



*Green and Safe
Hydrogen Solutions*

**Innovative H2 Solutions to Move Towards
Clean & Smart Territories**

European Commission JRC

"S3P Energy: Smart Mediterraneo

Bari, 23-24 June 2016

Energy Transition : H2 trends and opportunities (reminder)

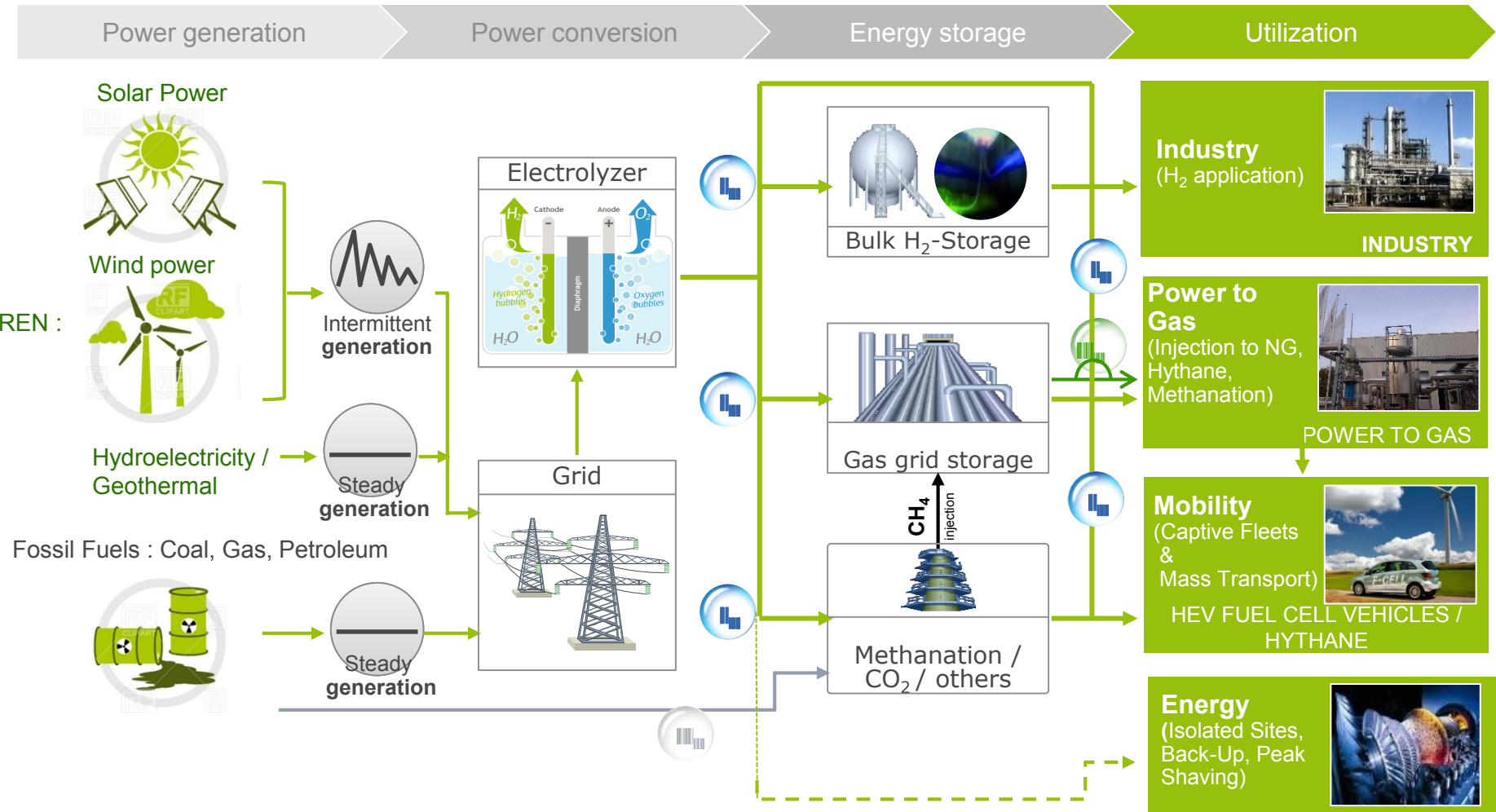
McPhy Energy : Who we are ?

