

## PEM Electrolyser for operation with off-grid Renewable Installations. ELY4OFF Project



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*Project Coordinator*  
*Innovation Area Manager (FHa)*

Emden, 12 February 2019

The background of the image is a clear blue sky. At the very bottom, there is a thin layer of white clouds, suggesting a horizon or a high-altitude view.

**WHO ARE  
WE?**

# Fundación Hidrógeno Aragón

- It is a **private, non-profit** organization, created to promote the use of hydrogen as an energy vector.
- Promoted by the Government of Aragon it was **founded in 2003** with the support of the administration, industry and the main society actors from different sectors of activity.
- **70 members** of key importance for the Aragonese economy



# Installations

- **Main building:** 1200 m<sup>2</sup>, with offices, labs and warehouse.
- **Integrated in the IThER project**, which is a **demonstration project** with a renewable energy infrastructure based on a wind farm 635 kW and a 100 kW photovoltaic system with different technologies linked to a hydrogen production facility compression (up to 350 bar) and dispensing hydrogen.



# Areas of work



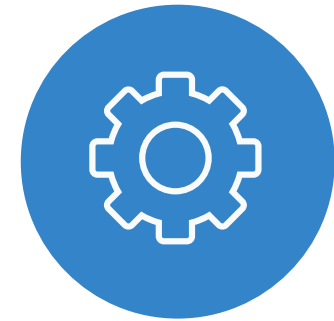
Research &  
Development



Innovation



Consultancy and  
training



Business  
development

# Background on Fuel Cell & H<sub>2</sub>

## EVERYWH2ERE



*Making hydrogen affordable to sustainably operate Everywhere in European cities*



## BIG HIT



*Building Innovative Green Hydrogen Systems in Isolated Territories*



## DEMO4GRID



*Demonstration of 4 MW Pressurized Alkaline Electrolyser for Grid Balancing Services*



## QualyGridS



*Standardized qualifying tests of electrolyzers for grid services*



## HYLAW



*Identification of legal rules and administrative processes applicable to Fuel Cell and Hydrogen technologies'*



## HYTECHCYCLING



*New technologies and strategies for fuel cells and hydrogen technologies in the phase of recycling and*



## ELY4OFF



*PEM ElectroLYsers FOR operation with OFFgrid renewable installations*



## ELYNTEGRATION



*Grid Integrated Multi Megawatt High Pressure Alkaline Electrolyzers for Energy Applications*

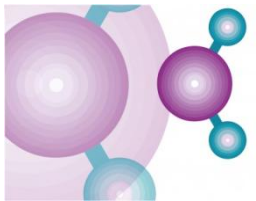


## ELYGRID



*Improvements to Integrate High Pressure Alkaline Electrolyzers for Electricity/H<sub>2</sub> production from Renewable*





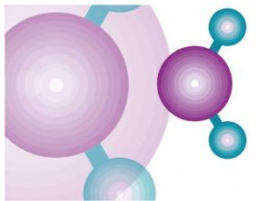
# SUMMARY

**Purpose:** the **development** and **demonstration** of an autonomous **off-grid** electrolysis system linked to **renewable energy sources**.

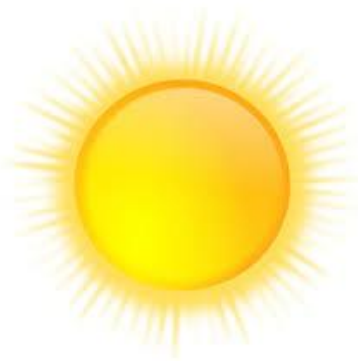
The **PEMWE** (Polymer Electrolyte Membrane Water Electrolyser) **industrial prototype** (50 kW) will be **directly linked** to track the solar **photovoltaic** power source producing over 1.5 tonnes of hydrogen per year and ensuring cold start and rapid response to changes

The **demonstration period** in a relevant environment (TRL 6) will last **8 months** and will take place in Huesca, Spain.

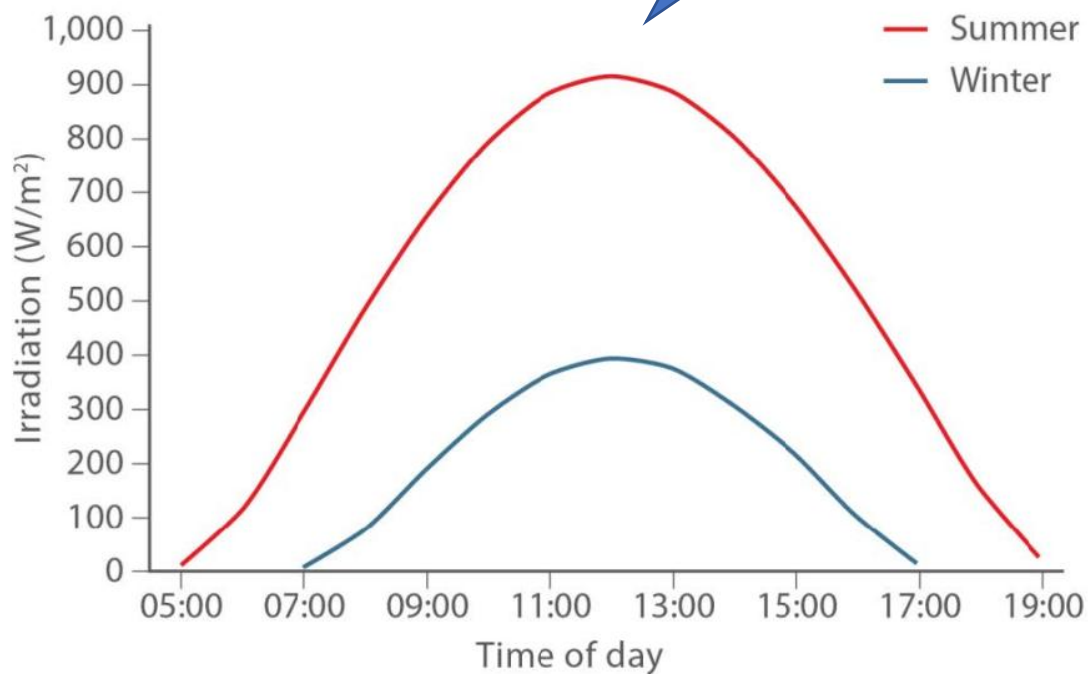
Grant number	700359
Application area	H2020 Energy
Start date	01/04/2016
End date	31/03/2019
Total Budget (€)	2.315.217,50 €



