



*Hydrogen storage technology*

*Smart energy days*

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## *Profile*

Founded in 1997

Our activity stem from the joint experience of two founders with several years of operating experience in the field of design and manufacturing of customized plants and safety systems for the use of special fluids.



## *Mission*

....We develop special system based on customer's needs ...

## Examples of our activity

Aero space testing system



Cooling system for C6F14



CO2 purification for snow cleaning process for Exomars space mission

# About Hydrogen .....

Since 2007 we are involved in research activity related to Energy storage

Common Hydrogen storage method :



Liquid H<sub>2</sub>



Compressed H<sub>2</sub>



Metal Hydride

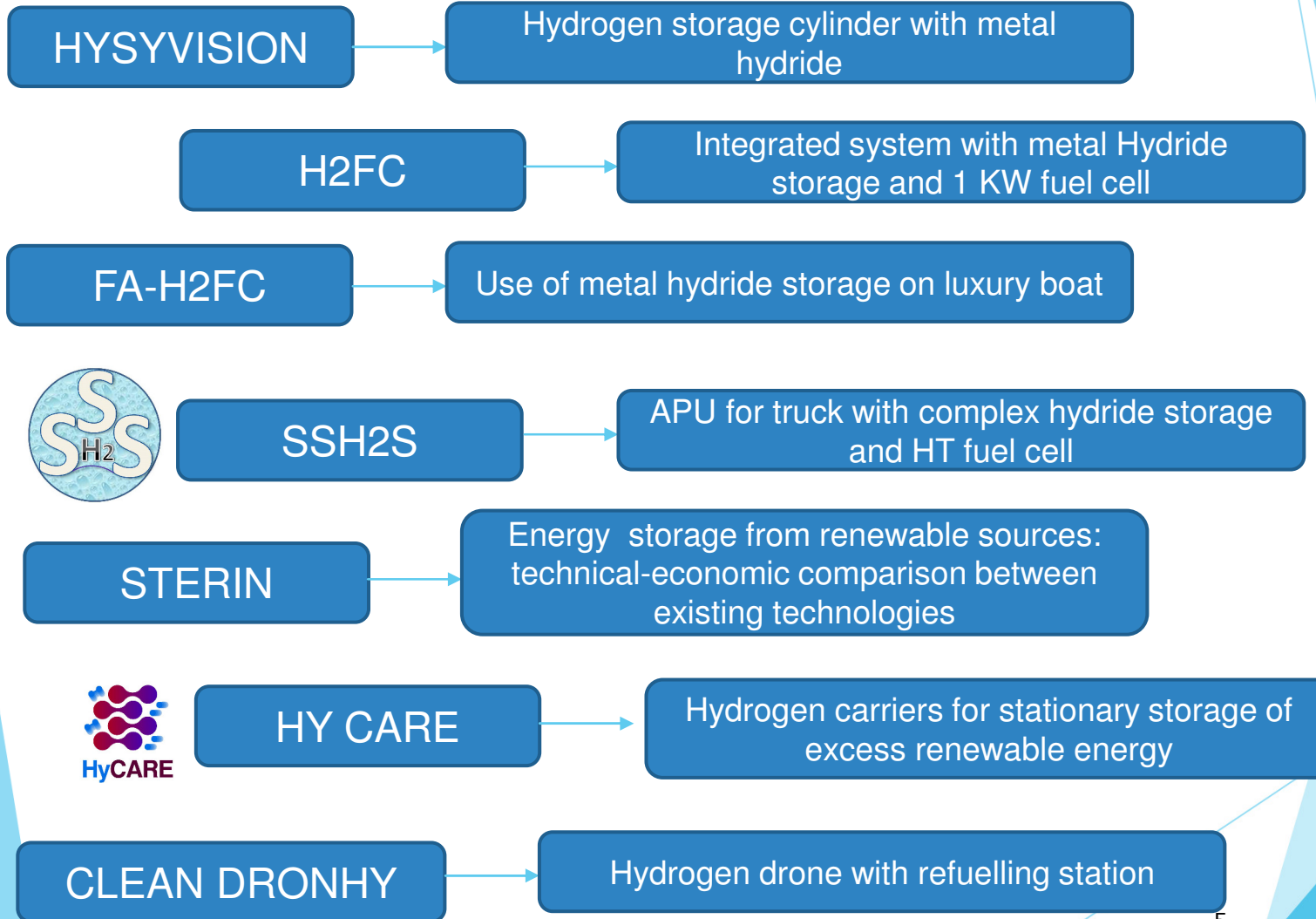


Tecnodelta research activity



# Research activity

Project on H<sub>2</sub> carried on :