PowerToH2 in Europe :

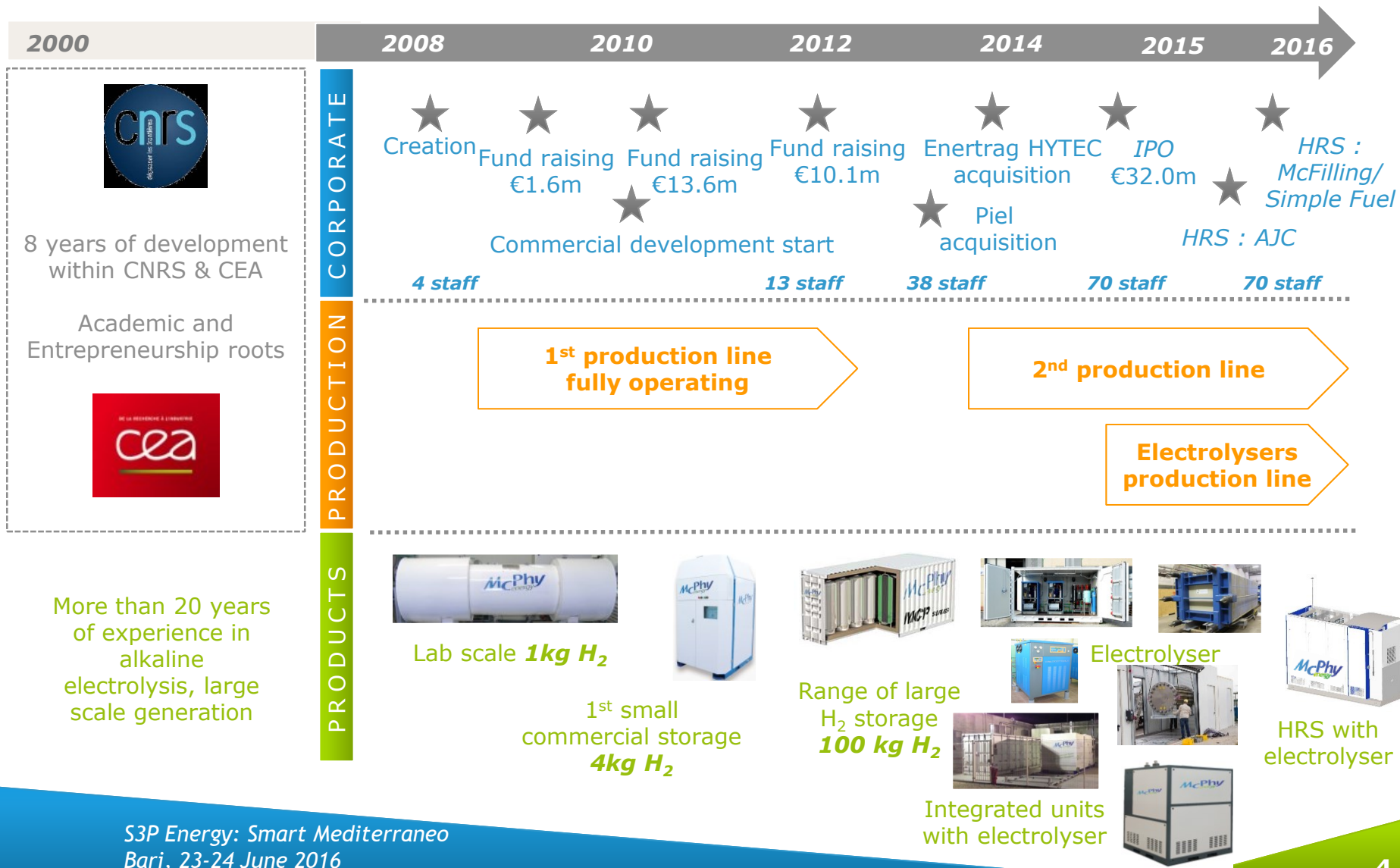
- Principles & Business Models,
- Technological Examples in Europe

Key Learnings





Regulatory environment is evolving & new business models are under construction



Manufacturing : strong footprint (2 locations) & partnerships (De Nora, Thyssen Krupp, ENGIE...)

France (La Motte-Fanjas)



- H₂ solid state storage – LTS, HDS, HES
- Test Platform + R&D center
- HRS – McFilling®



Italy (San Miniato)



- **Electrolyzer - Alkaline Technology 2.0 (<500kW, >500kW)**
 - McLyzer PIEL : 1 – 10 Nm³/h; p: 2,5-4-8 bar
 - McLyzer : 5 - 60 Nm³/h , pressure:10-30 bar
 - McLyzer :100 - X000 Nm³/h , 1 - 60 bar
- R&D and Engineering Team



Germany (Wildau)



- A dedicated Electrolyzer engineering team - Large Projects



Commercial Offices

France
Italy
Germany
North America
Asia Pacific
Eastern Europe - Russia

A Large Range of Solutions : H2 generators, solid state storage, HRS

A portfolio of innovative products ...



