



« *Beyond Li-ion batteries* »

## How to achieve zinc-air battery competitiveness for stationary energy storage systems

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

Emmanuel BENEFICE

CEO

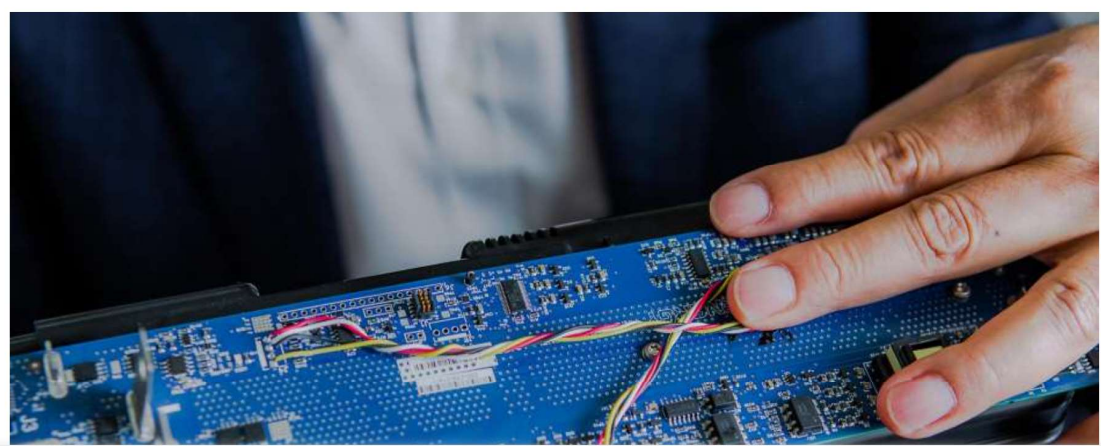
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Zinium est une filiale  EDF

BIZ & TECH // BUSINESS

# Zinc-air batteries touted as cheaper than lithium-ion for storing renewable energy

By Cathy Bussewitz | Sep. 26, 2018 | Updated: Sep. 26, 2018 5:36 p.m.



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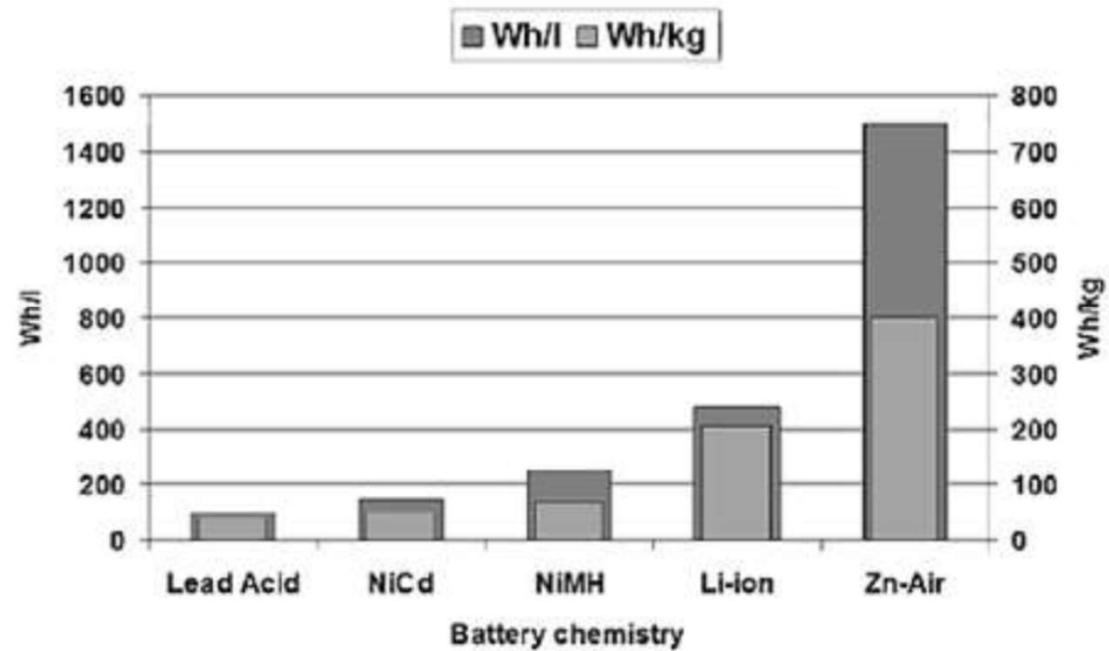
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## How to achieve zinc-air battery competitiveness for stationary energy storage systems ?

