

## NEWSLETTER 2\_2017

EMPOWER is an H2020 project on the topic “Modernising the European electricity grid: LCE 7 – 2014: Distribution grid and retail market” of the call “Competitive Low-Carbon Energy” of the HORIZON 2020 work programme 2014-2015.



The project started in January 2015, with focus on the local energy markets development. Innovative business models are being promoted to exploit the flexibility of generation, load and storage units at distribution level.

An ICT platform is being designed to manage this flexibility based on the business models. The ICT platform enables exchanging the signals between the SESP (Smart Energy Service Provider), brain of the system, and the field elements in order to ensure minimum cost of operation. The energetic scenario being envisaged is encouraging micro-generation and the active participation of prosumers in the electrical power flows.

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## *EMPOWER: leveraging citizen energy engagement*



### ***EMPOWER explained briefly***

The EMPOWER project focuses on local electricity markets development, through the creation of an energy trading platform. This target will be achieved through the next 5 steps:

Develop a new market design for local trading and involvement of the consumer/prosumer end of the distribution net by means of cloud based ICT. This market design will be based on the micro-market concept and operate in conjunctions with other micro-markets also to form a neighbourhood market. The market design will adhere, but will not be dependent on the structure of a micro-grid. In fact we assume a design that can contribute to the lay-out of efficient micro-grids in the future. The market design will converge towards the design and development of a set of software agents customized for trading within a local market. The agents should be accommodated within the SESP control cloud.

Develop prosumer oriented business models relevant for the market design developed. In particular we will seek to define the business concept for a role that we have called SESP and which cater for the local energy market. The SESP will enable the business transactions, the flow of communication, flow of energy and internal credit assignment. It monitors it and establishes trading channels with the central market or other local markets. The entity that controls the SESP role (i.e. the prosumer community, the local utility, a third party service provider) will significantly influence the choice of business model.

Develop an ICT based monitoring and management system that can be accommodated in the SESP control cloud. The control system will use prediction and big data analytics for market optimization to maintain grid balance within the SESP area by communicating demand response strategies to the local controllers.

Develop full bidirectional and secure communication between the market and business part of the SESP control structure and the physical infrastructure below that controls the flow of energy according to the business exchanges defined at a given time and the actual energy generation.

Integrate the different parts and demonstrate the viability of the concept created in at least two physical regions in Europe with different geography, demography, sociography and maturity in terms of prosumer activities, implementation of DER and new loads that call for efficient and intelligent demand-response programs.

EMPOWER believes in the strength of the synergy industry-university for building a sustainable future. This is reflected in the diverse the entities integrating the consortium.



The consortium is constituted by Schneider Electric, a reference in the control of electrical energy and industrial automation, Smart Innovation Norway AS, which manages the NCE (Norwegian Centre of Expertise) cluster of companies and institutions from the academia with special focus on the energetic markets, eSmart, which develops IT solutions, the norwegian distribution company Fredrikstad Energi Nett – FEN, the University de St. Gallen – UNISG, with large experience in developing business models, the Centro de Investigación Tecnológica en Accionamientos



Eléctricos de la Universidad Politécnica de Cataluña, CITCEA-UPC, characterized by its experience in Mechatronics and Enertronics, with special incidence in the fields of power electronics and digital control, Malta Intelligent Energy Management Agency – MIEMA, energetic agency which targets its research in the promotion of energy efficiency and the grid integration of renewable sources

Click [here](#) for watching the EMPOWER Whiteboard animation explaining the project.



Click [here](#) for watching the video explaining EMPOWER concept.

and NewEn Projects GmbH – subsidiary of Diersch & Schröder (DS), an energetic company with divisions on petroleum sector, renewable energy and IT services.

Click [here](#) for watching more videos related to EMPOWER project.

## *Moving forward with the project*

EMPOWER project started on January 2015. It is divided in 9 work packages being developed simultaneously to allow the conceptualisation and construction of the ICT trading platform that will enable the operation of grids with flexibility, introduced by renewable power generation and prosumers participation. The market and trade concept being developed are organized around a community of consumers, prosumers and regular small-scale suppliers operating micro-generators. Also, storage and the advantage of cross-market operations are included. The local market is managed by a Smart Energy Service Provider (SESP), through the ICT trading platform.