Small & med electrolyzers
<500 kW
1 - 100 Nm³/h



Large electrolyzers
>500 kW
100 - X000 Nm³/h



Disruptive H₂ solid storage technology :
Low and High Temperature



HRS – Hydrogen Refueling Stations
5 - 200 kg / day

- > Engineering : plug & play, project concept and realization
- > Client Assistance : preventive & corrective maintenance and replacement plan
- > Performance and Reporting : control and monitoring of key parameters

... addressing 4 main high-growth markets



INDUSTRIAL HYDROGEN



MOBILITY



POWER TO GAS



ENERGY

PowerToGas : H2 and Gas just an « old » story ?

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Multiple challenge :

Increase production of Renewable Energy

Reduce overall CO2 emissions

Increase economic efficiency of Conventional assets

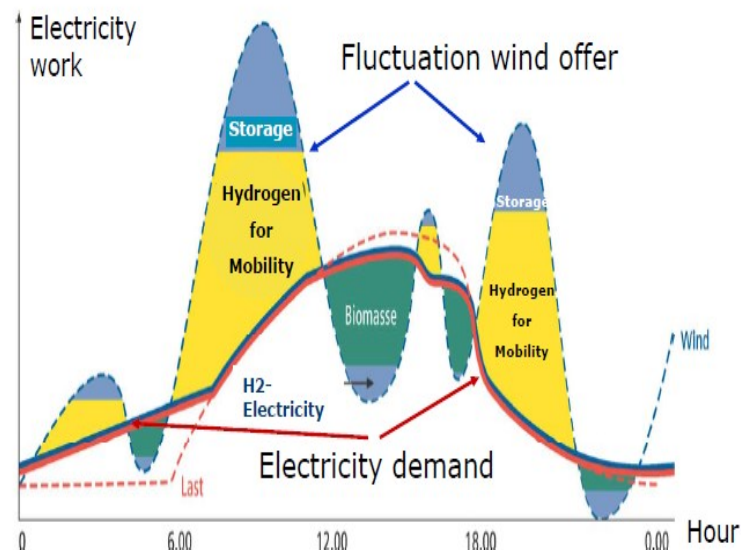
Contribute to the security of the grid

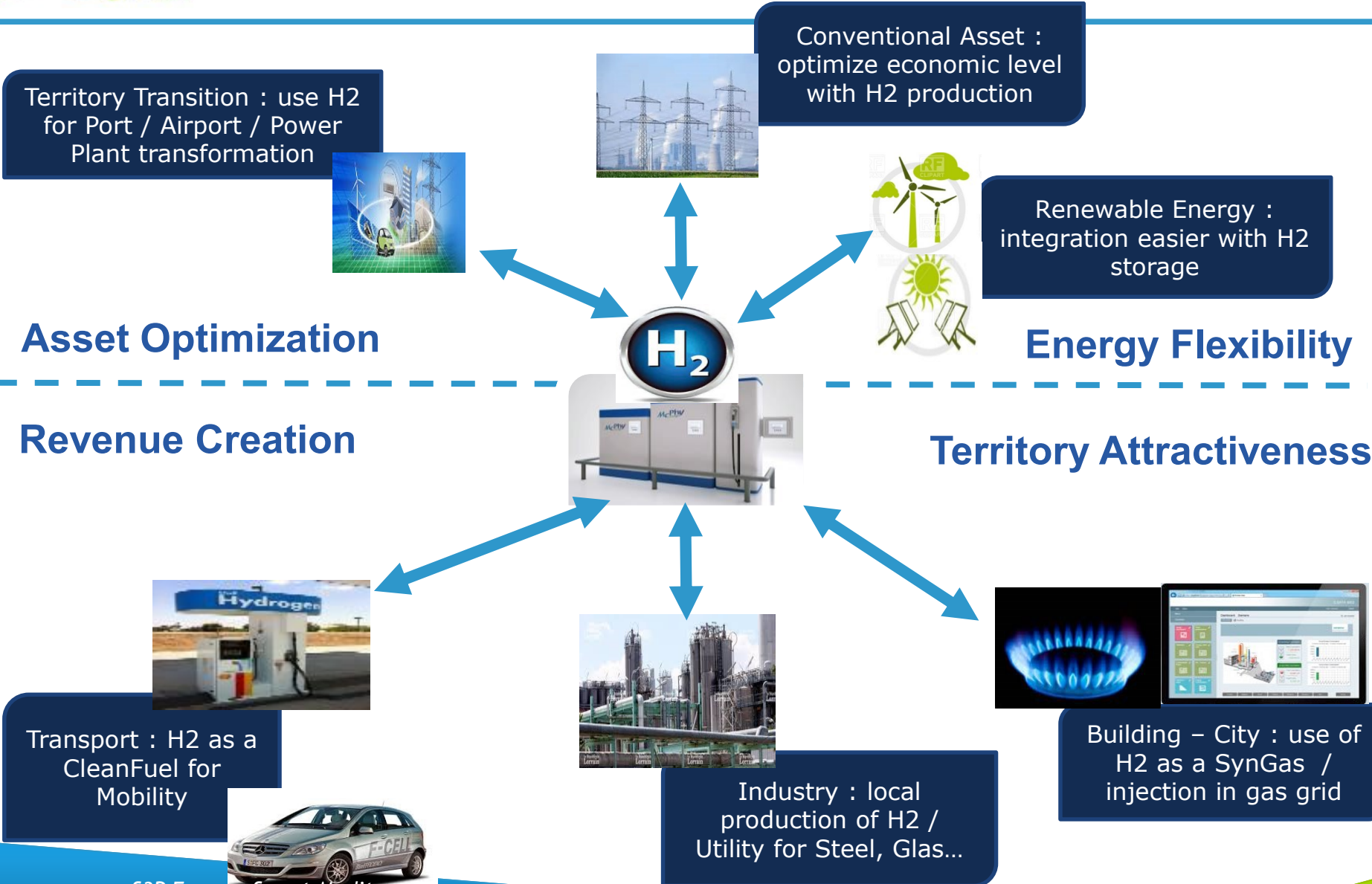
Propose new Energy Services to the customers and create new “Revenues” for Industry and Mobility Markets

