

**POWEO**

**Keynergie**  
STRATÉGIE ■ INNOVATION ■ ÉNERGIE

**Sether:**

**Innovative large scale electricity  
storage system**

**Damien Levecque**

**Clean Tuesday – 14th december 2010**





**❑ Need for new large scale electricity storage facilities: a big potential market**

❑ **SEThER**, an innovative technology presenting some competitive advantages

❑ **Nexts steps to develop industrials solutions using this technology**

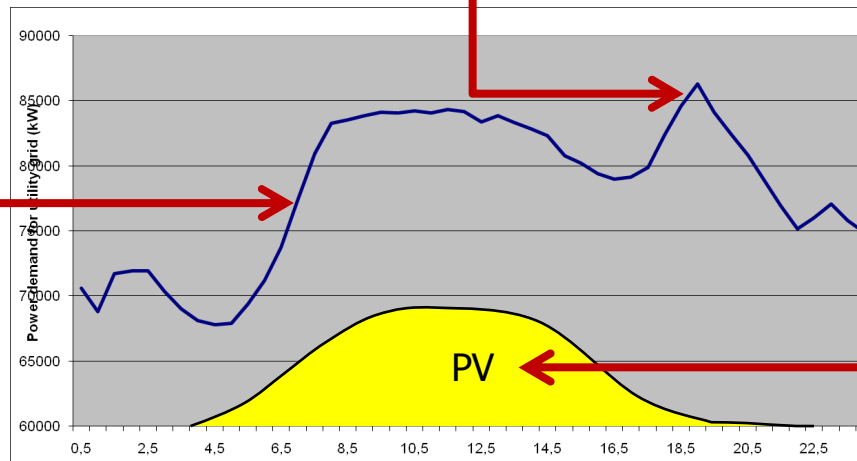
# Challenges for the grid: an increasing need for electricity storage



Electricity demand varies significantly across the day and the year

Average electricity demand increases but the peak of electricity demand increases more rapidly

Development of intermittent renewable energy technologies such as wind, solar PV...



## Electricity storage is needed:

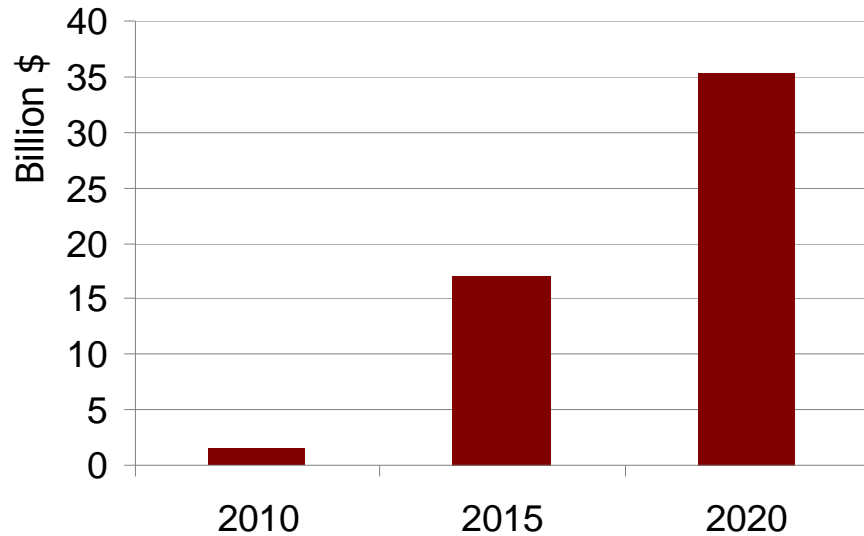
- To avoid investment in peak load capacity
- To balance supply and demand
- To facilitate the continue development of intermittent production such as PV and wind



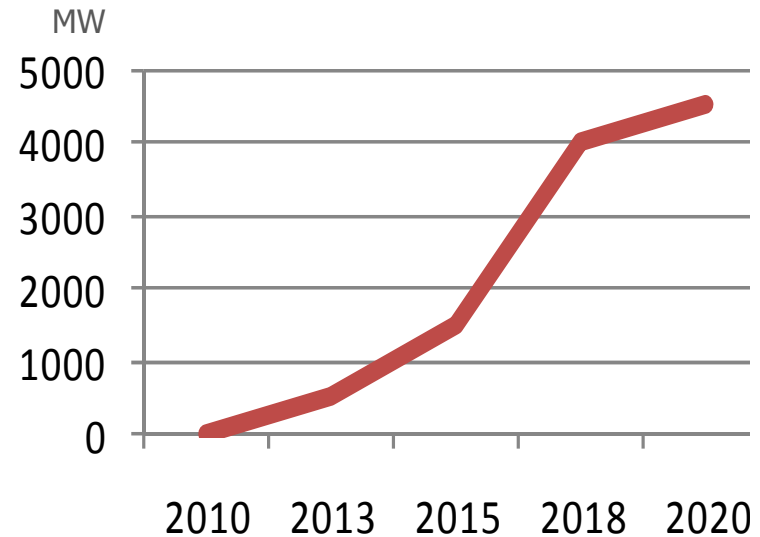
# Global grid-scale energy storage market

**The worldwide grid-scale energy storage market could represent up to 35 billion \$ by 2020**

**Forecast worldwide grid-scale energy storage market**



**Forecast worldwide installed energy storage capacity each year**



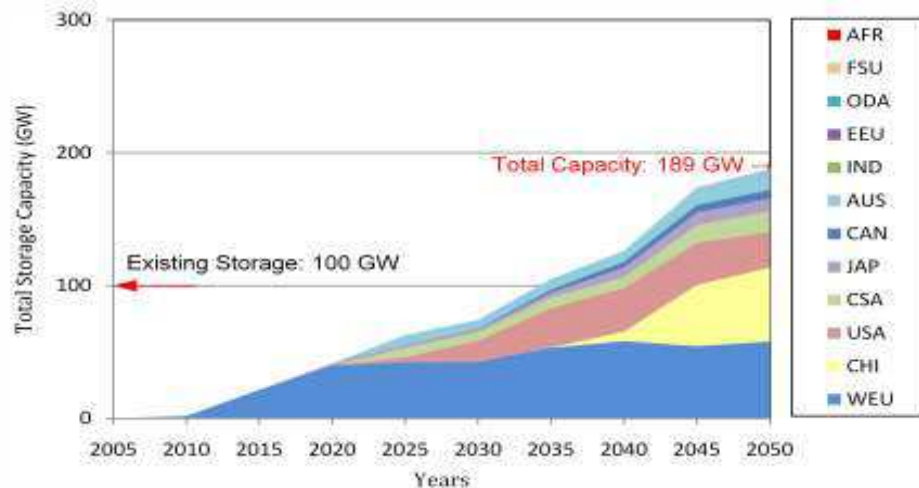
Source: Pike research and ESA (Energy Storage Agency)

