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THE GES HYBRID HYDROGEN BATTERY

Green Energy Storage

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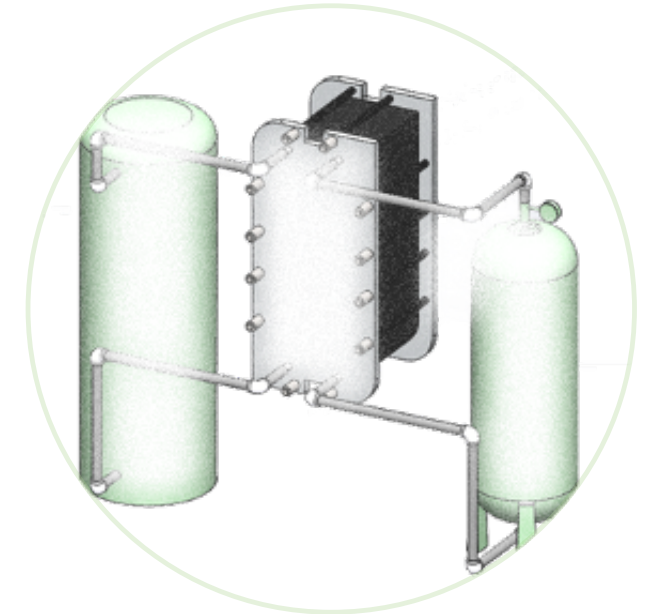


INNOVATIVE SME

TRENTO, ITALY

REDOX FLOW BATTERY

RESHAPING THE ENERGY TRANSITION



With our green and sustainable energy storage system, we build the future of renewable energy.

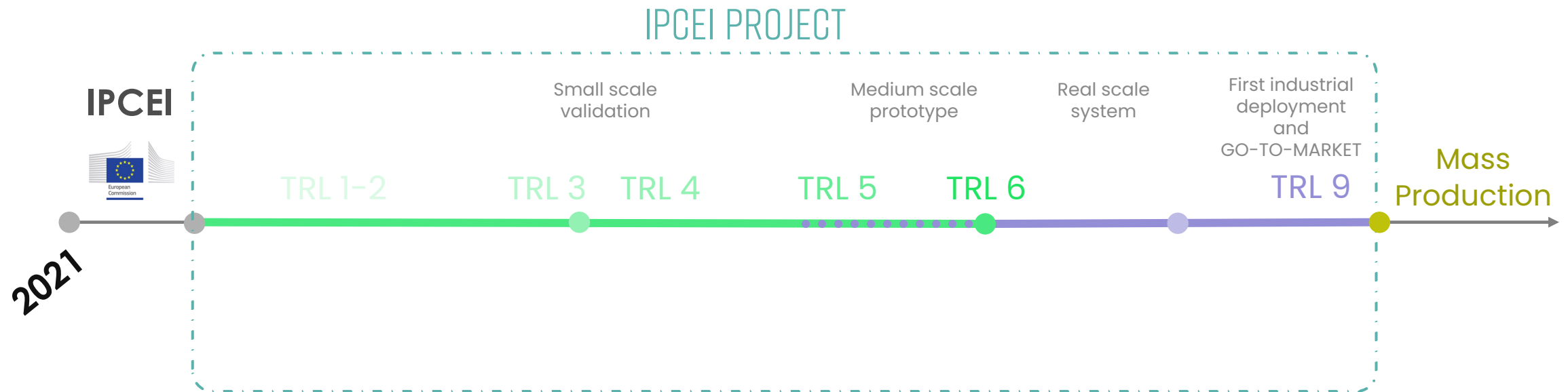
GES IPCEI PROJECT AND ROADMAP



BUDGET: 62 M€ (GES)
GRANT: 53 M€

GRANT DURATION:
6 YEARS

PROJECT GOAL: DEVELOP A NEW DISRUPTIVE AND COMPETITIVE RFB TECHNOLOGY FROM R&D TO FIRST INDUSTRIAL DEPLOYMENT (FID)



IPCEI batterie 2_SA.55813_Green
Energy Storage srl

LONG DURATION ENERGY STORAGE (LDES)