Reinforce “attraction attractiveness” of Territories

Capture and organize new Innovative System

And other : reinforce partnership with Stakeholders, contribute to Energy

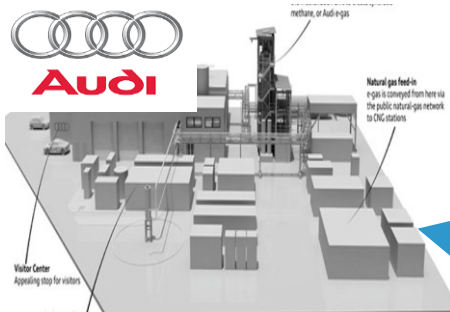




Business Model	E-source	Gas Type	Cost		Revenues		
			Storage	Curtail / Cut off	Energy	Mobility	Industry
Metrics used for New Business Model			€ / MWh Tech. Optim.	€ / MWh Nega Watt	€/Nm3 Gas Injection €/MWh Elec.	€/kg Sell bioFuel	€/Nm3 Sell GreenGas
Energy Model		H2 and/or SynGas	✓	✓	✓✓		
Industry & Service Model		SynGas and/or H2	✓	✓		✓	✓✓



Different Business Case Exist
A Multi application approach can help maximize revenues



WindGas "Business Case" GERMANY



Territory "Business Case" Puglia - ITALY



Port "Business Case" Marseille - FRANCE



Airport "Business Case" Berlin - GERMANY



Industry "Business Case" Grenoble-INDUSTRY

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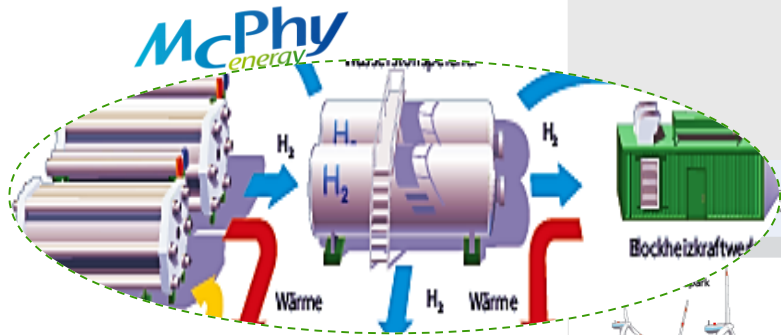
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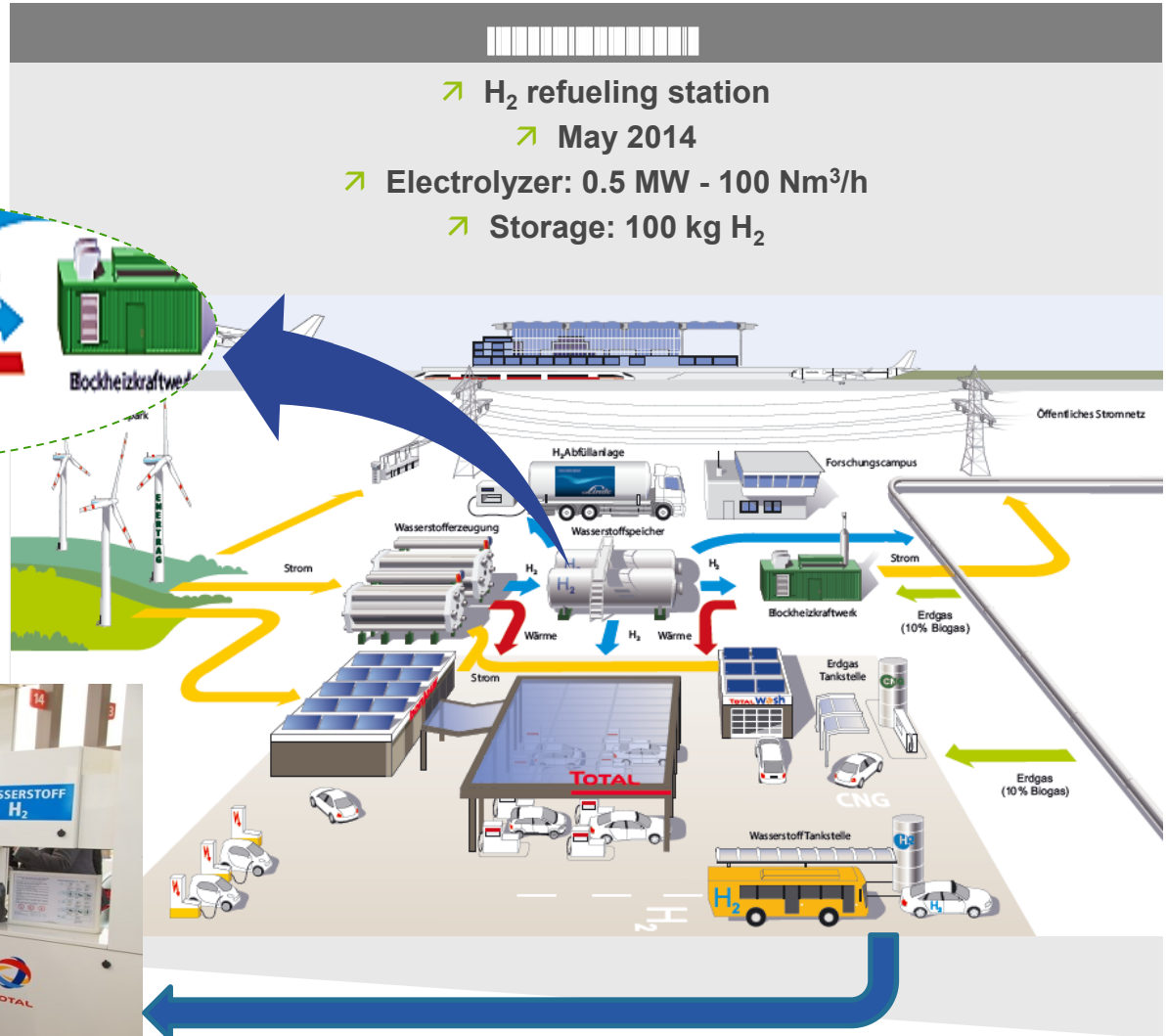
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Key Learnings





- H₂ refueling station
- May 2014
- Electrolyzer: 0.5 MW - 100 Nm³/h
- Storage: 100 kg H₂





A multi-energy , CO₂-free refueling station for vehicles

- > Hydrogen filling, electric vehicle charging, biogas filling
- > Display of several hydrogen technologies in the context of full integration of renewable energies
- > Under the umbrella of CEP, Europe's largest demonstration project for fuel cell mobility
- > €5 million of public funding

€10 million total investment by the project partners

- > Total Deutschland, Linde, McPhy Energy, Enertrag, 2G Energy

Display of McPhy advanced technologies

- > On-Site hydrogen production by water electrolysis
- > Innovative solid state storage for hydrogen



Germany, a pioneer pushing into the renewable energy age:

- > % share of renewables in electricity generation
 - > target 2020: 35% / target 2050: 80%
 - > actual 2014: 28% / half yr 2015: 33%

