

## **HYCHAIN-Minitrans Lessons Learnt**

“Deployment of innovative low power fuel cell vehicle fleets to initiate an early market for hydrogen as an alternative fuel in Europe”

**Largest DG TREN project in operation**  
**5 years (2006-2011)**  
**Total budget : 37.6 M€**  
**Total EC co-financing : 17 M€**



**Juan de Blas CEO (BESEL SA)**

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1. Deployment of a fleet of **up to 78** small-power vehicles
2. Establish a hydrogen infrastructure
3. Gain public acceptance
4. Fast launching of a business model

## HYCHAIN is a challenging project in terms of management

- A consortium of 24 Partners from four countries:

			
AIR LIQUIDE AXANE CEA INERIS INPG PAXITECH ASCOPARG	AIR LIQUIDE WI WIN HYDROGENICS MASTERFLEX	AIR LIQUIDE DEMOCENTER VEM FAST	AIR LIQUIDE BESEL CIEMAT DERBI RUCKER CEU DOMENECH IBERDROLA


- **AIR LIQUIDE**, Project coordinator, worldwide gas leader company
- **BESEL** (General Administrative coordinator), Spanish National Coordinator, several WPs leader.

## ORIGINAL PROPOSAL

2006 3 years deployment (FROM 2007 ON), Clip-on fleet 2011

Optimization  
Development  
Manufacturing  
Homologation

**Demonstration of technology  
Validation of business model**



2006 CURRENT SITUATION 2011

**2 years deployment (2008-2009), 2 step approach  
(1st fleet quick connector, 2nd fleet Clip-on final design)**



**HYCHAIN is an INNOVATION + DEMONSTRATION project**

## **PRINCIPAL INNOVATION BREAKTHROUGH:**

**Develop of an innovative Hydrogen cartridge CLIP-ON**  
700 bar, easy to use, safe, quick exchange of cartridges

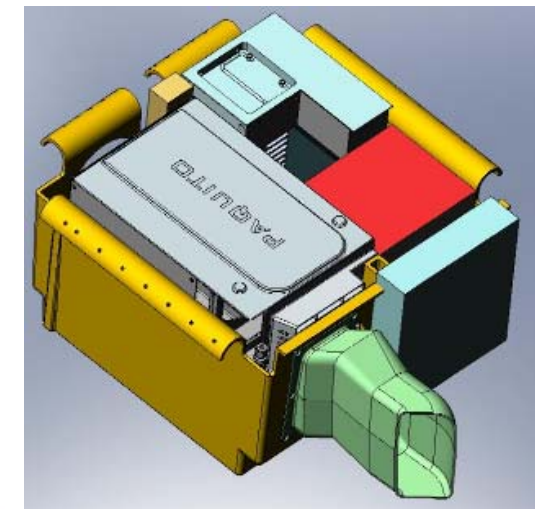
### **FC development**

350 W Paquito for the wheelchair, optimization of 250 W and 2,5 Kw for the cargobike and utility vehicle

**Homologation (or Certification) of the 5 HYCHAIN vehicles in the 4 participating regions.**

Compliance with safety standards and regulations.

Building up of a homologation pathway in absence of accepted framework.



## Project H2-Dispensador



Design of a vending machine to supply H2 cartridges.



# The Hybridation concept in HYCHAIN



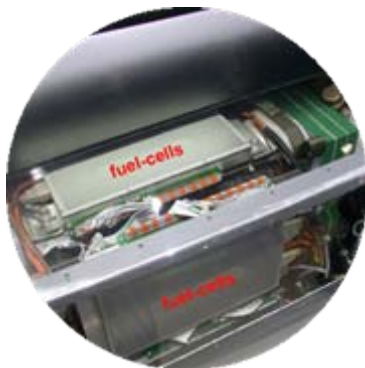
*Existing electrical vehicles powered with batteries (4 hours autonomy)*



