JORNADA D'ECOSISTEMA DE TRANSFERÈNCIA
I INNOVACIÓ EN ENERGIA

XRE4S
XARXA d'R+D+I
ENERGY FOR SOCIETY

TRANSHENER 2.0

IREC
Shaping Energy for a Sustainable Future

# *3D Printing Solid Oxide Fuel Cells*

## Nanoionics & Fuel Cells Group

## *Institut de Recerca en Energia de Catalunya*

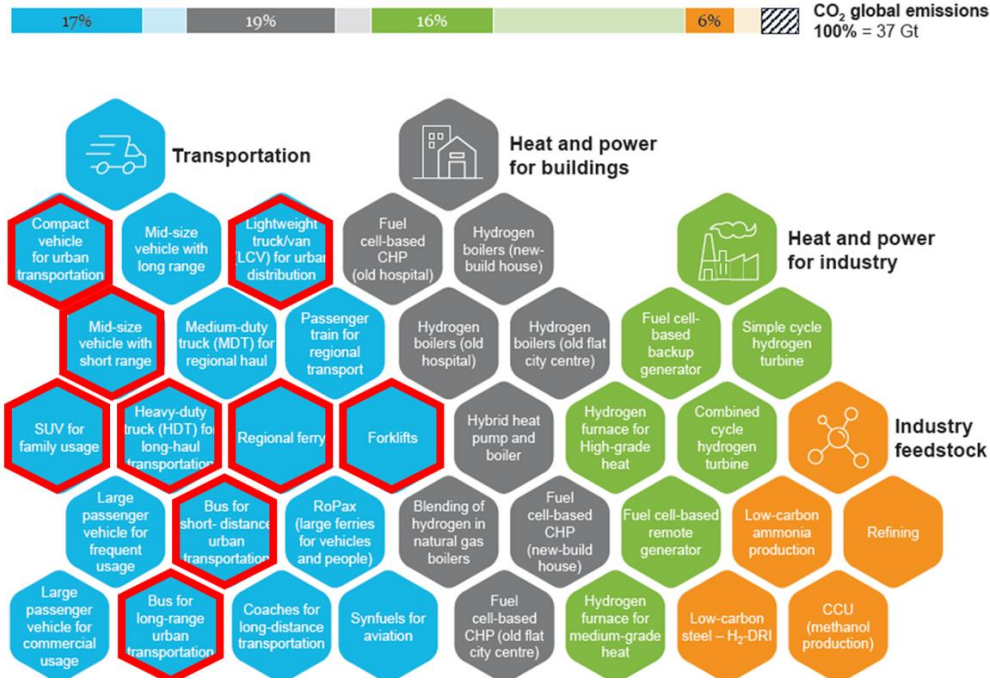
IREC
Shaping Energy for a Sustainable Future