1. Choose zinc and air for safety, low cost and material availability
2. Implement a robust zinc-air technology securing performance and lifetime
3. Design an ESS product with cost goals, not only zinc-air cells
4. Develop customer-oriented products and go to market on time : 2021

# Why zinc-air ?

## Energy density benchmarking

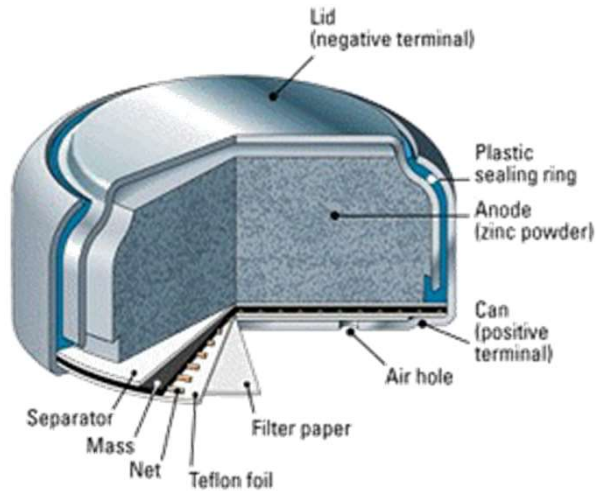


Source : Dalhousie University (Canada)

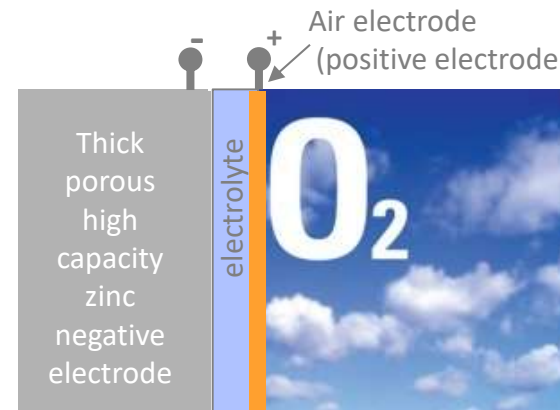
## Zinc-air batteries

From primary cell

To secondary « breathing » cell



**Zinc air button cell**



*A zinc-air secondary cell uses the oxygen of the ambient air for its redox reaction, with the anode zinc, within a liquid alkaline electrolyte.*

*While discharging, oxygen molecules pass through the selectively permeable membrane of the air cathode.*

*While charging, the cell rejects pure oxygen in the air.*

## About safety

### *Usual approach*

- Cooling liquid
- Admit thermal run-away hazard
- Reduce risk through
  - Small size packaging in shipping
  - active BMS in operation



### *Zinc-air approach*

- Natural air cooling
- Aqueous electrolyte
- **No** risk of thermal run-away
- Need of a BMS to optimize zinc-air lifetime, not for safety

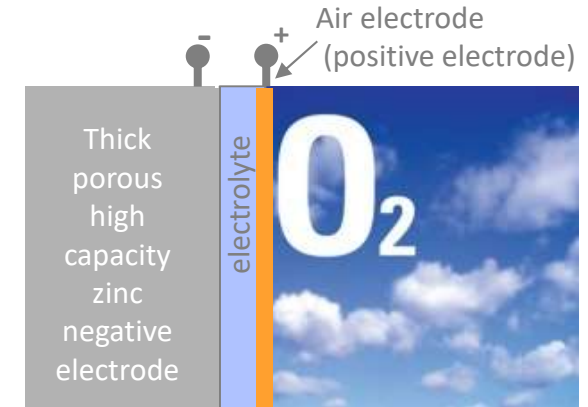
## Usual approach

- Optimize both anode and cathode costs
- How to limit use of expensive raw materials ?
  - Ex. Cobalt, Lithium
    - Risk of shortage ?
    - Strategic risk ?

## About costs

### Zinc – air approach

- Anode : no expensive raw materials, no rare earth
  - Zinc
  - $\text{Ca}(\text{OH})_2$ ..
- Cathode : free  $\text{O}_2$  from ambient air, electrode limited to a thin GDL membrane (C,  $\text{MnO}_2$ ..)
  - Low cost
  - Low weight
- Target density at cell level  $> 150 \text{ Wh/kg}$