### **Business Models**

Since the project started, the business models for taking advantage of flexibility in electrical markets have been identified and developed, taking into consideration two dimensions: costs of multiplicity and intervention costs. These business models propose ‘coupled services’, combining resource-centered and service-centered perspectives and will shape the strategies to operate the system.

### **SESP ICT platform**

For ensuring the desired operation of local energy markets, the SESP ICT platform is being developed, together with a SCADA. The original conceptual design of the EMPOWER platform includes three communicating entities, the metering cloud, the control cloud, and the market cloud. The proposed IT architecture for the SESP platform is based on Microsoft Azure cloud computing big data PaaS solutions. It supports all the before mentioned entities in a unified technical solution that minimises communication and data duplication overheads and at the same time improves flexibility and maintainability of the final system. Many different types of data are being stored, from dynamic metering data to static configuration data and customer data. Two types of communication channels will be used between SCADA and SESP. On the one hand, Azure Event Hub will be used for all messages from SCADA to SESP and, on the other hand, a SCADA web service will be utilized by SESP for sending control signals.

### **Pilot sites**

The before cited business models will be applied, through the ICT platform, in the pilot sites where EMPOWER will be tested, located in Norderhaugveien and Sandbakken (Norway), in Wolpertshausen (Germany) and in Gozo (Malta). The pilots’ specificities are being taken into consideration before applying the business models, ensuring an appropriate adaptation. To do so, the pilot characteristics in terms of elements installed, technologies used, functionalities and regulatory market constraints have been identified and the use cases to be tested have been selected.



## Empowering EMPOWER

Dissemination actions have allowed to spread the objectives and evolution of EMPOWER project. They include the organization of Symposiums, the 2<sup>nd</sup> TAG meeting, the attendance to conferences and workshops, the participation in webinars and the publication of articles, among others.

### Symposium on “Local energy markets: dream or facta” in the X INTERNATIONAL CONFERENCE ON ENERGY INNOVATION


The Symposium was held in Barcelona, in the ETSEIB School (UPC) on Thursday 26th January 2017.

*Power systems are being transformed by the digital era we are living on. Distributed generation is expanding and the engagement of prosumers in energy exchanges is being promoted. All these facts are contributing to an energy transition. This transition is being encouraged by the rise of local electricity retail markets, focus of EMPOWER Project. The symposium covered all these issues through the vision of industry and academia experts.*

The impact of the event was very significant, as the attendance surpassed 100 people. The invited speaker was John Hodemaekers, Chairman Executive Board of USEF (Universal Smart Energy Framework). His presentation dealt with the reinvention of the energy system by introducing a flexibility market connected to the traditional energy markets and addressed the need for an extended market model revolving around localised flexible energy use.


8:00	Registration
9:00	Welcome, <i>Josep M. Fort</i> , ( <i>Deputy Director of ETSEIB, UPC</i> )
9:15	EMPOWER project and pilots, <i>Dieter Hirdes</i> ( <i>SmartIQ, Norway</i> )
9:45	Universal Smart Energy Framework, <i>John Hodemaekers</i> ( <i>USEF, The Netherlands</i> )
10:30	Coffee break *
11:00	Business Models, <i>Emmanuelle Reuter</i> ( <i>Univ. St. Gallen, Switzerland</i> )
11:20	Market design, <i>Bernt Bremdal</i> ( <i>SmartIQ, Norway</i> )
12:20	ICT platform, <i>Stig Ødegaard Ottesen</i> ( <i>eSmart, Norway</i> )
12:40	Architecture, <i>Roberto Villafañila</i> ( <i>CITCEA-UPC, Spain</i> )
13:00	Enabling local market technologies: V2G, B2G and IDPR, <i>Daniel Haredero</i> ( <i>CITCEA-UPC, Spain</i> )
13:30	Panel discussion
14:00	Closure
* financed by CITCEA-UPC using funding of the EMPOWERH2020	
<a href="#">Register here</a>	
















This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 646476

“Local energy markets: dream or facta” Symposium programme



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"New contracts are needed to provide new services", John Hodemaekers (USEF).



Bernt Bremdal (Smart Innovation Norway AS) explains the EMPOWER ambition: "develop and verify a local market place and innovative business models, including operational methods to encourage micro-generation and active participation of prosumers to exploit the flexibility that this creates, for the benefit of all connected to the local grid".



