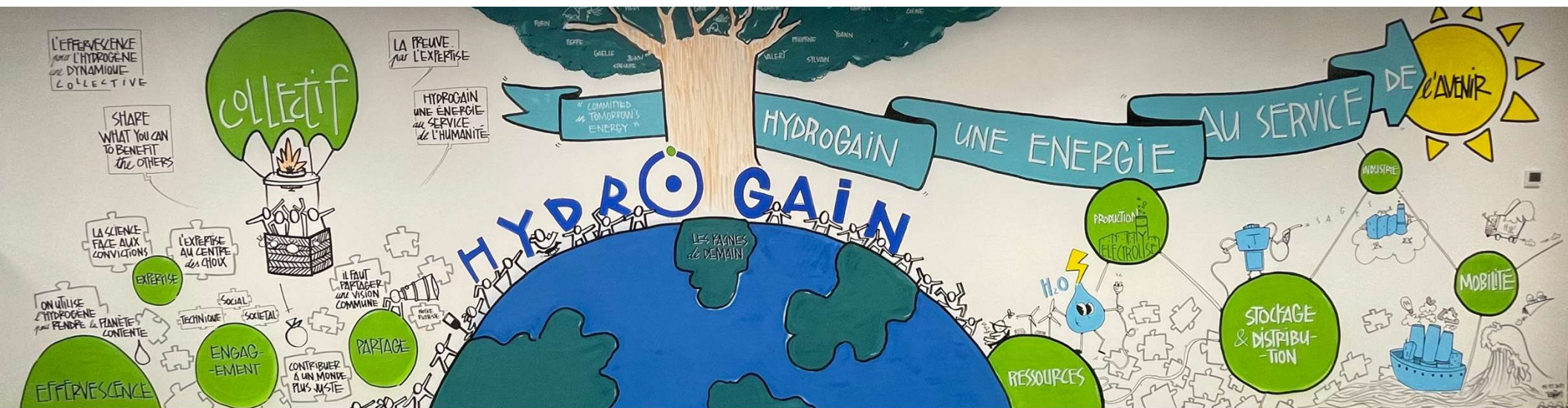


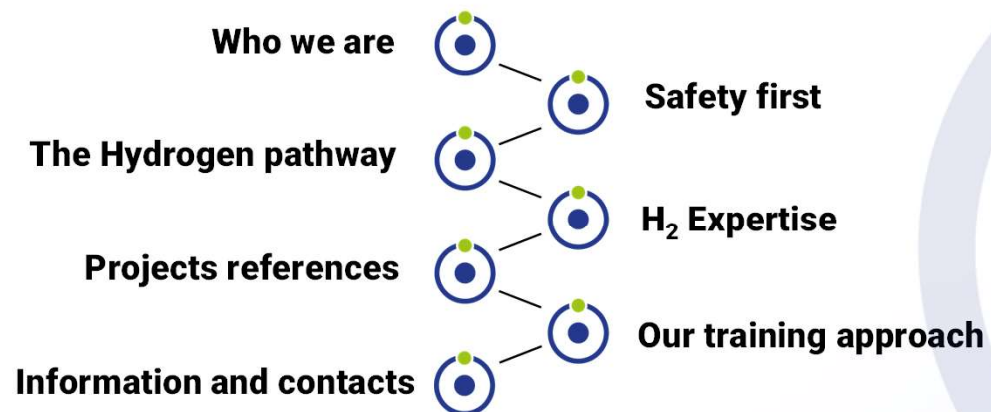


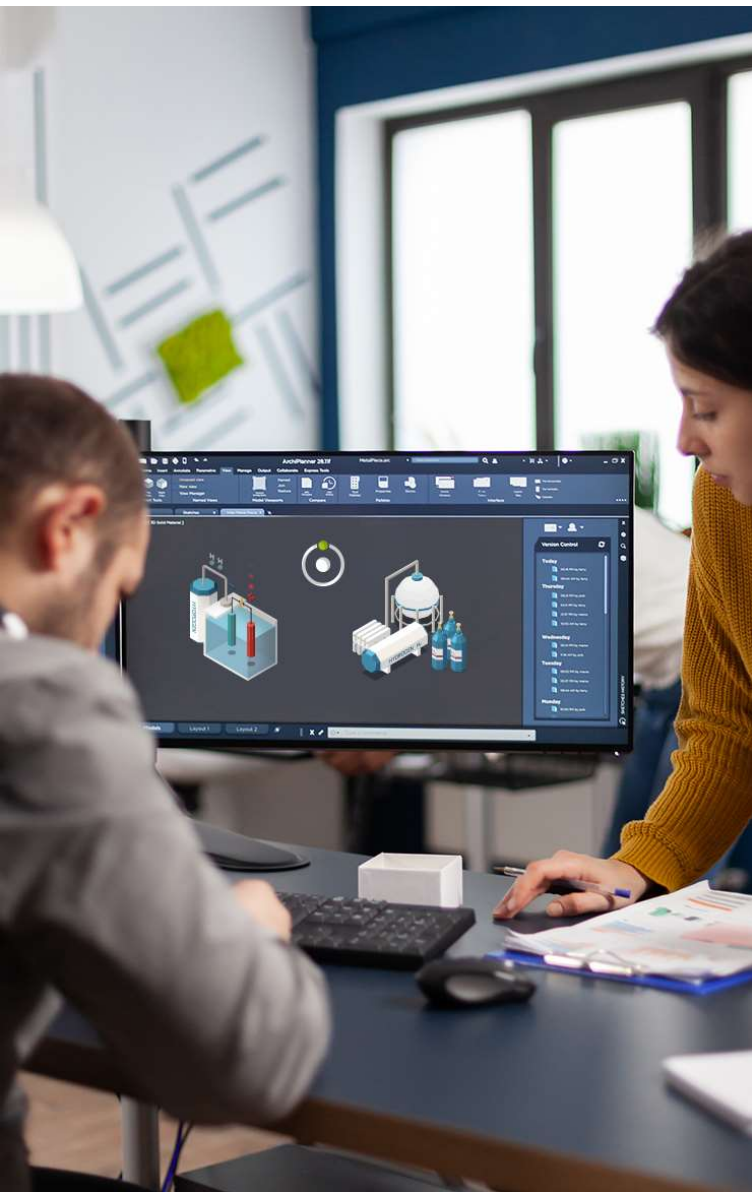
**Engineering & training
dedicated to hydrogen**





Summary





WHO WE ARE

EMPOWERING RENEWABLE HYDROGEN

- 🕒 Independent hydrogen engineering pure player
- 🕒 Over 20 years of expertise
- 🕒 Full H₂ value chain: design to operation
- 🕒 Four business lines
- 🕒 Trusted by major industrial players

SAFETY FIRST

PROTECT PEOPLE AND GOODS

PREVENTION

- Standards and regulations
- Technical guide (design rules)
- Feedback
- DMAIC 6 Sigma
- Process modeling
- Risks analysis and assessment
- Hazard modeling
- Quality Assurance
- Training
- Testing and qualifying

DETECT AND CONTROL

- Detection
- Supervision
- System operation procedure
- Operating alarm
- Safety alarm
- Automatic action
- Periodic control
- Passive safety
- Safety procedure
- Positive safety

MITIGATE

- Ventilation
- Safety distance
- Mitigation methods
- Emergency procedure



The Hydrogen sector must be exemplary in terms of safety in this phase of industrialization and deployment

HYDROGEN & HAZARD: FIRE...BLAST...BURST...DAMAGE

THE HYDROGEN PATHWAY

STAKES AND CHALLENGES