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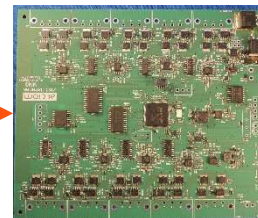
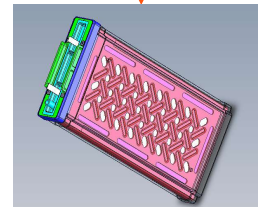
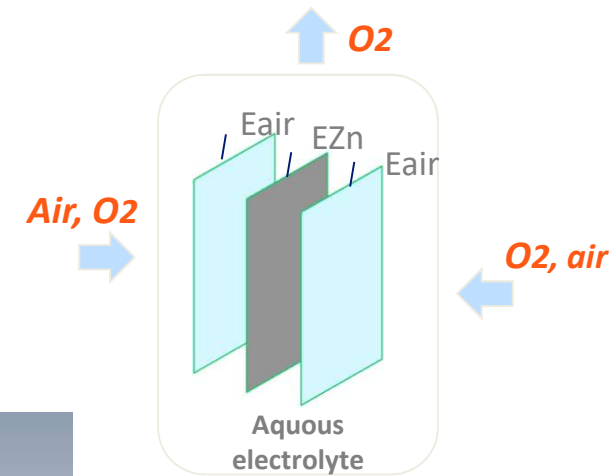
## Zinc-air secondary cells by Zinium, a unique design from the EDF labs to Zinium

- **2017 : Zinium Generation A**

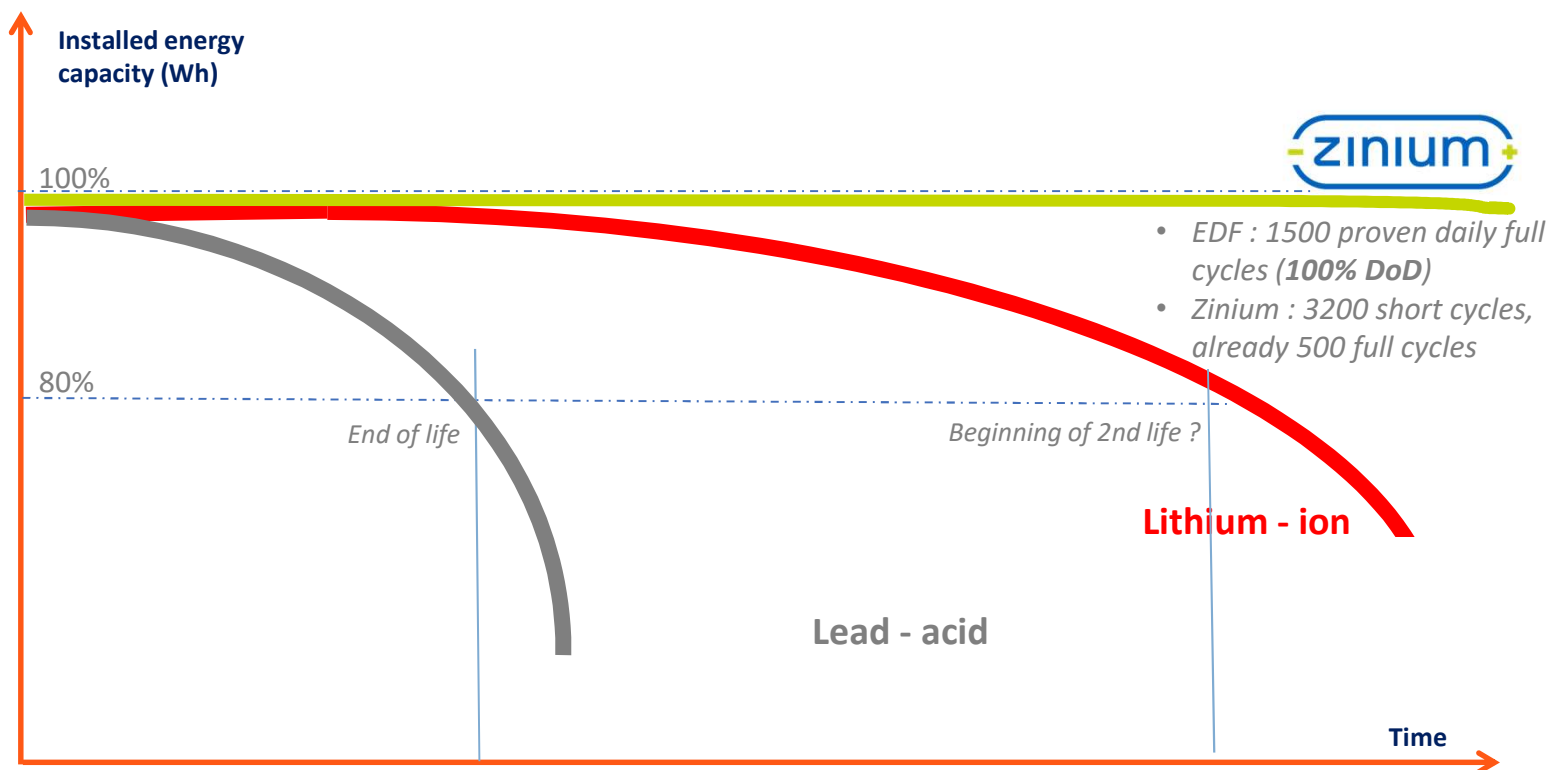
- Central Zinc anode 100cm<sup>2</sup>
- 2 Air electrodes for discharge
- Aquous alkaline electrolyte
- Nominal discharge voltage 1.2 V
- « Ready to make » 18 to 30 Ah cell design
- MMS piloting 10 cells in charge and discharge