# SINGLE ENERGY SUPPLY

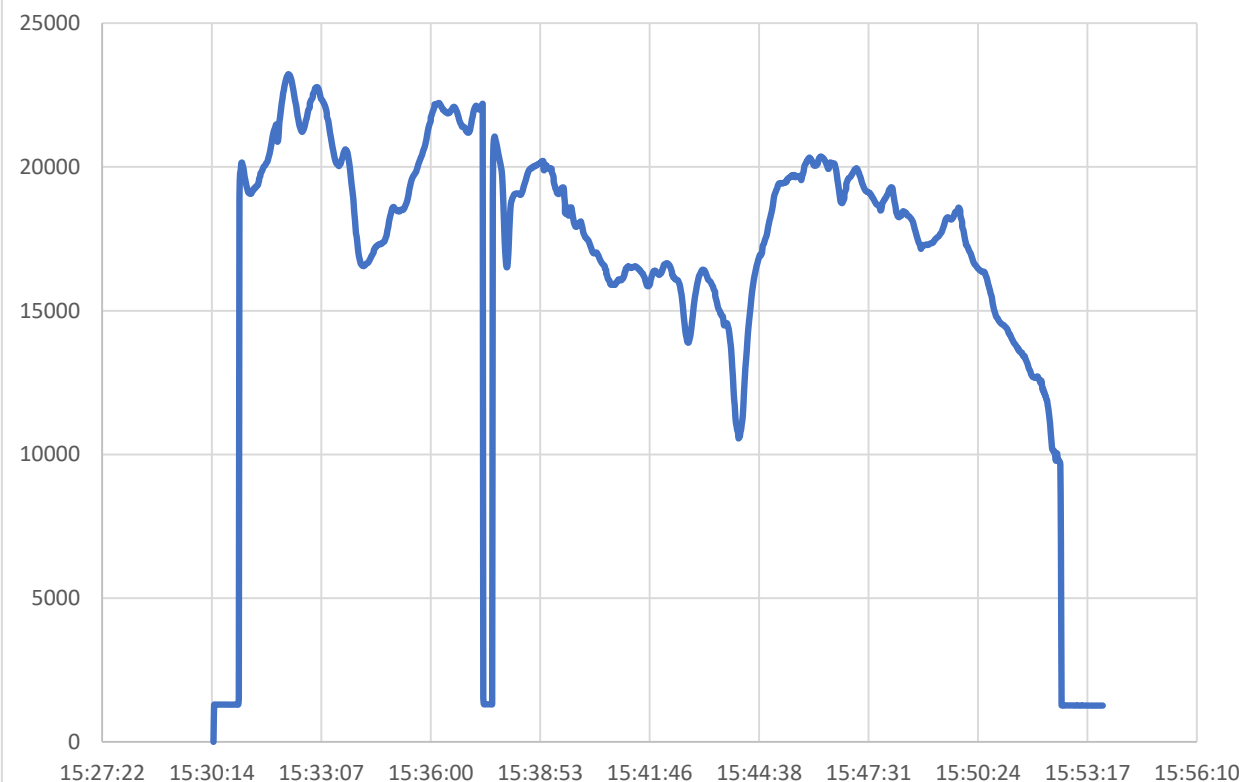


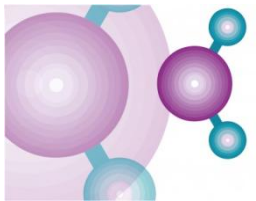
Ideal profile



Real profile

Total Power (W) - 28 Nov 2019, Huesca





# SINGLE ENERGY SUPPLY

**Emden, Germany**  
**Cloudy the following days**



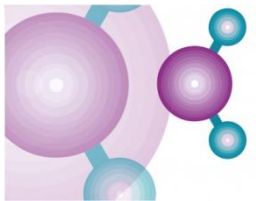
**Rainfall: 0%**  
**Humidity: 85%**  
**Wind: 14 km/h**