# Wind and solar energy development means storage

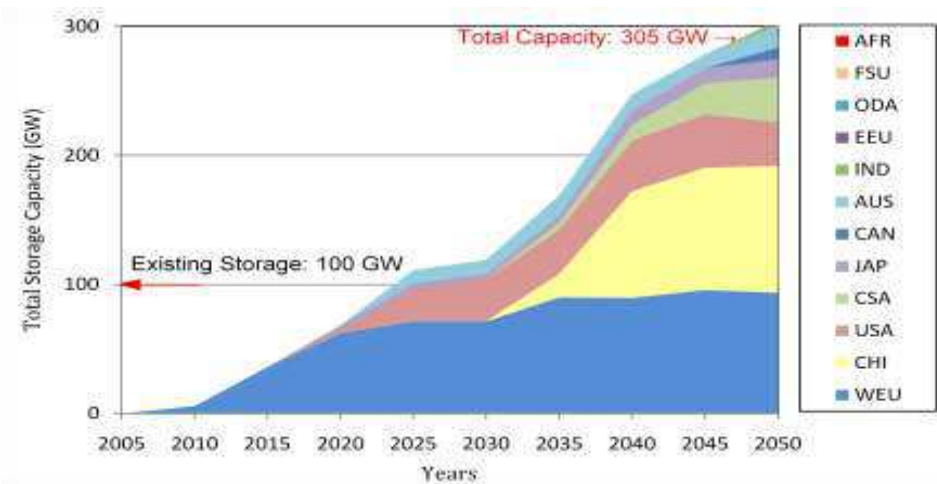
The main driver of the market of large scale electricity storage is the increase of the penetration of intermittent energies.

Growth of necessary energy storage capacity worldwide during 2010-2050 to achieve the BLUE Map scenario, ...

... low scenario

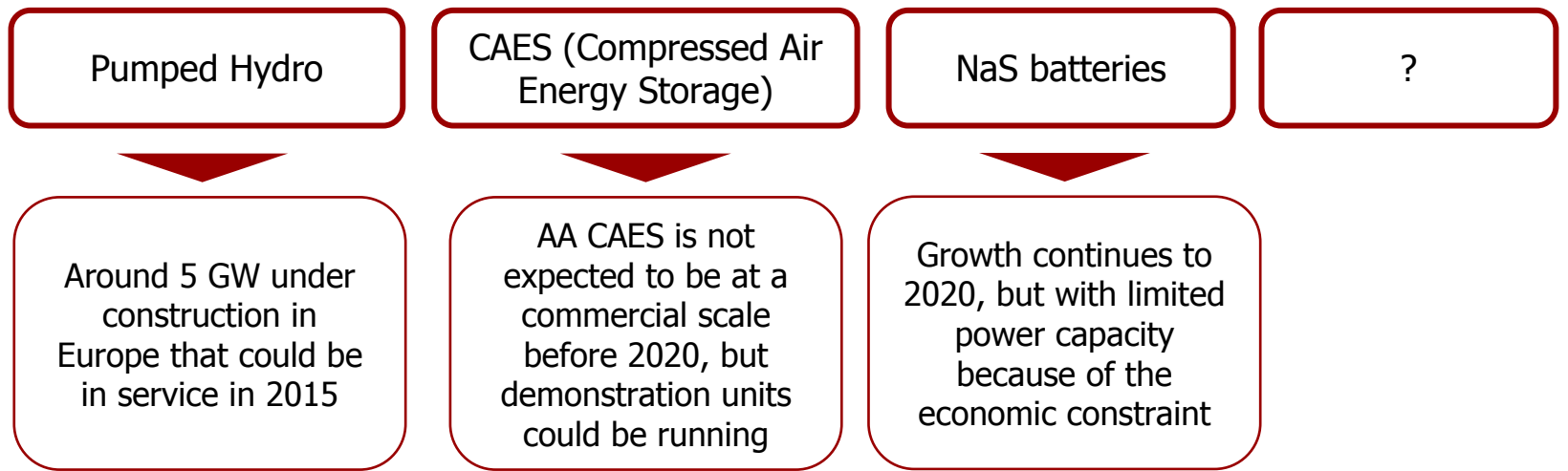


... high scenario



■ IEA estimates that the storage required for the integration of wind power ranges from 189 GW to 305 GW, meaning an additional storage capacity about 60 to 180 GW by 2050.

# A lack of technologies for large scale electricity storage



## Constraints or drawbacks

| Constraints or drawbacks | Pumped Hydro | CAES (Compressed Air Energy Storage) | NaS batteries | ?   |
|--------------------------|--------------|--------------------------------------|---------------|-----|
| Economic                 | Yes          | Yes                                  | No            | Yes |
| Location unlimited       | No           | No                                   | Yes           | Yes |
| Environment friendly     | Yes and No   | Yes and No                           | No            | Yes |

**Need for a new technology**



❑ Need for new large scale electricity storage facilities: a big potential market