- **2018 : Zinium Generation B1**  
R&D developments launched for industrial production in 2020

- Larger size
- Enhanced density
- Optimized efficiency and stability
- Easier to produce




## Zinium compared to other technologies : a long duration capacity - the use of all the capacity

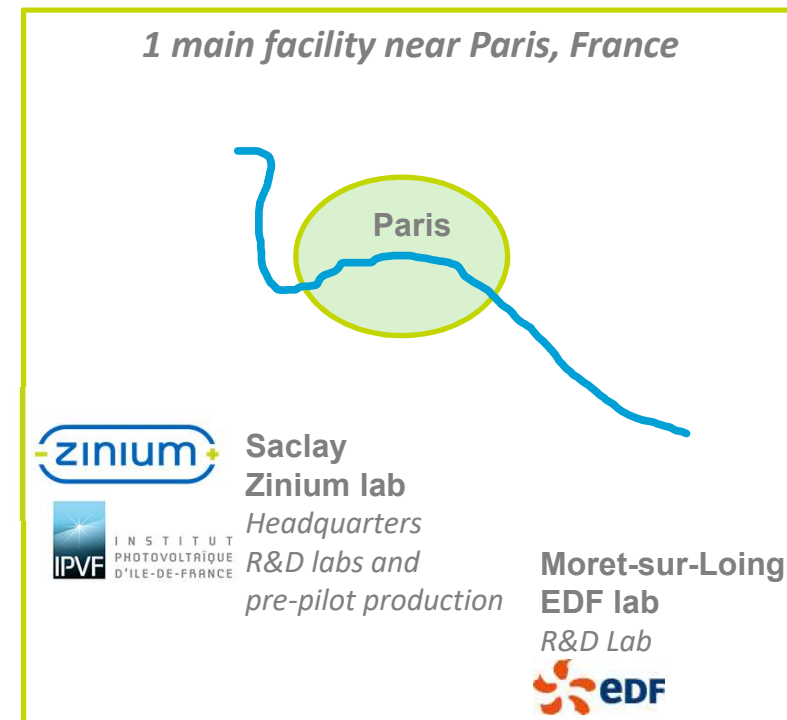




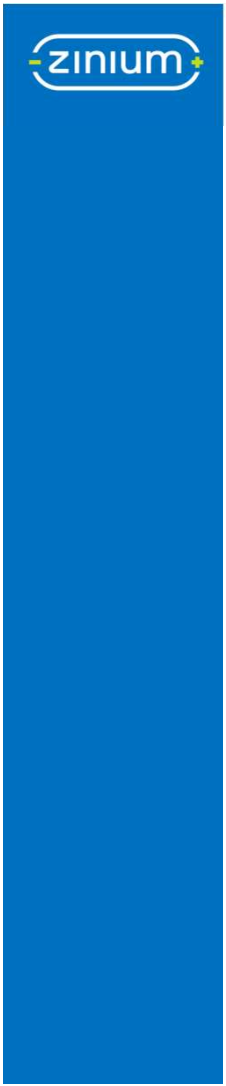
# Who is



- Company : **ZnR Batteries**, created in July 2016
- One commercial brand  protected in EU, USA, West Africa, Morocco, Singapore, etc..
- Spin-off company of EDF Labs
- Shareholder : EDF 100%, through EDF Nouveaux Business Holding
- Zinium develops :
  - Zinc-air secondary batteries (cells and modules)
  - Energy storage systems, based on zinc-air technology
- Team of 16, including 3 PhD and 8 engineers