Barcelona 21st June 2023

***Marc Torrell Faro***

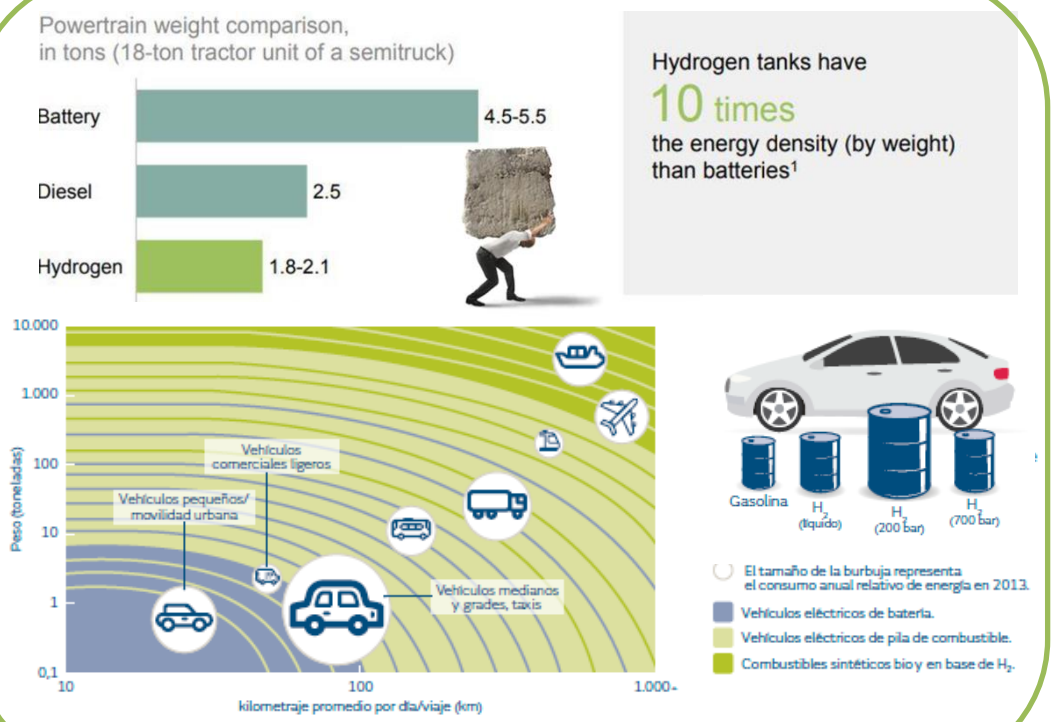
# CHALLENGES AND MARKET

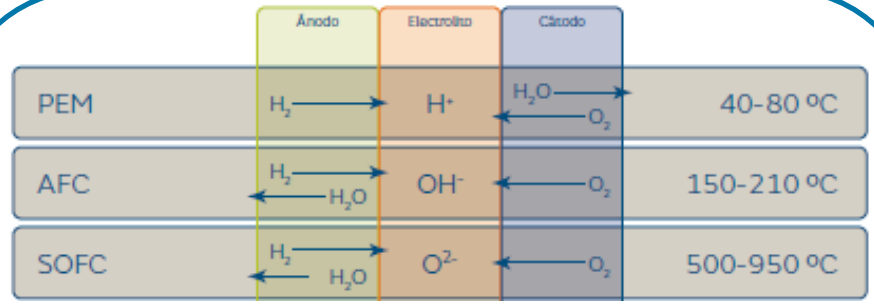



- EU takes ***$H_2$ as key energy vector*** *for the decarbonisation.*
- Renewable energy based scenario ***requires EFFICIENT hydrogen technologies***
- ***EU needs new actors producing and developing Fuel Cells & Electrolysers***
- ***Heavy transport sector*** *will be* ***decarbonised by the use of Hydrogen Technologies***

