

# L'hydrogène-énergie, un modèle industriel pour la transition énergétique en France et en Allemagne : mythe ou réalité ?

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Ambassade de France à Berlin, Wilhelmstraße 69, 10117 Berlin



Office franco-allemand pour les énergies renouvelables

## DÉVELOPPEMENT SCIENTIFIQUE ET STRATÉGIE INDUSTRIELLE

### RETOUR D'EXPÉRIENCE DE LA PLATEFORME MYRTE ET PERSPECTIVES ASSOCIÉES À LA TRANSITION ÉNERGÉTIQUE

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- 560 kWp of PV (3700 m<sup>2</sup>)



- 2 PEM Electrolysers totalizing 100 kW of charge (10 & 13 Nm<sup>3</sup>/h)



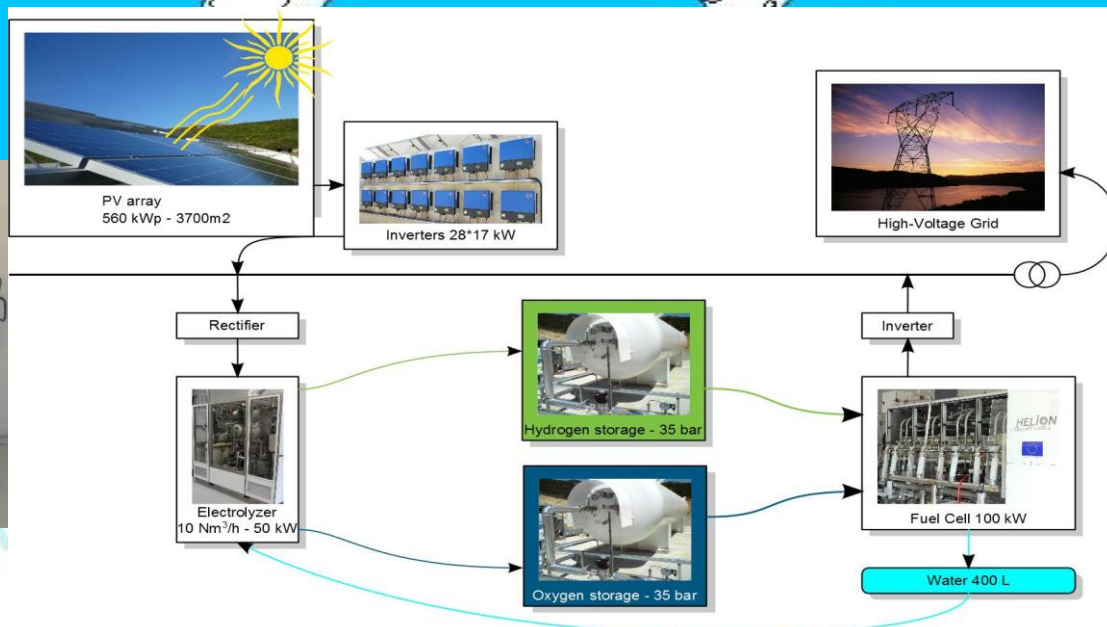
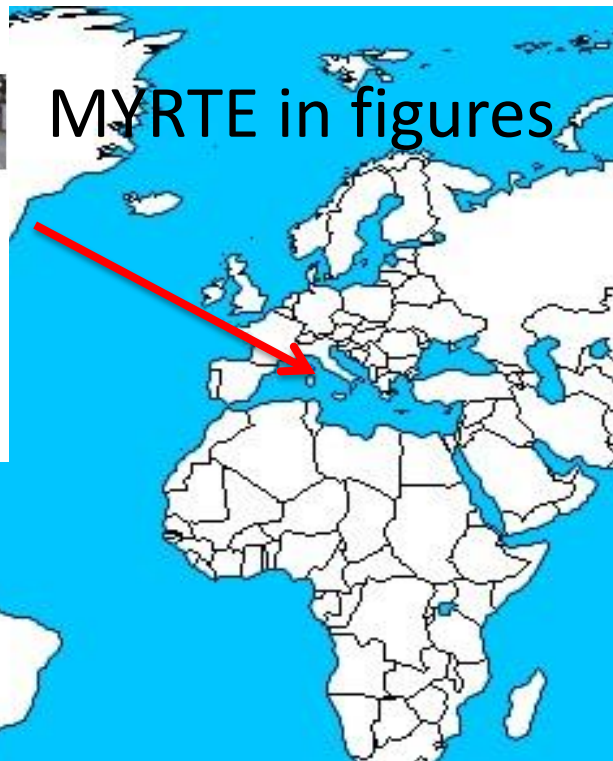
- 2 PEM Fuel Cells totalizing 150kW of discharge (100 kW & 50 kW)