*Removal of batteries And substitution by*



Fuel Cell module



Storage System





For disabled people centers, associations, residential homes for elderly, hospitals, airports, museums, and other public spaces

**2006**



- ✓ **Increased autonomy (50%)**, compared to conventional electric wheelchairs
- ✓ **20 % reduction in weigh**, compared to conventional electric wheelchairs
- ✓ **Lower recharging time, < 5 min**

Electric wheelchair	Meyra (Germany)
0.5 kW Fuel Cell	Axane (France)
2 x 2 litres @ 700 bars	Air Liquide (France)
Integration, engineering and testing	Besel (Spain)

**2009**



- ✓ **Increased autonomy (30%)**, compared to conventional electric wheelchairs
- ✓ **15 % reduction in weigh**, compared to conventional electric wheelchairs
- ✓ **Lower recharging time, < 5 min**

Electric wheelchair	Meyra (Germany)
0.35 kW Fuel Cell	Axane (France)
1 x 2,5 litres @ 700 bars	Air Liquide (France)
Integration, engineering and testing	Besel (Spain)

**Courier service, postal delivery (urban use), municipal police and others municipal services, individual user in urban spaces**

**2006**



**2009**



- ✓ **Cleaner and quieter** than conventional combustion engine scooters
- ✓ **Higher vehicle performance** than electric scooters based on batteries
- ✓ **Battery recharging through the fuel cell operation** (no grid recharging)

<b>Original scooter</b>	<b>Aprilia (Italy)</b>
<b>1 kW Fuel cell</b>	<b>MES –DEA (Switzerland)</b>
<b>2 x 2 litres @ 700 bars</b>	<b>Air Liquide (France)</b>
<b>Power train, integration, engineering and testing</b>	<b>Rucker/Besel(Spain)</b>

<b>Original scooter</b>	<b>Derbi (Spain)</b>
<b>1 kW Fuel cell</b>	<b>GAS-HUB (Japan)</b>
<b>2 x 2,5 litres @ 700 bars</b>	<b>Air Liquide (France)</b>
<b>Power train, integration, engineering and testing</b>	<b>Rucker/Besel(Spain)</b>

Service company (maintenance, services, ..) - Logistic service, post service ... Municipal companies (local service, ...)

2006



2009



- ✓ Respectful with the environment (emissions or noise)
- ✓ Power available for additional applications (cooling, lighting ...)
- ✓ High efficiency, low operation cost, Innovative design
- ✓ Increased autonomy (min. 150 km), quick refilling using hydrogen cartridges.

Multifunctional tricycle	Hawk Bikes (Germany)
250 W Fuel cell	Masterflex (Germany)
Cylinder 700 bar / 2 litres	Air Liquide (Germany)
Electronic, integration	Masterflex (Germany)

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**City Council Maintenance Services (garbage disposal, green spaces, cleaning, urban furniture, etc) ; Public Urban transport ; Private companies of transport**

**2006**



**2009**



- ✓ Detachable generator for **auxiliary mobile power** or as **range extender**, more than 30% increased range
  - ✓ **Shorter recharging time** than a conventional electrical systems
  - ✓ **Lighter weighted and larger filling capacity** than similar electrical vehicle with batteries

Base vehicle	VEM (Italy)
3 kW Fuel cell system	Axane (France)
4 x 20 litres @ 300 bars	Air Liquide (France)
Integration	VEM (Italy)

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<b>2 x 20 litres @ 300 bars</b>	Air Liquide (France)
Integration	VEM (Italy)

Public transport, historical areas, natural parks, university campus, industrial areas, airports, commercial centers, theme parks...

