



Motivation

Within the framework of the 2030 Agenda of the United Nations Organization, Sustainable Development Goals have been designed to address some of the most important social challenges. Of these, ensuring access to affordable, reliable, sustainable and modern energy stands out significantly. **FLOWBAT 2021** is an interdisciplinary thematic platform aimed to develop VFBS with enhanced energy density and power values. It is composed by different research groups, from the Spanish National Research Council (CSIC), with extensive experience in different topics as the development of energy conversion devices, the synthesis of suitable electrode materials, the optimization of separation membranes, advanced fluid dynamics control, the development of other electrolyte chemistries, advanced control, etc. Our first and ambitious goal is to manufacture a battery of 1 – 5 kW, optimizing its components and design.

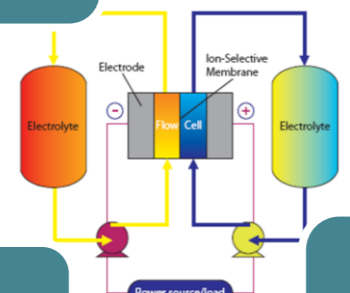
Key points to be addressed

- Electrodes**
- ✓ Electrochemical activity
 - ✓ Mechanical stability
 - ✓ Electrical conductivity
 - ✓ Low cost

- Electrolytes**
- ✓ Suitable concentration
 - ✓ Low viscosity
 - ✓ Proper redox potential
 - ✓ Vanadium salts
 - ✓ ¿Organic electrolytes?

- Membranes**
- ✓ Ions transport (electroneutrality)
 - ✓ Avoid cross contamination

- Engineering**
- ✓ Flow optimization
 - ✓ Leakages prevention
 - ✓ Instrumentation design
 - ✓ Efficiency improvement



Main goals



VFB of 1 – 5 kW (15 months)
“Stack” of 25 cells (20 x 20 cm)

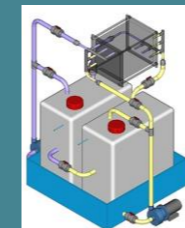
VFB de 10 KW (36 months)
“2-3 Stacks” of 30 cells

Advanced research (36 months)
Other chemistries, electrodes, membranes, electrolytes...

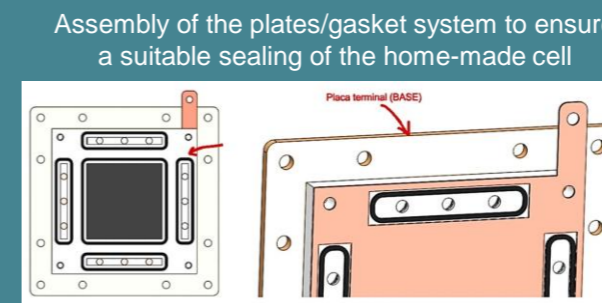
First steps...

... towards a VFB of 1 KW

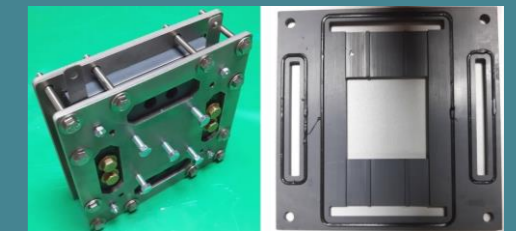
Engineering, fluid dynamics and control



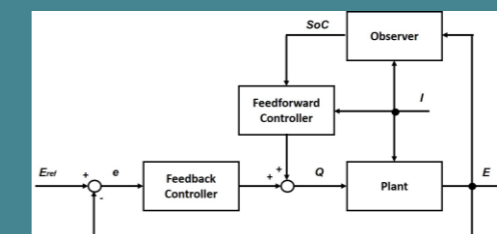
Designed hydraulic installation



Assembly of the plates/gasket system to ensure a suitable sealing of the home-made cell

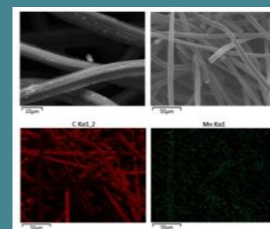


Assembled single cell (left) and a flowframe (right) with the gasket and the electrolyte distribution systems



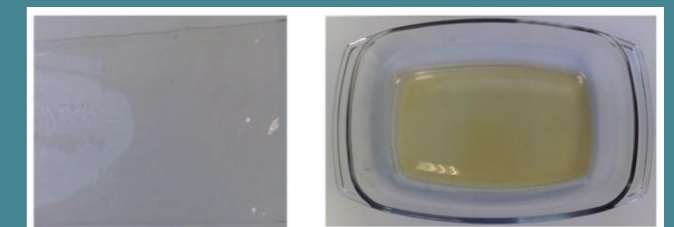
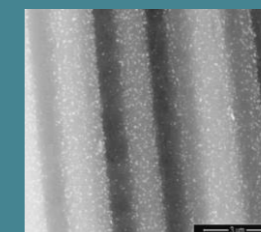
Control system architecture formulation

Optimization of the cell components



SEM images of a GF modified with Bi (negative half-cell electrode)

SEM images and EDX analysis of a GF modified with Mn nanoparticles (positive half-cell electrode)



Nafion®-117 membrane doped with SiO₂ (left) and PVDF (right)