# About hydride .....

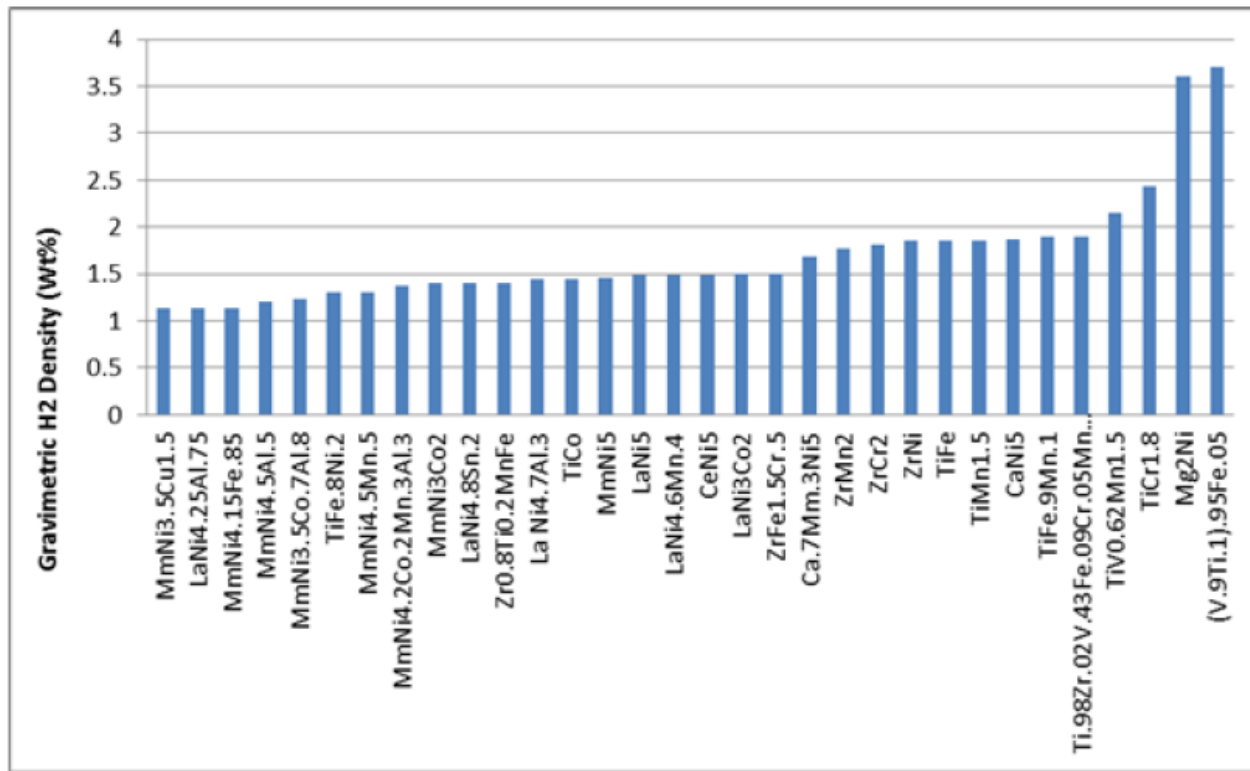
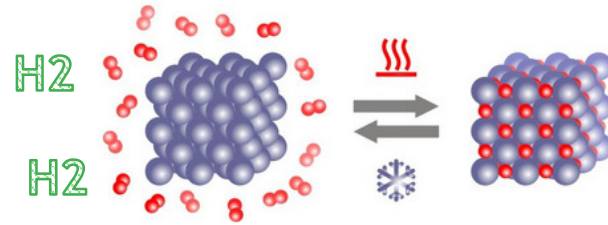
## Metal Hydride

Based on Metals(pure or alloy ) - La , Ni , Mn , Mg  
.....