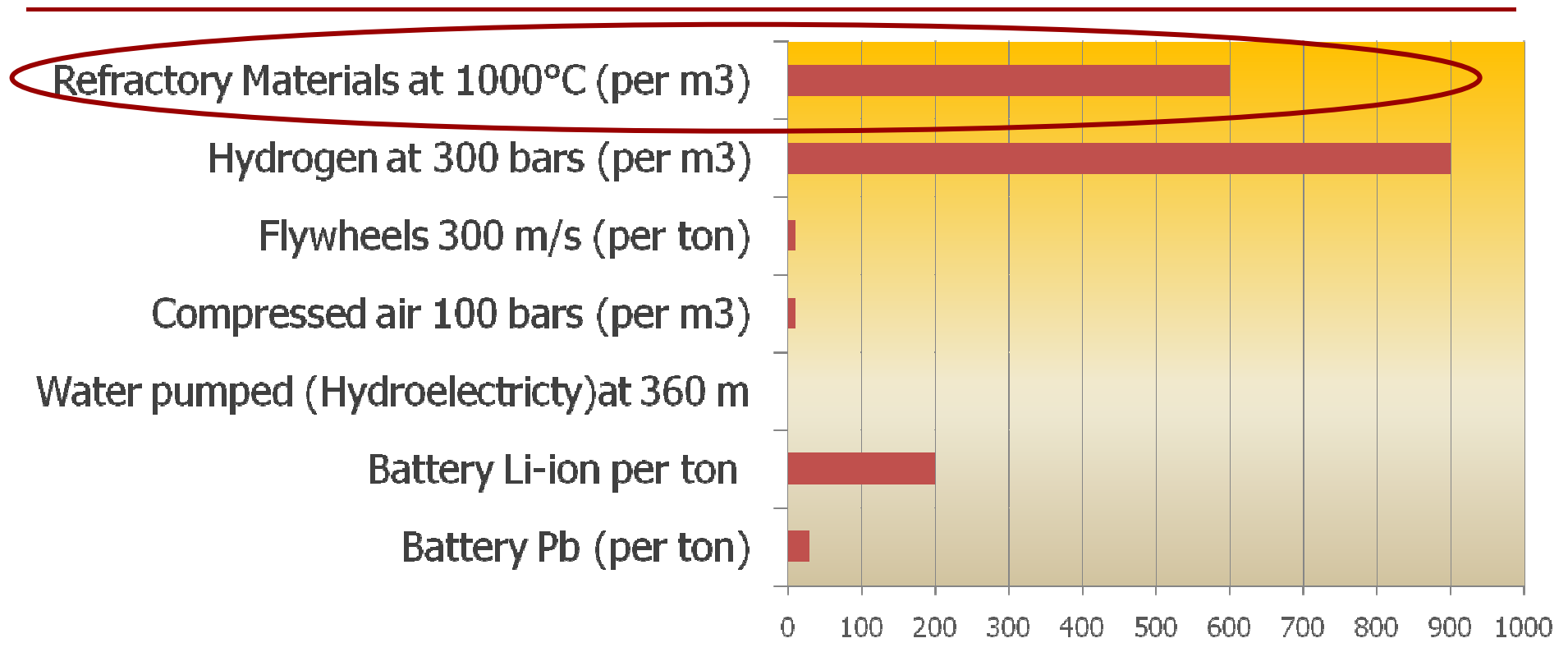
❑ **SEThER, an innovative technology presenting some competitive advantages**

❑ Nexts steps to develop industrials solutions using this technology



# Basic principle of Sether technology: origin of the idea

Comparison of energy density (kWh/t or kWh/m<sup>3</sup>)



**A refractory material has a high capacity to store energy at high temperature**



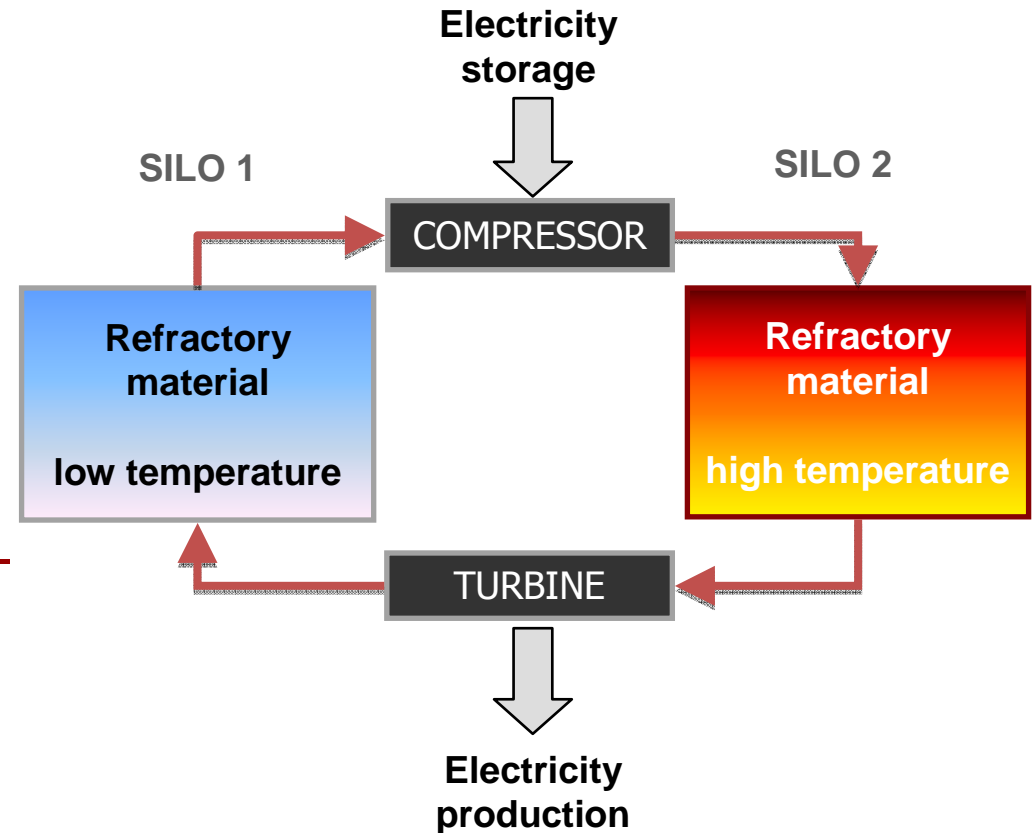
# Basic principle of Sether technology

## Loading phase

- The working gas is compressed from the low temperature silo into the high temperature silo
- The energy is stored in thermal form in the high temperature silo

## Unloading phase

- The gas is decompressed through a gas turbine
- Thermal energy conversion in electricity is performed by a turbine and an alternator



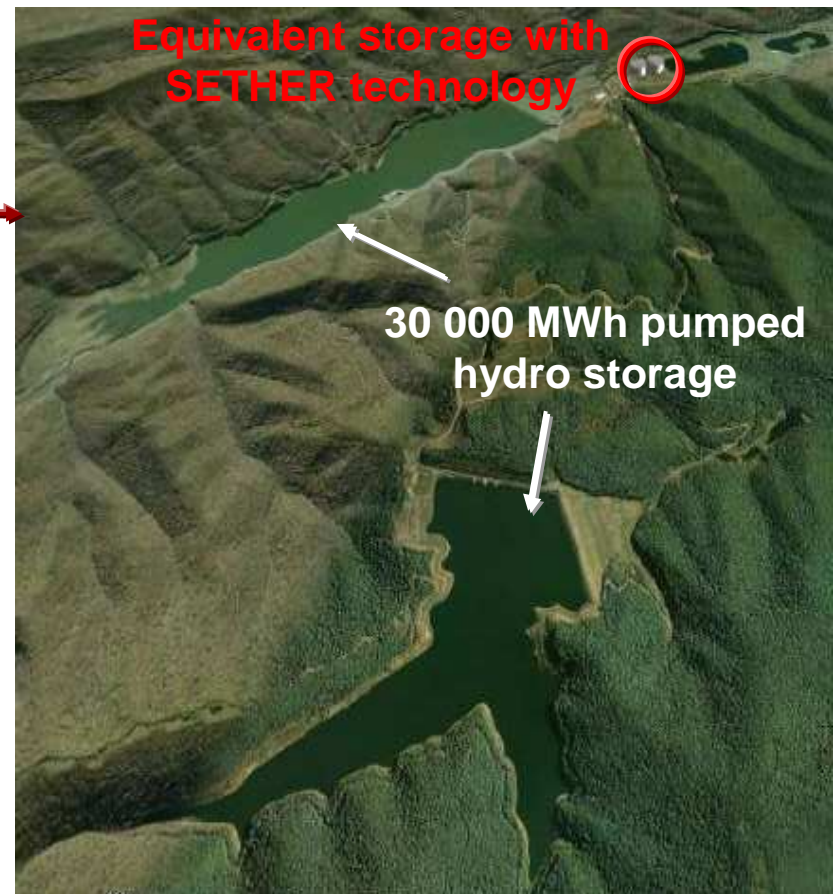
**The trick: the closed loop allowed high efficiency (70%)**