- ✓ Can use exclusively **renewable energies**
- ✓ Hybrid propulsion, **silenter and cleaner than Diesel propulsion**
- ✓ **Increased autonomy > 9h** (actually 4-8 h)



**2006**



**2009**

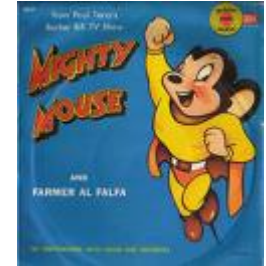
Hybrid Minibus	Tecnobus (Italy)
10 kW Fuel Cell	Hydrogenics (Germany)
Composite pressurized tanks	Dynetek Europe (Germany)
Electronic and integration	Hydrogenics (Germany)

# Barriers to overcome



*Political support*

*Technological Breakthrough*



*Normative & Homologation*

*User friendly*

*Management mess*



*Economical Environment*

*Business Development*

With the support of



*The Spirit of Hydrogen*

# 1. Technical challenges

Once a prototype is developed, it has to be turned to a commercial product:

- Need to be safe and reliable (robust)
- It has to be authorized for running in public roads (homologation)
- It has to meet marked expectations (design and cost)
- User friendly. Improve the specifications of competitive products,
- Sufficient number of units has to be tested in real conditions
- Investment in pre commercial production line is required



All the vehicles developed in Hychain are obliged to fulfill the normative and the EC requirements.

### **PROBLEM: THERE IS NOT SPECIFIC NORMATIVE**

- Homologation required for : *Bus, Utility vehicle and Scooter*

No regulation in place for H2 vehicles → **Single Vehicle Approval**

- Certification (CE mark) required for :Cargobike (< 0,25 kW pedal assisted) and Wheelchair (medical device)

