

DOCKETED

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Power-to-Gas

DRIVING CLEAN ENERGY FORWARD

McPhy
energy

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Presented: CEC Workshop,
Renewable Hydrogen Transportation Fuel Production
Venue: Sacramento, CA 95814



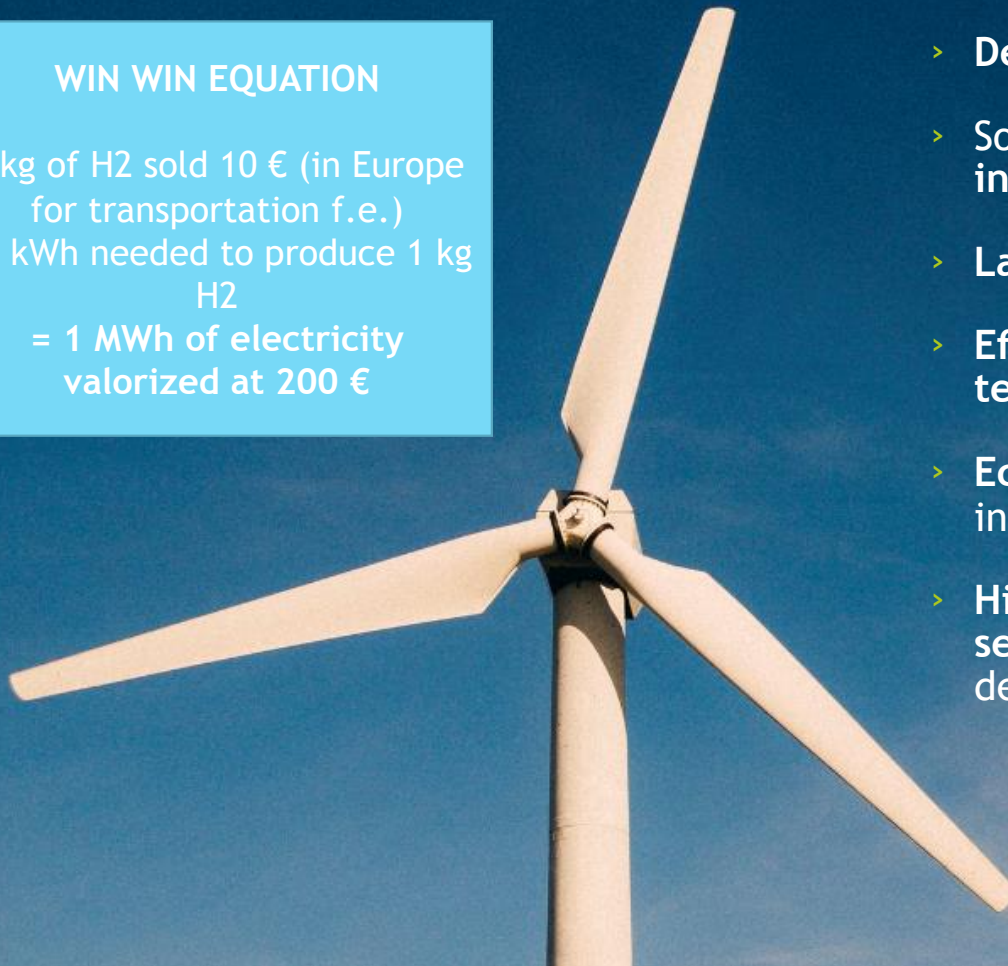
THE ADVANTAGES

Power-to-Gas: a high-potential solution

WIN WIN EQUATION

1 kg of H₂ sold 10 € (in Europe
for transportation f.e.)
50 kWh needed to produce 1 kg
H₂
= 1 MWh of electricity
valorized at 200 €

- Decarbonize the energy mix
- Solve the **electricity storage** + the **intermittency of renewable** issues
- **Large scale / Long term** solution
- **Efficiency: balancing the grid, short term response, flexibility**
- **Economically attractive** (gas grid infrastructure already existing)
- **High value product** which can be used in **several applications** with different degrees of flexibility