- Storage capacity: 1,75 MWh meaning more than 15 hours autonomy – 1400 Nm<sup>3</sup> of H<sub>2</sub> @ 35 bars



# MYRTE in figures



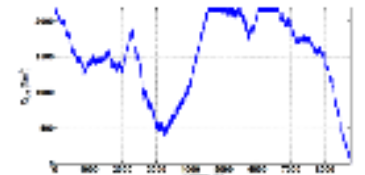
**Electrolyzer PEM  
10 Nm<sup>3</sup>/h –50 kW**



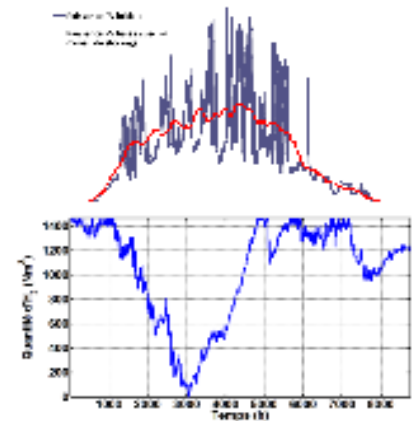
**PEM Fuel Cell 100 kW**



# Context and objectives of the MYRTE Project



**Lissage de la production PV**



## MYRTE objectives :

1. To develop a management and storage system for renewable energies to facilitate their integration into the network and improve the grid stabilization
2. To examine the capacity of the hydrogen chain to answer grid services like peak shaving or PV smoothing
3. To optimize the overall installation (electrical, gaz and thermal flow)
4. To modelize and to make economical studies

## MYRTE has been build on strong partnerships



## MYRTE is supported by

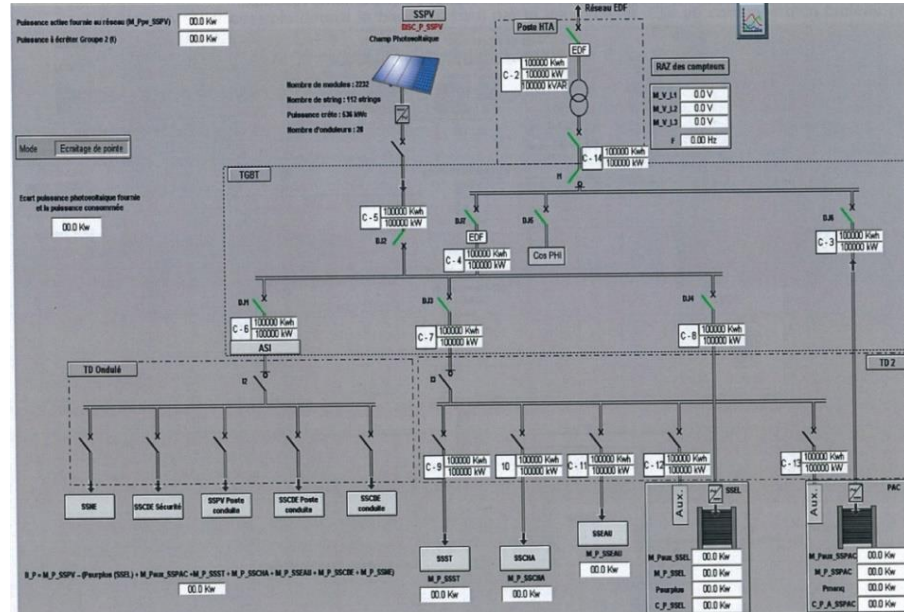
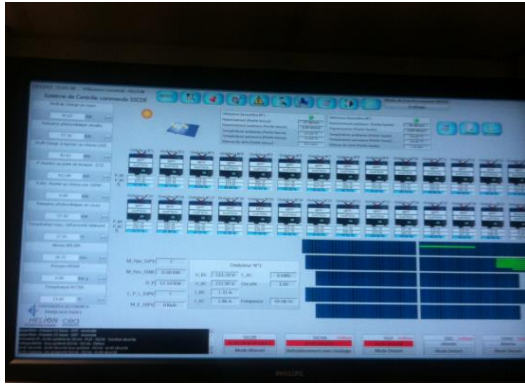