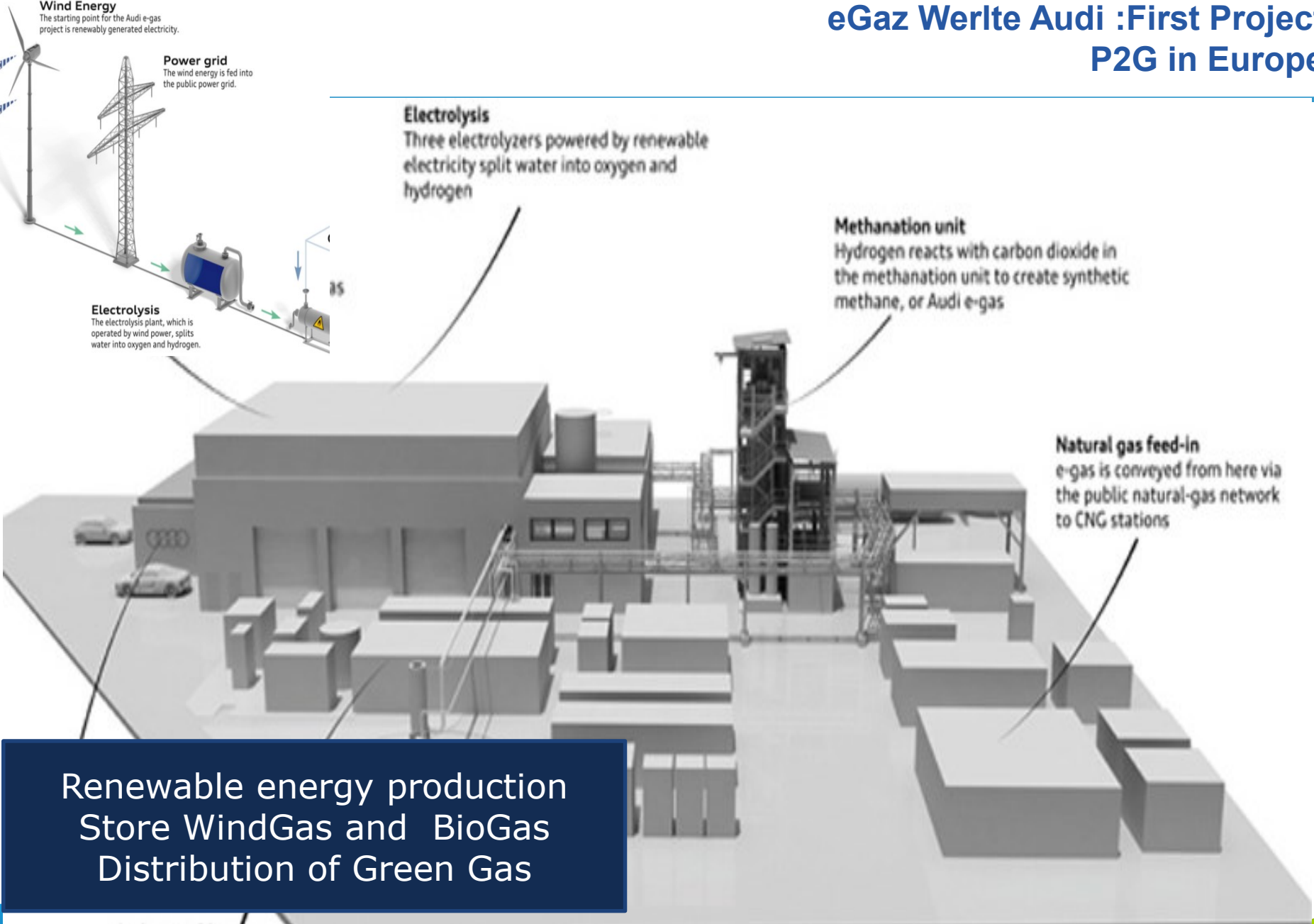
Integration of renewables by leveraging hydrogen as energy vector

- > hydrogen as flexibility tool:
 - > storage of excess renewable energy in natural gas grid: Power-to-Gas
 - > shifting renewable energy to use as fuel in industry and mobility: Power-to-Fuel