## Complex Hydride

Based on Ammine , sodium  
, Boron .....

# About Metal hydride . . . .



Storage capacity from 1 wt%....up to 4wt%

# About Metal hydride . . . .

## Comparison standard H2 cylinder vs Metal hydride tank



Volume = 50 liters  
Quantity of H2 @200 bar = 10m<sup>3</sup>  
Quantity of H2 = 0,89 Kg

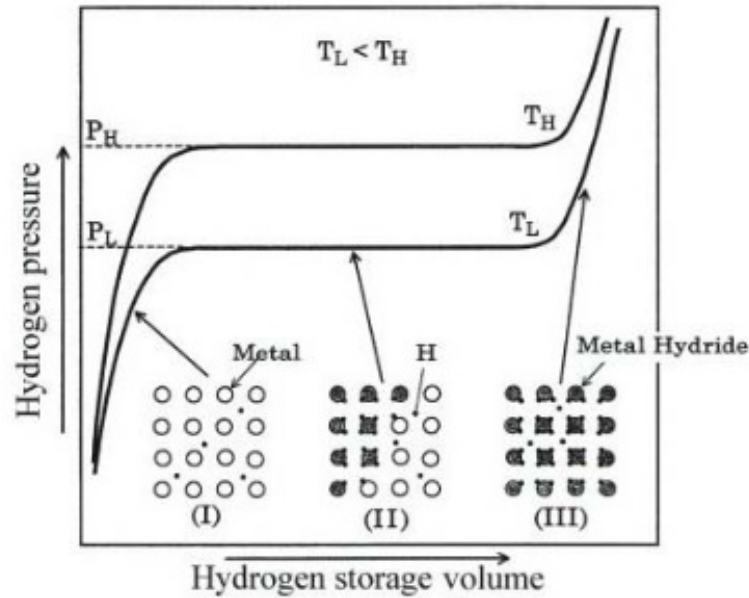


Volume = 15 litres  
Quantity of powder = 60 Kg  
Quantity of H2 = 0,89 Kg\*

\*Storage capacity from 1,5 wt%

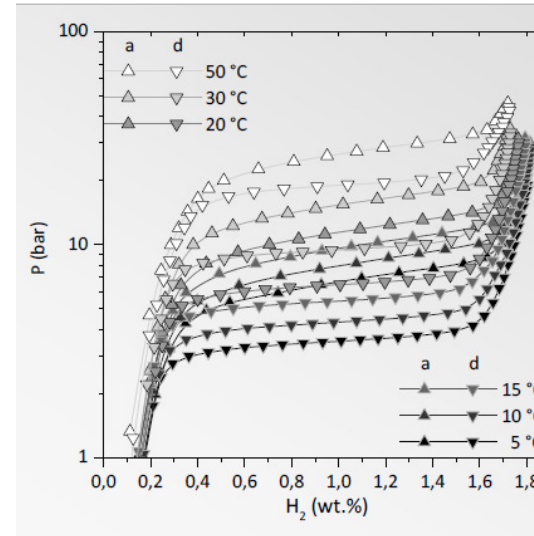


# About Metal hydride .....



- I. a solid solution of hydrogen ( $\alpha$  phase)
- II. a coexistent region of hydrogen solid solution & metal hydride
- III. metal hydride ( $\beta$  phase)