Roberto Villafáfila (CITCEA-UPC) describes the architecture design developed for EMPOWER project, based on SGAM (Smart Grid Model Architecture).



Stig Ødegaard (eSmart) exposes the ICT platform for local markets operation, "a dream that is going to be a reality."



## 2<sup>nd</sup> TAG meeting

The 2<sup>nd</sup> Technical Advisory Group (TAG) meeting was held in Barcelona, in the ETSEIB School (UPC) on Thursday 26th January 2017, after the Symposium.



*EMPOWER TAG meeting was held in the so-called Schneider Room of the Electrical Engineering Department of ETSEIB (UPC).*

The TAG meeting started analysing the status of the work packages related to Business models, the ICT platform and the Pilot sites deployment. Next, a debate took place based on the feedback of TAG members.

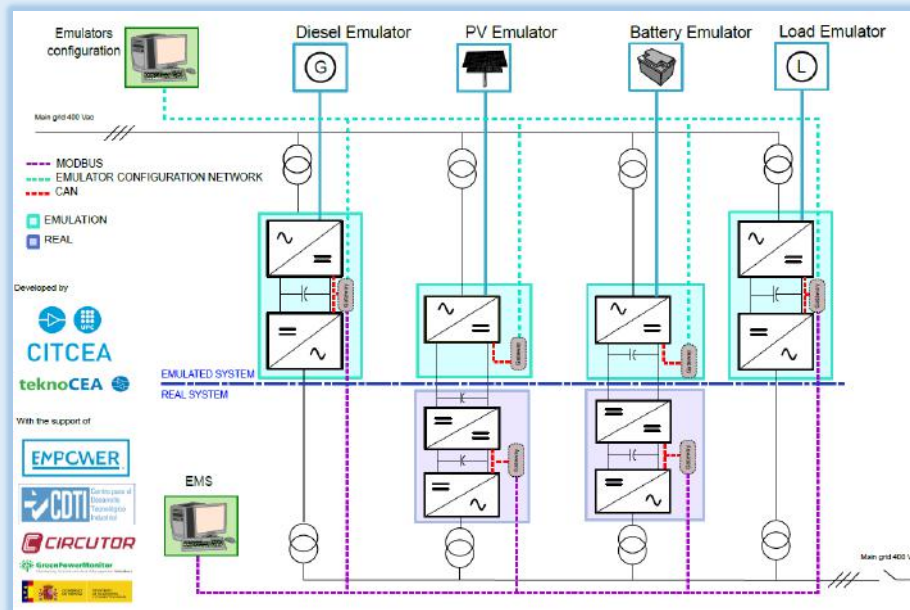


*CITCEA-UPC microgrid laboratory explanation and tests.*

Finally, the CITCEA-UPC Microgrid Laboratory was visited and tests were performed to show its capabilities and the response of a particular scenario designed for EMPOWER project.



CITCEA-UPC microgrid is an electrical installation in the UPC laboratory that consists of several converters interconnected electrically among each other and through a communication system.



Some of these converters behave as emulators, representing a particular source (generation, storage or load). The use of emulators avoids the installation of a real source (diesel generator, PV panel, battery, particular load, etc) and is a trustworthy manner of characterising their behaviour.

The emulators are connected to the main AC grid directly, or through a converter, which also exist in the real system being analysed.

A PC allows to define the configuration of each emulator and another PC acts as the Energy Management System (EMS), responsible for sending the signals for the coordinate operation of all the units. The interaction between the PCs and the converters is through a bidirectional communication system (represented through dotted lines in the scheme below).



*CITCEA-UPC microgrid ready for testing*

The microgrid can operate grid connected and grid isolated. The emulators can behave as photovoltaic panels, wind turbine generators, diesel generators, domestic loads, electric vehicles and batteries, among others. Furthermore, as the emulated devices can be aggregated, it is easy to scale the systems being analysed (for instance, converters can emulate a single PV panel or the whole PV plant). This microgrid allows to perform standalone tests (they concern a single sub-system and concentrate on standalone functionality), communication tests (they aim to test and validate the data exchanges between sub-systems) and system integration tests (they validate the whole operation of the system in a laboratory scaled platform).

