



Power to Gas in France and the GRHYD project

HIPS-NET Workshop
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■ What had been done before ?



European research project NaturalHY (Natural Gas + Hydrogen) 2004-2009

Using the existing natural gas system for hydrogen

- Project duration 2003 – 2009
- EU 6RP (39 Partner - Gasunie, GDF, NUON, DBI , GERG, ...)
- 8 Work packages (LCA, Safety, Durability, Integrity, End Use, ...)
- Budget: 17 Mio. EUR
- Comprehensive testing has been performed
- In the pipeline system no show stoppers has been identified
- Individual consideration of H₂ addition to the gas grid
- Not all elements has been investigated in the frame of the project (underground storages, compressors, turbines etc. were out of the scope)

French research project Althytude (ALternative HYdrogène dans les Transports Urbains à DunkerquE) 2005-2010

- Supported by ADEME



(French Agency : **A**gence **d**e l'**E**nvironnement et de la **M**aîtrise de l'**E**nergie)

- Leader : GDF SUEZ Research & Innovation Division
- Partnership with Communauté Urbaine de Dunkerque



- Experience with Hythane® fuel on 2 NGV city buses
- Hythane® = 80 % natural gas + 20 % H₂



- Results : a better combustion, better technical performance, increased energy efficiency (+7 %), more pleasant driving as assessed by bus drivers.
- The project also helped to modify French technical regulations.

HIPS

conducted within GERG (Groupe Européen de Recherches Gazières)
2011-2012



alliander



Gasum



SNAM RETE GAS



GDF SUEZ

- **What is the overall objective behind Power to Gas ?**

H2+ NG: Power to Gas a path to convert renewable electricity overproduction into a new energy vector for sustainable cities

- ❑ 20% renewable energies in Europe within 2020 → difficulties in integrating increasing intermittent electricity when generation exceeds demand
- ❑ Flexibility/arbitrage are necessary to integrate in the best way these green energies at the lowest cost
 - « Fatal » power could be used through Hydrogen production, via NG appliances
 - Arbitrage between different end uses for a better management of power and gas energies
- ❑ A new energy vector for sustainable cities
 - In complementarity with biomethane, hydrogen mixed with NG (6→20%) is a greener gas (↗efficiency, ↘CO₂, ressources savings)
 - Synergies of natural gas know-how, infrastructure and utilisation/appliances



« Smart Energy Grid » and global optimisation of power and gas systems

■ The GHRYD project



GRHYD Demonstration project



Supported by



and by



In the framework of the Investments for the Future program



Following a call « Appel à Manifestations d'Intérêt » on « hydrogen and fuel cells » managed by ADEME for the French State, the GRHYD project encompasses hydrogen injection into a natural gas grid and production of Hythane® fuel (composed of hydrogen and natural gas, was accepted end of 2012, and officialy launched on 30 january 2014.

Its aim : to transform electricity from renewables into hydrogen (when production exceeds demand of electricity), so as to make a valuable use of it through natural gas uses (heating, hot water, fuel,)



GHRYP demonstration project



The project started with a preliminary phase of about 2 years. It consists of 2 demonstration projects :

- An industry-size project of **Hythane[®] fuel**. A NGV bus station will be adapted to a hydrogen/natural gas mixture, starting with a 6 % hydrogen/NG ratio, up to 20 %.
- A project to **inject hydrogen in a natural gas distribution network**. A newly (re)built area of around 200 dwellings will be supplied by a mixture of hydrogen and natural gas, with hydrogen/natural gas ratio varying up to 20 % (vol).