Equilibrium curve of metal hydride

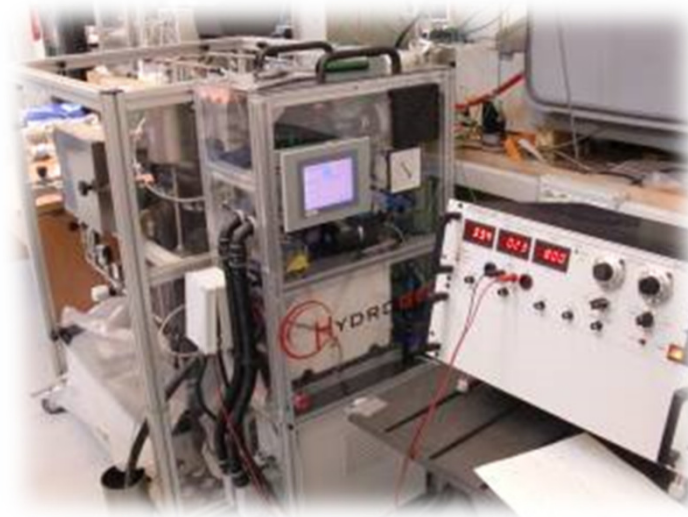
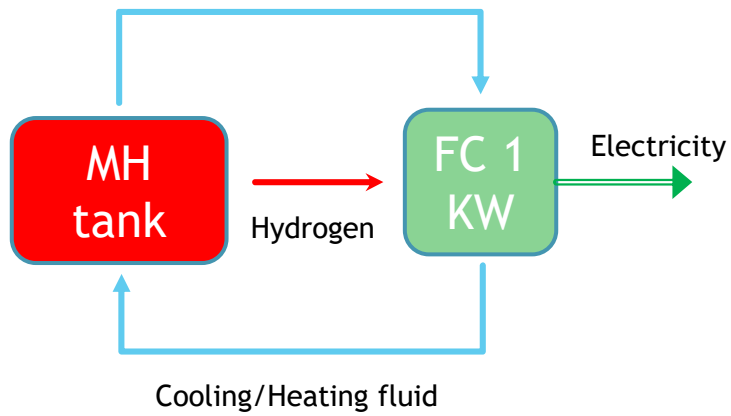


## About Metal hydride ....

### Main advantages :

- ▶ low pressure < 30 bar
- ▶ direct storage from production
- ▶ no cost for compression
- ▶ safe solution : without heat supply the hydrogen cannot be released
- ▶ increase the efficiency of the system with thermal management

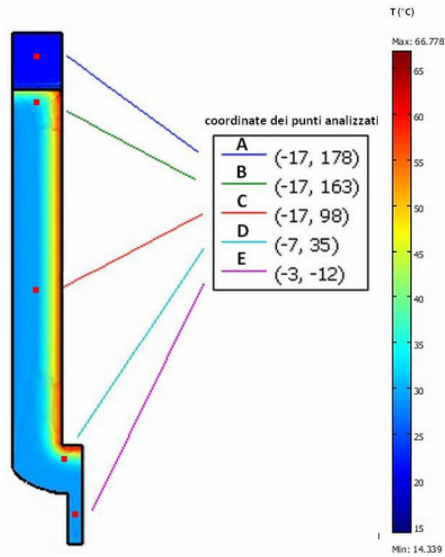
## MH Storage system coupled with 1KW Fuel cell



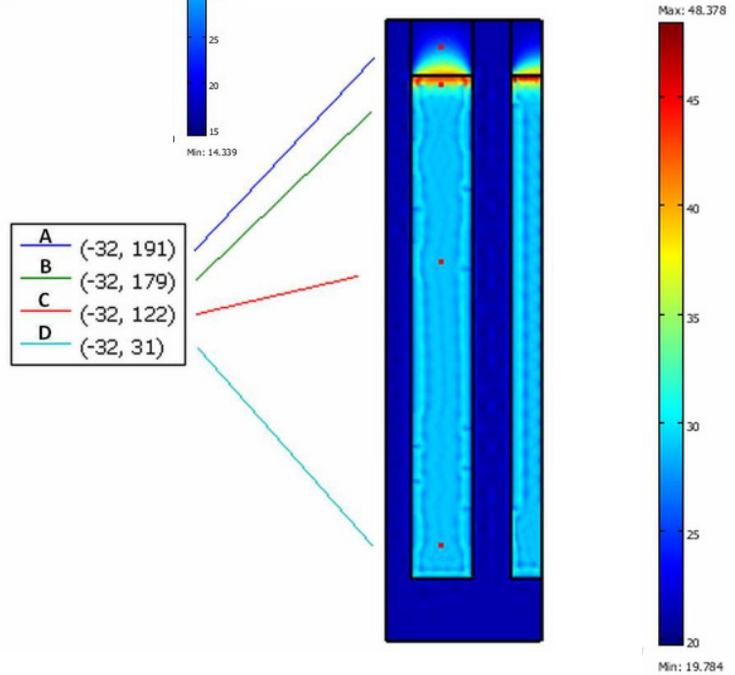
Test done on the system :

