



# albufera

Energy Storage 

Advances on Aluminium  
electrochemistry for battery application

Nice, october 2018



ALISE ALION LEITAT VARTA

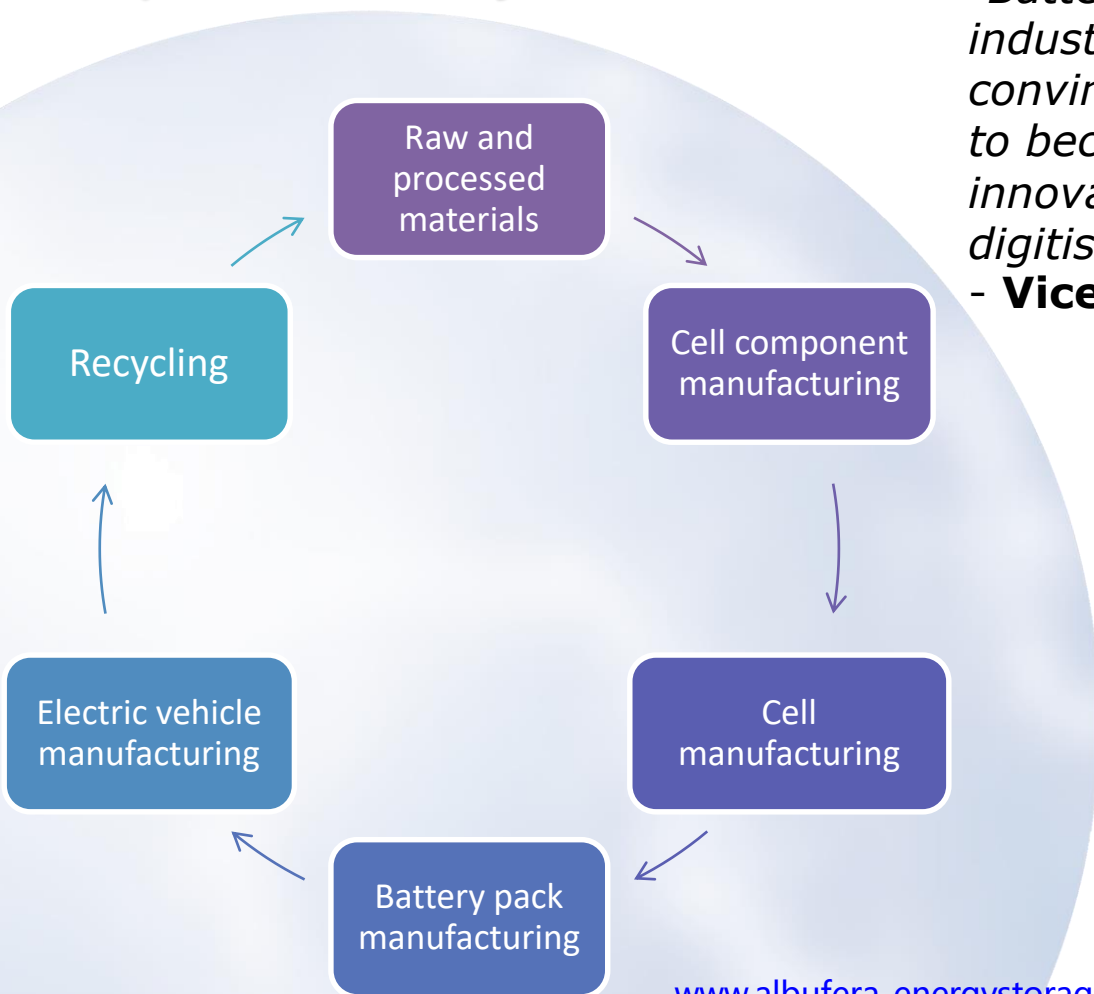
**Beyond Lithium-Ion Workshop**  
From Current Research to Industrial Application