# Main advantages of SETHER technology

- **Large-scale electricity storage connected to the grid :**
  - ❑ Energy: from 10 MWh to 1000 MWh
  - ❑ Power from 10 MW to 200 MW
- **High density energy storage** →
- **No geographical constraint**
- **High efficiency (70 %)**
- **More competitive costs than existing technologies**
- **Environmental friendly solution**

**Thermodynamic storage is 300 times smaller than hydro storage !**



Bath County – VA - USA



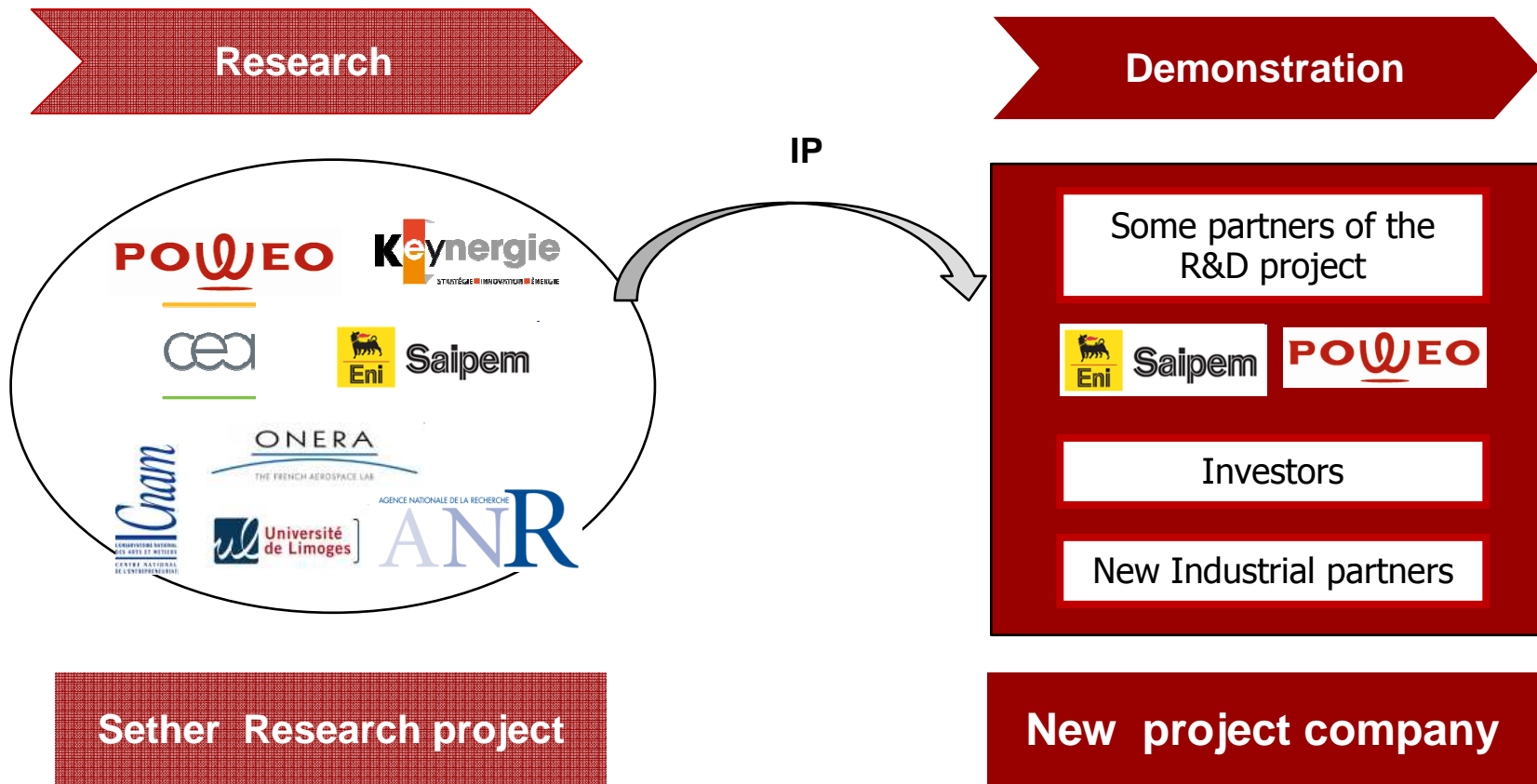
❑ Need for new large scale electricity storage facilities: a big potential market