- Working time → 6 hours and 20 minutes
- Power (average) → 0,76 kW  
with peak of 1KW for 2 hours
- Total energy supplied → 4,8 kWh
- Hydrogen consumption → 3120 NI
- Working temperature → 70°C

# MH Storage system



Optimization of the heat transfer rate  
Working on the geometry of the heat exchanger



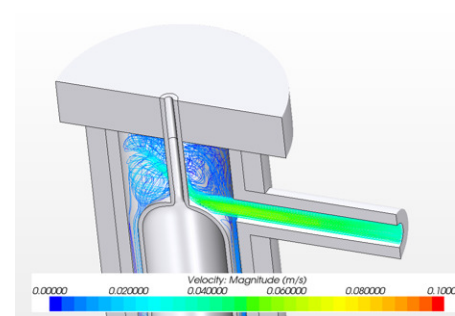
FEM analysis



Very low thermal conductivity !

# MH Storage system

Max H<sub>2</sub> content = 340 g each tank  
Type of hydride = LaNi alloy  
Max pressure = 35 bar  
Operating temperature = 20..70°C



CFD analysis



# Equipment



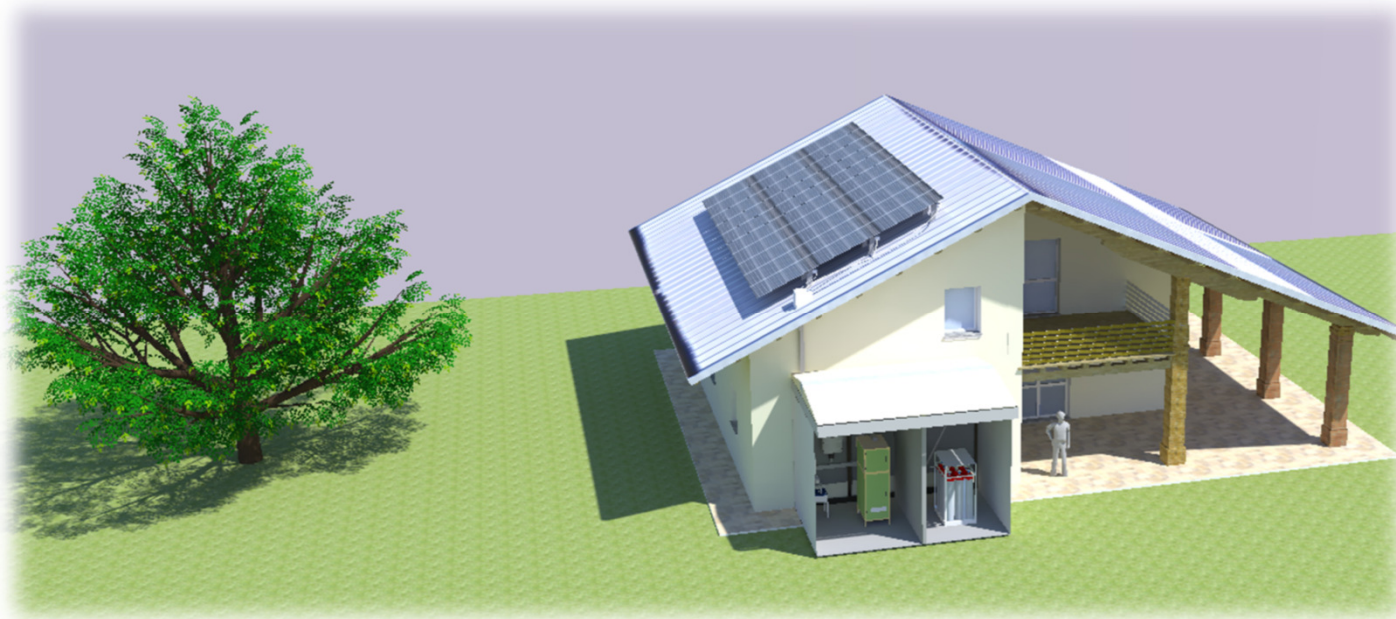
Tecnodelta's facilities



# Possible application

Private house

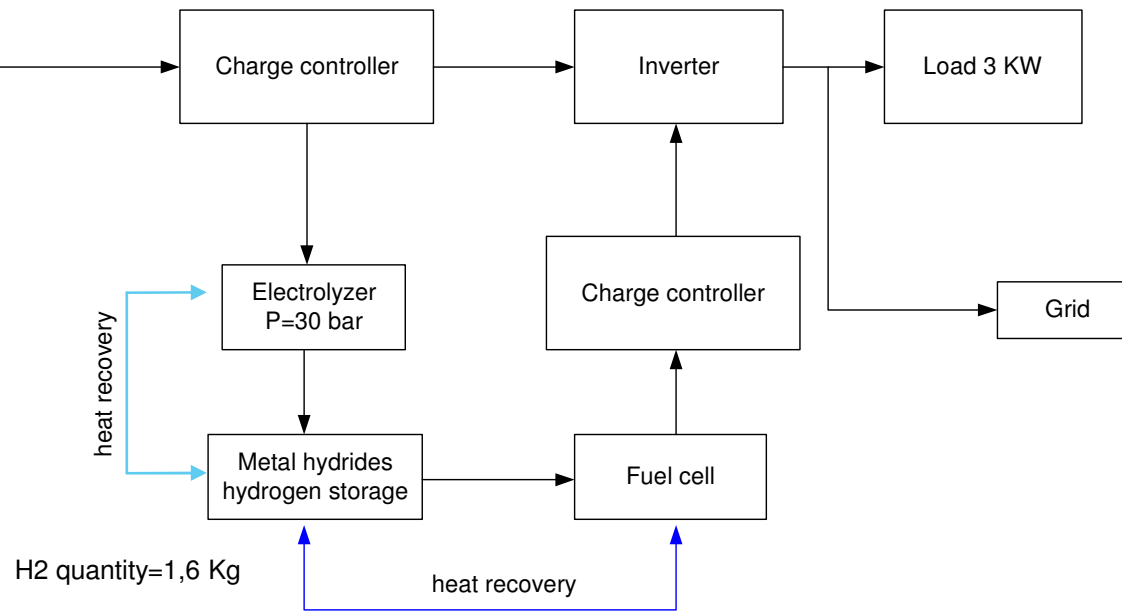
3KW power



# Possible application

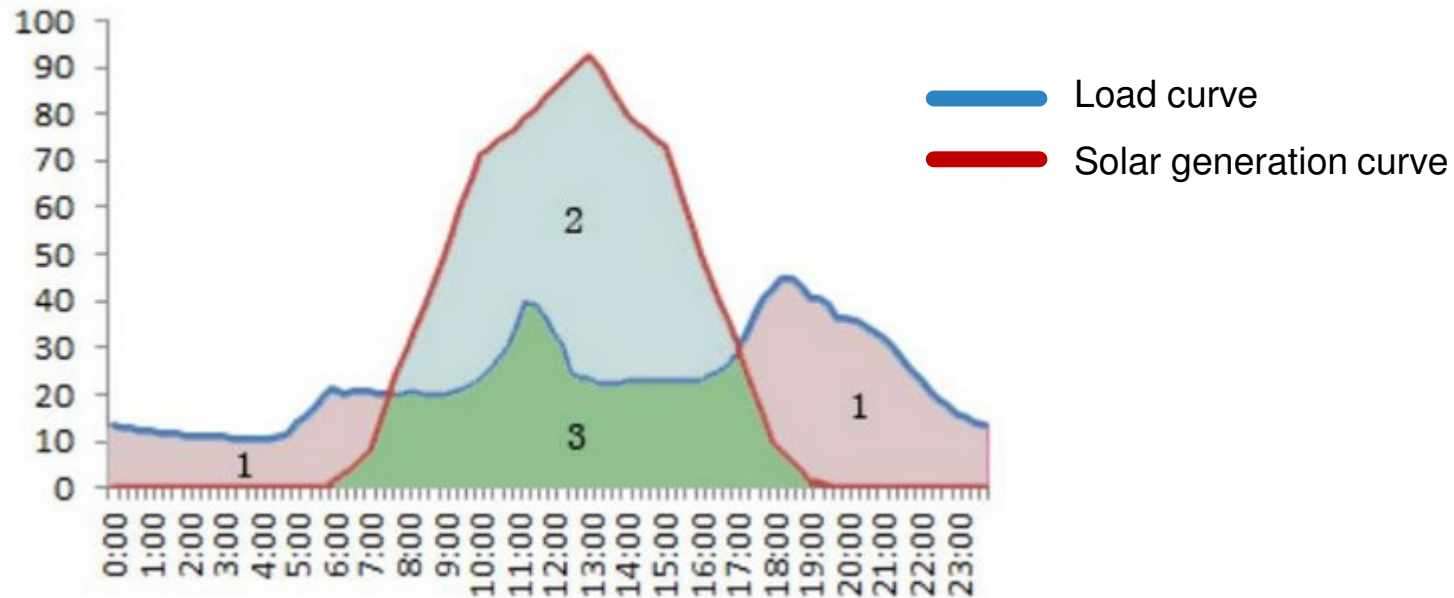