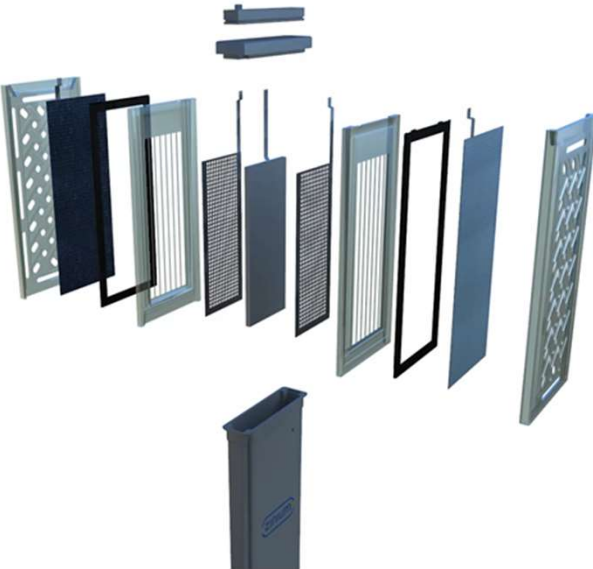


Zinium is a subsidiary of  **EDF**



# Rechargeable zinc-air by Zinium :

from Gen A cell to module, from module to system



1 kWh, 30 cells



5 kWh

- The charge or discharge rate is 6 to 10 hours : 1 cycle / day



## Our future Zinium modular systems for stationary storage

### Residential pack 5 or 10 kWh

A pack is a stand-alone autonomous system made of

- 1 Pod
- 5 or 10 modules of 1 kWh each, easy to handle and carry.  
1 module = 20 kg.

Output voltage :  
48V DC



### Scalable systems, up to several hundreds of kWh



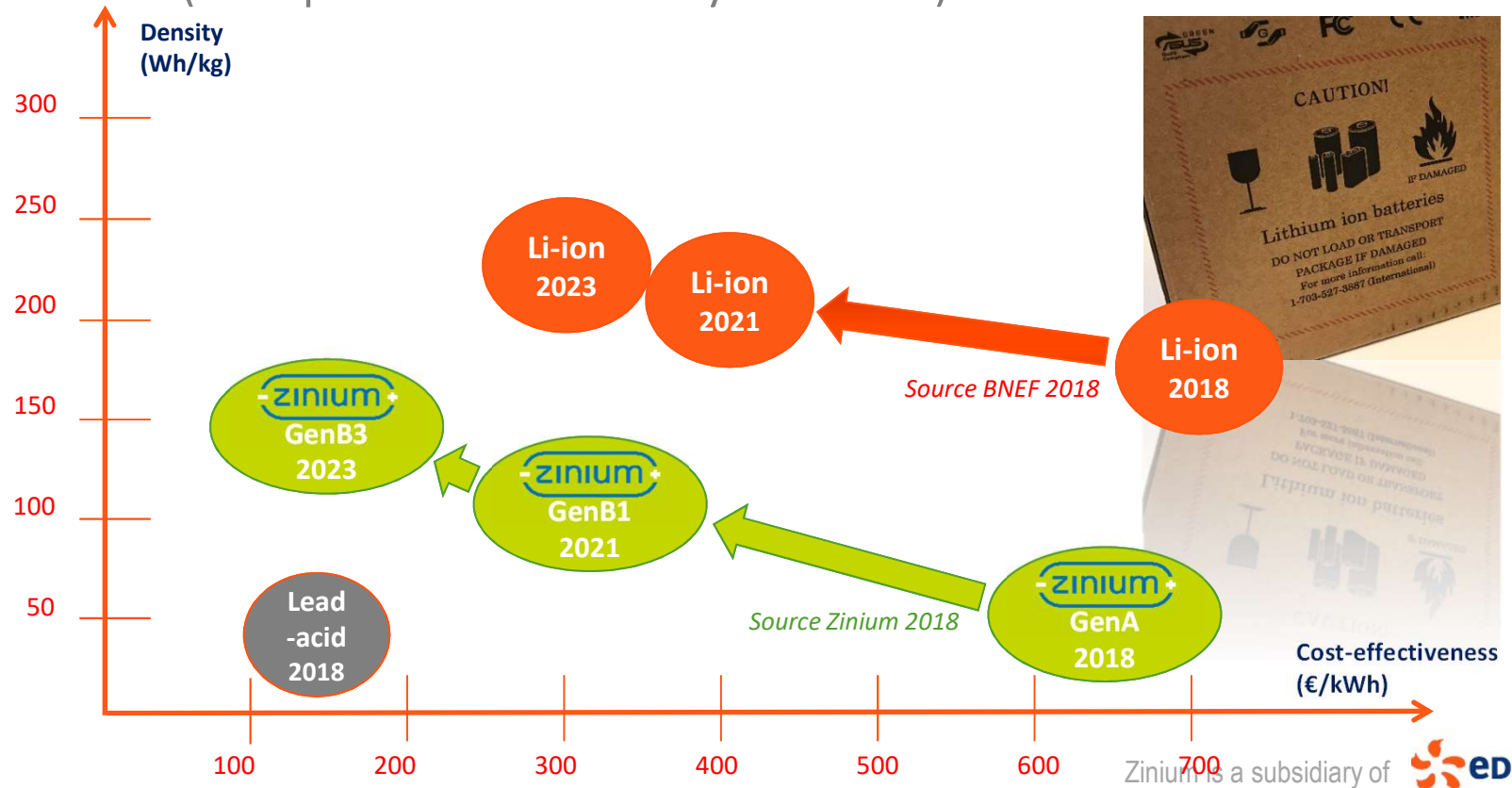
*Gen A2 20 kWh Unit  
Prototype September 2018*