## MYRTE is in operating since the beginning of 2012

	2012	2013	1st Quarter of 2014	Increasing the availability in 2014 by improving the overall process
<b>Operating time of electrolyser</b>	646 h	1100 h*	565 h	
<b>Operatig time of fuel cells</b>	30 h	115 h	52 h	
<b>Energy produced by the fuel cells</b>	1,5 MWh	7,3 MWh	4,9 MWh	

Hydrogen chain efficiency : 35-40%

# Global Management System



❑ 1000 data/second

❑ Safety Functions

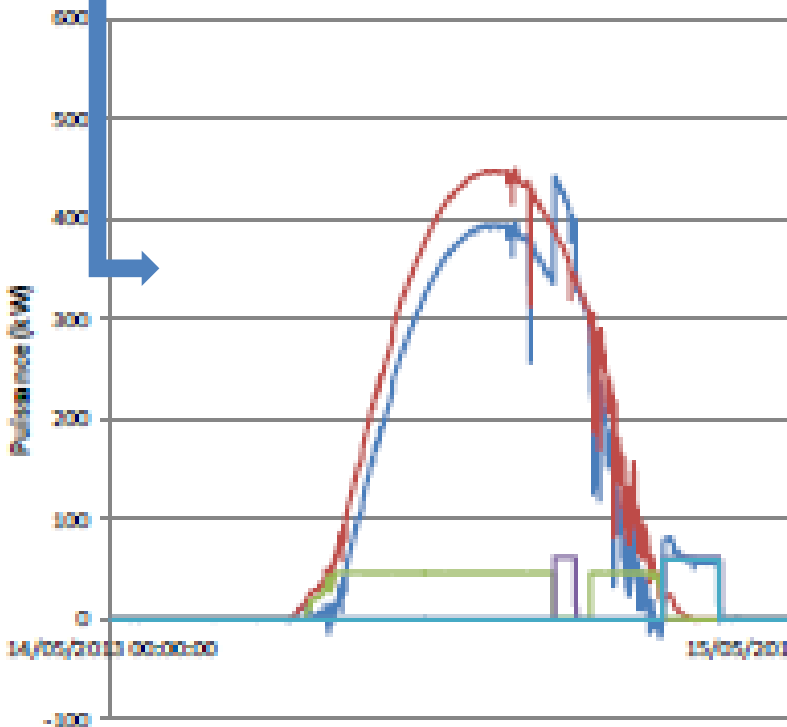
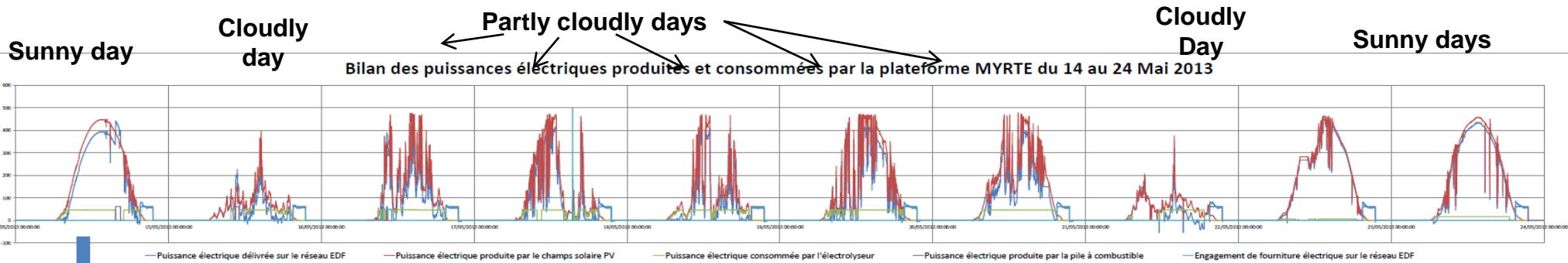
❑ Management of each sub-system and the overall system