❑ SETHER, an innovative technology presenting some competitive advantages

❑ **Nexts steps to develop industrials solutions using this technology**



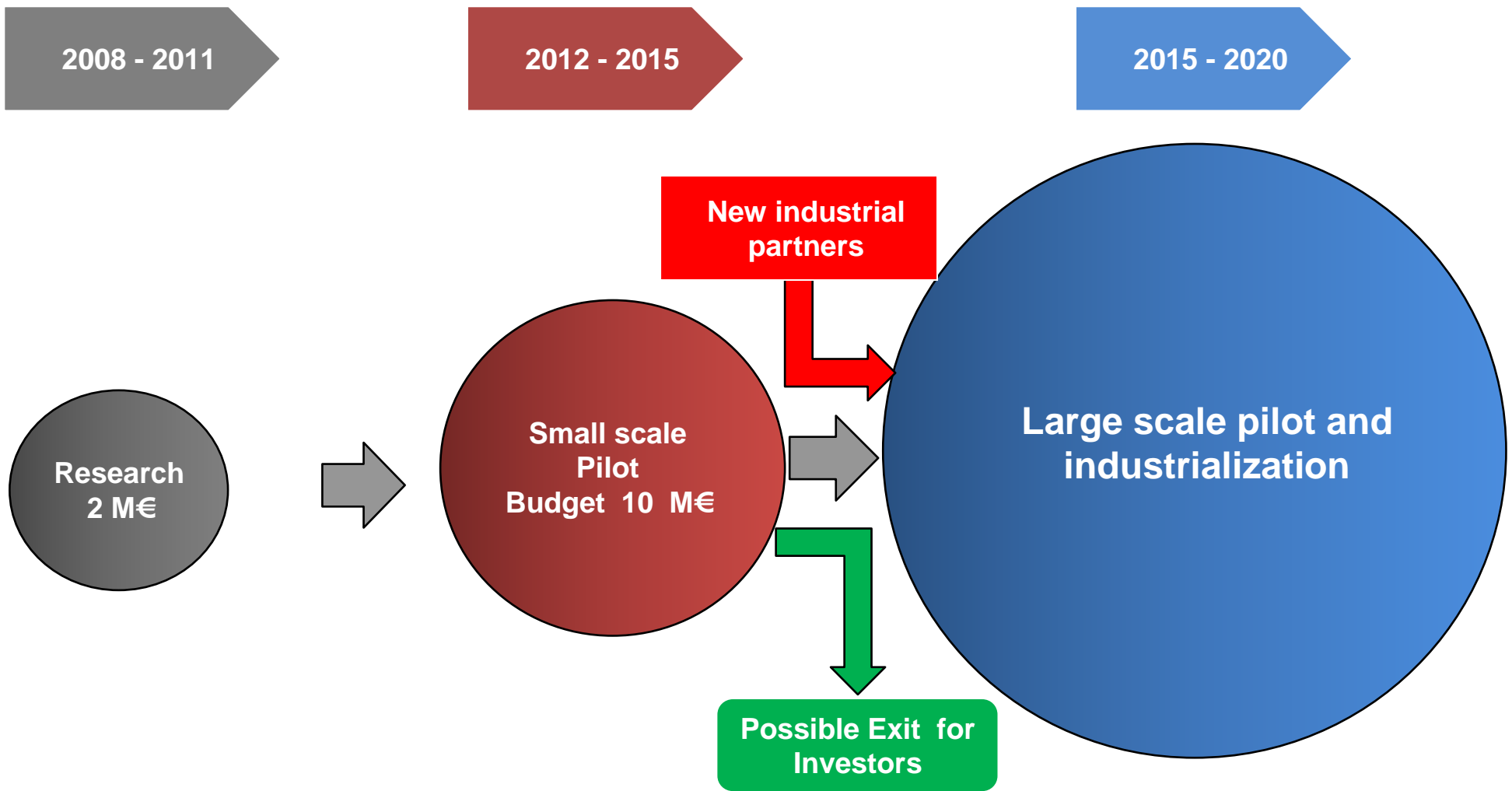
# Sether: An early stage project but...



... with very promising technology between research and demonstration



# Now and Next steps



# Key messages

## Market

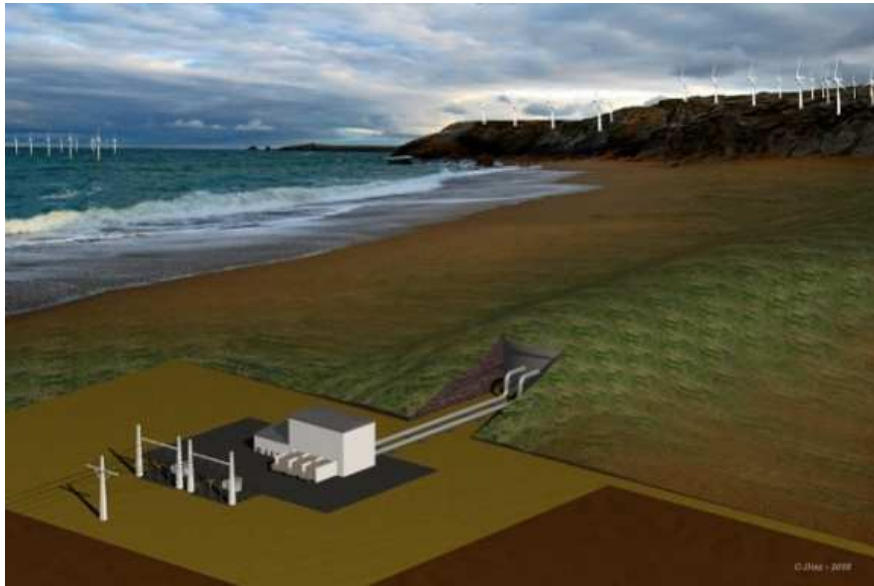
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- **Large scale electricity storage is an emerging and very promising market driven by renewable deployment**
- **There are few large scale storage technologies**

## Sether technology

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- **Technological and market studies have shown that Sether technology is feasible, relevant and competitive**
- **Strong competencies in R&D and industrialization of the partners involved**
- **The next step will be to perform a small scale demonstrator to convince players of the reliability of the concept, with a new dedicated company**