Temperatura

Precipitaciones

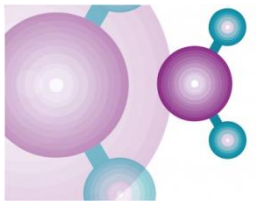
Viento





# SINGLE ENERGY SUPPLY





# SINGLE ENERGY SUPPLY

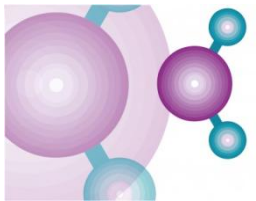


**62.5 kWp** in 13 strings

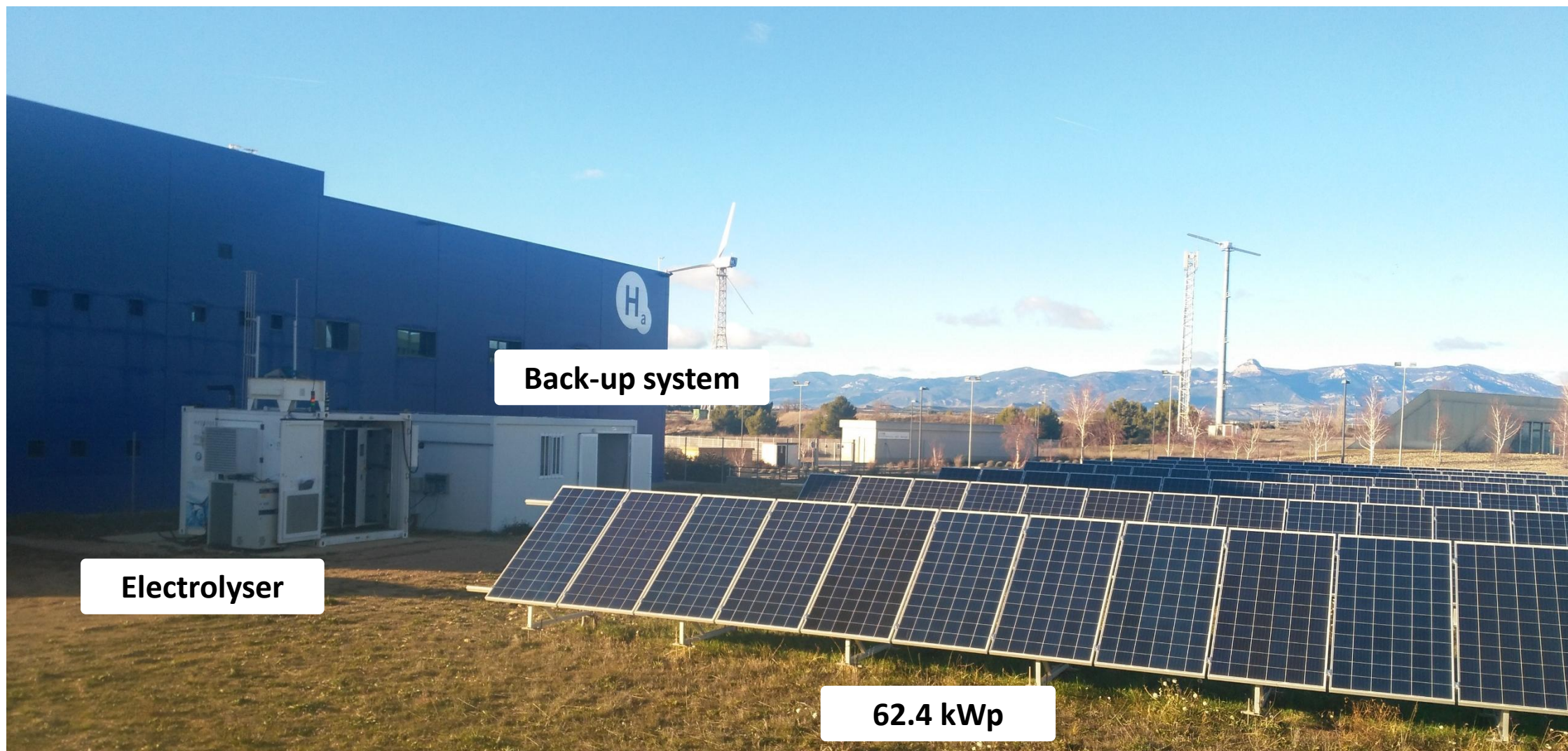
**450 - 800 V**

4.8 kWp per string

Eurener Modules 320 W



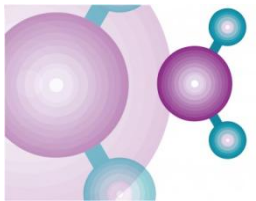
# DEMO SITE (Huesca)



