



Compétitivité des plateformes d'électrolyse alcaline très grande capacité (multi MW) au service de la transition énergétique

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Fondation de la Maison de la Chimie



mcphy.com

A premier industrial infrastructure

Business locations

5 Sites 
France, Germany, Italy, China and USA

OUTSTANDING INDUSTRIAL INFRASTRUCTURE.
WITH 3 CENTERS OF EXCELLENCE IN EUROPE

100 EMPLOYEES

LEADER IN HYDROGEN TECHNOLOGIES

McPhy
Driving clean energy forward

MAJOR REFERENCES
IN KEY MARKETS AND GEOGRAPHIC AREAS:
EUROPE, CHINA, NORTH AMERICA

MORE THAN 15 YEARS
OF RESEARCH AND INNOVATION

21 HRS
A DAILY POTENTIAL OF
64,500
ZERO-EMISSION KILOMETERS
#CLEANMOBILITY

McPhy WILL HAVE INSTALLED
16 MW
OF HIGH CAPACITY ELECTROLYZERS
= **MORE THAN**
77 TONS OF CLEAN HYDROGEN
PRODUCED PER DAY

CONSOLIDATED EXPERIENCE

EnergieDienst, a 1 MW Power to Gas project in Germany



McPhy France
HRS Center



McPhy Italy
Stack factory



McPhy Germany
Engineering



McPhy China
Sales & Service

Ready for the scale up of hydrogen technology

Flagship Reference

> 16 MW
Electrolysis

> 21 HRS
in operation (12)

Scalable Electrolyzer for
Industry, Energy

Large Hydrogen Refueling
Station for Mobility



15 years
of R&D

| Electrolysis

| HRS



LOW-CARBON
INDUSTRY



ZERO
EMISSION
MOBILITY

McPhy's references in Electrolysis

MCPHY WILL HAVE INSTALLED
16 MW
OF HIGH CAPACITY ELECTROLYZERS
= MORE THAN
7 TONS OF CLEAN HYDROGEN
PRODUCED PER DAY

Alc, ATM	Audi 6 MW 2013
Alc, ATM	Prenzlau 0.5 MW 2013
Alc, 30 b	H2Ber 0.5 MW 2014
Alc, 30 b	Hebei 4 MW 2017
Alc, 30 b	EnergieDienst 1 MW 2017
Alc, 30 b + PEM	Jupiter 1000 1 MW 2018
Alc, 30 b	RAG 0.5 MW 2018
Alc, 30 b	SMT-AG 0.5 MW 2019
Alc, 30 b	Confid. 2 MW HCD 2019

McPhy | March 2019

Key Learnings :

- ALKALINE brings robustness
- 30 bar is a must
- Efficiency is key
- Flexibility brings value
- Modularity is important

PtG | References under operation: Audi (Werlte) - 2013

Industrial hydrogen & Power-to-Gas: Audi, One of the first PtG project in Europe

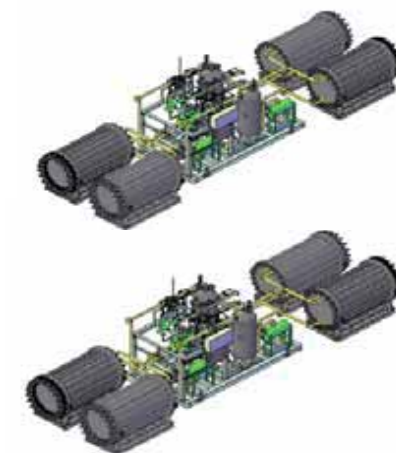
- Operated by Etogas
- **6 MW atm** Hydrogen production
- In operation since October 2013



HEBEI | 4-10 MW Platform – Project in realization Coupling with Mobility Project

Realistic outlook to a 10MW-platform today (HEBEI):

- Currently the shown layout is equipped with 4 Module of 2 MW with stacks of 0,5 MW
- Complete showcase for a wind power driven hydrogen plant incl. truck-out infrastructure and future HRS (400 kg)