October 2<sup>nd</sup>, 2018  
Nice Acropolis, France

Organized by Leitlat and VARTA Microbattery

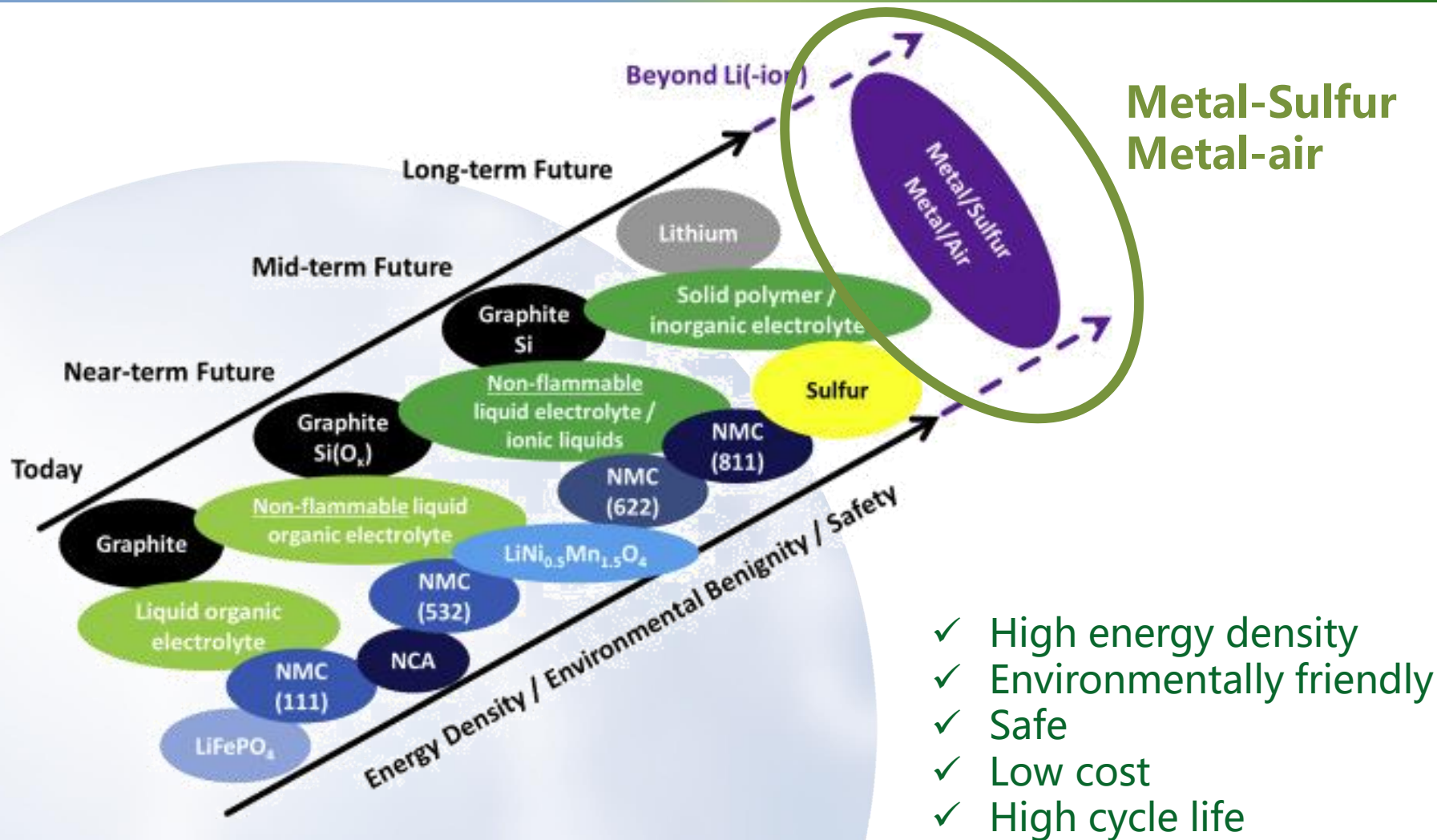
 These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements N° 666157 and N° 686646.