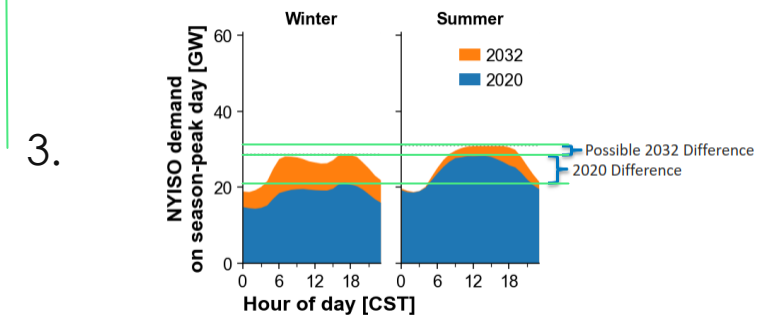
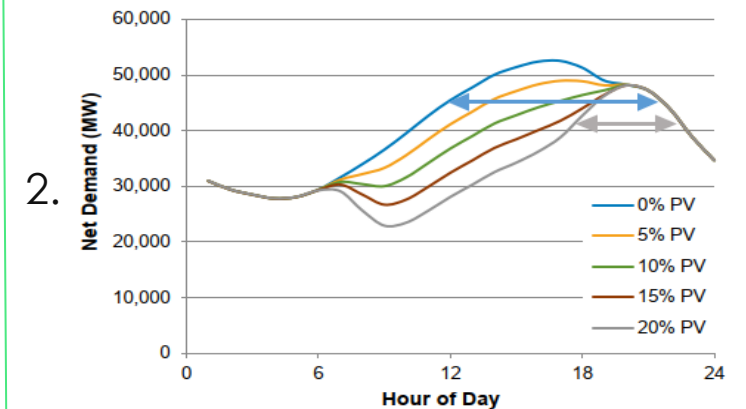
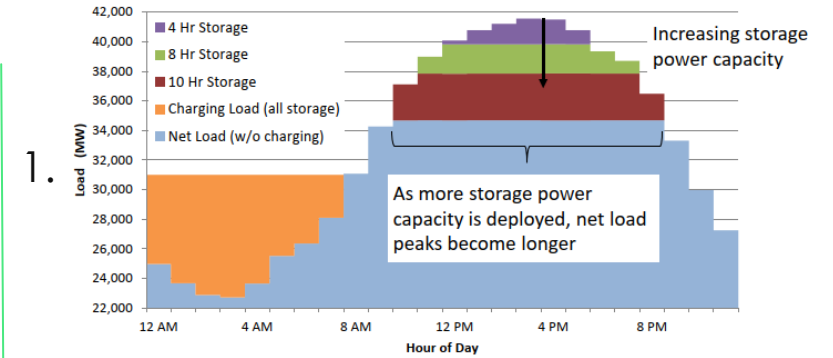
LDES : Energy/Power or Discharge duration > 4h
A shift in value proposition

NREL study – End 2023: «Moving beyond 4h Li-ion batteries: challenges and opportunities for long(er) duration energy storage»

3 scenarios:

1. **With short-duration Energy Storage (ES)** → helps lowering (summer) peak demand → new net peak becomes wider → **LDES is needed**
2. **VRE + short-duration ES** → reduction + shift of summer peaks w/VRE + additional peak reduction w/ short-duration ES → new net peak becomes wider → **LDES is needed**
3. **Transition to NET WINTER PEAKS**, that are wider and flatter → **LDES is needed !**