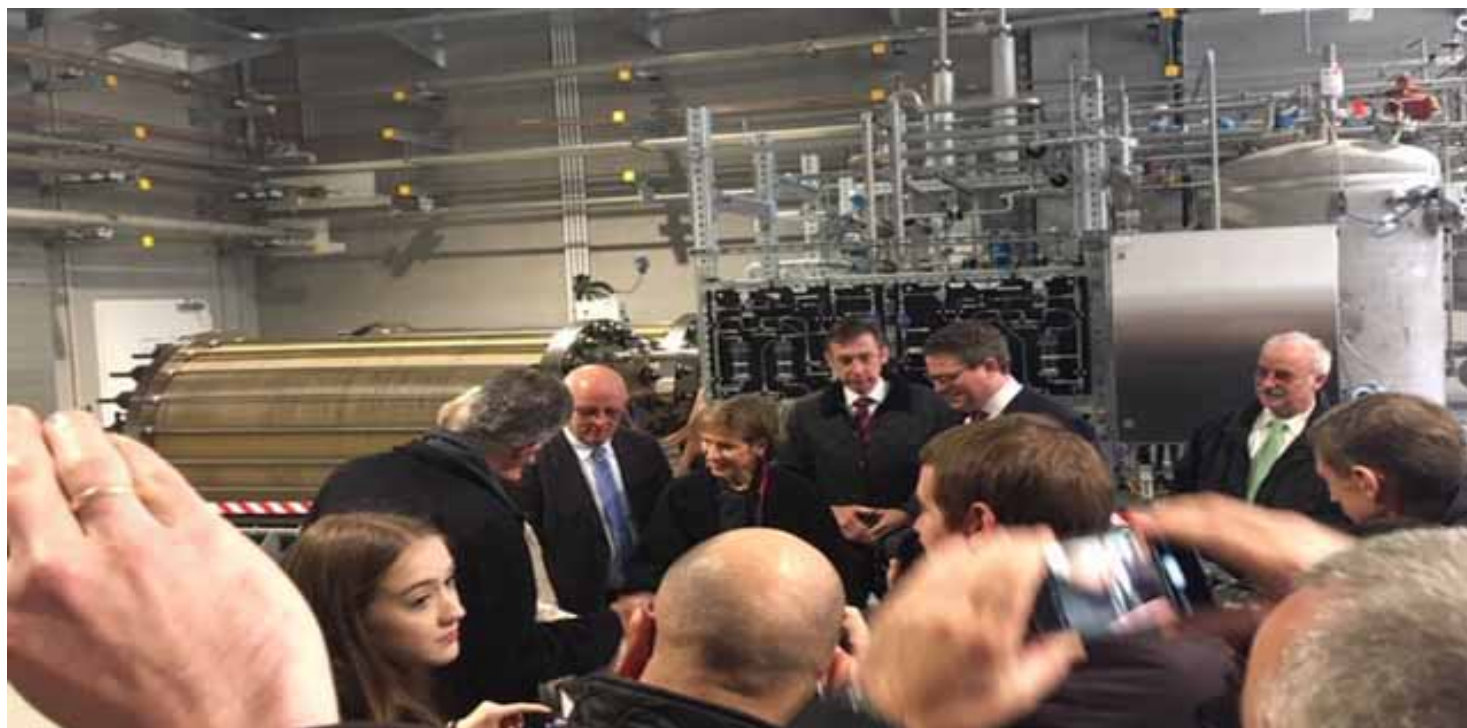
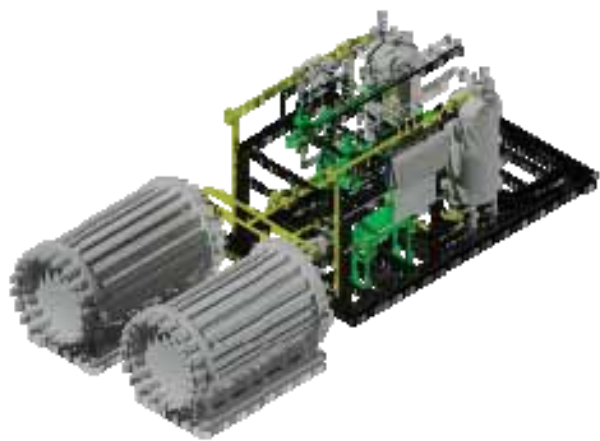
Starting Date : 2019
4 MW



PtG | EnergieDienst, ENBW Group (Germany) 1 MW at 30 bar

First hydrogen project in partnership with Center For Solar Energy

- 2 McLyzer 100 : 200 Nm³/h – 1 MW at 30 bar
- Delivery end 2017, commissioning in November 2017
- H₂ application : mobility, Industry, Storage