## European Battery Alliance



*"Batteries are at the heart of the industrial revolution and I am convinced that Europe has what it takes to become the world's leader in innovation, decarbonisation and digitisation."*

**- Vice-President Maroš Šefčovic**



\* <https://doi.org/10.1016/j.jpowsour.2018.02.039>



# Who are we?

## • Projects:

- ✓ **ALION** (H2020 NMP13-2014, GA: 646286) – Al-ion
- ✓ **ALPAM** (Spanish Ministry of Defense) – Al-air
- ✓ **CEBRA** (Spanish Ministry of Economy, Industry and Competitiveness) – Air cathode
- ✓ **ALIENA** (Spanish Ministry of Economy, Industry and Competitiveness) – Al-air
- ✓ **SALBAGE** (H2020-FETOPEN-1-2016-2017) – Al-S

## • Patents:

- ✓ **ES254017A1** “Celda electroquímica de aluminio/manganeso”
- ✓ **ES3432.2** “Celda electroquímica de aluminio/aire recargable”



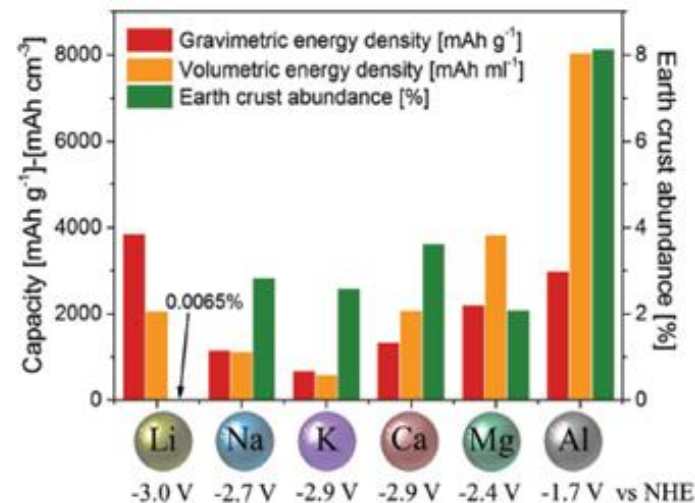
- ✓ In the Madrid Science Park (PCM)
- ✓ In a 100 m<sup>2</sup> laboratory full of specific equipment: Glove Box, Potentiostat, Press, 3D printer...



# Why Aluminium?

## Aluminium as **anode**:

- ✓ Third most abundant element on the Earth Crust
- ✓ Very interesting theoretical numbers:
  - Capacity= 2.98 Ah/g
  - Specific energy= 8.1 kWh/kg
  - Energy density = 22 kWh/l
- ✓ Abundant, cheap, easily handled, non dangerous
- ✓ Environmentally friendly
- ✓ High recyclability rates