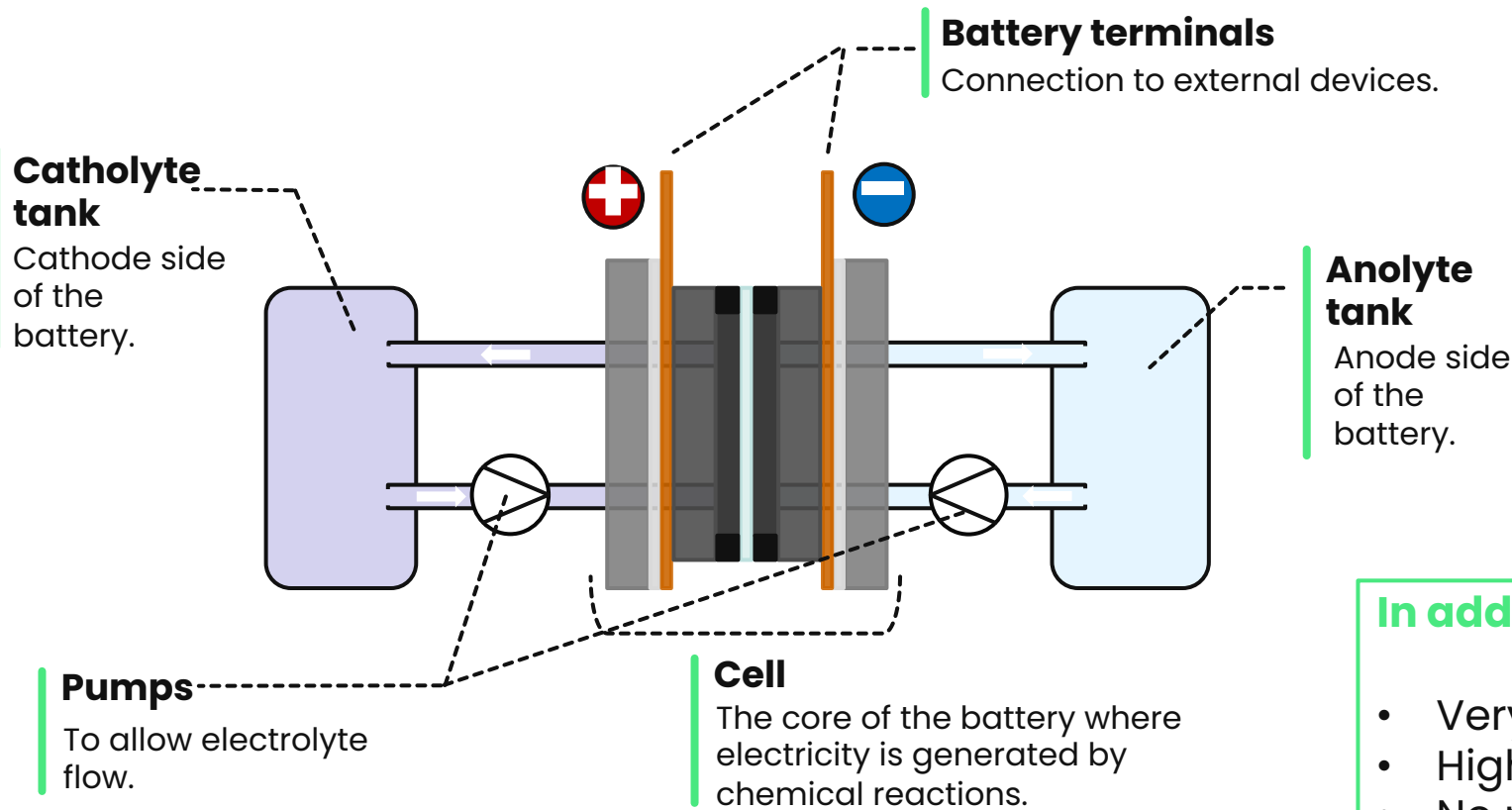
<https://www.nrel.gov/docs/fy22osti/80583.pdf>



REDOX FLOW BATTERY



Perfect candidate for LDES application!



Energy and power are independently scalable!

Energy ↔ Electrolyte volume

Power ↔ Cell/stack size

In addition:

- Very long cyclability (>10,000 cycles)
- High efficiency (>80%)
- No need for thermal management
- Competitive levelized cost of storage (LCOS) above 4h duration