❑ Implementation & Validation of Control Algorithms

❑ **Power Setpoint to be injected into the grid by the overall system:**

***The operator must implement into the GMS the load profile (power) to be injected automatically at each time into the electrical grid***

# Peak shaving case : example of a daily automatic mode for the overall system based on the EDF needs



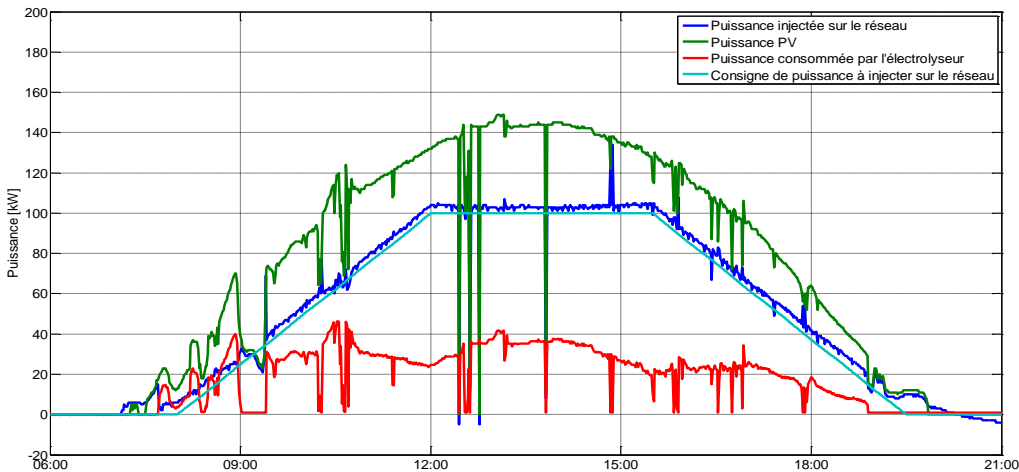
## Peak shaving days

- Energy storage during the day
- Providing power to contribute to the peak peak power shaving during the evening as request by the electrical grid manager

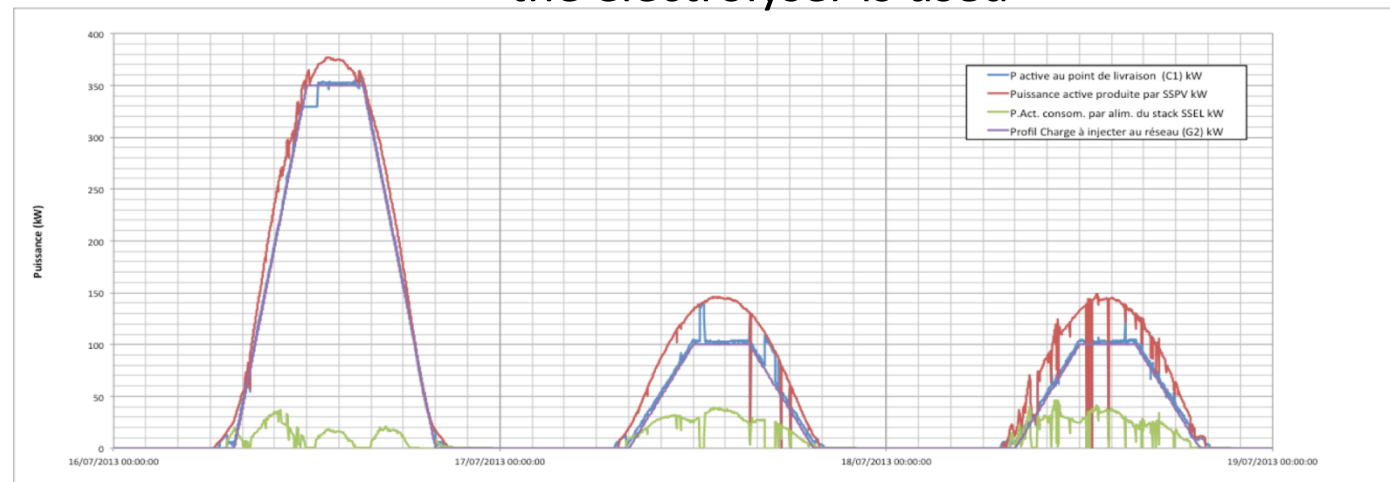
## Operating 24/7 all automatic

- Towards the capacity qualification to guarant the energy providing
- Towards the capacity qualification to module the demand profil 24h in advance

