Hydrogen as storage vector for Energy Storage

Brainstorming Workshop
Conclusions

The objective of this brainstorming session was putting together people from industry and academia in order to

1. **Identify technical and social challenges in the domain of energy storage**
2. **Define potential projects thematic in the same domain**
3. **Initialled interactions, create affinities between participants that may lead to setting-up projects**

Group 1

Members :

- D'amore Rafael (leader)
- Leo Mena Teresa
- Faiçal Serge
- Martin Javier Jesus
- Convert Mathilde
- Collardeau Marc-Antoine
- Penin Carolina
- Talbert Thierry

This group worked on the Hydrogen storage and identified 3 major challenges that could be treated in the frame of an ambitious project dealing with a holistic approach of hydrogen storage. This holistic approach must include energy management and a realistic economic mode that would increase social acceptance.

Challenge 1: Storage	Solutions / Resources	Partners
▪ Technologies (gas, liquid, solid) ▪ Transportation ▪ Security/normalization ▪ Social acceptance ▪ Economic model	▪ Benchmarking ▪ Specifics infrastructures ▪ Test bench (laboratories or territories) ▪ More formation resources ▪ Social acceptance: information, policy support ▪ Economic model: stochastic model economics	▪ National h2 Center ▪ Laplace laboratory ▪ Hydrogen Aragon Foundation ▪ National universities: UPM, Toulouse university ▪ Companies ENGIE, EDF, LEAF, EMA.
Challenge 2: Energy management	**Solutions / Resources**	**Partners**

system & production		
▪ Test of different models linked to intermittent power sources: Technologies & economics ▪ Power to gas ▪ Power to power	▪ Benchmarking ▪ Specifics infrastructures ▪ Test bench (laboratories or territories ▪ More formation resources ▪ Social acceptance: information, policy support ▪ Economic model: stochastic model economic	Companies: ▪ Compagnie du vent ▪ Electro /manufacturing ▪ Fuel cell ▪ Unities companies elect & gas ▪ Data analysis Laboratories/ research centers ▪ National universities ▪ CNH2 ▪ LAPLACE ▪ University of Toulouse
Challenge 3:	**Solutions / Resources**	**Partners**
▪ Realistic economic models & social acceptance	▪ Brenchmark	▪ Economist ▪ Government ▪ Computing engineering

Group 2

Members :

- Palmade Stéphane (Leader)
- Azara Carlos
- Angelo Sylvie
- Micheletti Andrea
- Silva José
- Guillon Christelle

the main challenge identified by this group is the use of cheap renewable, but intermittent, energy sources for H_2 continuous production. Electrolysis is not well adapted for intermittent operation, but coupling it with methanation and direct use for mobility applications may solve the problem. The main issues here, beyond technical ones are: Social acceptance; customizing the business model; and evaluating the environmental impact passing through a full life cycle assessment process.

Challenge 1:	Solutions / Resources	Partners
▪ H2 Storage	▪ Cost effective secure	
Challenge 2:	**Solutions / Resources**	**Partners**
▪ Electrolytes	Cheap renewable electricity sourcing ▪ Noble metals free	▪ CIRC ▪ EMAC

▪ H2 Mobility	Ageing Cost-effective ▪ Mid temperature electrolysis Compression fuel cell safety	
Challenge 3: Methanation	**Solutions / Resources**	**Partners**
▪ From CO_2 Biogas to Compressed Natural gas	Cost-effective resilient ▪ Biological methanol	LEAF
Other challenges		
▪ Social acceptance ▪ Business model ▪ Life Cycle Assessment		

Group 3:

Members:

- Montero Esperanza (leader)
- Baguena Eva
- Puydebois Ludovic
- Figueruelo Malo
- Garcia Tatiana

This group underlined 2 challenges:

- **The first is linked to training and this may lead to a project (Erasmus+) with objective developing common curricula for undergraduate and graduate students in the domain of hydrogen. This type of curricula should be modular and built such way that the participating universities could share students, teachers and teaching material. The training program must be validated by industry in order to ensure the future employability of the graduate students**
- **The second challenge is more technical: Incorporate H2 production and use of hydrogen in the case of standalone situations (like Islands) this must include different ways of production and should be coupled with the right dimensioning of the electrical grid. Hydrogen in excess may be shipped to the continent for commercialisation or imported form the continent in the case of insufficient production. A holistic approach is needed here and the reflexion must include local authorities. Hydrogen could in the ideal case replace (or reduce) fuel and/or diesel use.**

Challenge 1:	Solutions / Resources	Partners	Public concerned
▪ Harmonization of contents at EU level	Courses/ modules ECTS E-leaning MOOC's Exchange programs Pilot/demonstrators / FH visits integrated RES	▪ Universities ▪ Higher Education Institutions ▪ Research Centers ▪ Enterprises	▪ Undergraduate ▪ Graduate ▪ Post graduate ▪ Professional workers/ training

Challenge 2:			
▪ Triter H2 Compressed ▪ Cryogenic H_2	Production H2 in standalone situation (islands)	▪ Universities ▪ Higher Education Institutions ▪ Research Centers ▪ Enterprises	