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22th International Conference on Renewable Energies and Power Quality (ICREPQ'24)
Bilbao (Spain), 26th to 28th June 2024

Educational Station for the Generation and Use of Green Hydrogen.

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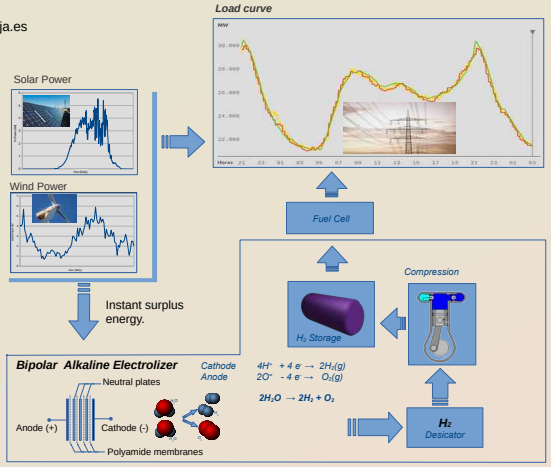
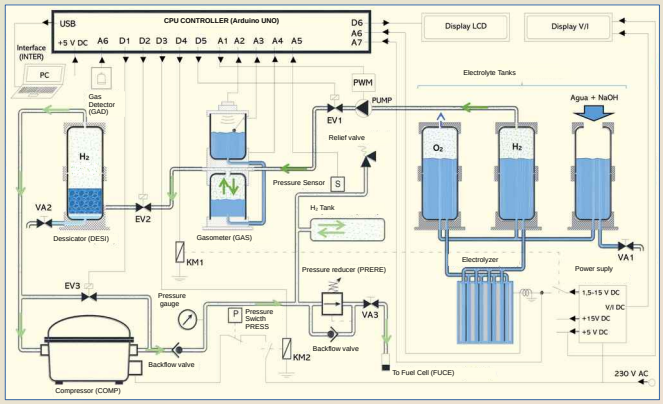
MAIN OBJETIVES OF THIS WORK:

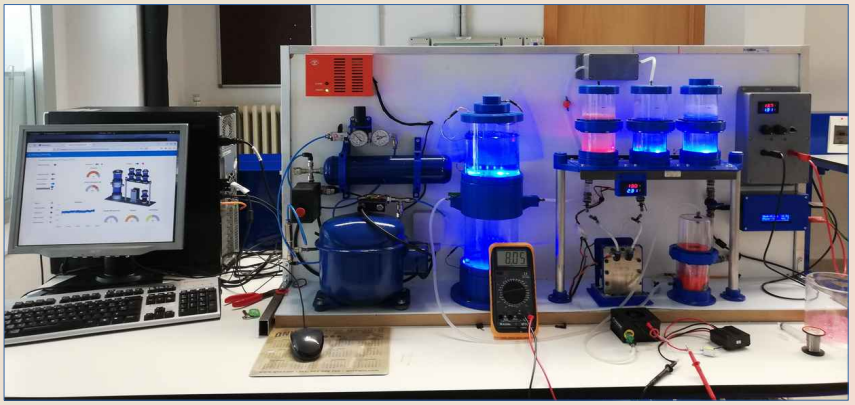
- Design and assembly an educational station dedicated to the generation, management, and application of green hydrogen.
- The hydrogen generated at this station will be used to feed the PEM type fuel cells, allowing the generation of electrical energy from hydrogen stored at a pressure of 10 bar in a steel tank.
- This station has been built using mostly 3D printing and the components used have an acceptable economic cost and are easily available on the market. Therefore, this installation can be effortlessly reproduced in any university laboratory.
- OpenSource design allows to control all station parameters and to improve the initial design of the system.
- In electrical energy systems with a high penetration of renewable sources, it is necessary to introduce large-scale storage systems. Thanks to energy storage based on hydrogen, better use of renewable generation would be possible as well as better adaptation to the demand curve.
- Through this station, it is possible to reproduce on a reduced scale the behavior of an electrical energy system that incorporates energy storage mechanisms using hydrogen technology.



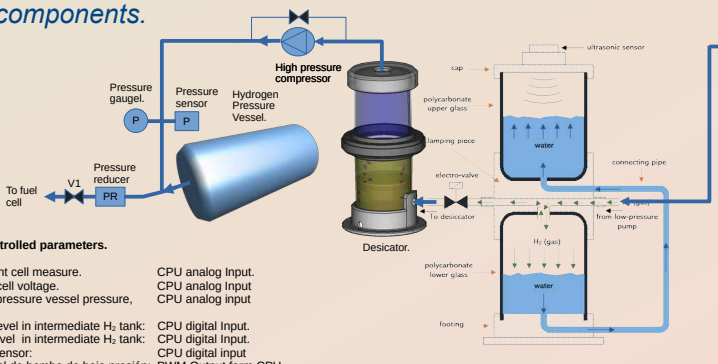
Plant overview with CPU controller

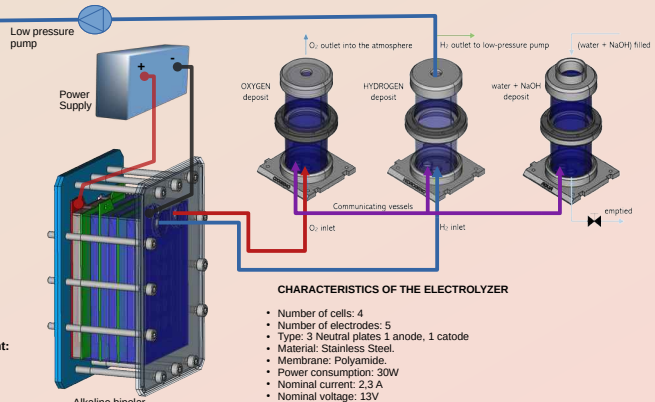


General view of the final appearance of the station



Main components.