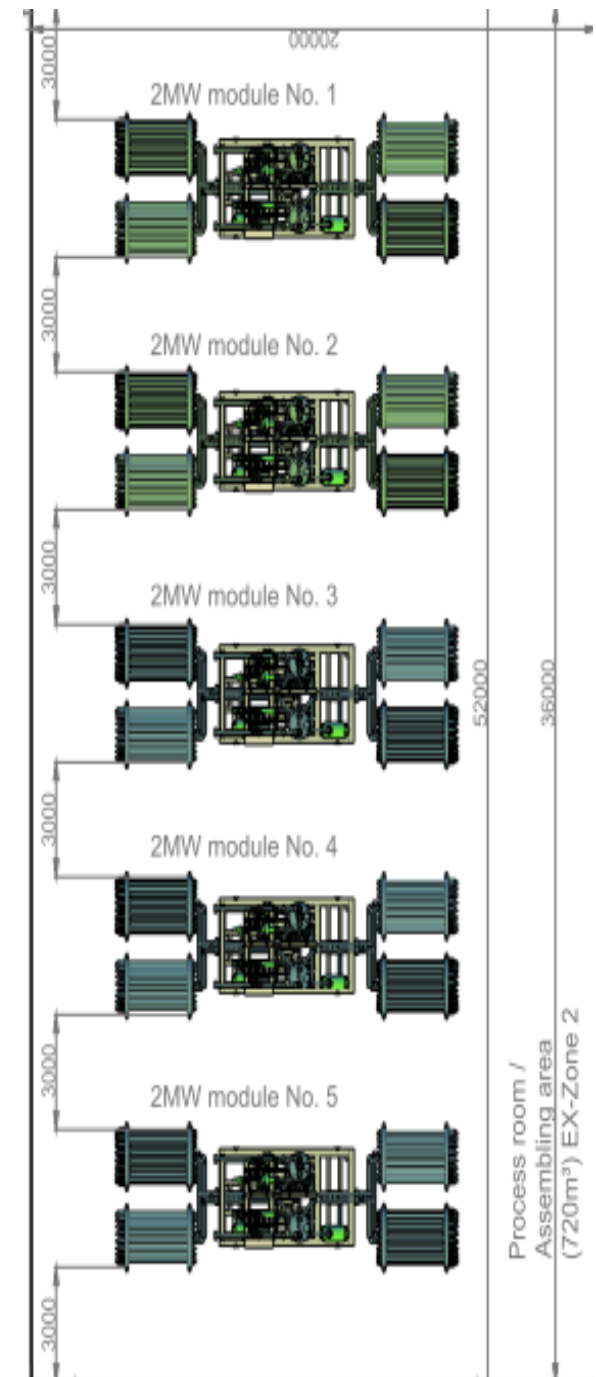
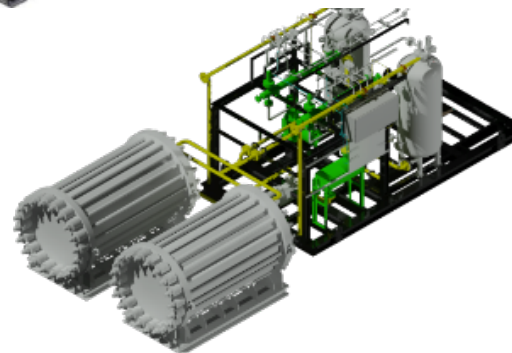
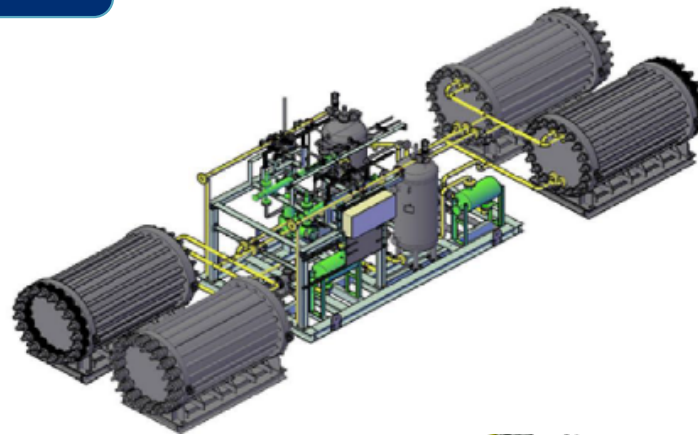
MCPHY SCALABLE MULTI MW SYSTEMS