For EMPOWER project, the microgrid enables the testing of the ICT platform being developed, before its implementation in the pilot sites. The SESP (Smart Energy Service Provider), brain of the system, sends the signals to the different units of the system (in the laboratory, the converters) to operate it according to a pre-defined optimization criteria.





## EMPOWER exhibition in Smart City Expo World Congress (SCEWC) and in the European Utility Week

Smart City Expo World Congress and the European Utility Week took place in Barcelona between 15th and 17th November 2016. eSmart was present in the SWEC Congress and CITCEA-UPC participated in SWEC and in the European Utility Week, so the EMPOWER project was shown there.

## EMPOWER webinar for KIC InnoEnergy Master School

What does “micro-market” mean in the energy sector? Are there new business opportunities related to them? Is there any current project working to encourage and enable the active participation of citizens to consume and produce energy in a local environment?

Pol Olivella, researcher at Smart Innovation Østfold (Norway), explained, on 26<sup>th</sup> October 2016, how the power system is evolving from centralized to distributed generation. These local electricity markets can solve problems at distribution level like saturated transformers or overloaded lines. Moreover, local transactions can bring new profits from flexibility services and increase the share of renewable energy without over costs so new business opportunities are arising. The EMPOWER project was also presented promoting the insight that significant reduction of greenhouse gas emissions and an increase of energy efficiency require radical changes in the way we produce and consume energy. Andreas Sumper, Coordinator of MSc Energy for Smart Cities, from UPC (Barcelona) was the moderator of this webinar.

### Guest Speaker:

Pol Olivella, Researcher, Smart Innovation Østfold (Norway)

### Moderator:

Andreas Sumper, Coordinator of MSc Energy for Smart Cities, UPC BarcelonaTech

### Date & Time:

Wed October 26, 2016, 11 hrs (CEST)

### Where:

You can watch it live directly from this link or watch it later via the KIC InnoEnergy YouTube Channel

## 2016 IEEE International Energy Conference Conference. Presentation of “Day-ahead micro-market design for distributed energy resources”

DOI: 10.1109/ENERGYCON.2016.7513961

This paper, authored by Pol Olivella, Guillem Viñals, Bernt Bremdal, Iliana Ilieva, and Stig Ødegaard was presented at 2016 IEEE International Energy Conference (ENERGYCON) Conference, held in Leuven on 4-8 July 2016.

**ABSTRACT:** This paper defines a day-ahead micro-market structure and illustrates its capability of increasing distributed energy resources' integration. This micro-market mimics in the distribution level the structure of the current European day ahead markets and their rules to introduce competition, and is based on the social welfare indicator. Micro-markets could overcome two major challenges of pool markets: they could consider the distribution network to ensure feasibility of the matched configurations and they could handle a high penetration of renewable energy without generation costs. A micro-market is controlled and supervised by the micro-market operator who executes the auction algorithm. This paper exposes a state-of-the-art about micro-markets, proposes a structure and a set of rules, and shows micro-market's behaviour in a case study. The results show that with under-sized distribution networks the micro-market can effectively improve the social welfare with respect to other simpler approaches.

## **2016 CIRED Workshop. Presentation of “Design characteristics of a smart grid dominated local market”**

DOI: 10.1049/cp.2016.0785

This paper, authored by Iliana Ilieva, Bernt Bremdal, Stig Ødegaard, Jayaprakash Rajasekharan and Pol Olivella, was presented at CIRED Workshop, held in Helsinki on 14-15 June 2016.

**ABSTRACT:** This paper describes the roles, services and relationships that a local market would encompass, and the type of market interactions that should take place in it. The local market place constitutes an arena for a new business role - the smart energy service provider, which represents the entity with the most central functionalities with respect to local market operation. The local market is described as consisting of three key elements of brokerage/sale: energy, flexibility and other services. Three alternative market settings are considered: islanding mode, interaction with the wholesale market and a third one where other market agents (aggregators/retailers) carry the interactions with the wholesale market. Finally, the paper specifies the relationship between the smart energy service provider and the various local market actors and provides a clarifying user case.