# PV Smoothing : Example of a daily automatic mode for the overall system based on the smoothing constraints by the french energy regulator



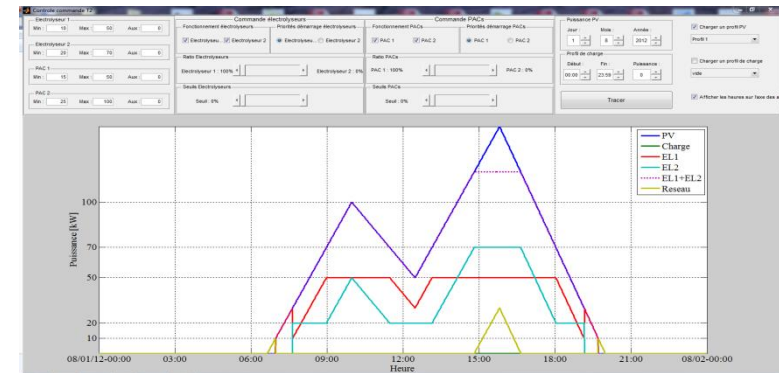
- At the day D, we define the power profil that the systems have to provide/ensure
- The day D+1, the system is operating using the PV power output, the electrolyser and the fuel cells
  - If there is not enough power form the PV plant, the fuel cells is used
  - if there is too power form the PV plant, the electrolyser is used





# Further works

- Integrating the forecasting solar production
- First PV guaranty experimentation with EDF (local electrical grid dispatcher)  
*Fit MYRTE production with D+1 Power load forecast*
- Validate our models used in the software and analyze the sensitivities of parameters.
- Management and Optimize the overall systems  
(Hydrogen storage, heat storage and valorisation)
- Economical Study.
- Analysis of availability, operations of maintenance
- Upgrade the systems with an other equipment



**Greenergy Box® : FC (70 kW) & Electrolyzer (13**







# are the next steps?

## ► Today, international reference for technology demonstration

- ◆ Coupling PV + H<sub>2</sub> storage + grid services
- ◆ Green Hydrogen production



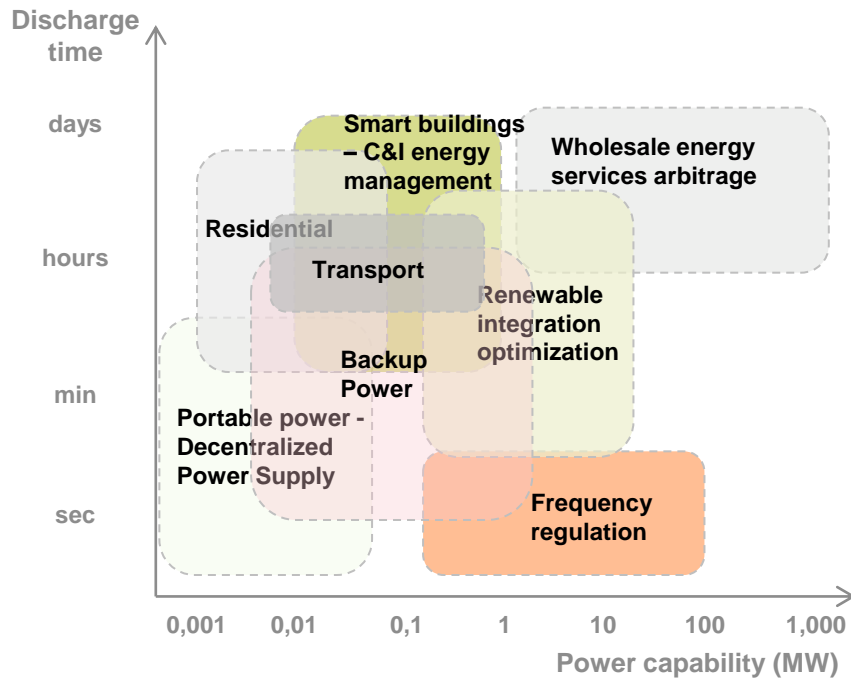
## ► Tomorrow, reference for energy transition