10 MW

2 MW
McLyzer 400

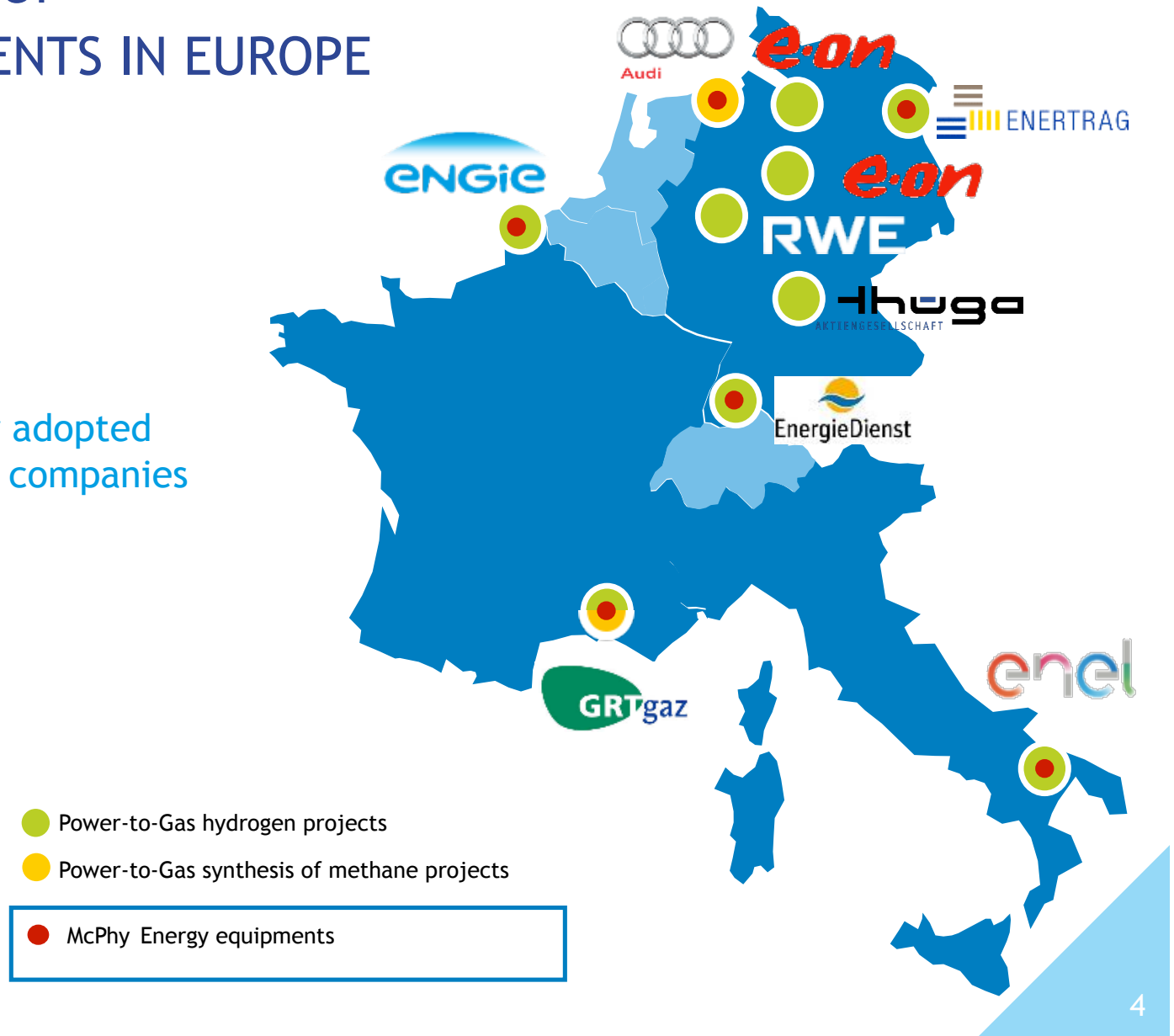
1 MW
McLyzer 200

0,5 MW
McLyzer 100



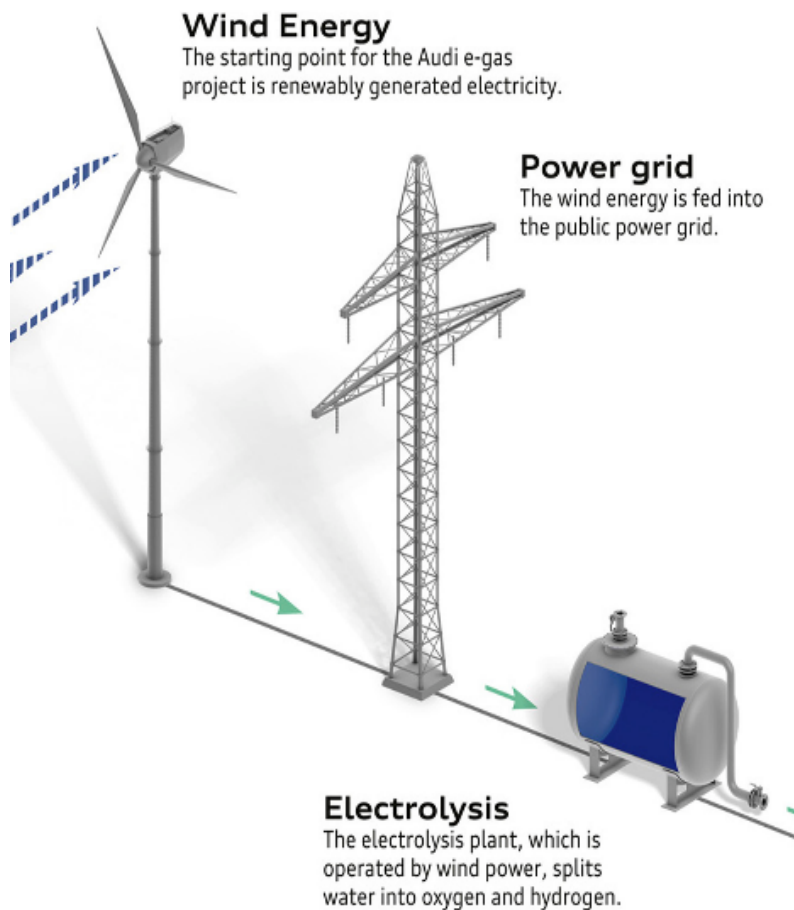
EXAMPLES OF ACHIEVEMENTS IN EUROPE

A solution widely adopted
by major European companies



AUDI E-GAS PLANT(GERMANY) 2/2

One of the first PtG project in Europe



Operated by Etogas