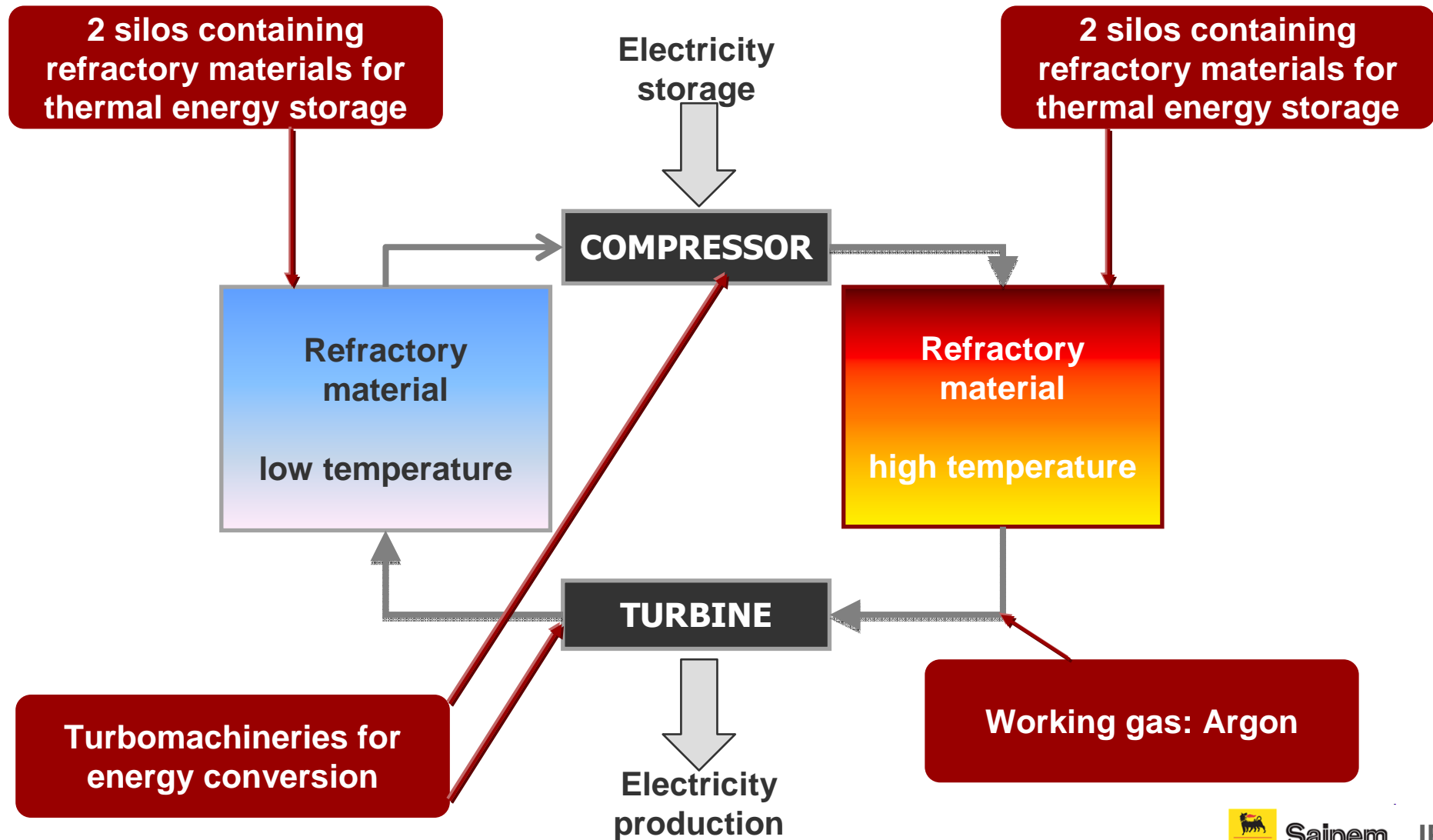
**Thank you for your attention**

**Damien Levecque**  
**damien.levecque@poweo.com / 01.70.60.74.93**

# Back-up

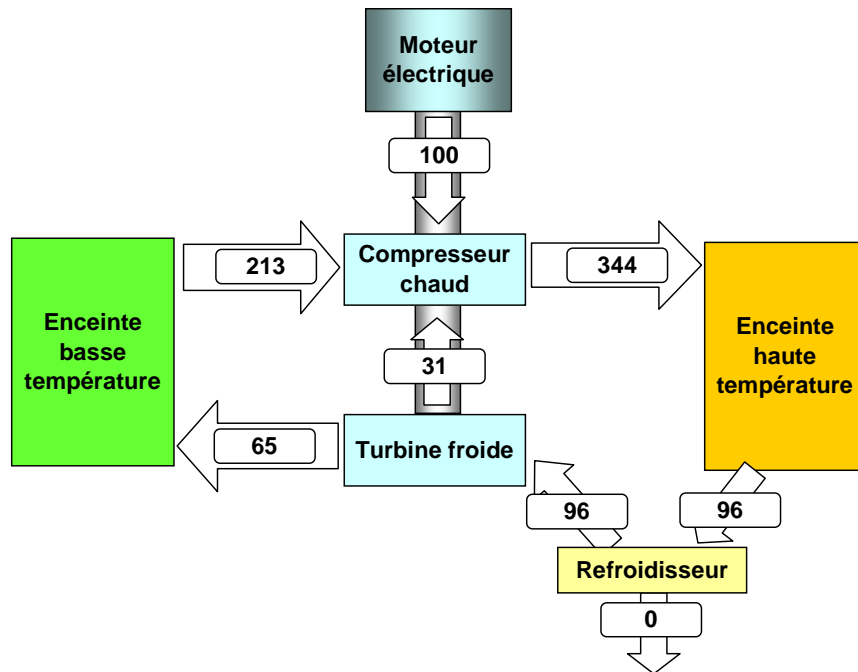


# Basic principle of sether technology: Physical description

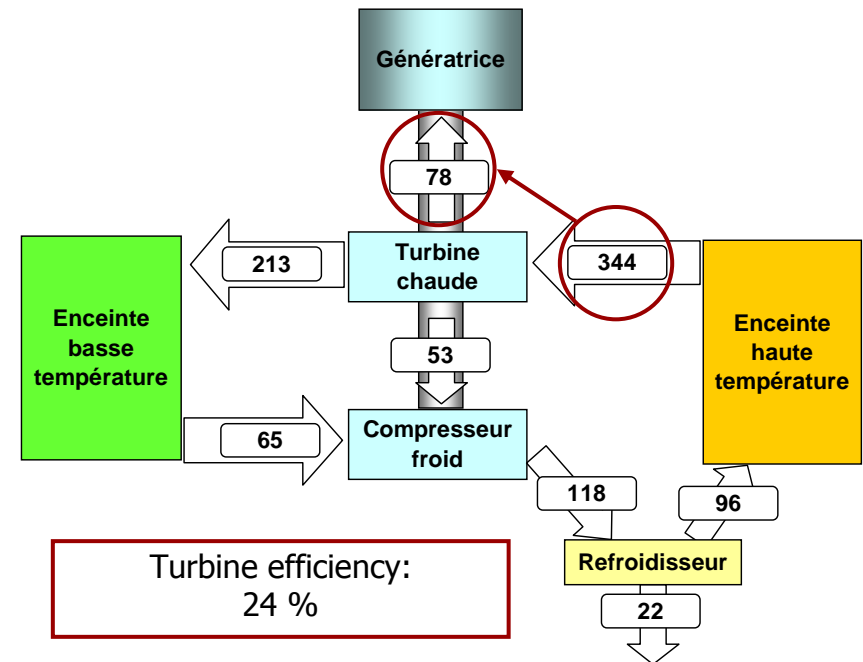


# High efficiency

Typical energy flow while loading

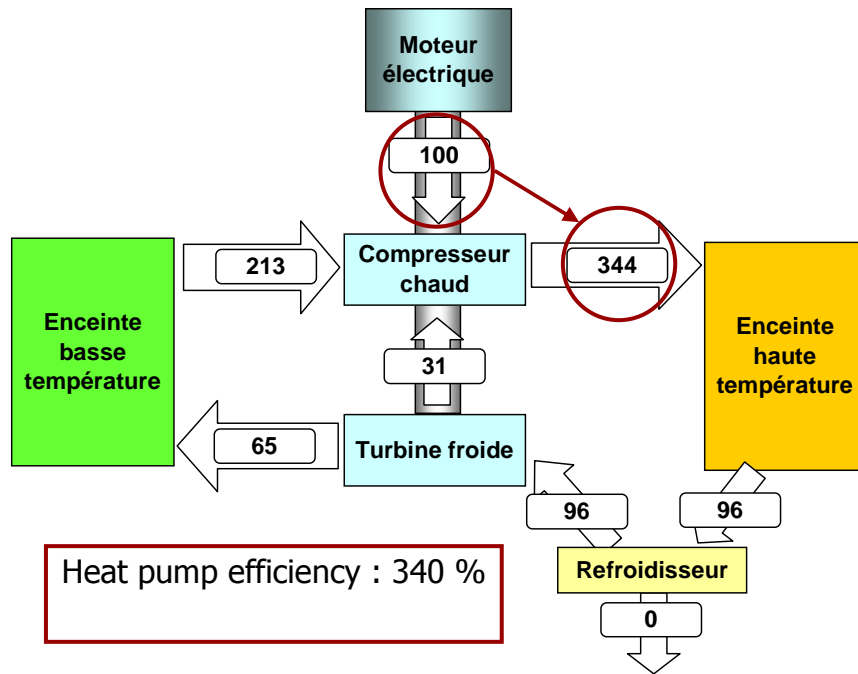


Typical energy flow while unloading

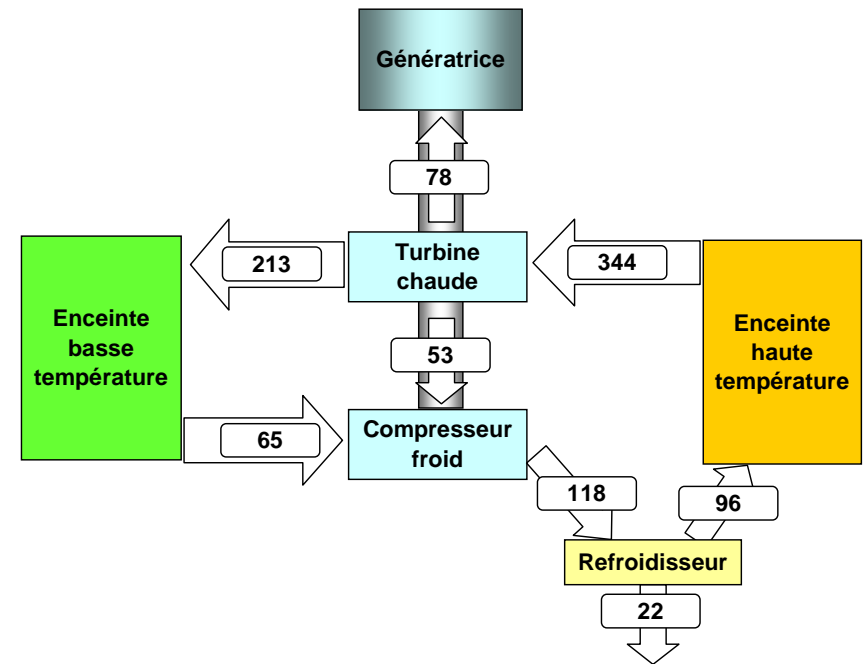


# High efficiency

Typical energy flow while loading



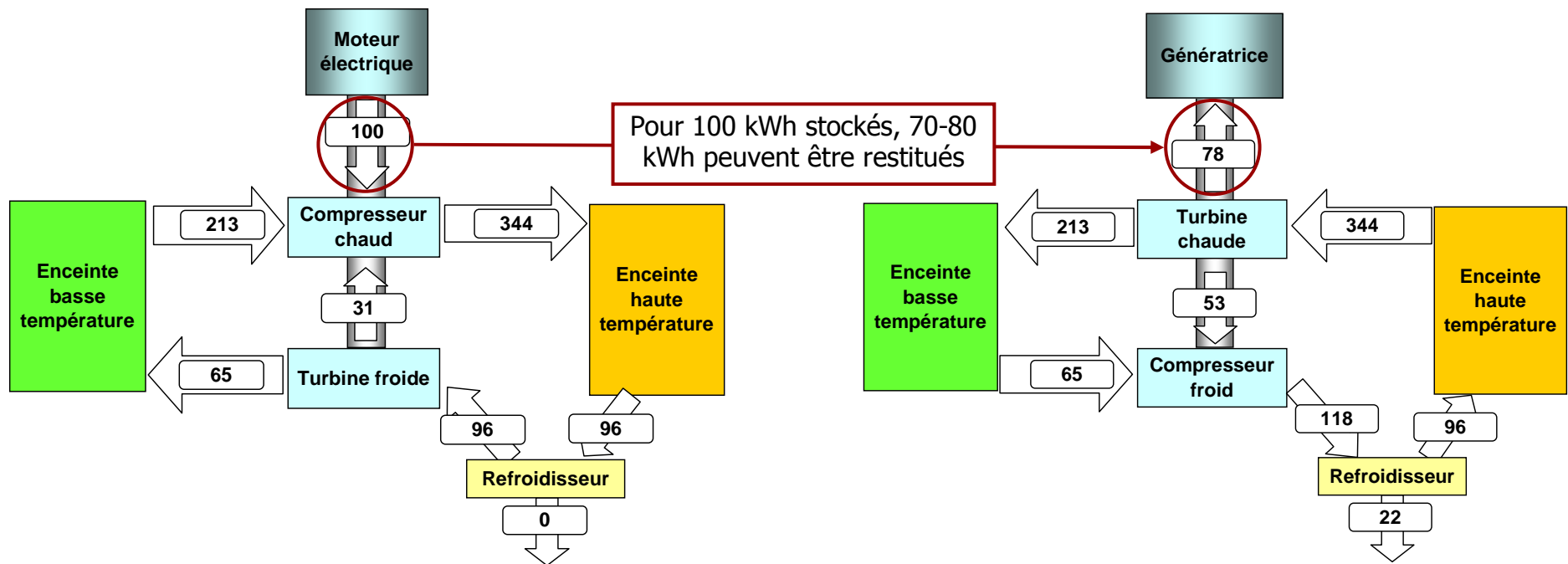
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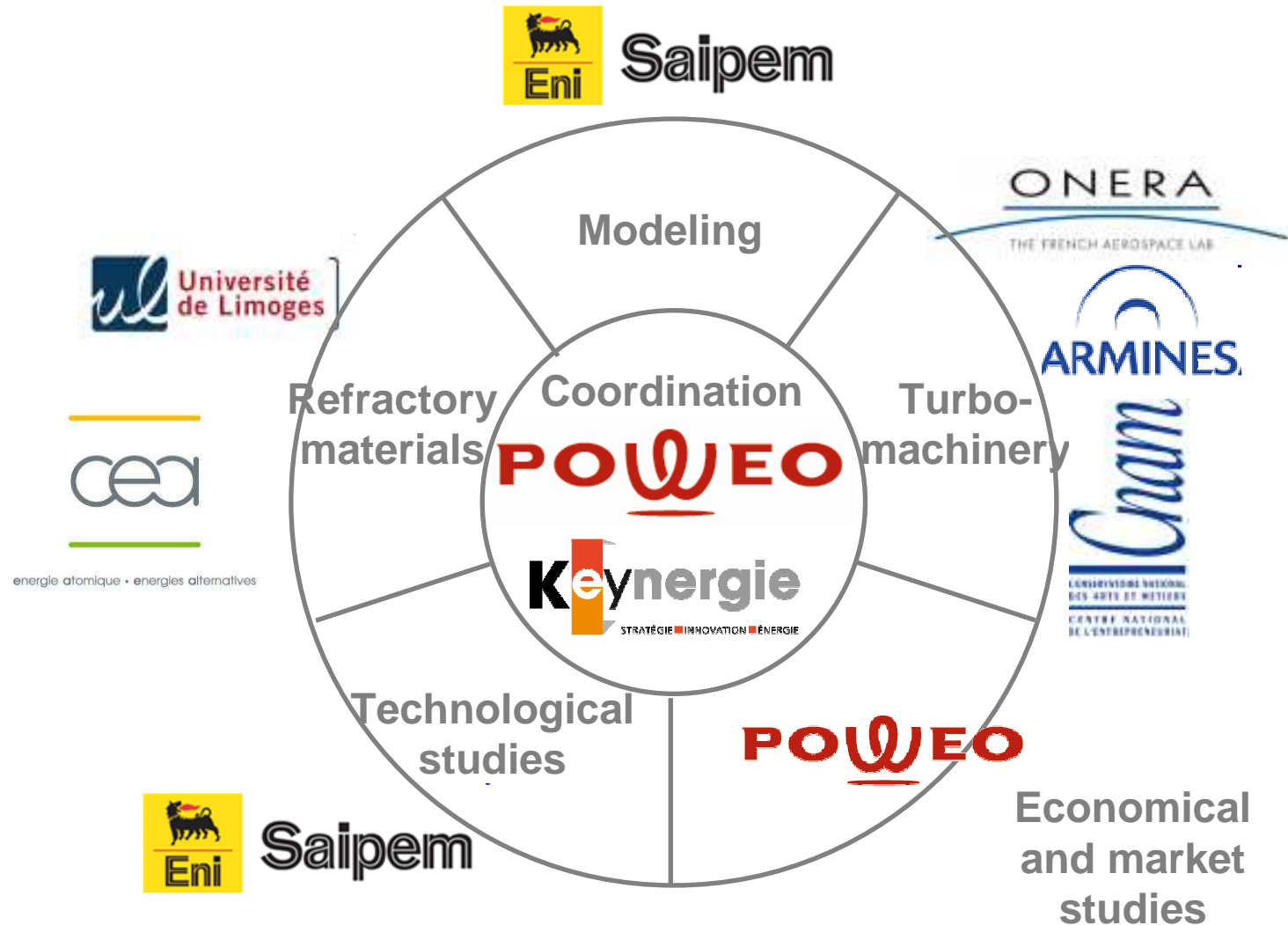