Zinium is a subsidiary of





Zinium compared to Li-ion (residential ESS 10kWh): safe, non-polluting,  
- dense enough for the selected use case  
- low-cost (total production cost at system level)

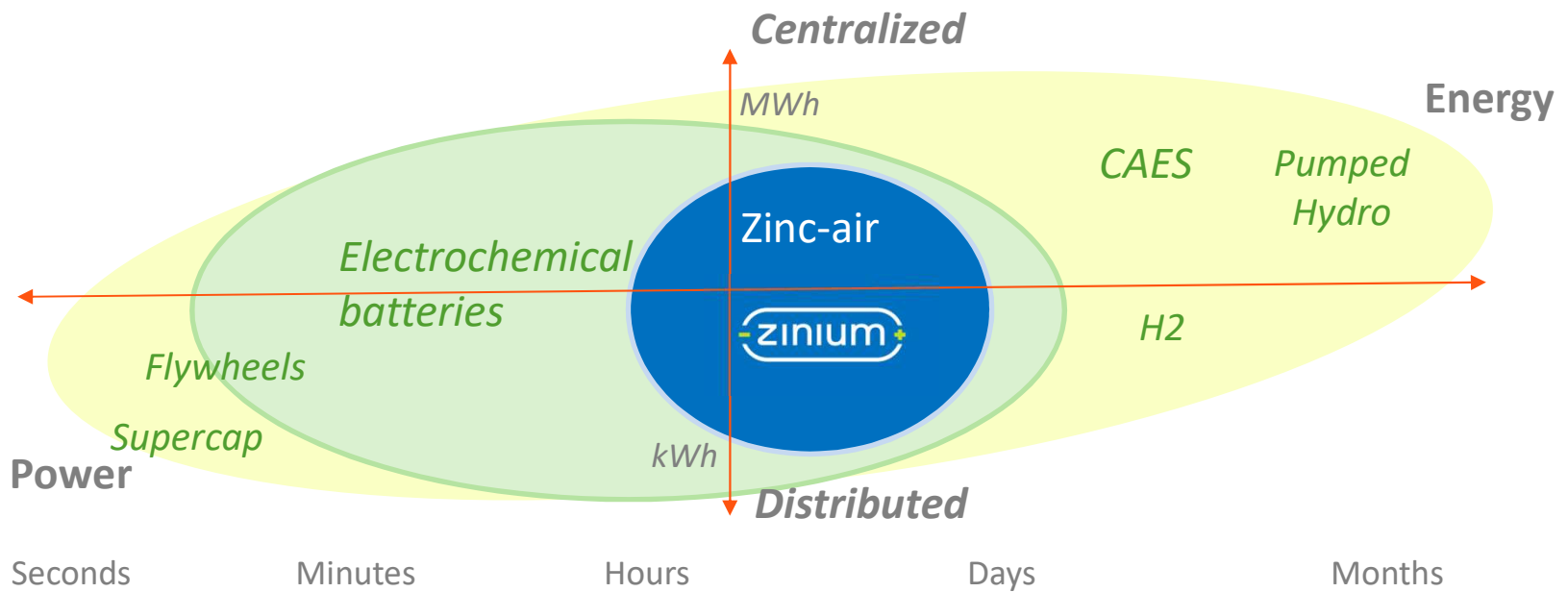


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2021