- ◆ Explore and play new profiles to deliver new services to the grid
- ◆ Integration of new storage technologies (metal hybrid...)
- ◆ Focus on Smart Grid & MYRTE control command
- ◆ Research on power to gas
- ◆ Refueling station for H<sub>2</sub> and electrical
- ◆ Expertise center for university research
- ◆ Technology showcase
  - ◆ Professionals & academic
  - ◆ Tourism



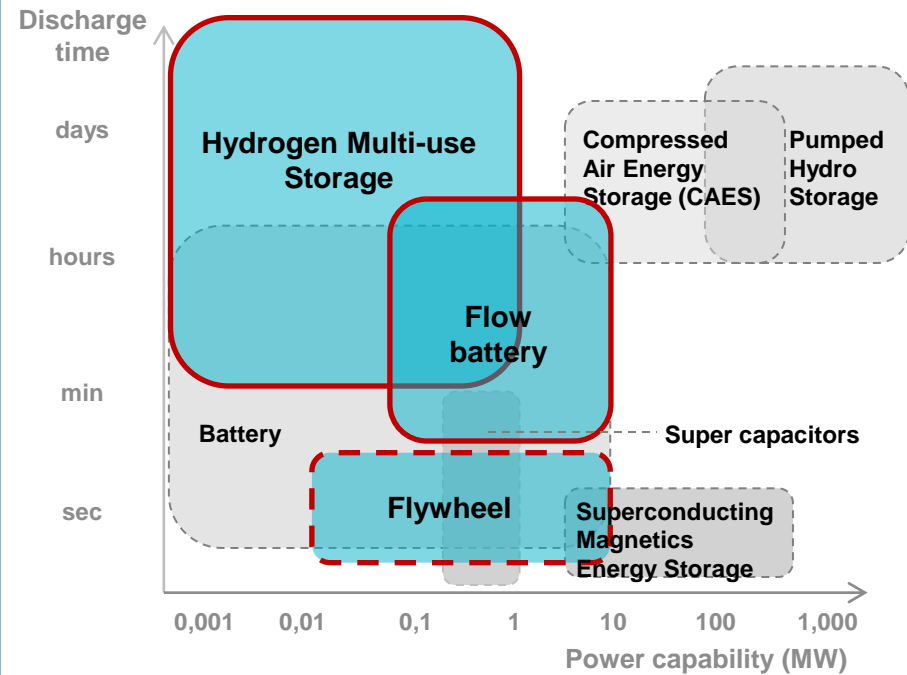
# Storage applications and technologies

## Each application has its own requirements



Source: AREVA, ENEA, CVA, BNEF, NERC....

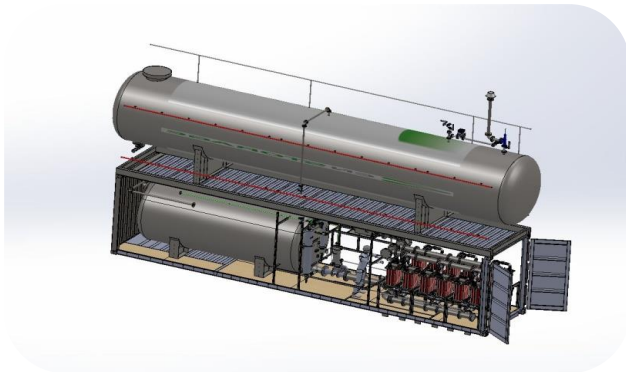
## Each technologies has specific capabilities



**Technologies in blue areas are those supplied by AREVA**

# The cost competitive flow battery

(currently under development)

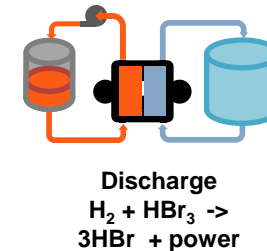
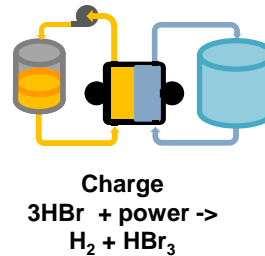


✓ **High cost-competitive solution for stationary applications**

## USERS

- ✓ Local / regional / remote sites authorities
- ✓ Renewables farms operators
- ✓ Project management companies
- ✓ Transmission & Distribution System Operators