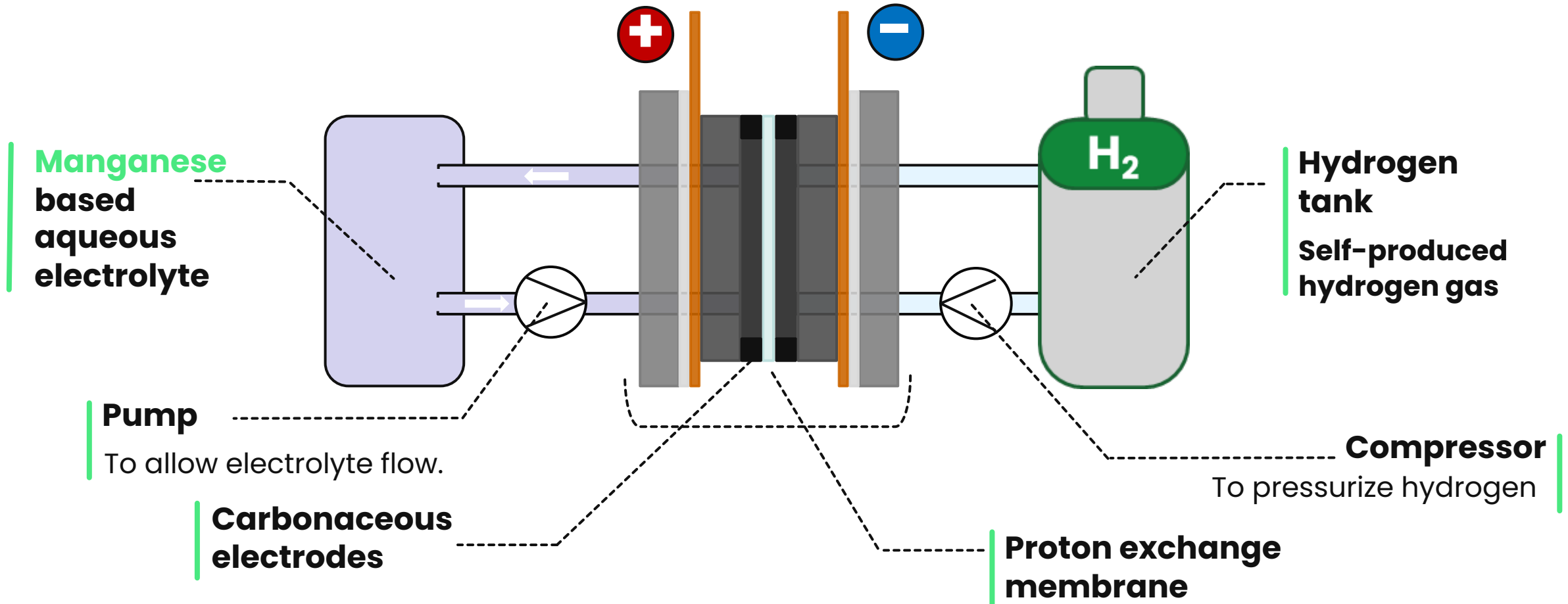
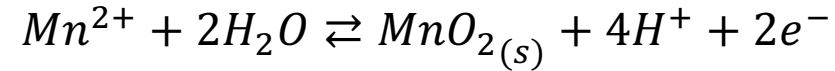
GES REDOX FLOW BATTERY



SoA Manganese use: 1 electron



GES: exploitation of two electrons



GREEN ENERGY STORAGE KPIS



1 High energy density >75Wh/l

The high energy density enables significantly reduced size and weight compared to traditional flow batteries

2 Energy efficiency >85%

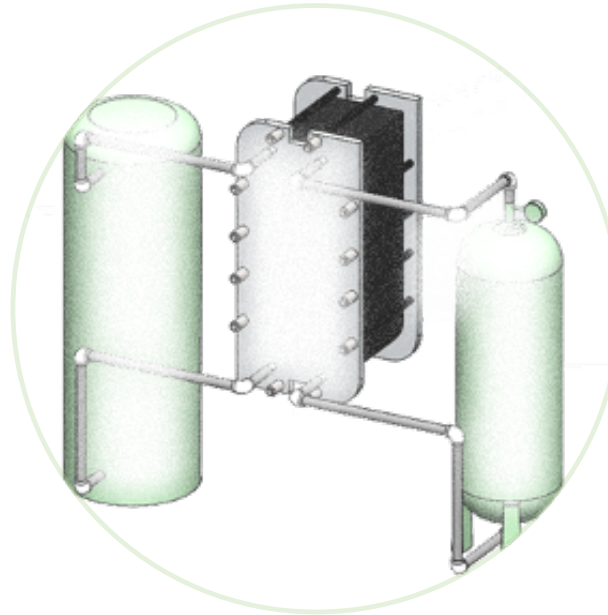
Energy efficiency is higher compared to the state-of-the-art of flow batteries and fuel cells

3 LCOS in MP <0,02 Eur/kWh/cyc

A low LCOS makes the product highly competitive, outlining a profitable and long-lasting investment

4 Self-discharge rate close to zero

It is a distinctive feature of this technology, enabling the system to be used in applications that anticipate disconnection from the electricity grid for long periods



5 Lifetime > 10k cycles

This number of cycles makes the GES battery a long-term asset which, based on its usage characteristics, can exceed 20 years

6 Room temperature

In addition to direct impact on safety, operating at room temperature enables use in different environments, both indoor and outdoor

7 Maintenance

The battery architecture allows the replacement of individual components quickly and with limited costs