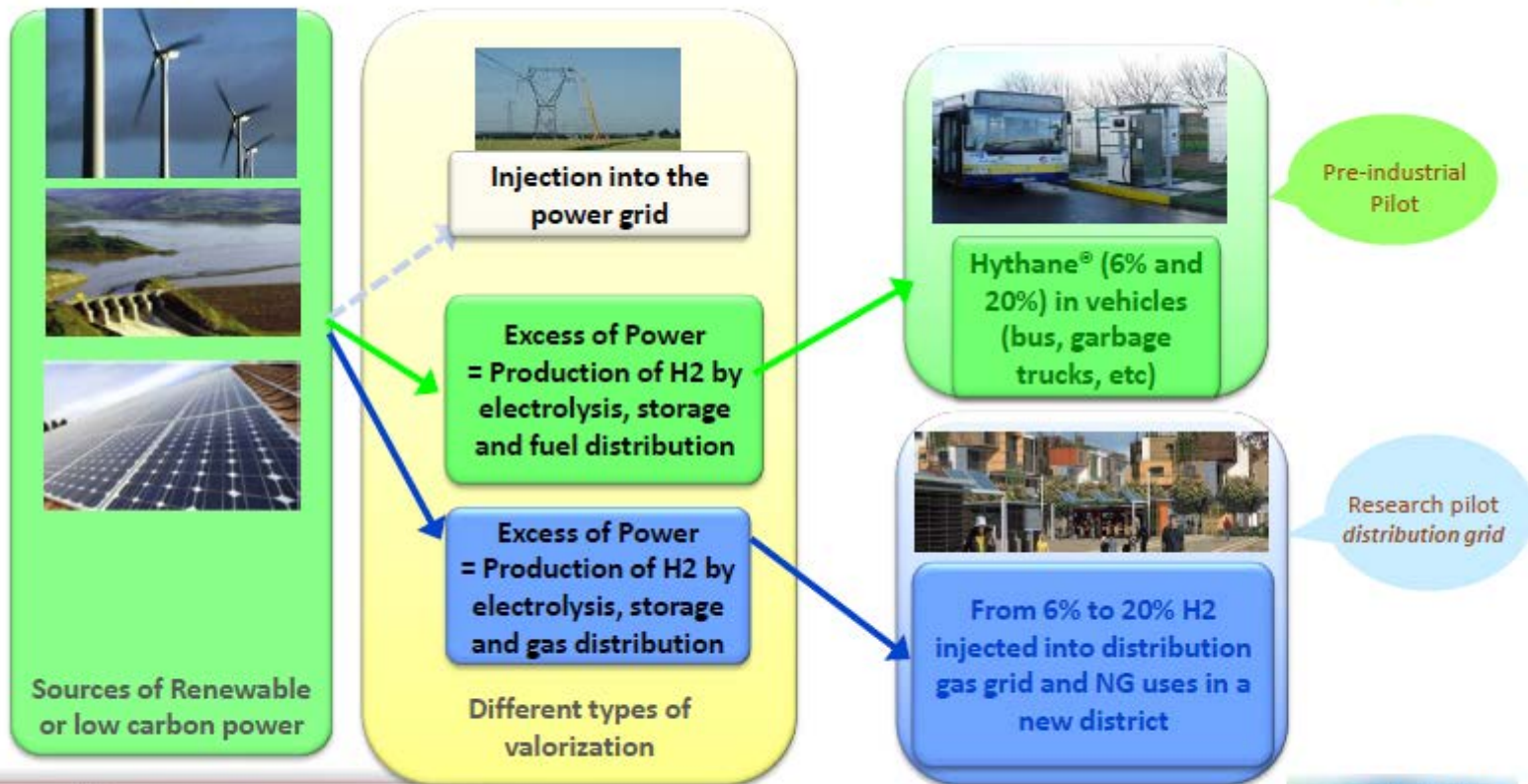


These two pilots have a 5 year duration. They will allow the evaluation of this new technology, from various outlooks (technical, economical and environmental). Experience gained in the relationship with local communities and inhabitants will also be a plus for the future.



Grid Management by Hydrogen Injection for Reducing Carbon Energies

2 pilots for production, distribution and local use of renewable H2 mixed with natural gas





- Complete assessment (technology, economy, environment, society)
- Preparation of the deployment and construction of global economic models

GRHYD Partners



GRHYD involves 12 partners :

- **Crigen, R&D Division of GDF SUEZ** (Project leader) 
- **AREVA H2 & energy storage** (PEM electrolyzers) 
- **CETH2** (PEM electrolyzers) 
- **McPhy Energy** (H2 solid storage) 
- **COFELY INEO** (mixing station) 
- **GNVERT** (Hythane® fuelling station) 
- **CEA** (coupling electricity/H2 production/storage, software, testing of materials), 
- **CETIAT** (technical center for testing of appliances) 
- **INERIS** (institute for safety) 
- **GrDF** (distribution network operator) 
- **STDE** (urban transportation) 
- **Dunkerque Grand Littoral** (community) 

- Total budget : 15,3 M€

GHRVD demonstration in new district



- A project to **inject hydrogen in a natural gas distribution network**. 200 dwellings will be supplied by a mixture of hydrogen and natural gas, with hydrogen/natural gas ratio varying up to 20 % (vol).

OBJECTIVES

- Technical feasibility study : Safety is a key point.
- Measure of performance of « green » hydrogen production & storage
- Variation of the mixture from 6% to 20%
- Assessment of social acceptability, economical and environmental results

GRHYD : Hythane® demonstration for buses



▪ **OBJECTIVES**

- Technical and economical analysis of Hythane® fuel supply for a fleet of natural gas buses
- Impact evaluation of 6% and 20% H2 fuel and associated procedures for long term.
- Deployment of the solution in a sustainable economical model

In short



2004

2011

2012

2018

...



NATURALHY

- Security issue: max 20 à 25%vol H2 mixed with NG
- 20% acceptable for grid, appliances and meters tested in the project

ALTHYTUDE

- Simple adaptation of vehicles and infrastructure
- Technical feasibility and environmental benefits of Hythane® (↓CO₂, ↓NO_x, ↑efficiency)

3 markets will be explored :

- Optimisation value RES
- ➡ ■ New gas for sustainable cities
- ➡ ■ Hythane® fuel for fleets

Some challenges to solve:

- Environmental: reduction of GES and local pollution
- Technical feasibility and adaptation of electrolyser and storage technology
- Efficiency: decrease of fossil energy consumption
- Economy: reduction of costs
- Social acceptance

Targeted objectives for H2/GN chain:

- H2 Production competitive with / NG at the injection point
- Commercialisation of a NG/H2 mixture with an acceptable over price
- Adapted regulatory
- Environmental Value creation and service offer to the electricity grid
- Business development for french firms (H2 storage, electrolysis...)

**CRIGEN is the operational research and expertise center
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and emerging technologies**

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