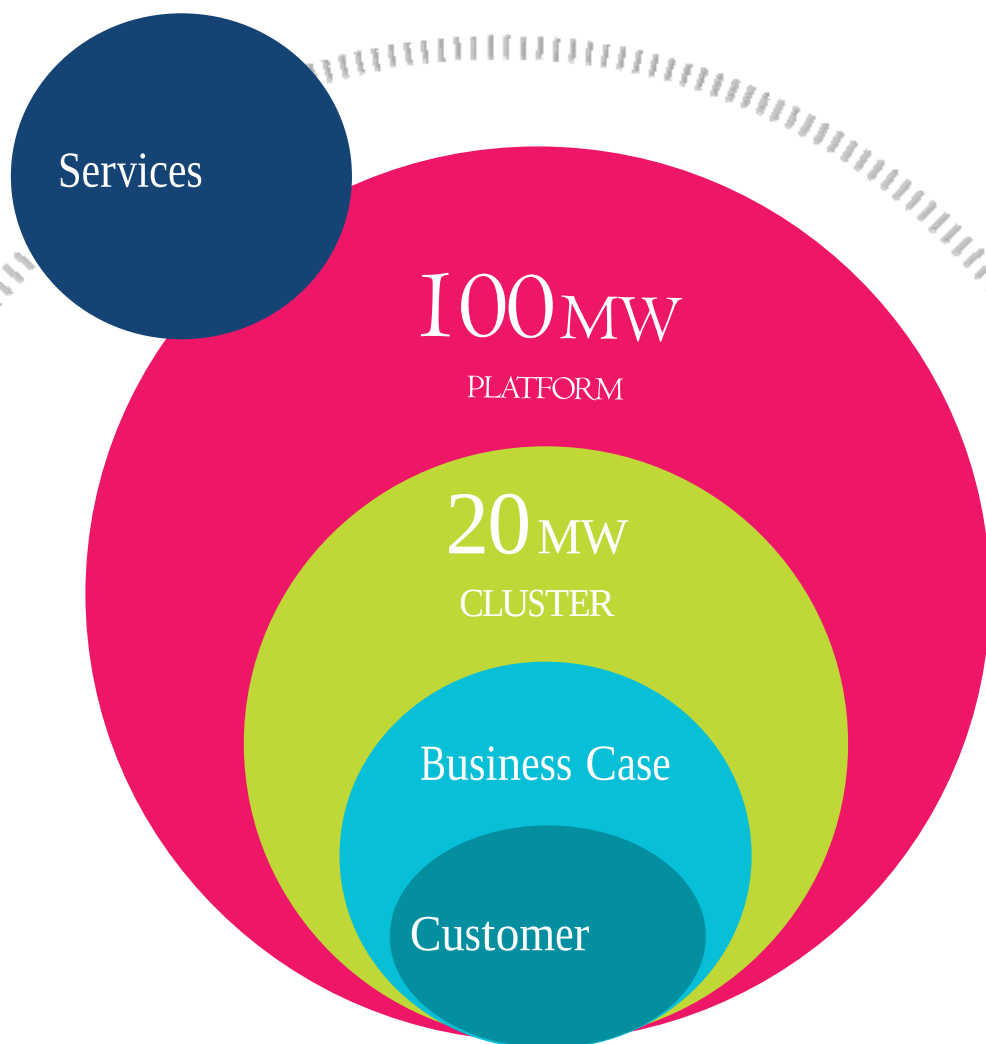


PtG | Jupiter 1000 - Fos sur Mer - 1MW electrolysis for GRT gaz with both Alkaline and PEM technology

- To be commissioned in 2019, Fos-sur-Mer (France)
- Hydrogen production equipment, Alkaline 30 bar and first reference in PEM



Integrated Value Proposal for Industry



Focus on Viable Business Case with Customers :

- Key Segments : Advanced Fuel (refineries, methanol, ammoniac..), Green Chemicals, Steel Plant, P2G...
- Projects screening with TCO approach
- Feasibility study : Business case & Basic Engineering

Differentiate on Large ELY Platform :