8 High Sustainability & Recyclability

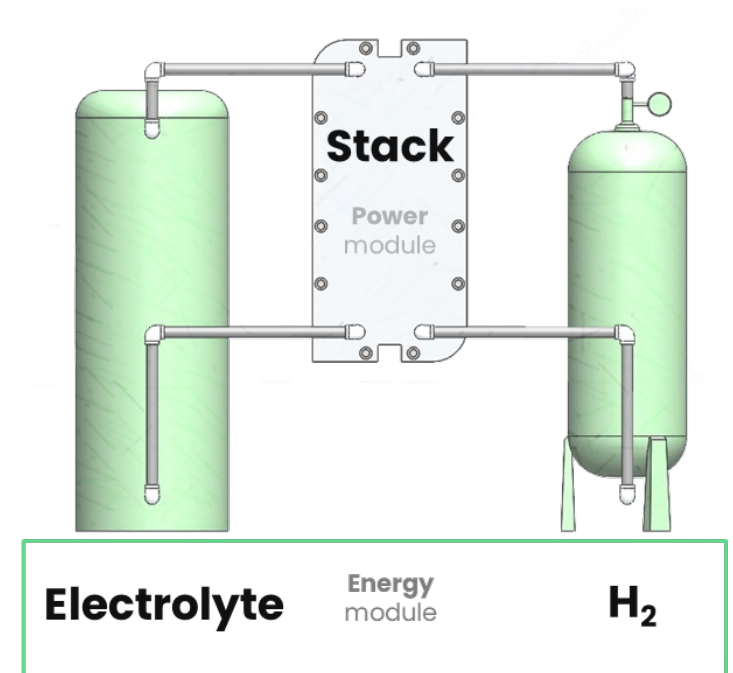
Environmental impact to be at minimum

GES RFB TECHNOLOGICAL ADVANTAGES



COMPARED TO OTHER BESS TECHNOLOGIES:

- **1 ACTIVE MATERIAL SUPPLY CHAIN:**
 - Abundant, Inexpensive and Safe catholyte active material
 - Secure supply chain of catholyte active material
- **HYDROGEN:**
 - NO need of supply chain, manufacturing industry for anolyte → cost saving
 - NO H₂ logistics
- **BATTERY:**
 - Very high energy density
 - NO Thermal management needed
 - Competitive forecasted LCOS value for duration >4h



H₂-GES RFB SYSTEM PROOF-OF-CONCEPT (LAB SCALE)



VALIDATION
OF THE
TECHNOLOGY

GES
Gas-Liquid cell

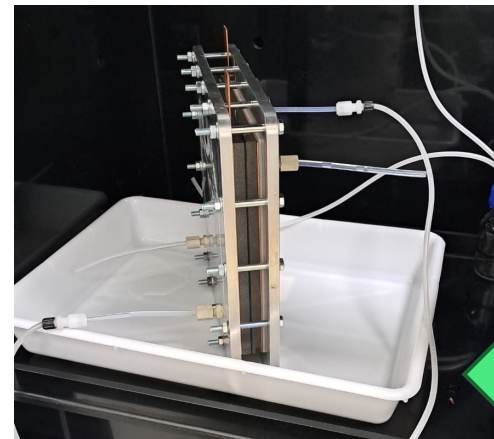
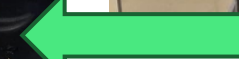
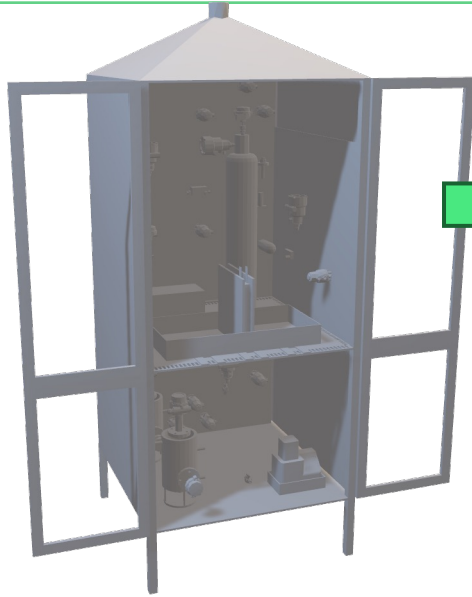
Time-lapse

Charge : H₂ production
Discharge : consumption of produced H₂

H₂-GES concept is functioning at closed circuit:

The hydrogen produced in charged is consumed in discharge to deliver energy

GES RFB SCALE-UP



CURRENT STATUS: SCALE UP

- Battery Balance-of-Plant design, including H₂ storage and management
- Battery hardware and software development for a complete performance characterization
- ATEX and safety standards → HAZOP development
- Test-bench manufacturing (currently ongoing)
- Mediums-scale preliminary tests

PARTNERSHIPS AND VALUE CHAIN



GES BM will slim and ease construction, production and supply chain of the value chain.
Partners are essential to **speed up the go-to-market process.**





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SOCIAL



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**Ministero delle Imprese
e del Made in Italy**

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