Hydrogen production equipment with power of 6 MW

Preventive and corrective maintenance contract

JUPITER 1000 (FRANCE) ^{1/2}

A large demonstrator in South of France, close to Marseille



An installed capacity of

1MW



Hydrogen injection

up to 200 m3/h



Methane production

up to 25 m3/h

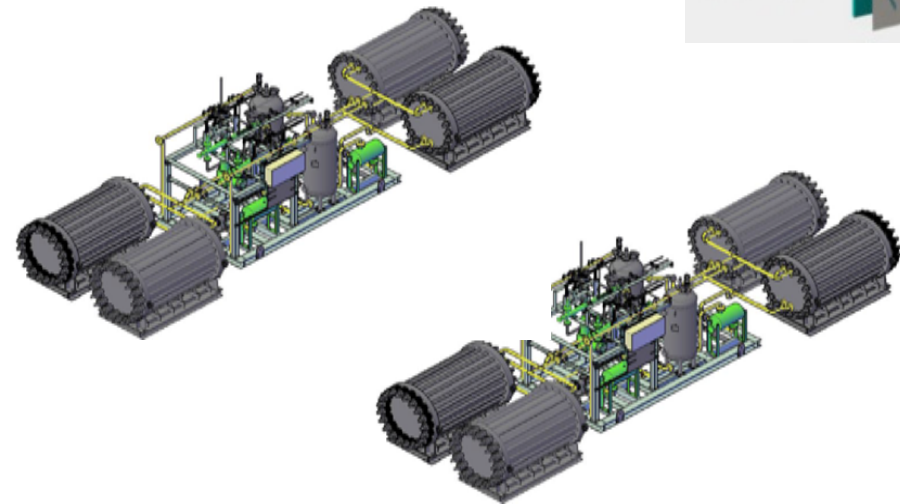
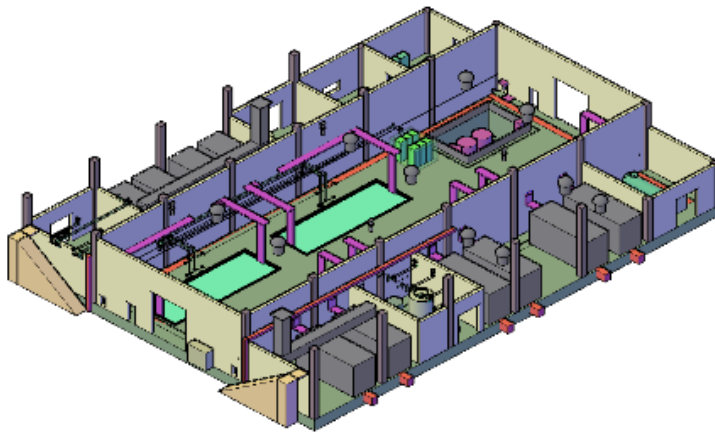