# CHALLENGES AND MARKET




**Tipos de pilas de combustible**

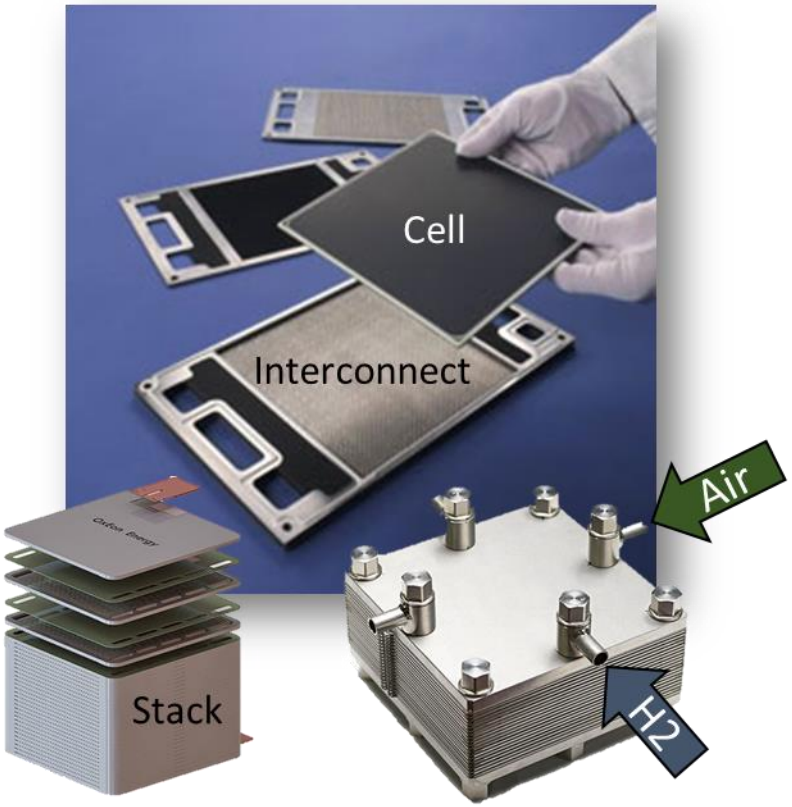
| | PEFC | AFC | PAFC | MCFC | SOFC |
|---|---|---|---|---|---|
| Combustible utilizado | Hidrógeno o metano | Hidrógeno | Hidrógeno | Metano | Hidrógeno o metano |
| Rango de potencia (kW) | 1-100 | 1-100 | 5-400 | 300-3.000 | 1-2.000 |
| Eficiencia (%) $H_2/CH_4$ | 60/40 | 60/- | 40/- | -/50 | 70/60 |
| Temperaturas de operación (ºC) | 40–80 | 65–220 | 150–210 | 600–700 | 600–900 |
| Aplicación | Transporte Electricidad Cogeneración Generación distribuida | Electricidad Aplicaciones espaciales | Electricidad Cogeneración | Generación estacionaria a gran escala | Electricidad Cogeneración Generación distribuida |

- ***PEM is nowadays the adopted solution due to better mechanical properties for mobile applications.***
- ***SOFC are ceramic based devices working at high temperatures presenting higher efficiencies.***
- ***Ceramic manufacturing has been limited to planar and tubular cells.***