## Overview of the process



## Technical specifications

Discharge power	150 kW (scalable)
Round trip efficiency	70%
Cycle life	> 10 000

## Main advantages

- ✓ Fully automated charge/discharge management
- ✓ Scalable cycle and autonomy
- ✓ Competitive cost solution

# The autonomous and multifunctional Greenergy Box™ hydrogen battery

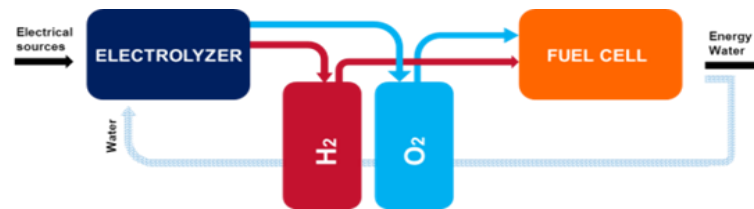


- ✓ **Power at any time and everywhere solving renewables intermittency**

## USERS

- ✓ **Local / regional / remote sites authorities**
- ✓ **Renewables farms operators**
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## Overview of the process



## Technical specifications

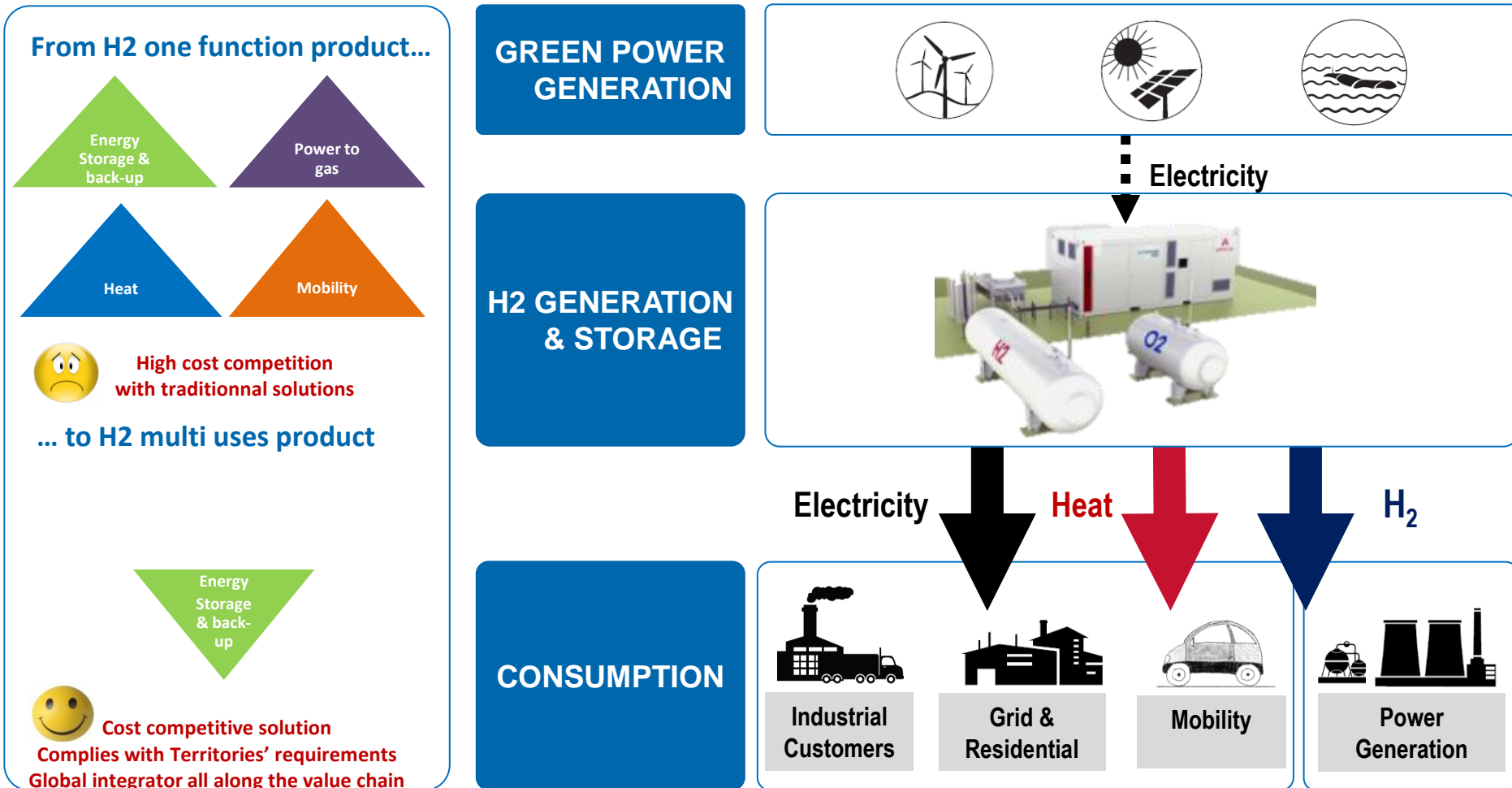
Maximum charge power	16 - 75kW up to 5 systems in parallel
Discharge power	20 - 100 kW
Round trip efficiency	70-80 % (heat included)
Electrical efficiency	30-35%

