions, strategies and priorities were gathered and shared among partners. Based on this information the research and demonstration topics that are of common interests of ELECTRA partners were identified and the areas of potential cooperation were selected.

These activities allowed achieving the following results:

- Identification of R&D topics of interest for International Cooperation;
- Definition of a set of KPIs to monitor WP10 activities;
- New connections with extra European smart grids institutions;
- Sharing of experience in smart grids;
- Smart grids networking by dedicated workshop and meetings

ELECTRA was fully involved in Mission Innovation (MI), a global initiative of 22 countries and the European Commission that aim to accelerate global clean energy innovation with the objectives to make clean energy widely affordable and to meet the long-term climate goals while providing affordable, reliable, and secure energy supplies. The initiative was subscribed by 20 Countries representing 80% of Global Clean Energy R&D investments. Each Country agreed on doubling the R&D investment over the next five years. The initiative is also complemented by a private sector initiative. ELECTRA partners actively contributed to

Innovation Challenge 1 (IC#1) (Regional Grid, Distribution Grid, Microgrids and Cross Innovation). In particular, they contributed to the development of a questionnaire for the identification of R&D priorities in the context of Smart Grids. Six R&D tasks were identified and the cooperation on these will be launched by early 2018. Four task programs of work based on the identified topics were already elaborated and are currently under revision by other Mission Innovation partners with the aim to identify common research and innovation priorities. Webinars and physical meetings will be organized throughout 2018 in order to agree on the next steps of IC#1.

1.7.2 Implementation of a researchers mobility scheme

Graeme Burt (University of Strathclyde, United Kingdom), ELECTRA WP9 leader

Graeme Burt, prof. of the University of Strathclyde, illustrated the results and achievements obtained by the ELECTRA Researcher Exchange (REX) programme. The purpose of the program was to reinforce collaboration among research partners and facilities and enhance project results through the close collaboration.
It was developed a REX scheme that will also be transferred to EERA: a methodology for managing REX Calls for applications. Moreover, exchanges brought a significant experience from technical but also personal perspective and early stage experiments were also enabled and supported by this program.

Q&A

- *Which are the main barriers that were encountered during this program? Lack of support from the hosting organization? Who bears the cost? How can we promote the program? Which is the order of magnitude of the costs of an exchange?*

The main difficulties that were faced by researchers were related to administrative costs and procedures and to the need of finding a suitable replacement that could substitute the researcher in his company during the exchange. Moreover, some researchers shown a high degree of naivety regarding the procedure and did not know how to properly submit the application. In order to promote the program, the satisfaction rates of the participants and the achieved results shall be better disseminated. Regarding the costs, the actual costs borne by the participants were higher than the costs that we have initially estimated.

- *Will the program continue?*

In the framework of the EERA community, partners would like to set up another mobility scheme; however, it must still be defined.

1.7.3 Development of joint research facilities

Mihai Calin (DERLab)

Mihai Calin, from DERlab illustrated the results of the development of joint research facilities. In the ELECTRA project, a comprehensive database of knowledge-based research infrastructure, testing facilities and important demonstration facilities that can be used by ELECTRA partner and external users to compare and identify essential capabilities. The database includes also non-proprietary research results, best practices and methods and joint efforts to improve and expand the capabilities to meet the overall objectives of the ELECTRA IRP.

The database was published online and contains profiles of the institutes and their infrastructure, standards compliance and testing services. The database served as input for the collaboration with international initiatives like ISGAN, EERA JP, etc. In particular, in the framework of the ISGAN's "Smart Grid International Research Facilities Network", the database was used as input for a discussion (moderated by DERLab) concerning current and future cross-lab research projects involving advanced DER interoperability testing, smart grid modelling, and power system component testing. The European smart grid research infrastructure database was also used to support deeper engagement across the EERA JP Coordination Areas, including the exchange of models, tools, and experimental practice. This tool represents an essential instrument that gives visibility to European Research Infrastructures at international level thanks to the active involvement of ELECTRA in ISGAN SIRFN activities.

Q&A

- *Which are the differences between European laboratories and extra European ones?*

European laboratories are leading the international cooperation and, in some fields, they have become the leaders. Several European laboratories are providing knowledge and skills to build new laboratories in extra European countries (Korea, Singapore, etc.) where innovative technologies can be deployed. In order to maintain this leadership, European laboratories shall always be equipped with modern devices and investments in human resources shall be promoted in order also to cover the existing gaps.

1.8 Round Table 2 "*Grid main challenges and how to bring the WoC concept to maturity*"

Moderator: *Andrei Morch (SINTEF)*
Participants: *Antonello Monti (Aachen University), Davide della Giustina (Unareti, DSO), Venizelos Efthymiou, (EURELECTRIC, ETIP SNET, SET Plan SG), Thomas Strasser (AIT) Graeme Burt (DERLab)*

The discussion covered the following main questions:

- Can we elaborate a common and agreed definition of "frequency"? How and when shall we measure it?
- When the penetration of distributed renewable energy become a critical aspect?
- In the telecommunication sector, the disruptive change happened when the obligation to maintain the global balance of the whole system was removes. How close is the electricity sector to this point?
- Is DC coming back?
- How can we move toward the large-scale deployment of new concepts?

Venizelos Efthymiou, listed the expected changes of future electricity systems. Distributed control architecture will seamlessly link all active elements of an integrated grid. Micro grids will be equipped with systems capable of realizing the functionalities developed in the ELECTRA project and the combination of different technologies will support the achievement of stability requirements set by regulators. Moreover, the targets set by the European Commission in the Winter Package require to further empower the role of prosumers in the management of power grids: local energy communities shall be developed; consumers shall be allowed to store, consume and self-generate energy: DC technologies shall be deployed in the near future; local energies shall be used for the benefit of local communities. WoC represents a solution that can support this transition.