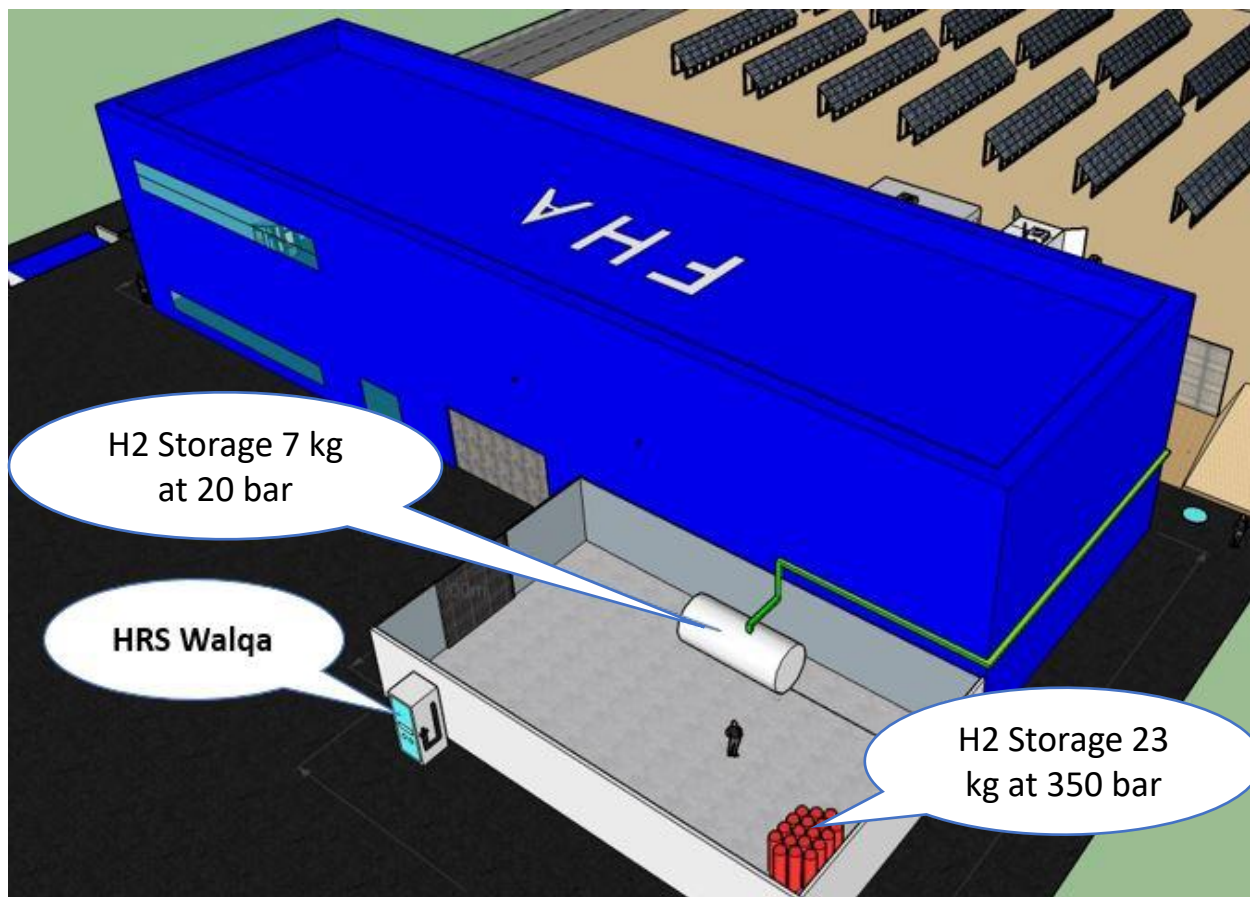
**Back-up system**

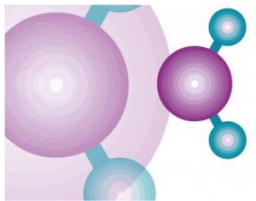
**Electrolyser**

**62.4 kWp**



# DEMO SITE (Huesca)





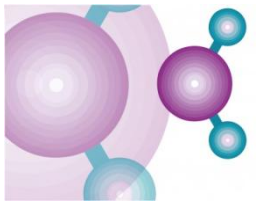
# DCDC CONVERTERS



epic power

- ✓ To **adapt** the voltage produced by the PV field to the required voltage of the stack (with MPPT)