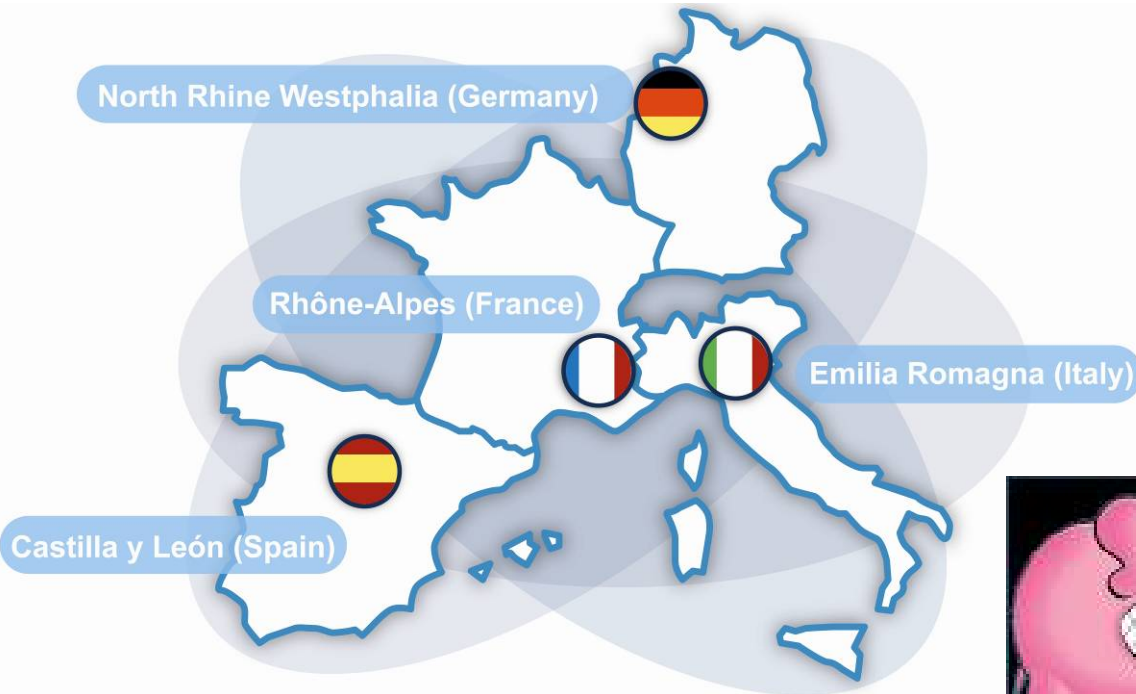




## 2. Normative & Homologation

- ✓ Single Vehicle Approval → **safety must be demonstrated**
  - Crash safety, fire safety (from H<sub>2</sub> leak, other vehicle source of fire, external sources), electrical safety
- ✓ Authorities must recognize manufacturer (full responsibility)
- ✓ Conformity certificates from other countries are only recognized if approved by that country's *authority*
- ✓ Electrical part is challenging as well – lack of reference for Fuel Cell
- ✓ **Strategy adopted:**
  - **Vehicle by vehicle approach**
  - **Start homologation process in Germany (TUV is the most experienced auth.)**
  - **Modular approach: homologation of the mechanical, then electrical, then hybrid part of the vehicles.**
  - **Long process (no less than a year)**





*National Coordinators are in charge of this negotiations.*

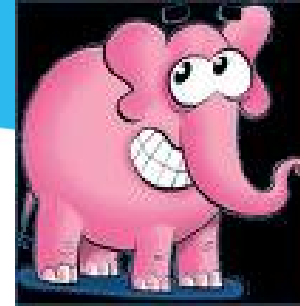
***Political support is fundamental***



***“Politicians support you by different reasons”, not always because they believe on your product***

#### **Problems faced:**

- Conflicts between different political parties (commonly commitment is required)
- Negotiations had to be re-started after each election with the new government.
- Delays in the approval of the municipal budget, with direct impact on the time schedule of the project.



### What a customer request?

They asked for a definitive proven technology (better than existing), commercial information, sales contracts for the vehicles and associated services (maintenance, hydrogen logistics, training, etc.). They need to feel safety and comfortable (guaranties)

All these issues ARE NOT ABSOLUTELY defined at the beginning of the negotiations (all is in process) but you need compromises (sales) as you have committed certain expenses with suppliers. The chicken and egg problem.

**NEGOTIATIONS HAD TAKEN OVER 2 YEARS**

**October 2007.**





## 5. MANAGEMENT MESS 24 partners all types

The reporting to the EC is a complex process that includes the submission of exhaustive technical and financial documentation:

- ✓ Periodic Activity Report
- ✓ Periodic Management Report
- ✓ Vehicle's risk analysis
- ✓ Audit Certificates of each project partner, etc etc.
- ✓ Deliverables and milestones

**Not all partners are used to prepare such reports.**



**High workload for the management bodies of the project. Delays in reports preparation**



**Delays in EC payment**





## 5. BUSINESS CASE

- **Produce a new technology**, then look for a **market niche**, try to **avoid a direct conflict with the “big players”**, sign a **alliance with any of them**, convince politicians to **develop a normative** to support your technology. Then try to **shot to a cake neither to big nor to small** or you will be easily eliminated. Then wait for a **sudden change in the end users point of view**, **waste money** and **pray...**
- **Then Lawyers**

**1st CONTRACT: Contract for the sale of the vehicles**



**2nd CONTRACT: Contract for the hydrogen supply**



**3rd CONTRACT: Contract for guarantee extension**





# 7. ECONOMICAL ENVIRONMENT: Oil economy vs Hydrogen economy

- **Transport sector in Europe, 95% of liquid fuels derived from oil**
- **2020 UE Objective: Until 1,8 mill H2 vehicles sold every year in Europe**



**Consolidated business models.**

**Recover of investments already made.**

- **Oil companies – Transport companies**
- **Vehicles producers**
- **Governments**

**Other alternative technologies (Hybrid, Biofuels, etc).**



**High necessary of investments ( Hydrogen infrastructures development)**

**2 Hydrogen production models.**

**Centralized → Gas companies**

**Distributed → Democratic**

**Step by step entrance avoiding to face the Big players (required market niches)**

**Ej, Low power vehicles**

See you in HYCHAIN District!  
THANK YOU



Visit us [www.hychain.org](http://www.hychain.org)

*The Spirit of Hydrogen*

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- Vehículos híbridos.
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- Electrónica de Potencia.
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