CPU Controlled parameters.

01. Current cell measure.	CPU analog Input.
02. Total cell voltage.	CPU analog Input
03. High pressure vessel pressure,	CPU analog input
04. Max level in intermediate H_2 tank:	CPU digital Input.
05. Min level in intermediate H_2 tank:	CPU digital Input.
06. Gas sensor:	CPU digital input
07. Control de bomba de baja presión:	PWM Output form CPU.
08. Relay Nº1 High Pressure Compressor:	Digital output. High Pressure compressor control.
09. Relay Nº2 ON/OFF Electrolyzer:	Digital Output, Electrolyzer control.
10. Ultrasound Level Sensor 1 in intermediate tank.	
11. Ultrasound Level Sensor 2 in intermediate tank.	
12. SDA in LCD screen.	Serial Data
13. SCL in LCD screen.	Serial Data
14. Bypass solenoid valve Relay.	CPU digital output.

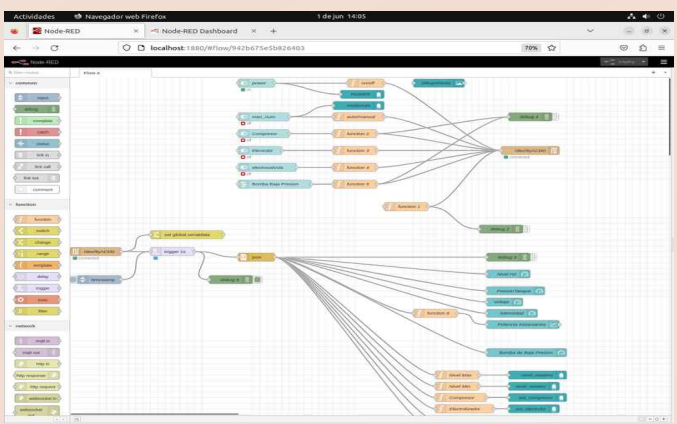
CPU Instructions: Basic specific instructions to control the plant:

aut, man: Configure controller in manual o auto mode.
on , off : Power on/off the plant.
com_1, com_0 : Power on/ off high perssure compressor.
bbp_nn : Control the low pressure pump. nn is the power applied to the pump.
byp_1, byp_0 : Power on/off bypass solenoid valve. This valve makes it easy to start the high pressure compressor.
ele_0, ele_1: Power on/off electrolyzer.

CHARACTERISTICS OF THE ELECTROLYZER

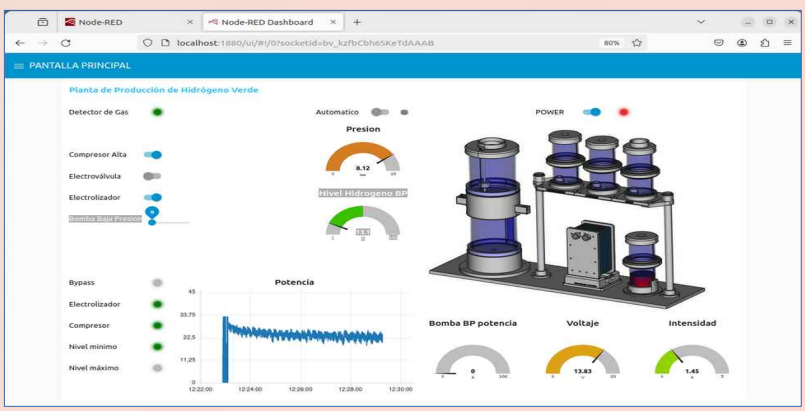
- Number of cells: 4
- Number of electrodes: 5
- Type: 3 Neutral plates 1 anode, 1 catode
- Material: Stainless Steel.
- Membrane: Polyamide.
- Power consumption: 30W
- Nominal current: 2,3 A
- Nominal voltage: 13V
- Cell voltage: 3,25V.
- Hydrogen production rate: 86mg/h.
- Hydrogen production rate(vol/h): 0,97 L/h.
- Storage pressure: 8bar
- Storage vessel: 0,8L.

Node- Red Interface



¿Why node-red interface?

- Makes it easier for the user to view and control the plant.
- Receives the system variables and transmits the appropriate commands to the hydrogen generating plant.
- Allows you to view system variables in clear and intuitive way.
- It is possible to develop and implement a custom dashboard quickly without the need to code



Grupo de Investigación.
Planificación, Operación y Control de Sistemas de Energía Eléctrica.