- 20 MW Platform
- 100 MW Platform

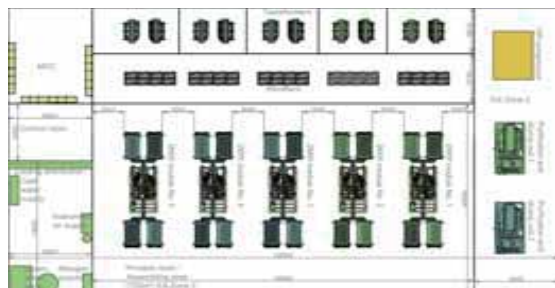


Increase Service Proposal

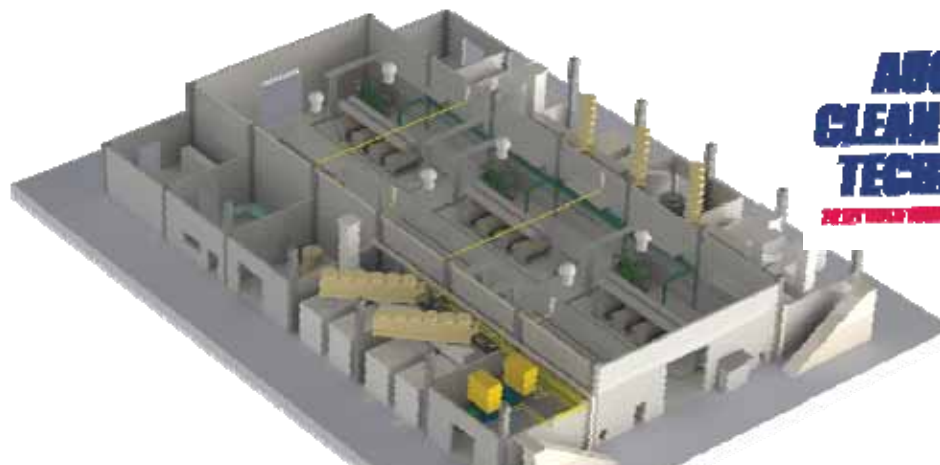
- Turnkey ELY and EPC Partner
- Financing
- Maintenance
- Digital Solution "Big Data"

Multi MW platforms : McPhy Innovation

Before : 10 MW
> 1.000 m²



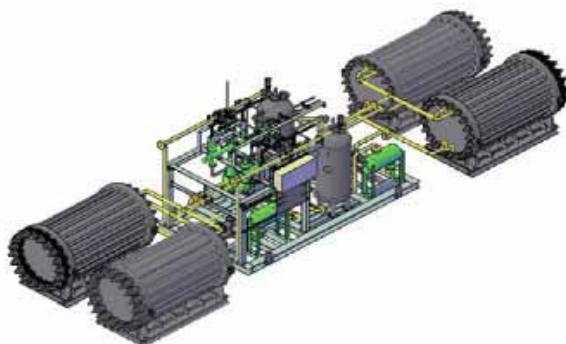
Now : 20 MW
< 900 m²



**AUGMENTED
CLEAN HYDROGEN
TECHNOLOGIES**
20 MW HYDROGEN PRODUCTION PLANT

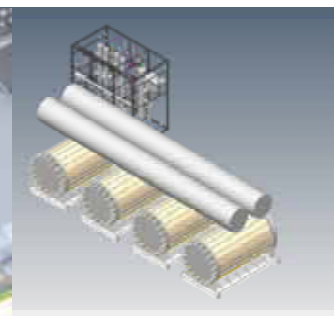
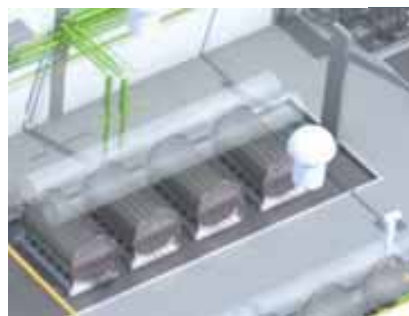
16 MW
reference