## **“Timing-based business models for flexibility creation in the electric power sector”. Journal article published in Energy policy (ELSEVIER)**

This paper, authored by Thorsten Helms, Moritz Loock and René Bohnsack, was published in Energy Policy on May 2016 (Volume 92, Pages 348–358)

DOI: 10.1016/j.enpol.2016.02.036

**ABSTRACT:** Energy policies in many countries push for an increase in the generation of wind and solar power. Along these developments, the balance between supply and demand becomes more challenging as the generation of wind and solar power is volatile, and flexibility of supply and demand becomes valuable. As a consequence, companies in the electric power sector develop new business models that create flexibility through activities of timing supply and demand. Based on an extensive qualitative analysis of interviews and industry research in the energy industry, the paper at hand explores the role of timing-based business models in the power sector and sheds light on the mechanisms of flexibility creation through timing. In particular we distill four ideal-type business models of flexibility creation with timing and reveal how they can be classified along two dimensions, namely costs of multiplicity and intervention costs. We put forward that these business models offer ‘coupled services’, combining resource-centered and service-centered perspectives. This complementary character has important implications for energy policy.

## Bridge meetings

The EMPOWER project participated in the Bridge meeting in January in Brussels. The EMPOWER representatives in the working groups (WG) are Emma Reuter from UNISG working in the WG on Business Models; Pål-Christan Olsen from eSmart in the WG on Data Management; Andreas Sumper from UPC in the WG on Regulations; and Trine Wildt Andersen from Smart Innovation Norway AS in the WG on Customer Engagement. Dieter Hirdes represented EMPOWER project in the plenary meeting.

## “Prosumer bidding and scheduling in electricity markets”. Journal article published in Energy (ELSEVIER)

This paper, authored by Stig Ødegaard Ottesena, Asgeir Tomasgardb and Stein-Erik Fletenb was published in Energy on January 2016 (Volume 94, Pages 828–843)

DOI: 10.1016/j.energy.2015.11.047

**ABSTRACT:** This paper proposes a short-term decision-support models for aggregators that sell electricity to prosumers and buy back surplus electricity. The key element is that the aggregator can control flexible energy units at the prosumers. Our objective is total cost minimization by trading in an electricity spot market also taking into consideration costs from grid tariffs, use of fuels and imbalance penalization. We explicitly model the flexibility properties of the underlying energy systems in the prosumers' buildings. In addition, we include the bidding rules and handle the interrelations between hours. Finally, we capture the information structure of uncertain parameters through scenario trees. This results in a two-stage stochastic mixed integer linear program where the bidding decision is made in the first stage and the scheduling in the second. We illustrate the approach in a case study with a diverse portfolio of prosumers. By simulating over a two-month period, we calculate the value of flexibility and the value of stochastic planning.

## Papers accepted

“Creating a local energy market”, Bernt Bremdal, Pol Olivella, Jayaprakash Rajasekharan, Iliana Ilieva. Conference paper accepted in CIRED 2017 (Glasgowm Scotland)

“EMPOWER - Designing a local power market”, Bernt Bremdal, Pol Olivella, Jayaprakash Rajasekharan. Conference paper accepted for IEEE PowerTech 2017 (Manchester, United Kingdom)





## *Interested in the project?*

### *Join our TAG*

#### **The Technical Advisory Group (TAG) and suitable profile of its members**

The TAG is an instrument for dissemination, general promotion and preparation for EMPOWER exploitation. It is constituted by members of the industry or academia that are experts on the topics included in the project (microgrids, smart grids, electrical markets, communication systems, operation and control of electrical systems) and which are not directly related to the project (their institution is not inside the consortium). An example of topic that could be treated during a TAG meeting is international communication formats and standardization.

#### **Responsibilities for TAG members**

The TAG includes members from the most important types of stakeholders and constitutes a network of interest that shall help to promote the project in a knowledgeable manner, solicit target for exploitation and yield advice on the demo and our R&D effort. This means that TAG members should be aware of the progress of the project. They are invited to the project meetings and to any event organized in the project frame and they should give advice at different stages of the project.

#### **What kind of arrangement (e.g.; financial) that was included when becoming a TAG member?**

Unfortunately, any part of the budget of the project can be dedicated to the TAG. This means that its members they cannot be paid and any expenses derived from project meetings or attendance to related events can be covered.

### *Join our Network of Interest*

Joining our Network of interest means keeping you informed of all the news of our project and the possibility of being part of the TAG (Technical Advisory Group) being constituted.

Sign up [here](#) to be a member of Friends of EMPOWER.

