The GRHYD project

Grid Management by Hydrogen Injection for Reducing Carbonaceous Energies

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Background and Overview of GRHYD

Investment for the Future:
The GRHYD 'Power-to-Gas-to Grid' project

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- Selected mid-2011 by the French Government, as part of the **'Investment for the Future'** *pilot and technology platform for renewable and low carbon energy: hydrogen and fuel cells.*

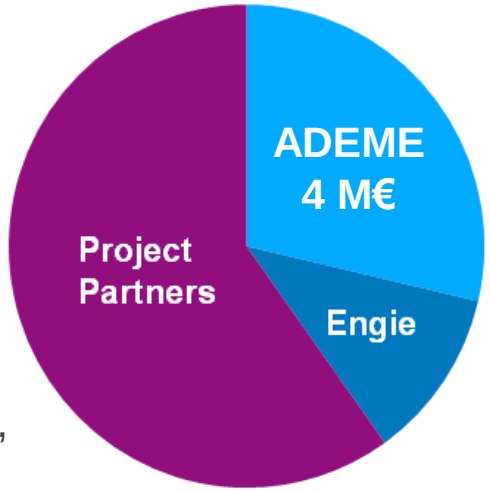
- France's first ever 'Power-to-Gas-to-Grid' project in France **and a significant step** towards the development of hydrogen at urban level.

- The GRHYD project also addresses the theme of "**Hydrogen for a Sustainable City" as this energy is Green.**

An Experts Partnership to build a new supply chain based on Hydrogen-enriched natural gas

- **Dunkirk municipality**
- **The area's public bus company,** DK'BUS Marine.
- **Leading energy company** ENGIE plus 3 subsidiaries:
  – **ENGIE Ineo** (energy management for the H2 production&storage station,
  – with **GRDF** (GN-H2 mix injection and distribution in the gas grid),
  – and **GNVERT** (CNG) for the Hythane® refueling station for buses.
- **OEMs**: AREVA H2Gen and McPhy Energy, for H2 production and storage
- **R&D and technical centers**, CEA, INERIS, CETIAT

Budget: 15.3 M€



GRHYD = Two pilots based on Hydrogen to assess the relevance of underlying Power to Gas supply chain

GRHYD Objective : Produce H2 from renewable electricity, supply it to customers as an NG-H2 mixture by means of the gas distribution grid, and consume it locally

Residential use, heating, cooking, hot water, CHP, and mobility (fuel for buses)

A NEW TYPE OF GAS FOR GRID

A new kind of gas for homes

A new 200-home estate will be supplied with NG-H2 blends.
The H2 content may fluctuate but will never exceed 20% vol.

SUSTAINABLE MOBILITY

A new fuel for urban buses

By piloting Hythane® fuel on a commercial level.
The NGV station and dozens of urban buses will be adapted to Hythane® (20% vol. H2)

02

Demonstration “injection of GN-H2 gas”

R&D Pilot : « new gas for residential uses » Hythane® to be supplied to 100 houses

Objectives	Progress	
Technical feasibility study	▪ **Design optimization of the H2 chain vs energy needs (heating, hot water, cooking) and availability of 'green' electricity**	✓
Safety (regulations)	▪ **French Ministry gave in June 2016 its approval for injecting H2 in gas grid, for GRHYD experimentation**	✓
Performance assessment of 'green' H2 production & storage	▪ Technology innovation for electrolysis (PEM) and H2 storage (at low pressure on metallic hydrides)	
Social acceptance	▪ No objection for this new 'gas' at home, but clear and complete information needed	✓
Assessment of economic and environmental results.	▪ **Support mechanism to valorize the renewable value of this green gas, to be designed (guarantee of origin,…)**	

List of investigations prior to the demonstration launch in the new quarter of Cappelle-La-Grande

- Software developments : for design optimisation, and for H2 station control vs green electricity
- Technical studies
  - Domestic gas boilers and gas cookers & ovens
  - Gas meters for the domestic lodges & for the boiler plant
  - Tightness of gas devices (inner equipments, grid equipments)
  - Gas detection devices
  - Gas odorization
  - Non-Demixion of the gases NG and H2
  - PE pipeline permeation
  - Embrittlement of metals
  - H2 effect on the caloric value of gas mixtures

- Safety studies : Simulation of several scenario => the effects remain inside the site
- Social acceptance: Inquiries and assessment before & after the demonstration

R&D Pilot : « new gas for residential uses »
Progress on gas distribution grid and buildings

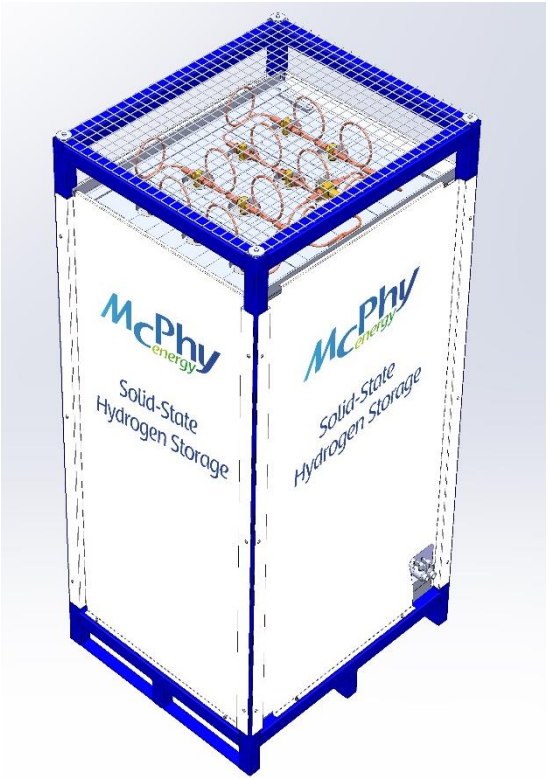
R&D Pilot : « new gas for residential uses »
Progress on H2 production & storage station