According to Graeme Burt, prof. of the University of Strathclyde, the key transversal aspects that shall be tackled by future research programs are:

- Communication among researchers and with industrial partners: ensure an adequate level of communication in order to limit the risks taken by industrial partners when deploying the most promising solutions tested in the demos
- Scalability and replicability analyses are fundamental to pave the way toward large scale deployment
- An estimation of the impacts on system integration of the solutions tested in the demos shall be done. During the test phase not only the TRL (technology Relevance Level) shall be assessed but also the "System Readiness Level" in order to evaluate the impact of the proposed solution on current system.

Thomas Strasser, from AIT, illustrated the research and innovation priorities identified by the European research infrastructure project ERIGrid. The project aims at developing integrated power system testing approaches that are capable of coping with the increase complexity of power systems caused by the need to deal with uncertainties of load and generation, the need to deal with social issues, to integrate other energy carriers, and to support the digitalisation of power grids. According to the main findings of the project, future research should be focused on:

- Improvement and integration of design and validation tools;
- Development of system level validation procedures and benchmark criteria;
- Improvement of research infrastructures supporting system level validation;
- Developing protocols for education, training of network operators and standardization of innovative components.

Davide della Giustina, from Unareti, an Italian DSO, illustrated the view of Unareti about the medium and the long-term research and innovation actions. The strategy comprises 3 types of main paths:

- Research: participation to research projects to identify new technologies not currently available on the market. Return on Investments on the long-term.
- Pilot: investment on small-scale demonstrators to test new technologies in field, before moving to the deployment. return on investments on the medium-term.
- Deployment: large investments on technologies with a high TRL. Expected return on investments on the short-term.

The technologies tested in the demos include: the development of an Integrated Distribution Management System (IDMS) that fully supports the distribution management process; the possibility to ensure a strong IT/OT integration that can support the functionalities of enhanced planning and operation; advanced protection devices that enable the logic selectivity of MV faults; the automatic reconfiguration of the network (self-healing - partial) thus reducing the duration of interruptions; advanced remote control devices that contribute to reducing operational costs and interruptions durations and finally fiber optics connection to

MV/LV substations that enables service automation and improve the reliability of communication for monitoring, control and smart meter data collection services

Q&A

- *What the next steps, what technologies should be investigated in your opinion?*

Davide della Giustina, (Unareti): currently we are collecting ideas that are to be tested in the laboratories, like for example the possibility to manage autonomously the LV grid. Once these ideas are tested in the laboratories these concepts will be tested in the field.

- *What is considered to be the strongest service or the most valuable functionality of a Web of Cells concept supporting its future implementation?*

Venizelos Eftymiou, said that the capacity to adapt to the technology evolution and to support the transition from a centralized to a distributed system is a WoC important feature.

- *From your point of view what do you consider to be the main obstacles, barriers or limitations for the evolution of WoC?*

Graeme Burt and Venizelos Eftymiou state that in several European countries, DSOs are not so proactive with respect to investments in research and innovation. Moreover, regulation is not supporting innovation in energy networks adequately.

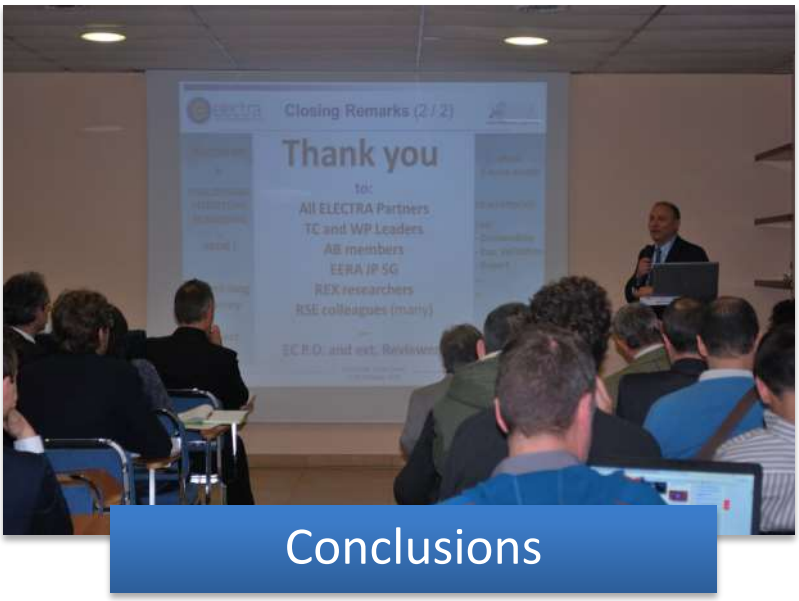
- *Multi-vector energy systems have been mentioned several times during the first round table. Can you see this as a part of the vision for the future power system?*

Antonello Monti replied that this trend is already considered in several scenarios. For example, the energy scenarios developed by German government already takes into account the need for flexibility of future energy systems. Gas can become the main source of flexibility in the future.

1.9 Closing remarks

Luciano Martini (RSE, Italy), ELECTRA coordinator

Luciano Martini thanked the audience for the active participation to the event and the ELECTRA partners for the fruitful cooperation provided in the framework of the project and stressed the importance of digitalization to fully realize the transformation of the European electricity grids.



Disclaimer

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