# SOLUTION/PRODUCT

**State of the Art in SOFC:**

- Flat ceramic cells (ESCs/FESCs)
- Complex metallic interconnects



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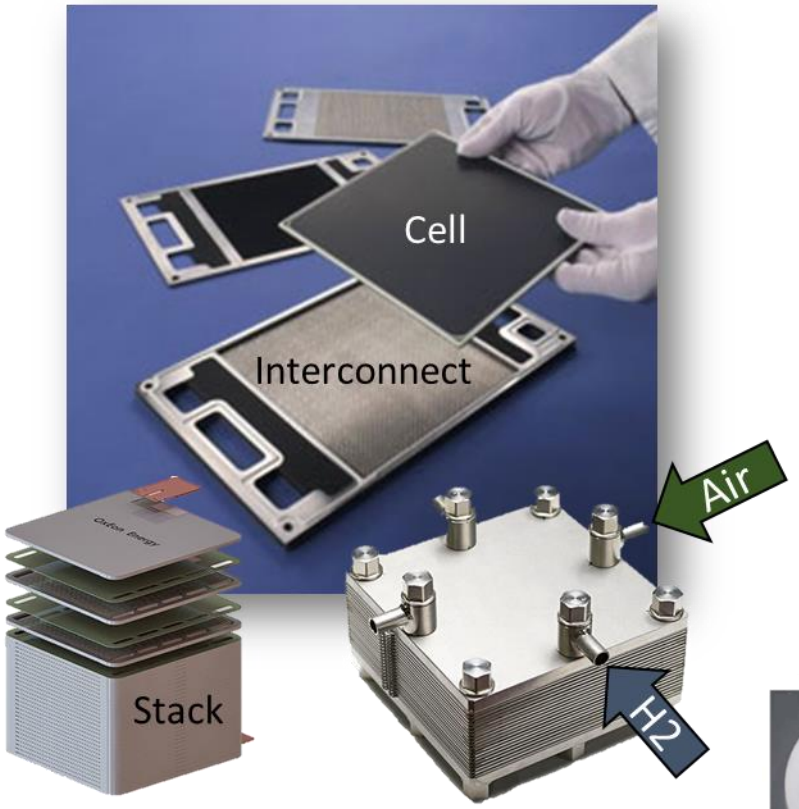
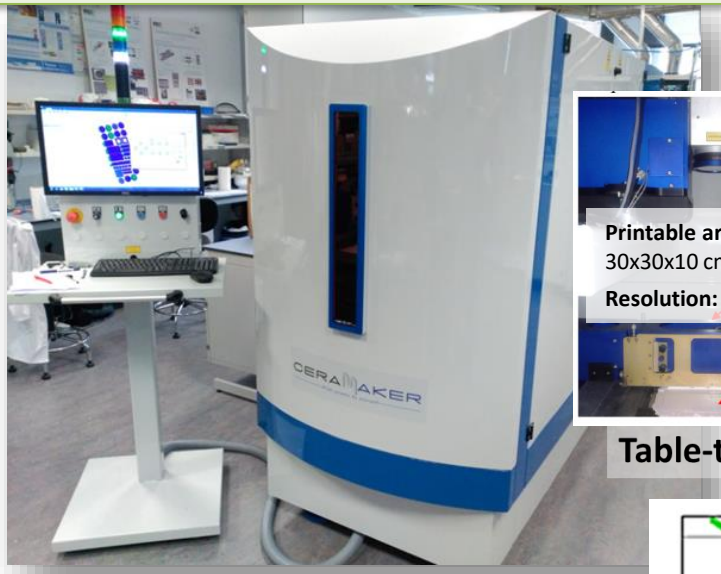



*Disruptive solution based on 3D printing of ceramics by SLA*




**INDUSTRIAL SLA printing**:

- Layer-by-layer (doctor blade)
- Laser photo-polimerization

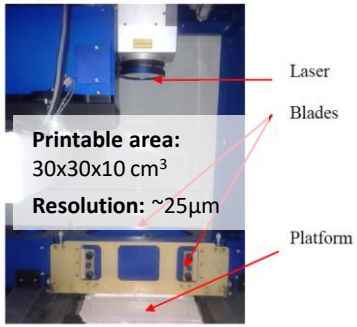
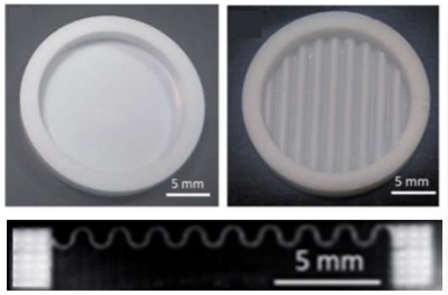
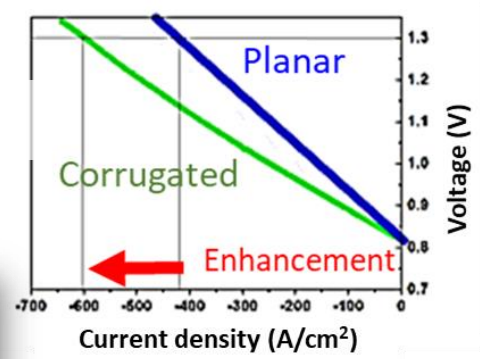