Before : Stack Design 2 MW



2 years
of R&D

Now : Stack Design 4 MW



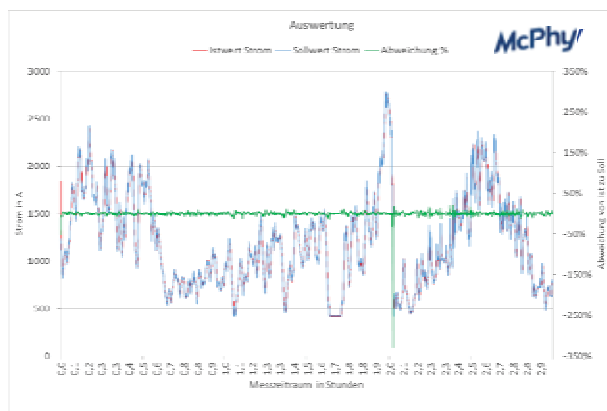
DE NORA
des recherches pour l'avenir

**Best In Class
Electrode &
Stack Design**

Design and specification matching with industrial use & energy market

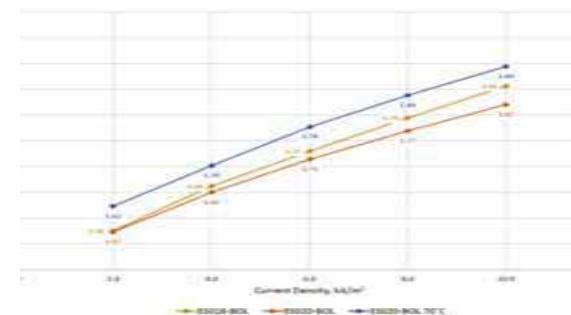


Augmented McLyzer
Our new generation of electrolyzers



*An innovative solution
combining the reliability
of ALKALINE and the
flexibility of PEM*

- **30 bar** high pressure production
- **Reduced foot print** : 44 m² / MW
- **BOP optimization**
- **High purity of H₂ : 99,999 %**



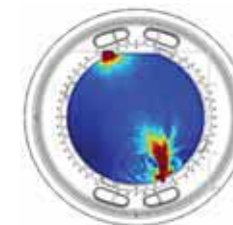
- $\cos\phi > 0,9$ from 15% to 110% of load range
- High efficiency with High current density @ 9.000 A/m²

- Fast dynamic response enabling Service System :

Nominal Load : 0% to 100% < 30 sec.

Off Peak : 100% to 0% < 5 sec.

- Mature and industrialize products
- Optimized CAPEX and OPEX



20 MW cluster: an optimized architecture easy to integrate in industrial context

MCC/Control cabinets

Designed by McPhy, Manufactured by approved sub-suppliers

KOH Handling station

Electrolyzer modules (4MW)

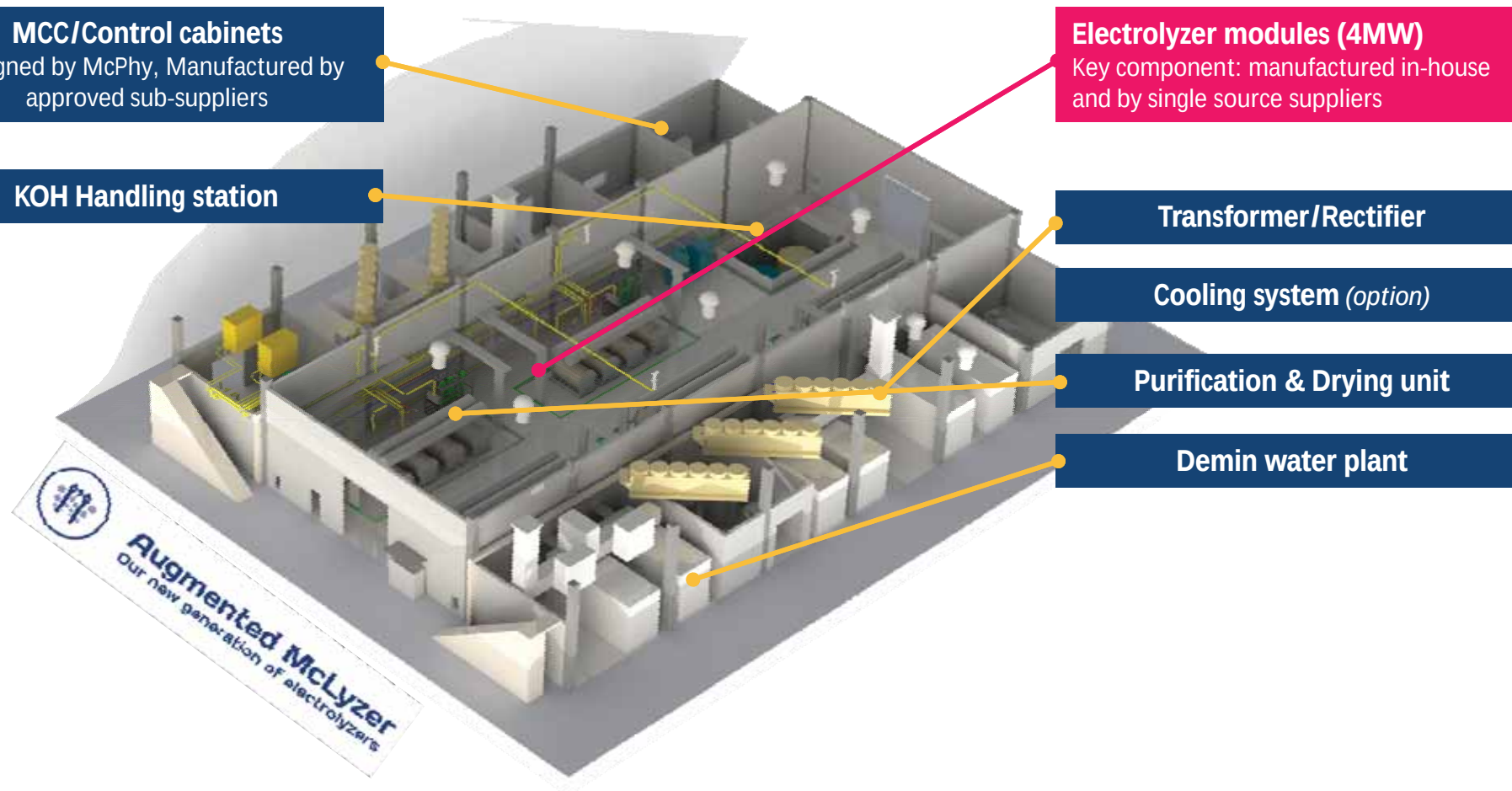
Key component: manufactured in-house and by single source suppliers