# Use case for zinc-air : energy rather than power



*Possibility to be explored : hybridize zinc-air with power-oriented technology*





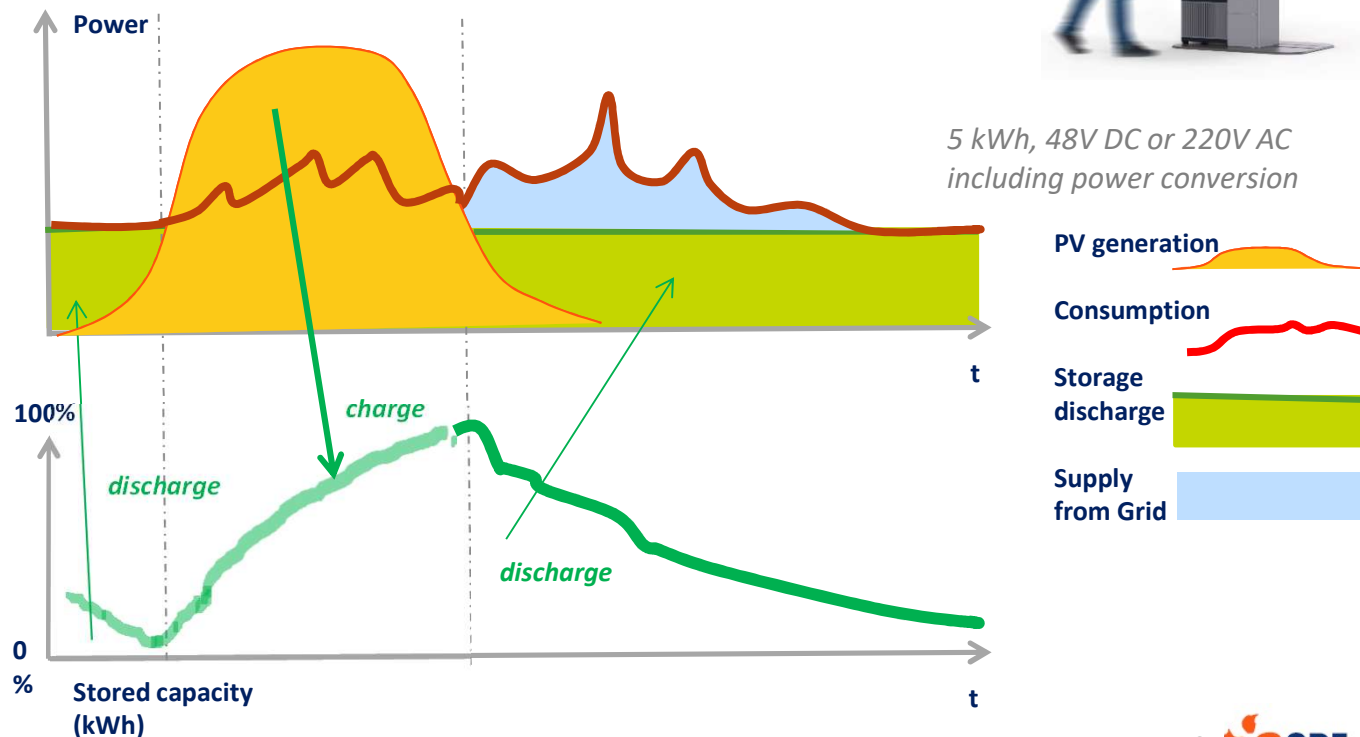
### Use case #1 :

Residential house with PV on reliable grid.