**Table-top factory**

Enhanced performance

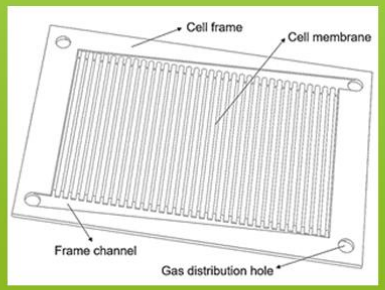



# SOLUTION/PRODUCT

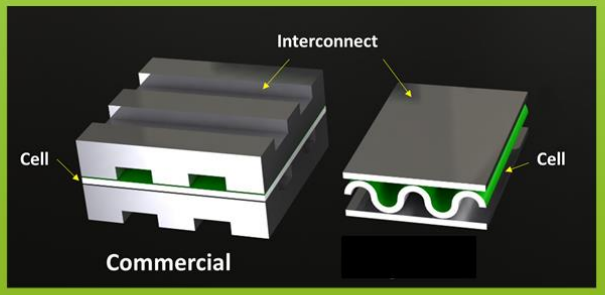
## Game-changing ultra-compact SOEC stack…

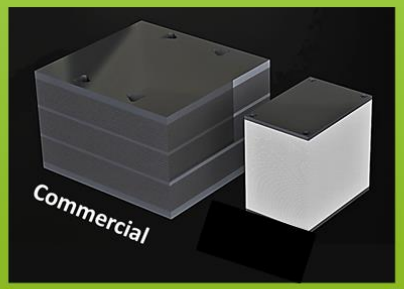
3D cell with functionality

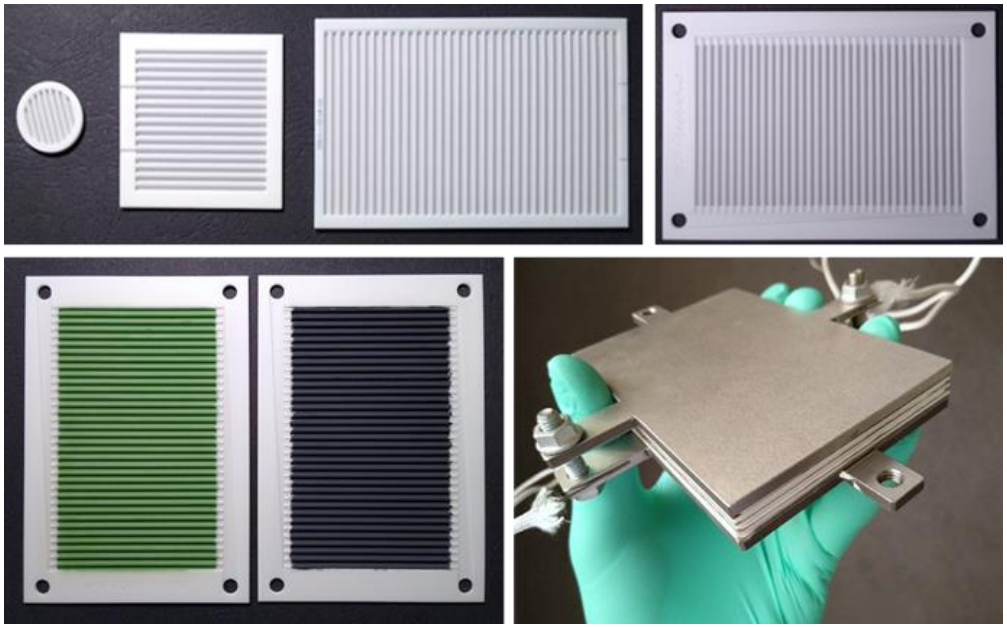



Flat and thin interconnects


Simple stacking, more active area and great compactness



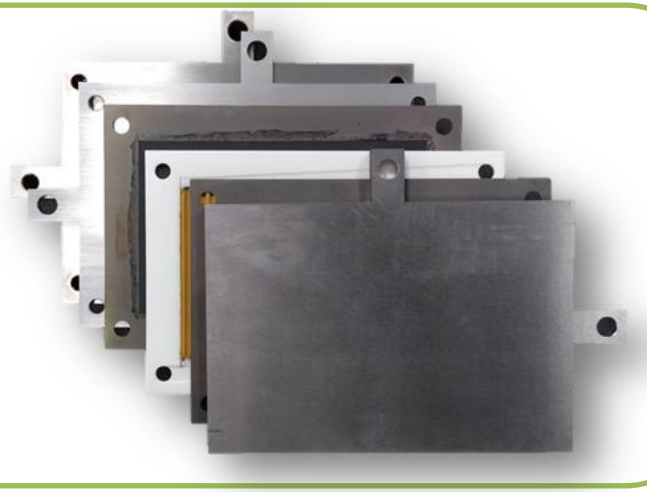



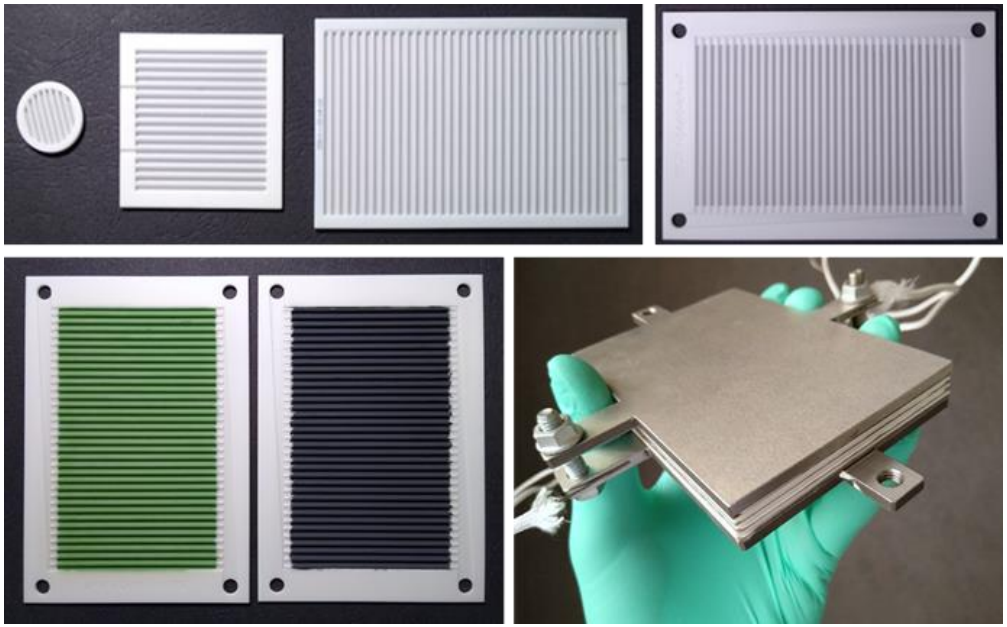




***TRL 4-5 → Market deployment 2028***
***Based on SoA Materials and high MRL***

# SOLUTION/PRODUCT

- *Higher active area/ Higher performance*
- *Better mechanical properties*
- *Flexible design and fabrication*
- *Higher volumetric and gravimetric power density*






***TRL 4-5 → Market deployment 2028***
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# DEVELOPMENT PLAN

*The main added value of 3D-POWER is to develop an innovative and zero-emission portable power source suitable for mass customization. The 3D-POWER technology represents a new paradigm for the use of highly efficient solid oxide fuel cells in portable applications realized with emergent 3D printing technologies.*

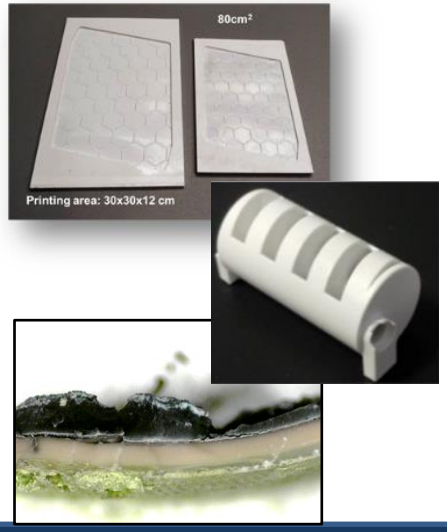
*The developed and deployment of these novel 3D energy concepts will result in a new family of standalone power sources with superior performance capabilities, quick start-up and high specific power and energy density suitable for portable applications.*