# High efficiency

Typical energy flow while loading

Typical energy flow while unloading



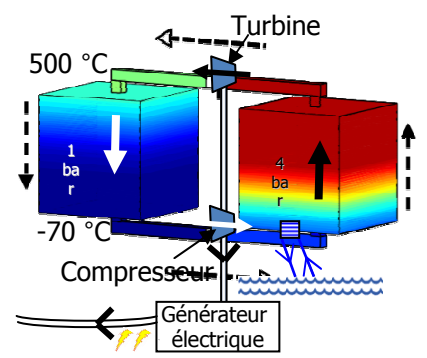
# Strong complementary skills within SETHER research project



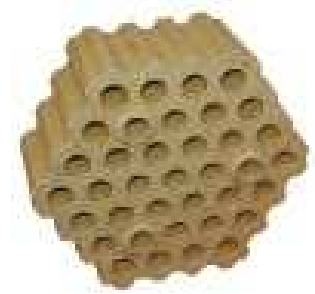


# Main results of SETHER research project: a promising technology

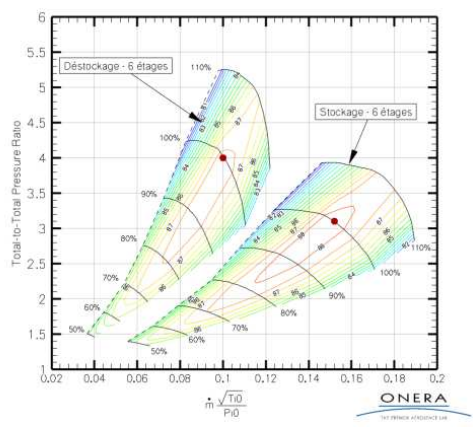
## ■ Full system modeling



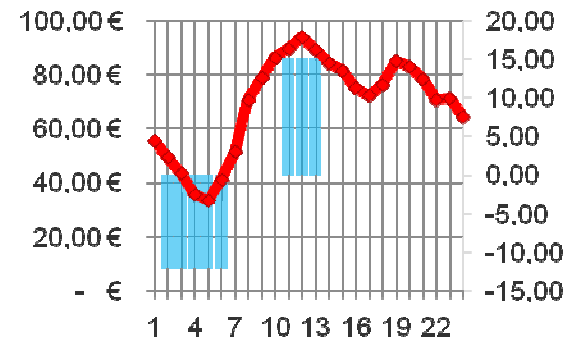
## ■ Refractory materials study and testing



## ■ Turbomachinerie modelling



## ■ Economic and market study





# Development and Next steps

2008 - 2011

## Feasibility study

- Technological study and system modeling
- Experimental test of refractory materials
- First Market and economic study
  
- 0.9 M€ granted by ANR
- 2 M€ invested to be ready for prototype development

2012 - 2015

## Small scale demonstrator (100kW to 500 kW)

- Objectives :
  - Prove experimentally the system efficiency with existing equipment
  - Convince on the reliability of the concept
- Estimated cost: 10 M€
- Public funding expected : 4 M€
- Opportunity to set up a dedicated start-up
- Private funding needed 2 to 3 M€

2015 - 2020

## Large scale demonstrator (10 MW) and industrialization

- Partnership with turbine and compressor manufacturers