solution : increased self-consumption rate



5 kWh, 48V DC or 220V AC  
including power conversion



- ✓ No loss of power production
- ✓ Less power supply from grid at peak hours

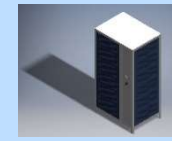
## Target markets for Zinium products



5-20 kWh



20-200 kWh



20-200 kWh

**Zinc-air residential storage system on reliable grid**

Markets : advanced countries in energy transition

**Zinc-air commercial and industrial storage system on grid**

Markets : advanced countries in energy transition

**Zinc-air hybrid system for off-grid or microgrid applications**

Market : isolated sites in any country, island grids

## Zinium next steps



2018

Generation A  
zinc-air cell

Residential  
demonstrator  
Gen. A  
*5-10 kWh*

Demonstrator  
pre-pilot line



2019

Generation B1  
high density  
zinc-air cell

Off-grid /  
microgrid  
demonstrators  
Gen. A and B  
*10-20 kWh units*

R&D on  
manufacturing  
process

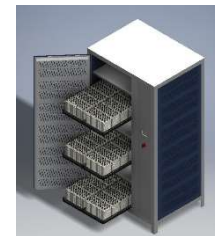


2020

Generation B2  
zinc-air cell  
Hybrid systems

Target market  
Gen. B  
products  
*10-20 kWh*  
*N x 20 kWh*

Pilot line design  
and building



2021

Pilot line  
go live

**Go market**



Thank you for your attention

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<http://www.znr.fr>



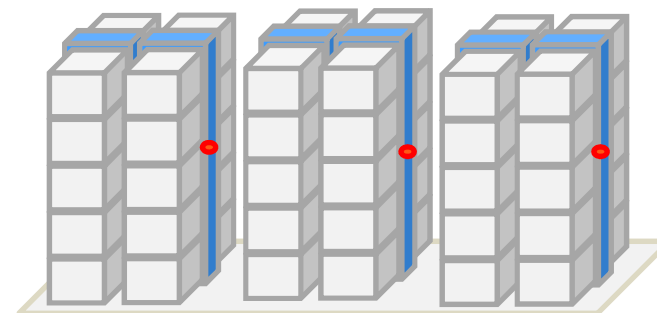
@ziniumfr

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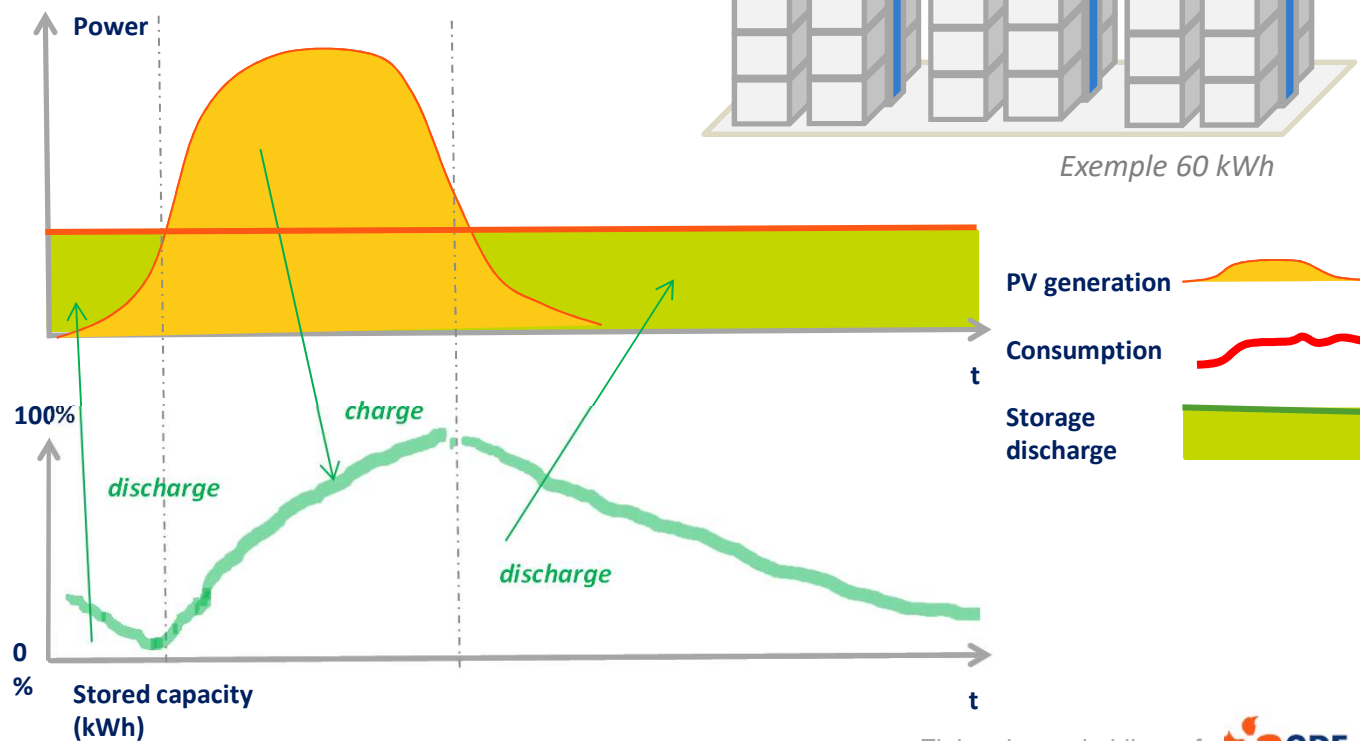


- ✓ No genset
- ✓ No lead-acid batteries
- ✓ Less maintenance cost

Use case #2 :  
Off-grid telco tower  
Solution by



Exemple 60 kWh





Use case #3 :  
Off-grid house/village with PV  
Hybrid solution by 



10 kWh, 48V DC or 220V AC  
including power conversion

- ✓ No loss of power production
- ✓ Less power supply from grid at peak hours