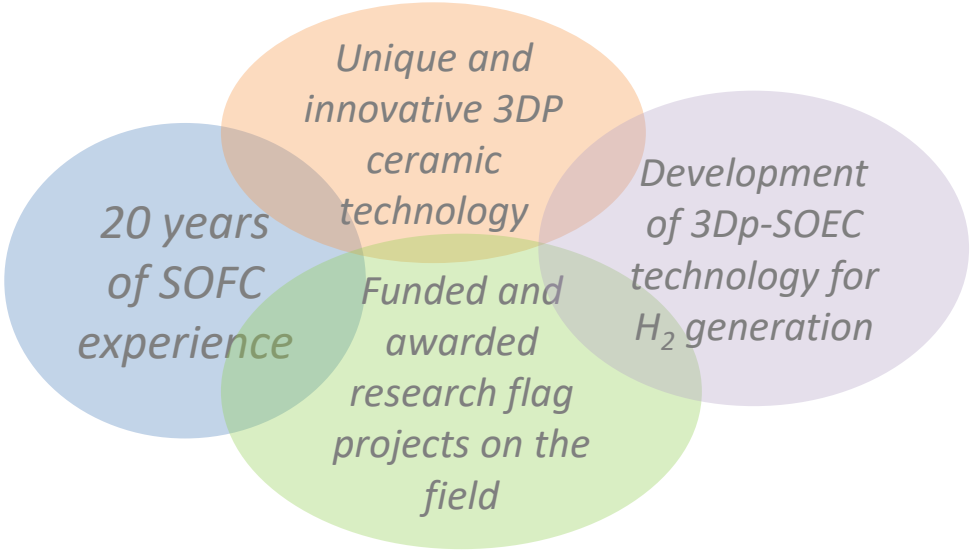
- ***Three IPR (Patents) on the field***

*EP3754768A1 Granted*

*EP22383154 Filled*

*EP4138165 Filled*



# TEAM

*…leading a 35 researchers team*

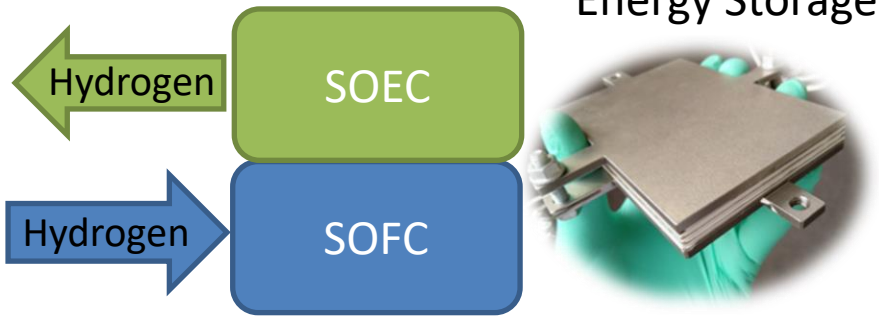
Prof. Albert Tarancón
*ICREA Professor*
*Group Leader*

Dr. Nerea Alayo
*Researcher at IREC*
*Business developer*

Dr. Marc Torrell
*Senior researcher at IREC*
*SOC & 3D activities coordinator*

## Collaborators & Projects

SOC Reversible technology




BACKGROUND

SOEC **>20M€ approved investment**

CLEANHYPRO
Open Innovation Test Bed for Electrolysis Materials for CLEAN HYdrogen PROduction

NEEDS

SOFC **Spin-off foundation (on going)**

- *Partners*
- *Projects*
- *Market*

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**Con financiación de:**

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MINISTERIO DE CIENCIA E INNOVACIÓN
AGENCIA ESTATAL DE INVESTIGACIÓN