Building an infrastructure for market deployment of fuel-cell based mobility

- > 2016: from 15 existing to 50 stations for H₂
- > 2023: 400 stations will form a national network

eGaz Werlte Audi :First Project P2G in Europe



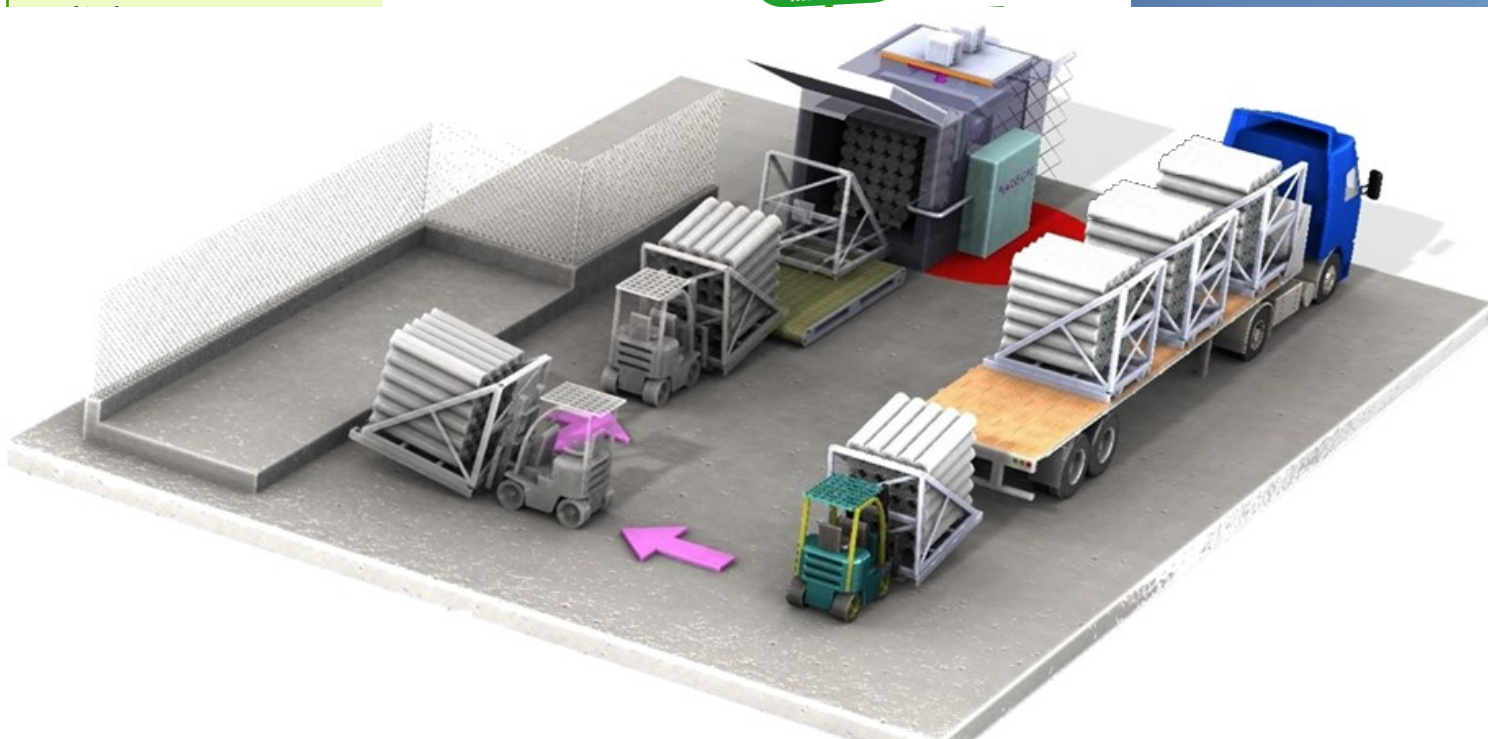
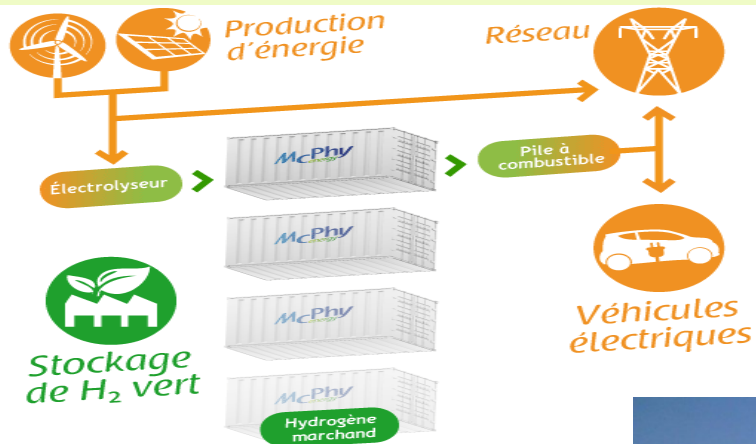