Transformer/Rectifier

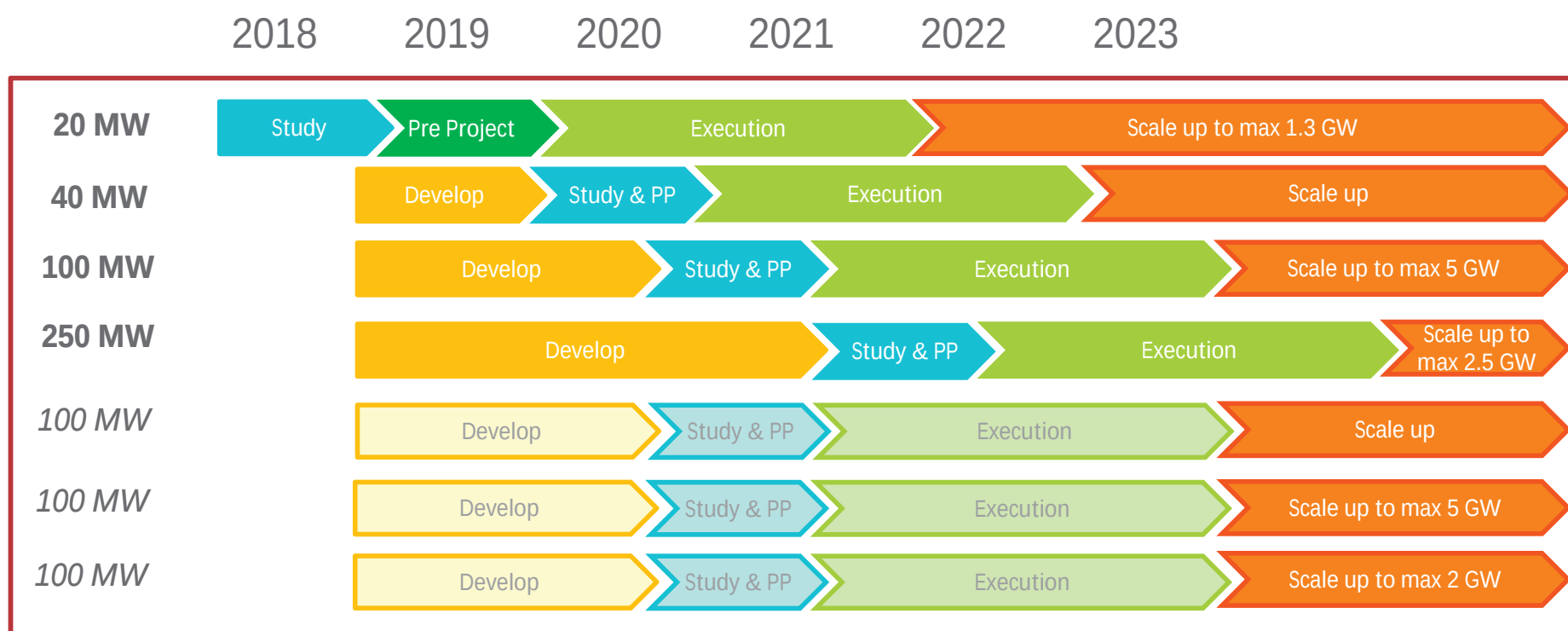
Cooling system *(option)*

Purification & Drying unit

Demin water plant



Major industrial players commit to very large platform projects



Some outputs from our economic simulations

HYPOTHESIS		
	Units	Value
Number of hours of operation	h	5 000
Cost of Electricity	€/MWh	20,00
Cost of Capital (IRR)	%	5%
Maintenance Cost	% of Capex	1%
100 MW System at 30 bars		100%
CAPEX	K€/MW	635
Flow	Nm ³ /H	20 128,74
Quantity H ₂ /year	Kg	9 050 693
Cost of Capital	€/kg	0,35
Specific Energy Consumption (30 bar)	kWh/kg of H ₂	53,62
Cost of Power	€/kg	1,07
Maintenace Cost	€/kg	0,07
Total OPEX	€/kg	1,14
Full Cost of H₂	€/kg	1,493

HYPOTHESIS		
	Units	Value
Number of hours of operation	h	2 500
Cost of Electricity	€/MWh	20,00
Cost of Capital (IRR)	%	5%
Maintenance Cost	% of Capex	1%
100 MW System at 30 bars		100%
CAPEX	K€/MW	635
Flow	Nm ³ /H	20 128,74
Quantity H ₂ /year	Kg	4 525 347
Cost of Capital	€/kg	0,70
Specific Energy Consumption (30 bar)	kWh/kg of H ₂	53,62
Cost of Power	€/kg	1,07
Maintenance Cost	€/kg	0,14
Total OPEX	€/kg	1,21
Full Cost of H₂	€/kg	1,914

HYPOTHESIS		
	Units	Value
Number of hours of operation	h	8 000
