

## Dates and events

### Next:

**Düsseldorf (Germany), March 15-17, 2016**

IRES 2016, 10th edition of the International Renewable Energy Storage Conference

**Leuven (Belgium) April 4-8, 2016**

IEEE ENERGYCON 2016 - INTERNATIONAL ENERGY CONFERENCE dedicated to experts carrying out research focused on energy and power systems

**Rome (Italy), April 23 – 25, 2016**

SMARTGREENS, the 5th International Conference on Smart Cities and Green ICT Systems devoted to advances and applications in the field of Smart Cities, Green Information and Communication Technologies, Sustainability, Energy Aware Systems and Technologies

### Past:

**Abu Dhabi (United Arab Emirates), 19 January 2016**

INGRID project has been presented at the European Commission workshop arranged within the WFES 2016 (World Future Energy Summit 2016)

**Vienna (Austria), 5 November 2015**

INGRID project has been presented within the Strategic Conference at the European Utility Week 2015



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# Newsletter

## Consortium

**Engineering Ingegneria Informatica**  
(coordinator)

[www.eng.it](http://www.eng.it)



Italy

McPhy Energy S.A.

[www.mcphy.com](http://www.mcphy.com)



France

Hydrogenics

[www.hydrogenics.com](http://www.hydrogenics.com)



Belgium

Tecnalia

[www.tecnalia.com](http://www.tecnalia.com)



Spain

RSE

[www.rse-web.it](http://www.rse-web.it)



Italy

Enel Distribuzione

[www.enel.it/it-IT/reti/enel\\_distribuzione/](http://www.enel.it/it-IT/reti/enel_distribuzione/)



Italy

ARTI

[www.arti.puglia.it](http://www.arti.puglia.it)



Italy

Studio Tecnico BFP

[www.studiobfp.com](http://www.studiobfp.com)



Italy

## Imprint

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Project Web Site: <http://www.ingridproject.eu>



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## Editorial by ARTI

Welcome to the third issue of the newsletter of INGRID, the 7FP strategic project dealing with high-capacity hydrogen-based green-energy storage solutions for grid balancing. The newsletter will introduce you to some of the technologies used, the main advances and the consortium of the project.

*Enjoy your reading.*

## RECENT DEVELOPMENTS WATER ELECTROLYSER UNIT DEVELOPMENT BY HYDROGENICS

One of the key building blocks of the INGRID demonstrator site is the water electrolysis system.

Here pure water molecules are decomposed into oxygen (O<sub>2</sub>) and hydrogen (H<sub>2</sub>) gases by applying a direct current (DC) through electrodes immersed in a water-salt solution. For INGRID project, the consortium partner Hydrogenics has engineered, built and tested their largest single electrolyser to date based on this robust alkaline technology. The unit is a self-sufficient hydrogen production plant.

Besides the water electrolysis modules, it contains a gas-liquid separation system for both hydrogen and oxygen, and a purification system yielding a 99,999% grade pure hydrogen product. Additionally all the power conditioning is being done inside the system, transforming high voltage alternating current (AC) of green origin taken from the grid to a DC voltage suited for electrolysis. A high performance water purification system treat the incoming city water so that the volume of splitted water is made up and added into the processing unit. Last but not least an integrated control and safety system takes care of the communication with the surrounding equipment.

The over-all efficiency of the electricity-to-hydrogen conversion has been verified in factory acceptance tests and ranges from 60 to 80% for this type of units, depending on the exact operating point. Water electrolysis thus becomes a corner stone in many of the new technologies that are able to store excesses green power by either using hydrogen gas as such, or by using the hydrogen for further chemical processing.

In the picture on the right, the water electrolyser is depicted.



## A FOCUS ON TECHNOLOGIES ICT VISION SUPPORTING INTERACTION BETWEEN DSO AND EMS BY ENGINEERING

In the last months, the INGRID Energy Management System (EMS) has been finalised along with the Human Machine Interface (HMI) for plant administrators and maintenance operators. Moreover, the ID (Intelligent Dispenser) for the green e-mobility has been released, to monitor the column which will be placed beside the INGRID plant, for electric vehicle recharge. These two deliverables have terminated the activities inside the Work Package dedicated to the EMS and all its software components.

The EMS is based on the multi-carrier hub paradigm for modelling the behaviour of the entire plant. An optimiser, built upon this model and based on genetic algorithm, is responsible for elaborating the optimal power flow inside the plant, every hour. Indeed, the EMS is able to merge and harmonise the contrasting requirements coming from the Distributor Service Operator (DSO), in terms of expected power consumption profile, and the ones linked to the actual business of the plant. In this way, the INGRID plant is able to chase its own profit, providing ancillary services to the grid at the same time. The results of the optimisation phase feed a Decision Support System (DSS) which allows its users to send the desired set points to the plant devices.

The DSS allows to select between DSO-oriented and profit-oriented solutions, i.e., set points which try to follow the DSO requests or to maximise the revenue

of the plant, never losing the focus on the opposite trend. In any case, a medial solution is always available, which represents a trade-off between the two needs. The HMI monitors the plant activities 24 hours, 7 days a week.