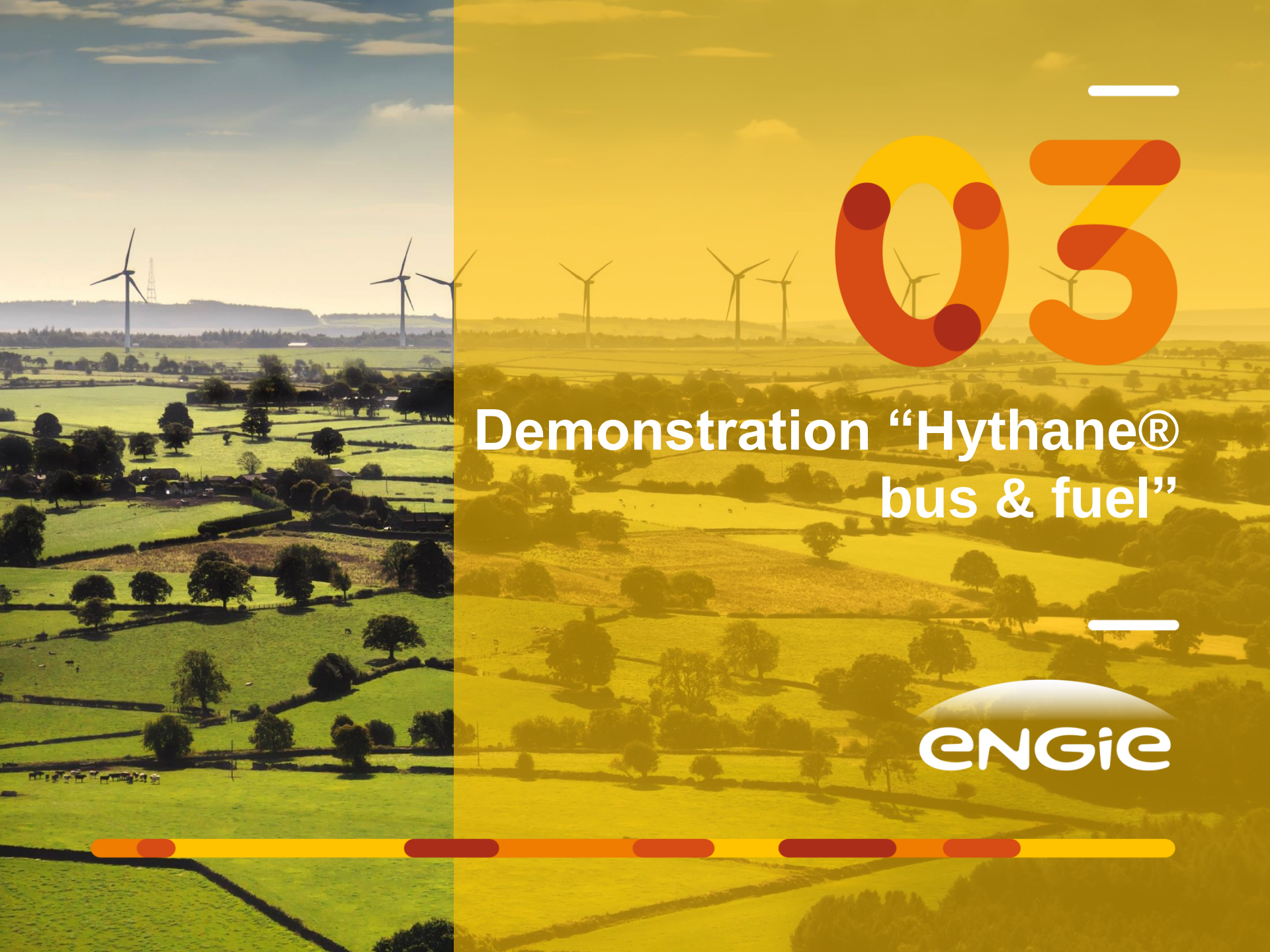
AREVA H2Gen electrolyser

10 Nm^3 H2 /h

McPhy solid hydride storage

4 - 5 kg H2




03
Demonstration “Hythane®
bus & fuel”
ENGIE

Power to Gas has major environmental benefits

- **Advantages of the H2/NG blend as a vehicle fuel** (Hythane®, ‘H2 enriched NG’):
  - **Higher engine efficiency** (+7% vs CNG)
  - **Lower emissions of local pollutants** (-10% vs CNG)
  - **Lower consumption of primary energy** (fossil energy replaced by renewable H2 energy).

Industrial Pilot “Hythane® fuel for bus fleet”
Deployment of a new vehicle fuel on a commercial scale

Objectives	Progress	
Technical and economic analysis of Hythane®	▪ **Design optimization of the H2 station** vs fuel needs and ‘green’ electricity	
Safety (regulations)	▪ Ongoing risk assessment & management for permitting issue	
Deployment of Hythane®	▪ Bus, engine and depot adaptation ▪ Regulation for vehicle “homologation” to be adapted (IVECO) ▪ **Hythane® fuel station start planned for 2018**	
Social acceptance	▪ **Introduction of the new fuel to passengers: no objection noticed trough first sociological studies**	✓
Development of a sustainable economic model	▪ Early Life Cycle Analysis (LCA) ▪ Ongoing negotiation between Hythane® supplier (ENGIE GNVERT) and Dunkirk municipality for a 15 years contract	

Industrial Pilot “Hythane® fuel for bus fleet”

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Thank you !

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