- ✓ Capable of following RES **variability** quickly
- ✓ **Novel** electronic structure
- ✓ Efficiencies > **92%** in all conditions
- ✓ **13 units** (4,8 kW)

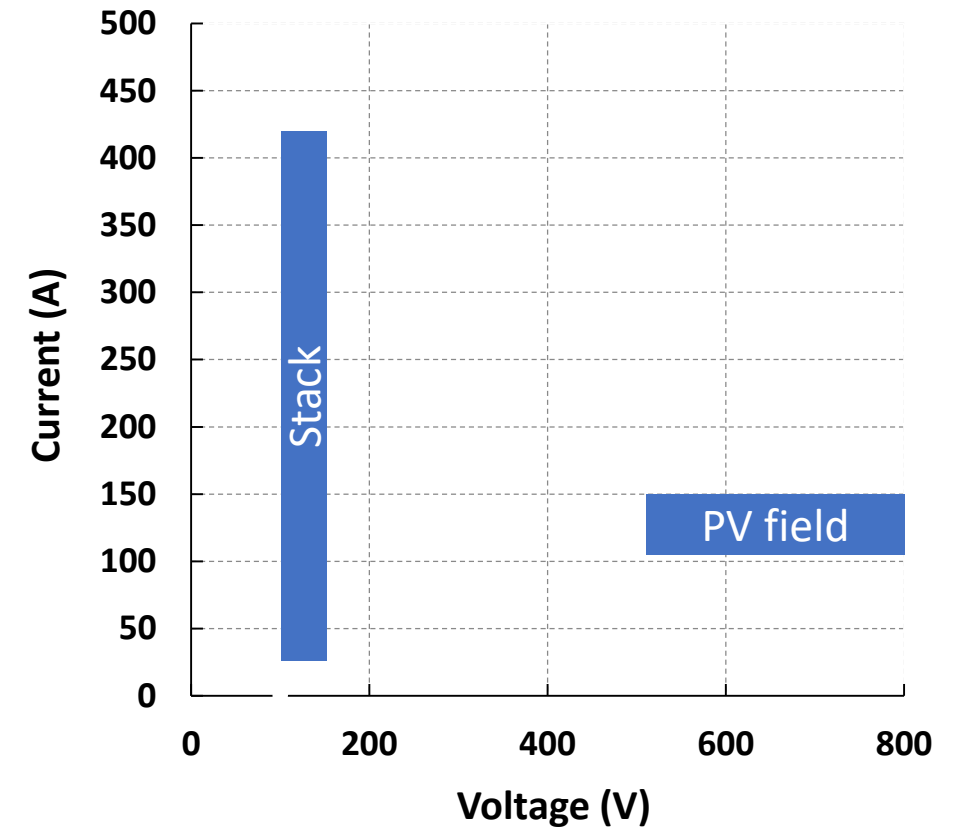
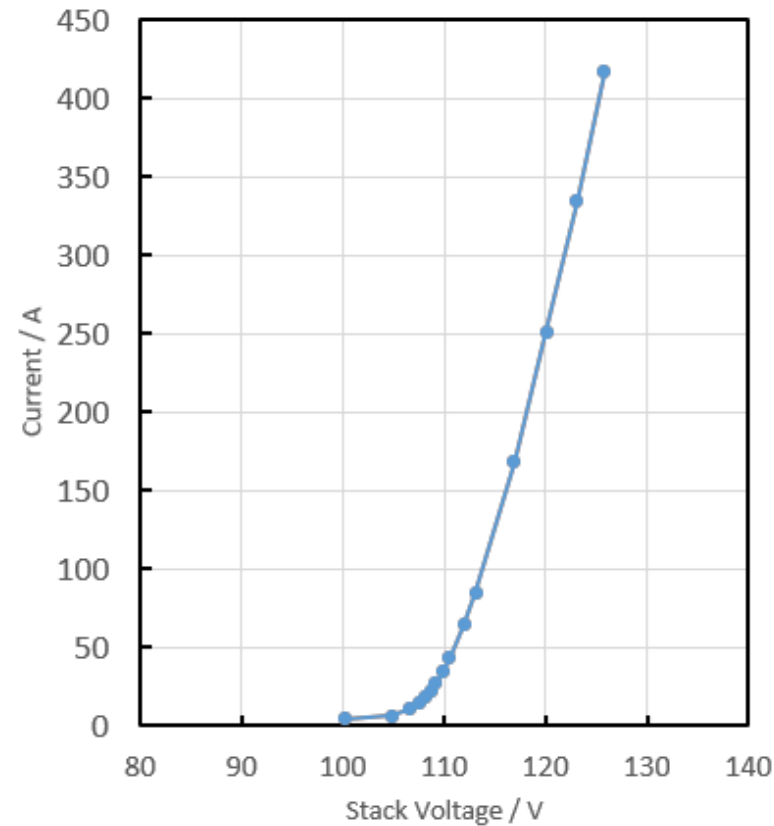
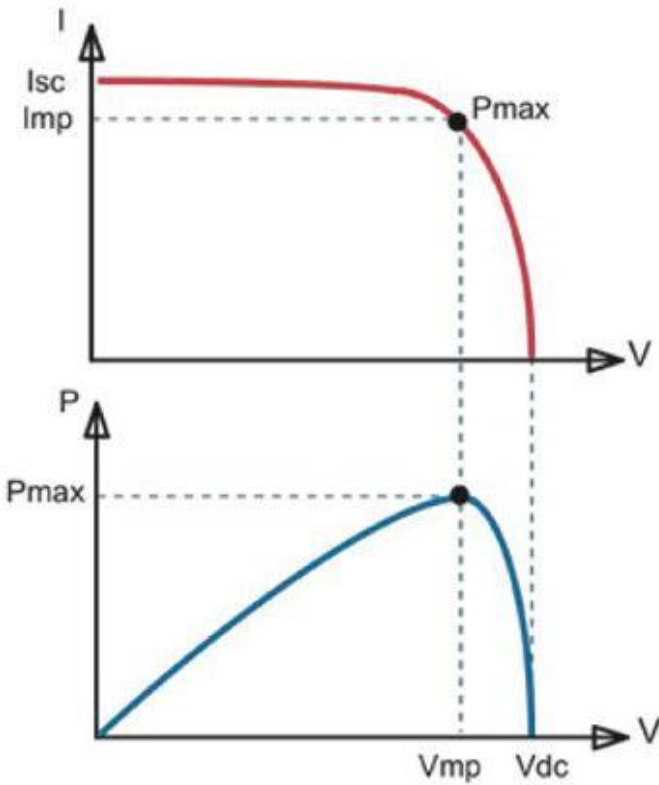