6 MW H₂ Alkaline
electrolyzer
- 1.200 Nm³/h
in service since 2013

INGRID PROJECT

- 750 kg H₂
- 30 MWh
- PtG & green H₂ for industry/transport





Consortium : 7 Industrial Partners, 1 Laboratory R&D
One innovative platform:
CO₂ Capture, H₂ Production (1 MW)
and Synthetic Methane – Methanation



INNOVEX

Asco
Industries

Clients industriels en aval
du réseau de GRTgaz

Stations H2 in Service

Stations H2 – delivery in progress



Berlin (DE)
200 kg / Day
700 bar



HTEC Woodside (US)
> 20 vehicles
700 bar




Grenoble
> 1.000 refilling




FCH JU 2014
Sarreguemines
10/15 Véhicles




Grenoble HYWAY
> 25 cars




Lyon HYWAY




Paris COP21




Valence
> 10/15 Véhicules

Give preference to a global approach vs. single usage

Work at territory Level, taking into account local opportunities / constraints,

Build the project with Local Partners, Stake Holders...

Upstream : Secure Electricity Supply

Downstream : analyze market potential and secure a « base line » of revenues on each market segment : Gas Injection x Grid Services x Industry x Mobility

Secure by “mixing” different source of revenues on a medium term period

Anticipate both regulation and permitting impact

Thank you for your attention ...



“ Yes, my friends, I believe that water will be one day used as fuel, that the hydrogen and the oxygen, which make it, used separately or simultaneously, will provide a source of inexhaustible heat and light and with an intensity the coal could never reach”

Jules Verne, L'Île Mystérieuse - 1874



> Build simultaneously H2
et



> propose scalable and
affordable equipment...

> ...adapted to real OEM needs
and territory challenge :
Energy Transition
Clean Air
Local job and Value

> With global H2 system :
production (electrolyzer),
storage...



+



= H2



- > From old times to new era, solution to launch H2 mobility on each Territory



**Coming soon
in partnership with PDC-IVC**

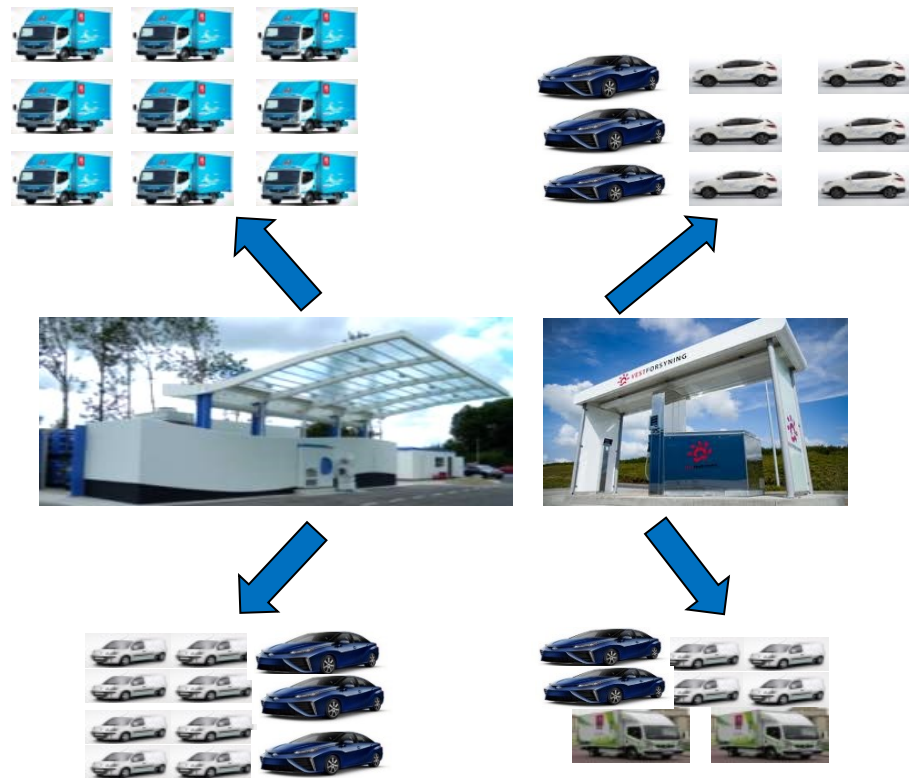
> From old times to new era



**Integrated HRS
including H2 OnSite
Generation**

**Small H2 Cluster « First Vehicles »
10/15 vehicles by Starter Kit**

**Large H2 Cluster including large Fleet, Trucks....
100 vehicles**



*Starter Kit: small units enabling to start Small and Fast.
10 Starter Kit can accelerate H2 Mobility dissemination, improve service level
and be complementary to large Scale HRS > 200 kg*