## Private house – lay out



# Possible application

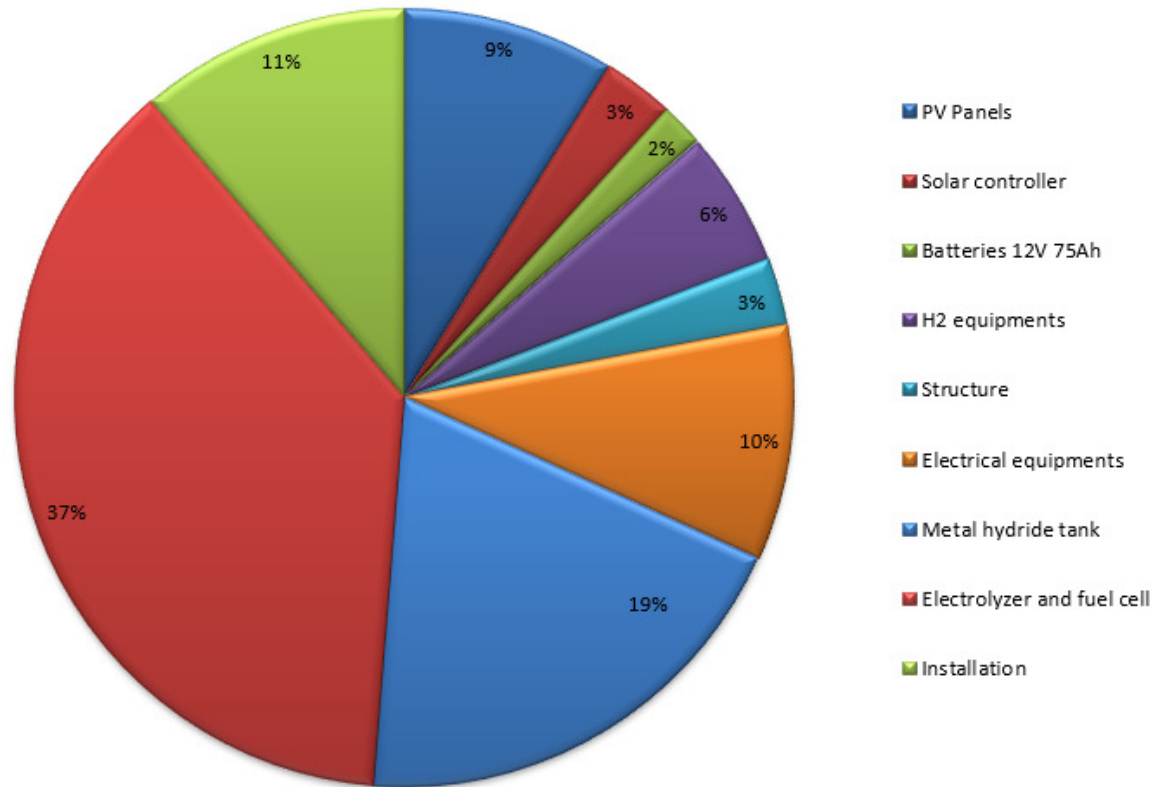
Example : Daily solar production curve ( sunny day)



- 1- Request of power from external source
- 2- Extra power produced by solar panel
- 3- Power used from solar panel

# Possible application

## Cost analysis





*Thank you for your attention !*

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