Commissioning

2018

HEBEI (China) 1/2

4MW electrolysis solution for SINOPEC



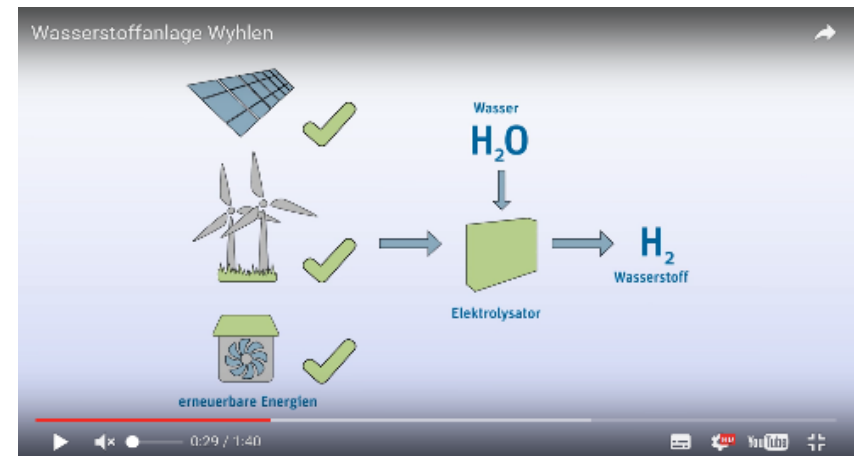
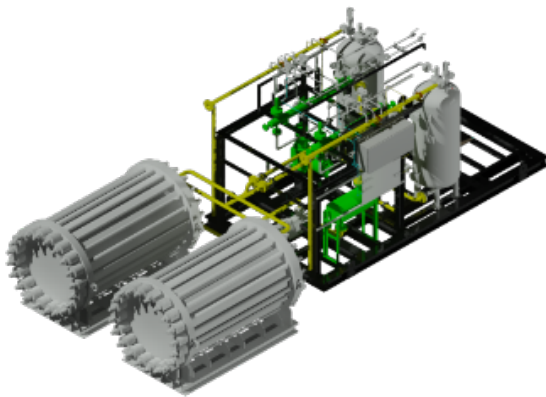
End User SPV of HEBEI Construction
Storage of Wind Gas 200 MW wind park in the North of Hebei province

- > 2 McLyzer 400 : 400 Nm³/h - 4 MW power
- > **Solid Storage**
- > Delivery in May 2017,

ENERGIEDIENST (GERMANY)

1 MW Electrolysis

- > 2 McLyzer 100: 200 Nm³/h - 1 MW
- > H₂ applications: Mobility, Industry, Storage
- > First H₂ Project in partnership with Center For Solar Energy
- > Delivery end 2017



The background of the slide is a photograph of industrial electrolyzer equipment. It features a complex network of silver-colored pipes, valves, and electrical conduits. Some pipes are wrapped in white insulation. The equipment is mounted on a blue metal frame. Yellow and blue cables are visible, connecting different parts of the system. The overall scene is a technical, industrial environment.

WITH THE @ENERGIEDIENST PROJECT
MCPHY WILL HAVE INSTALLED

13 MW

OF HIGH CAPACITY ELECTROLYZERS
> 5 TONS OF CLEAN H₂
PRODUCED PER DAY



Thoughts for Consideration

NA Markets

- Is the grid services model adequate to create a business case? Especially challenging if 'returning' power to grid is a key part of energy storage solution requirement
- The biggest cost driver for electrolyzer H₂ is Cost of Electricity ~ 50 kWhr/kg = \$7.5/kg @ \$0.15/kW-hr.
- Any serious discussion on integrating wind & solar to make renewable H₂ needs to address electric pricing - especially when not supplied by renewable source
 - Incentive schemes will be critical
 - @ Life Cycle Level - lower electric rates vs. grants for capex?
 - Provide differentiated incentive schemes targeted to address different solutions
- Large scale electrolyzer solutions are here with low capital cost and high durability & reliability performance



Power-to-Gas

REFERENCES UNDER OPERATION

H2

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energy