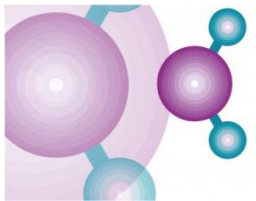


# DCDC CONVERTERS

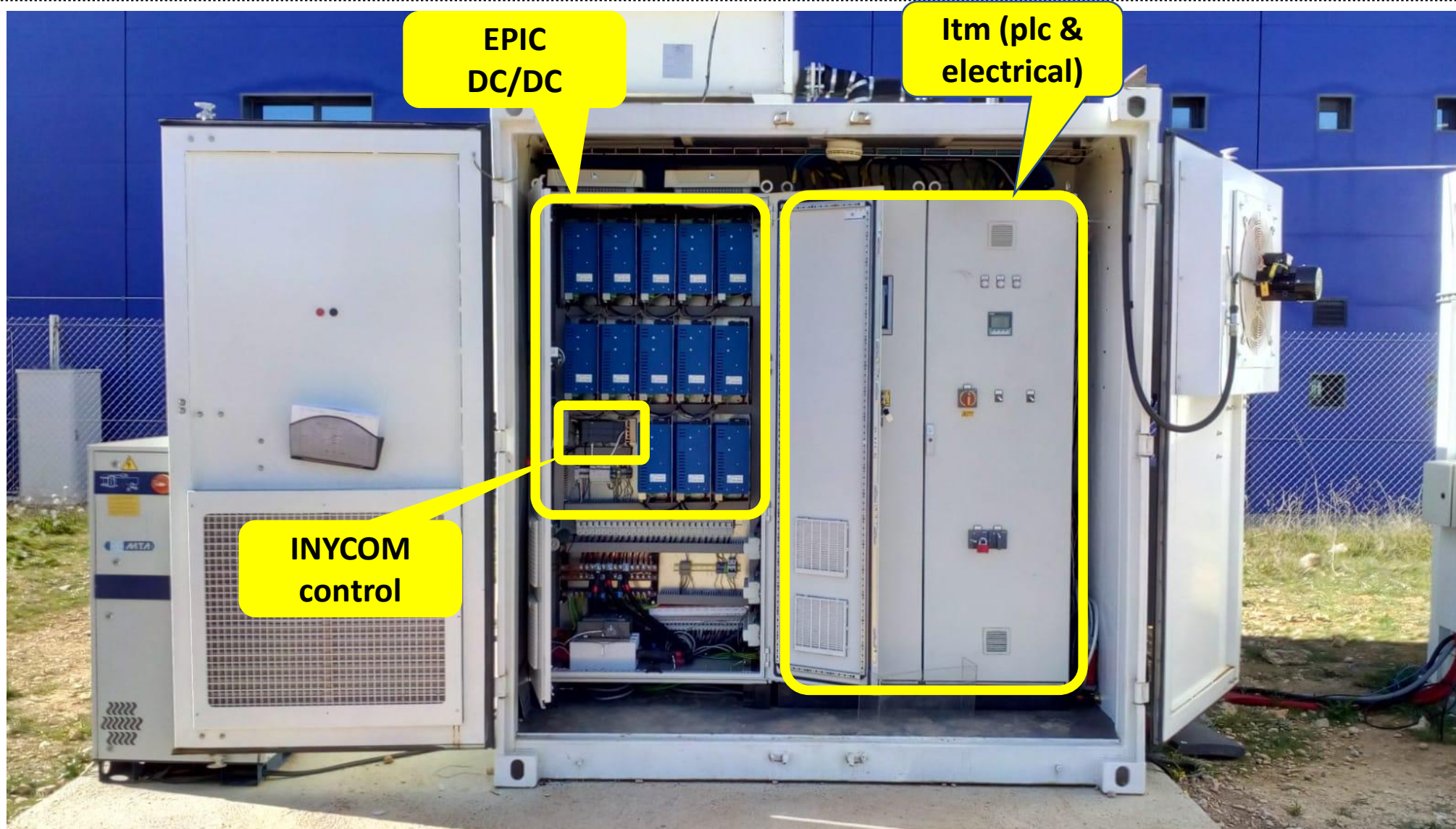
PV field output: 450 – 800 V

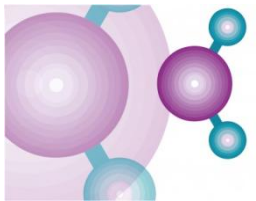
Stack requirements: 110 – 160 V



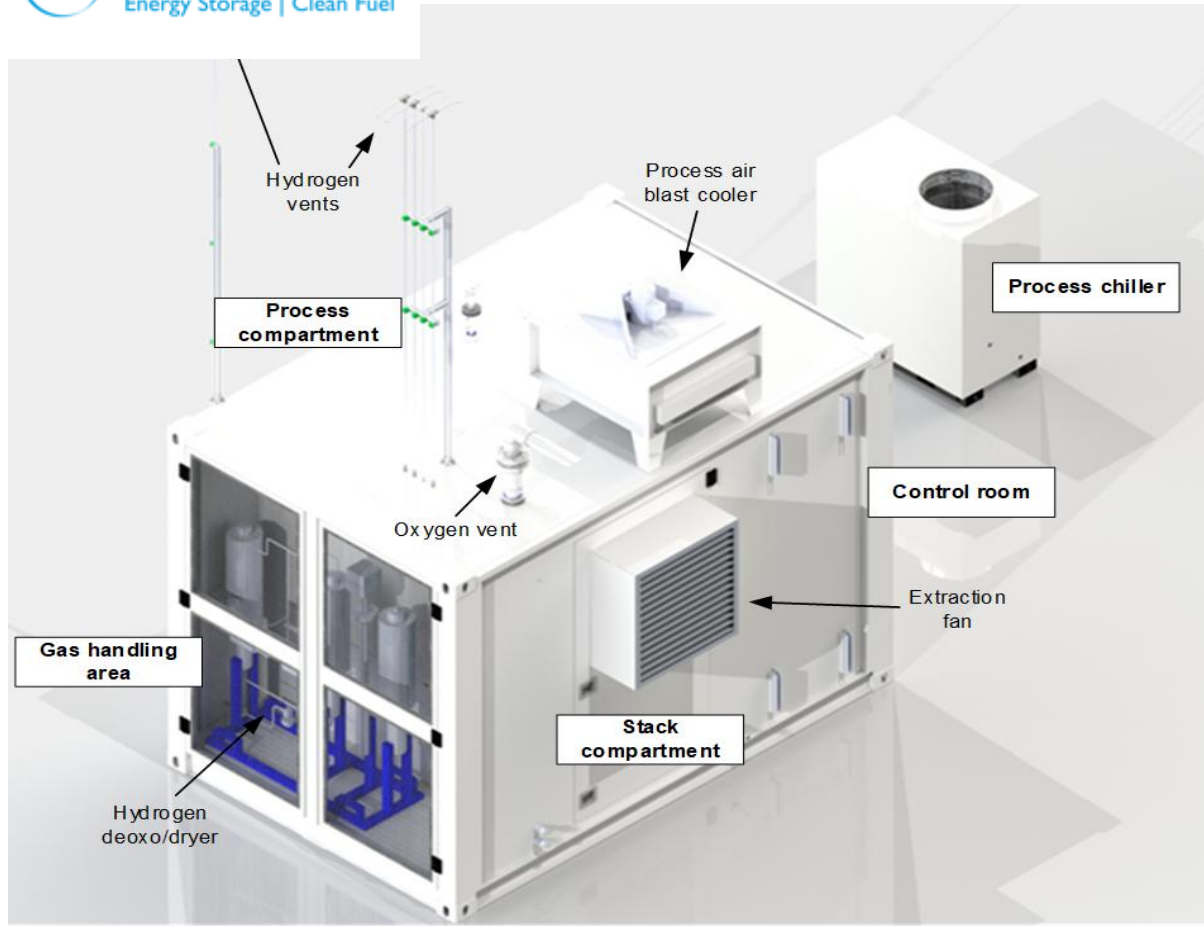


# DCDC CONVERTERS

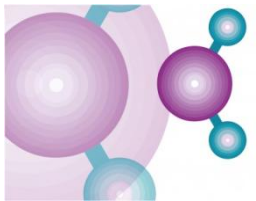




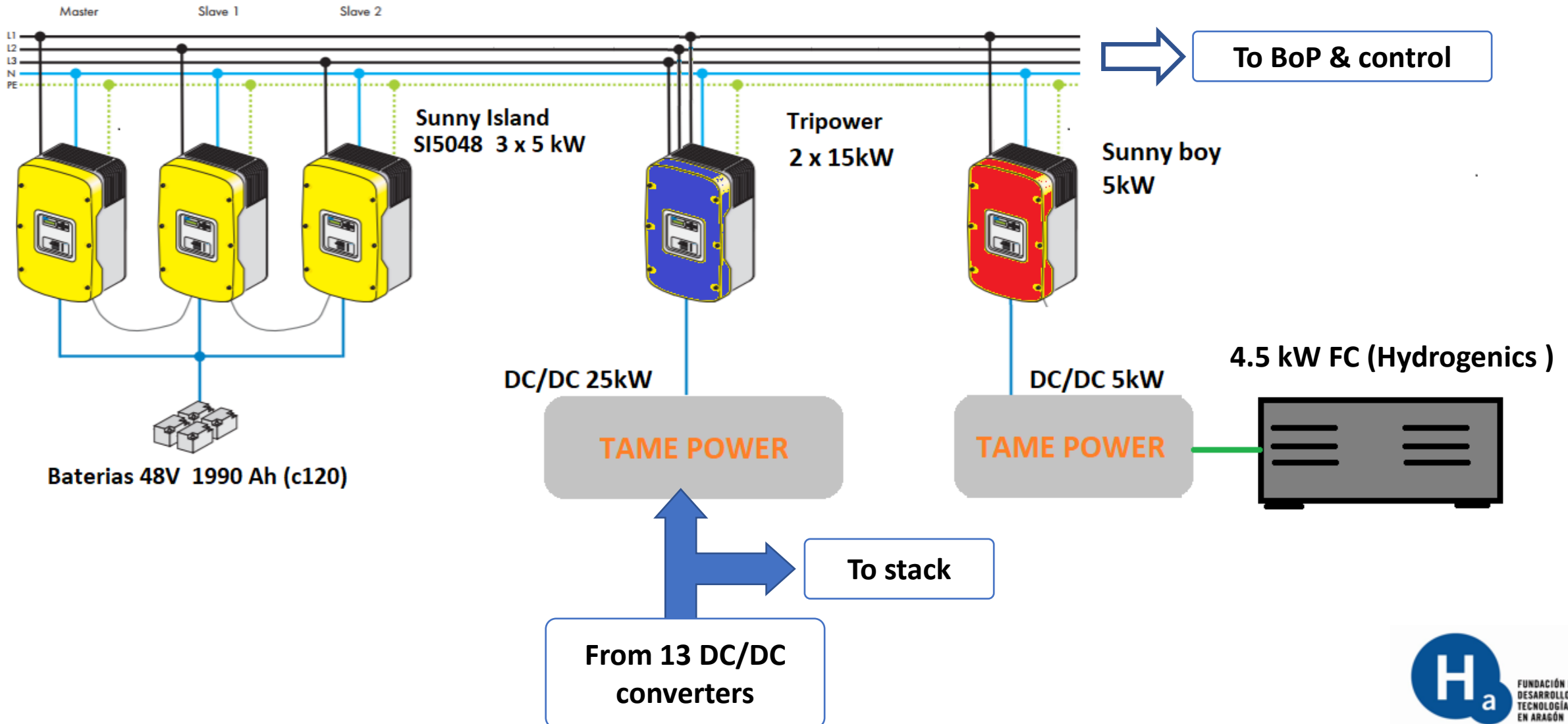
# HGAS PEM ELECTROLYSER

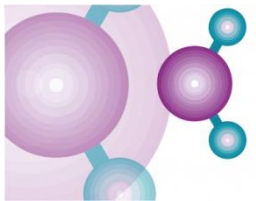


- ✓ Promising results, but an MEA could not be developed in time -> a **commercial MEA** was tested
- ✓ Optimization of **BoP consumption** (variable pump, thermal insulation, ...)
- ✓ Non-typical **FAT**: no rectifier at factory -> on site after DCDC integration
- ✓ Final tests done 5-8 Feb 19 were successful: **good dynamic response**
- ✓ Many **control modifications** due to off-grid