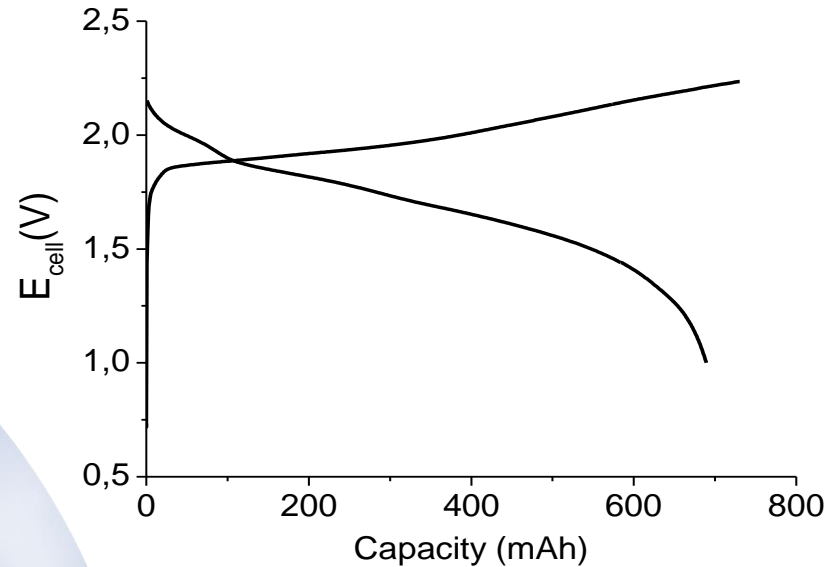
## Aluminium battery roadmap

2020  
Al-C

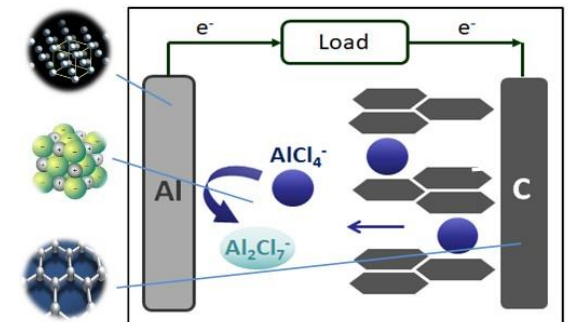
2025  
Al-air

2030  
Al-S

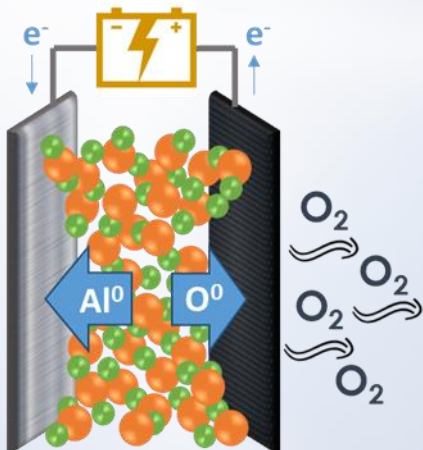
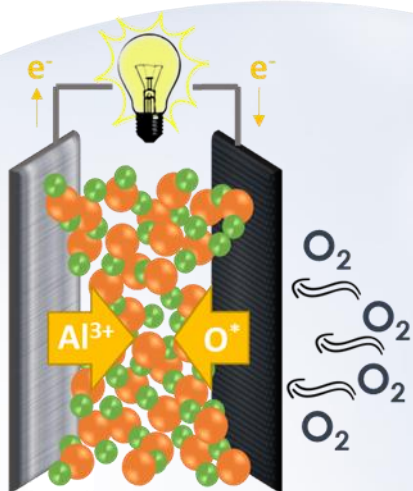
2020 → Al-C



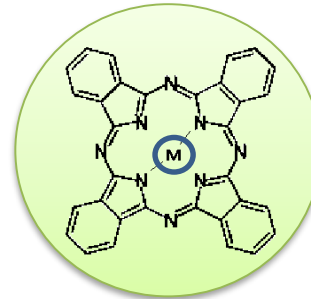
- Energy density: actually 50-60 Wh/Kg → expected 100-120 Wh/Kg
- High cycle life: up to 7000 cycles
- High efficiency >90%
- Safety and sustainability increase
- High recycling rate (>80% Al-ion vs. <50% Li-ion)
- Cost reduction
- Ultra fast charge