The interface can be used both for monitoring and security purposes, in order to have an overall and

complete view of the plant operation and state. In its turn, the ID monitors the recharging stations, and is ready to be used also for further scenarios, in the context of the green e-mobility. For this reason, the ID is compliant and integrates the EMM services, made available by ENEL. In the following picture, the final architecture of the EMS is depicted.



## INGRID PARTNERSHIP: AN INTRODUCTION TO MCPHY ENERGY

**McPhy Energy, masters of the hydrogen value chain in order to give a solution to the challenges of the energy transition**

Established in 2008 in La Motte Fanjas (France), McPhy Energy is a leading developer of hydrogen-based solutions for industry and energy markets.

The company draws on its exclusive technique for storing hydrogen in solid form and its years of experience in producing hydrogen through water electrolysis to design and manufacture flexible production, storage and distribution equipment.

**INGRID & McPhy Energy, a vision of the importance of a solid state storage**

The INGRID demonstrator places the hydrogen

solid state storage as the heart of the project. The goal is to transform renewable energy surplus in hydrogen that is stored in solid state disks (Magnesium hydrides).

The interest of the McPhy Energy collaboration is doubled. It is in part to give support on the long expertise of the solid state technology to establish the feasibility "at large scale" (solid state storage of around 1 ton); but also to demonstrate the economical relevance of the business model generated.

**The three pillars of the McPhy Energy Solution**  
The company contributes to the demonstration platform deployment through the implementation of

- **McStore storages**: five blocks, presenting each one a hydrogen storage capacity of 150 kg,

containing the McPhy Energy disks; the blocks are transportable and once filled will be transported to the final user;

- **McPhy H<sub>2</sub> loading station**: two filling stations are installed on the INGRID site; they allow to fill the McStore blocks with the hydrogen produced by the on-site electrolysis unit;

- **McPhy H<sub>2</sub> unloading station** installed on the final customer's site, this unit allows the application of the blocks in order to release the stored hydrogen and use it for new energetic applications.

The collaboration of McPhy Energy for the INGRID demonstrator allows to validate the positioning of hydrogen as the key energy vector, value creator.

## GOOD TO KNOW: by ARTI

One of the most important meeting in Europe on hydrogen has been recently held in Naples last December, from 15th to 18th. The 6th edition of the "European Fuel Cell Technology & Applications Piero Lunghi Conference" was a great opportunity to face the cutting edge of hydrogen and fuel cells, in order to discuss about short, medium and long-term visions on R&D, as well as on market opportunities, global policies and future energy scenarios. More than

300 scientists and technicians from all over the world had the possibility to interact amongst them and with prominent academics, researchers, students, politicians and entrepreneurs in the field of fuel cells. The event stated one important remark: hydrogen can be one of the most relevant fuel option in next years, with an increasing wide adoption between 2020 and 2030.

During the conference, the General Assembly officially proposed to Italian Environment Ministry a

strategy plan to afford 25 hydrogen re-fuelling stations by 2021, up to 100 by 2025. Moreover, a possible business model was proposed with private-public partnership schemes. The run for the hydrogen economy is already begun.

**For more information: [www.europeanfuelcell.it](http://www.europeanfuelcell.it)**

## INGRID PARTNERSHIP: AN INTRODUCTION TO RSE

**Ricerca sul Sistema Energetico, 70 years of history in research**

**Ricerca sul Sistema Energetico - RSE SpA** ([www.rse-web.it](http://www.rse-web.it)), established as a separate company from CESI in 2006, is a joint stock company, whose unique shareholder is GSE SpA. It develops research in electro-energy sector, with particular focus to the strategic national projects of general public interest, financed by the "Fondo per la Ricerca di Sistema" (System Research Fund) of the Italian Economic Development Ministry.

**RSE**, thanks to the experience of its researchers and national and international scientific relations, carries out research on the entire energy supply chain in an applications and experimental view, ensuring the

consistent continuation of research in progress and the development of new initiatives, both organically and in response to external and market demands.

**RSE's role in the INGRID Project**

In the INGRID Project, RSE contributes to explore new ways to increase the role of renewable energy resources (RES) in the energy system, based on new technologies adopting the hydrogen vector. Main contributions in the project are related to: analysis on electricity distribution networks and methodologies for integrating RES based generation; development of the Energy Management System (EMS) of the INGRID pilot (forecasting, monitoring, and security modules especially), and analysis of field data to evaluate results in both the "open" and in the "closed" loop.

## NEWS

**INGRID Project at the IRES conference to be held in Düsseldorf (Germany) on 17th March 2016**

INGRID project will be presented at the 10th International Renewable Energy Storage Conference (IRES 2016) in Düsseldorf (Germany) on 17th March 2016. The title of the paper is "INGRID Project: High-capacity Hydrogen-Based Green-Energy Storage Solutions for Grid Balancing".

**INGRID project is in the DOE Global Energy Storage Database**

INGRID project has been featured in the **DOE Global Energy Storage Database (US Department of Energy)** that provides free, up-to-date information on grid-connected energy storage projects.

**Join INGRID community on LinkedIn**

**INGRID project is now also on LinkedIn.**

Join our community on LinkedIn project page at <https://www.linkedin.com/company/ingrid-project>