## Main advantages

- ✓ **No logistics required** when coupled with Renewables
- ✓ Ultra-reliability
- ✓ **Autonomy adaptable** to customer need
- ✓ Fully automated charge/discharge management
- ✓ Clean and silent



# Hydrogen technologies are very flexible



Multi-uses model enables to combine ROI, energy transition, innovation

# Hydrogen has positive impacts in Territories



*Reducing the dependence to the fossil fuels*

**Revitalize industrial areas and low revenue areas**

*Developing specificities and international attractiveness*

**Fighting against climate change**

**Creation of local jobs**

*Decrease of public operating expenses*

*Building together with state authorities*

*Capitalizing on innovative technologies, growing local academic community*

**>> FOCUS ON...**

- ✓ Islands
- ✓ Rural electrification
- ✓ Remote stations
- ✓ Hostile environments

## Our offer of services to answer to your Energy transition stakes

**Strategic plan defining**



**Funding research**



**Solutions integrator**



**Project management  
OPC & ecosystem**



**Change management**

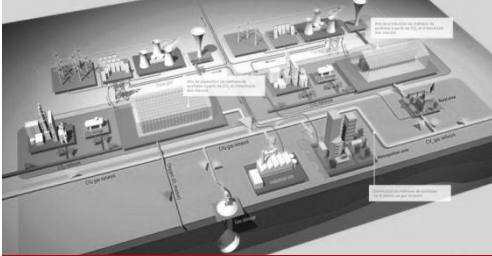


**Territory valorization  
Communication & Economic development**



# We leverage the lessons learned from MYRTE to broaden our project portfolio

## 4 GRHYD project

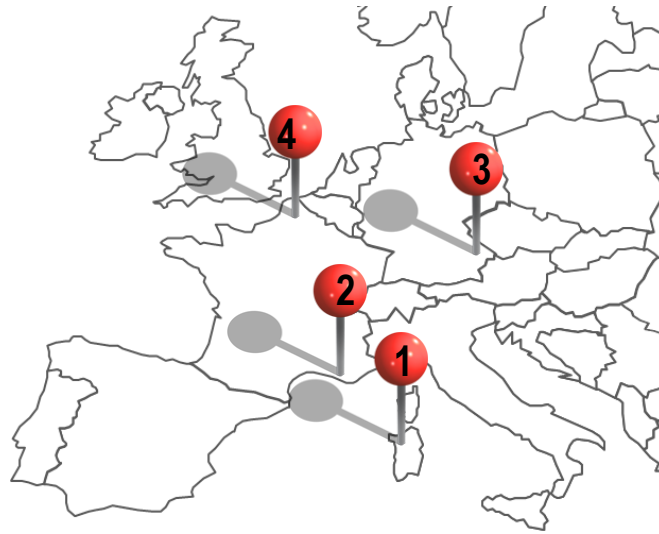


Validating the feasibility of Power-to-Gas and multi-use

## 2 La Croix Valmer



Managing the electricity supply of a childcare centre



## 3 ZAE: Smart Grid Solar



Integrating Renewables into the Bavarian electricity mix

## 1 MYRTE



Coupling solar field & hydrogen for strengthening the Corsica grid

# Thank you

WE HAVE  
OUR OWN  
ENERGY  
MIX.



1/3 SOLAR,  
1/3 WIND,  
AND MOM  
DOES THE  
REST.