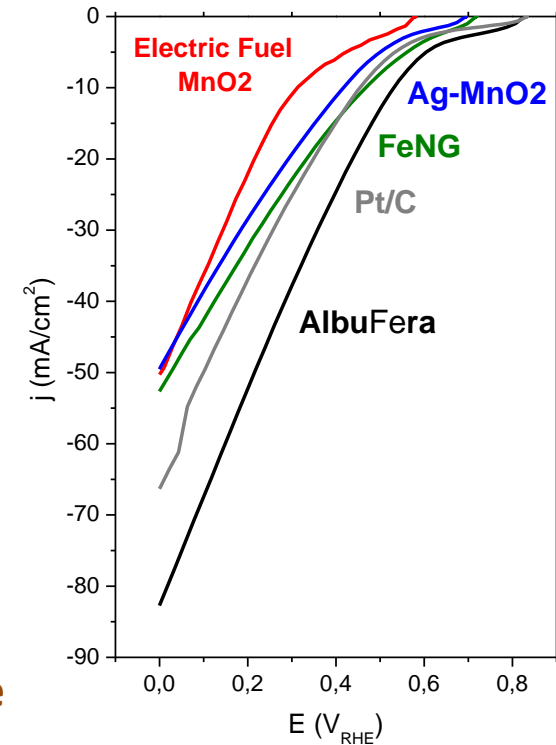
2025 → Al-air



## New air cathode:

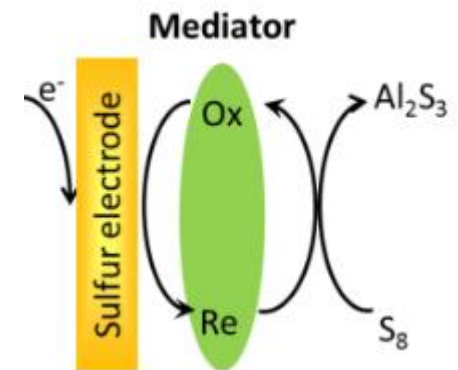
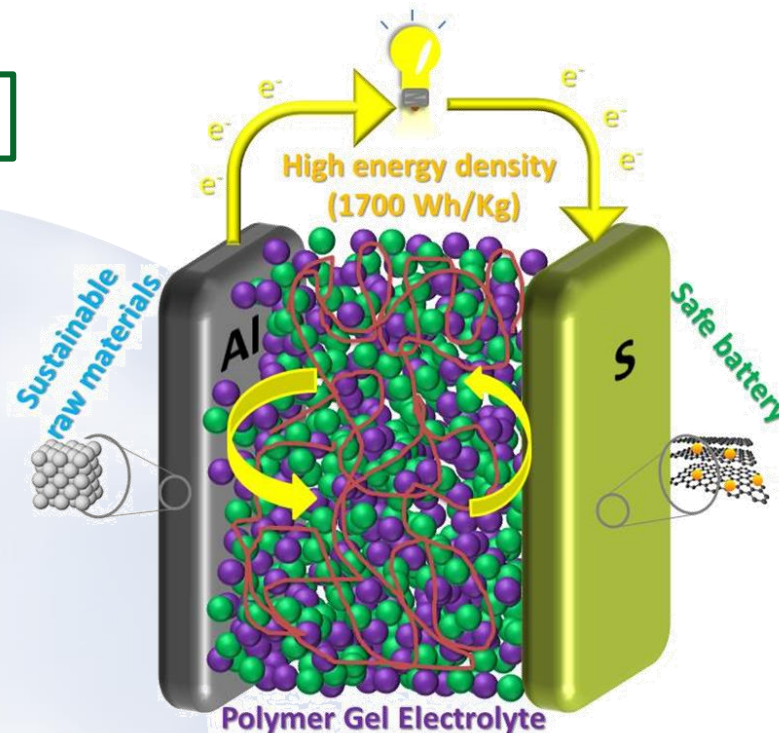


- High gravimetric energy density
- High volumetric energy density
- Lower cycle life
- Safety and sustainability increase
- High recycling rate
- Cost reduction
- Low power applications





2030 → Al-S



Schematic representation of redox mediators function.

- Ultra high energy density (up to 1.7 kWh/kg)
- Safety and sustainability increase
- Polymeric gel electrolyte → flexible battery
- Very low cost
- High recycling rate



# Thank you for your attention!

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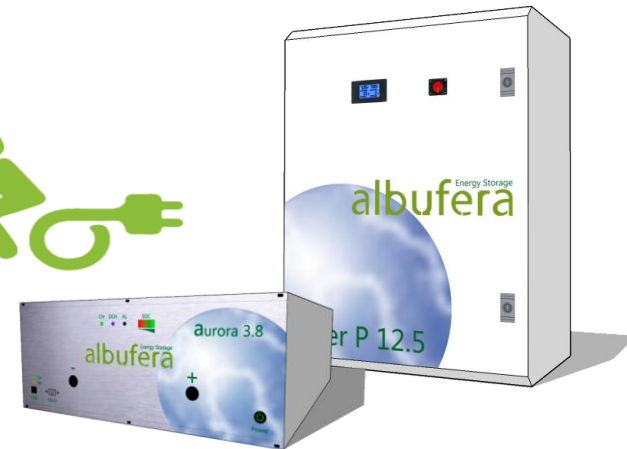


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Instituto de Almacenamiento Energético Albufera

**MaBIC**  
Metal Air Batteries International Congress



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