Cost of Electricity	€/MWh	35,00
Cost of Capital (IRR)	%	5%
Maintenance Cost	% of Capex	1%
100 MW System at 30 bars		100%
CAPEX	K€/MW	635
Flow	Nm ³ /H	20 128,74
Quantity H ₂ /year	Kg	14 481 110
Cost of Capital	€/kg	0,22
Specific Energy Consumption (30 bar)	kWh/kg of H ₂	53,62
Cost of Power	€/kg	1,88
Maintenance Cost	€/kg	0,04
Total OPEX	€/kg	1,92
Full Cost of H₂	€/kg	2,140

McPhy : a “scalable” Industrial Plan

Stack manufacturing McPhy Italy



2018 Ind.

Capacity : 50 MW / year – “Hebei Like”

2019/2022 evolution of Ind.

- 100 MW capacity
- 200 MW capacity in two shifts
- 400 MW capacity in two shifts external storage



> 100 MW capacity
Toll manufacturing

TOTAL > 500 MW / year

BOP Assembly– Contractors



2018 :

12 to 25 BOP / year – “Hebei Like”

2019/2022 :

Sub contractor Skid and BOP :

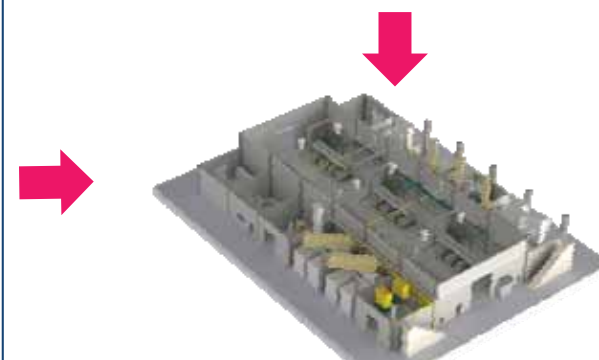
- France : 25 to 75 BOP per year
- Germany : 25 BOP per year
- China : under evaluation

TOTAL > 100 BOP / year

Key Components secured with Supply Agreement



- Electrodes
- Transformers
- Separators
- + H2 Test platform for New ELY



100 / 500 MW per year



Driving
clean energy
forward

Thank you!

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