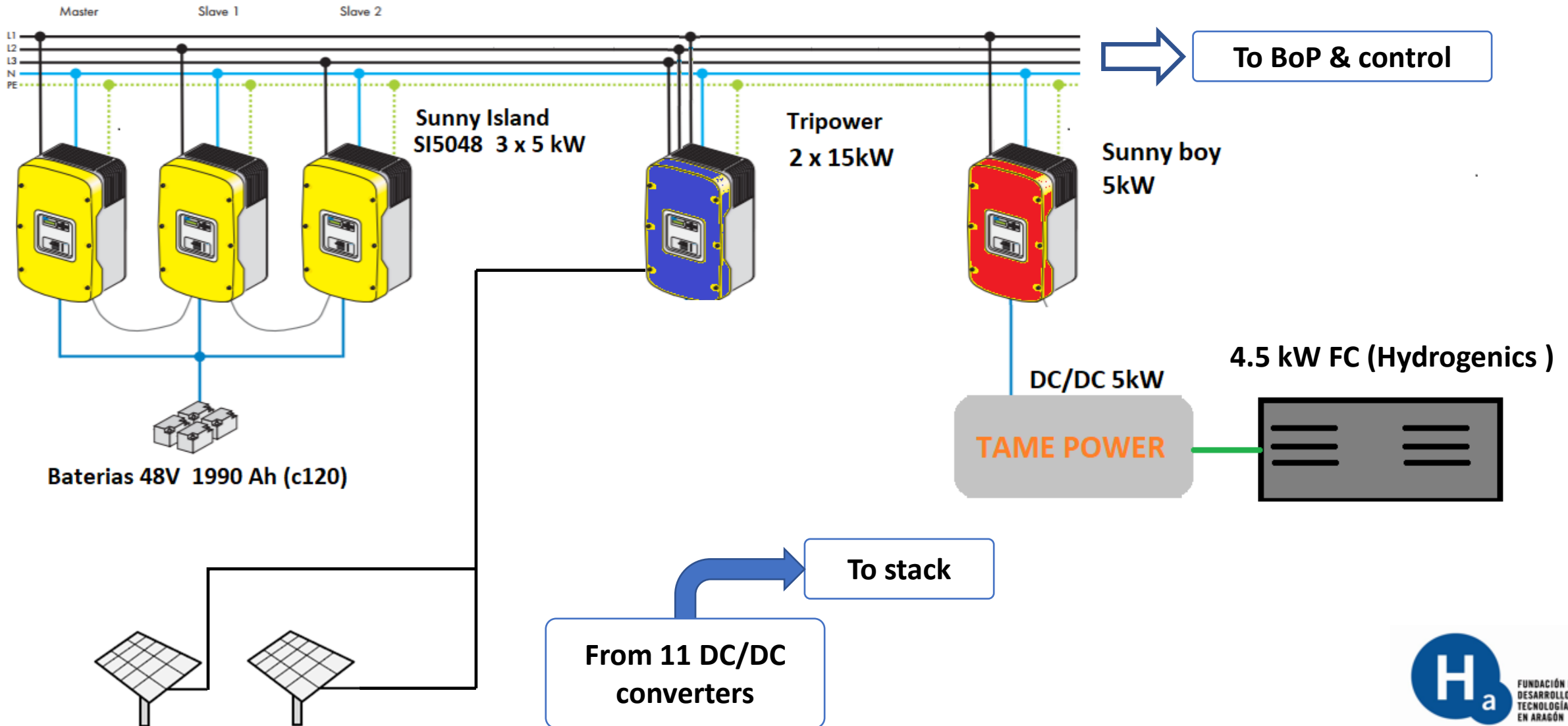


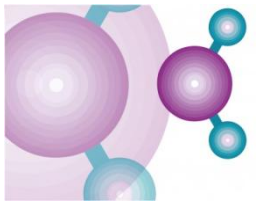
# HYBRID STORAGE SYSTEM (I)





# HYBRID STORAGE SYSTEM (2)





# HYBRID STORAGE SYSTEM





Idle

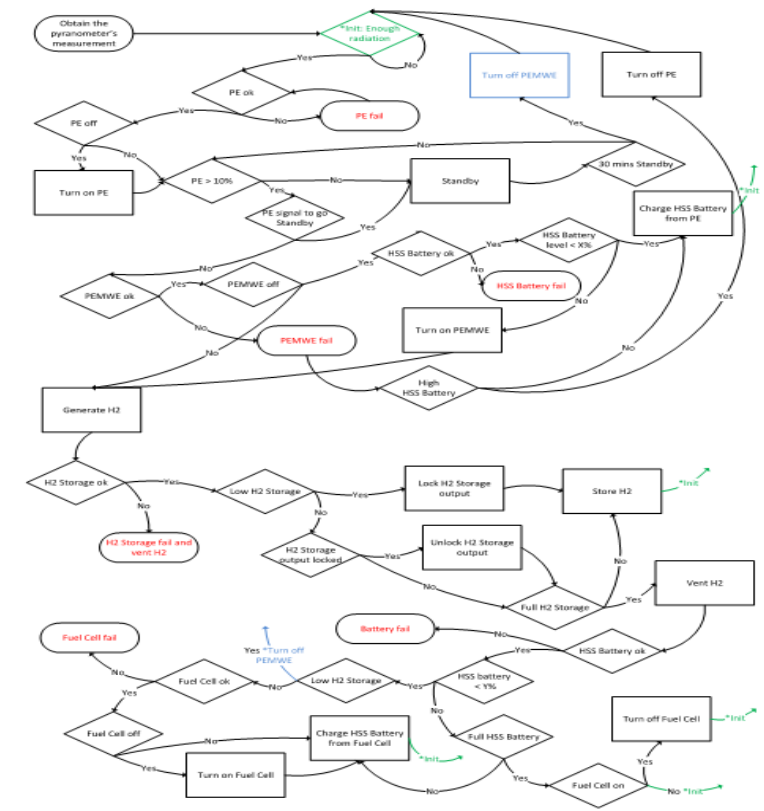
The PEMWE's BOP **essential consumptions** are covered (PLC, anti-freezing system) as well as the PLCs in the microgrid. **24/7**

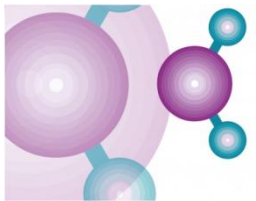
# Standby

The PEMWE's BOP **non essential consumptions** are covered, as well as those covered in the Idle status

## Generation

The PEMWE's stack is **generating hydrogen**, being the BOP consumptions also covered.

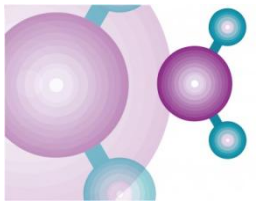




# CURRENT STATUS

- ✓ Integration of the components and commissioning is taking more time than expected -> current **delay** of 6 months.
- ✓ Successful tests last week -> demo period to start in **March** 19 (*permits obtained, official documentation in elaboration*)
- ✓ Project ends in March -> an **extension** has been requested
- ✓ Other **on-going activities**: LCA, cost analysis, recommendations to overcome regulatory barriers, exploitation plan, ...
- ✓ **Business cases** assessed (CEA): re-electrification, grid injection, mobility



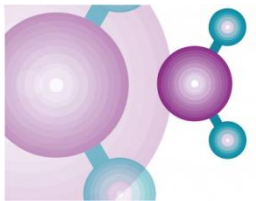


## High System Efficiency

through improved  
PEMWE and direct  
DC/DC

## Reliable

Hybrid Storage System  
with enhanced  
autonomy



European  
Commission



*This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No (700359). This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe research.*

*Many tanks for your attention,*

**Pedro Casero**

*Project Coordinator*

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