HYDROGEN PRODUCTION

- Decarbonizing industrial process (steel industry, cement industry, chemistry, etc.)
- Hydrogen storage solutions
- Support the electrolysis field
- Scaling up production facilities

🎯 Produce renewable H₂ on a large scale

🎯 4.5 GW by 2030* VS 35 MW 2024
8 GW by 2035*
(France)



MOBILITY/ TRANSPORT

- Fuel Cell design and manufacturing
- Deploy refueling stations across the territories
- Support other uses

🎯 80 refueling stations in 2024 (France)

🎯 70 000 H₂ vehicles by 2030 VS 2025 in
2024 (France)



TRAINING

- Developing skills and hydrogen expertise
- Support the industries and stakeholders in the hydrogen sector

🎯 2035 objectives: > 60 000 jobs VS 6300 in
2023 (France)

H2 EXPERTISE

ENGINEERING SUPPORT AND CONSULTING

Technical and operational support in carrying out **investment and development projects**:

DESIGN

Definition and sizing of H₂ system
(Electrolyzer, Fuel Cell, Storage, etc.)

TEST AND COMMISSIONING

Testing, qualification and start-up of
installations

MAINTENANCE

Instrumentation procedures, operation
and management

Projects across the entire hydrogen value chain:

- Hydrogen **production**
- **Storage**
- **Refueling** station
- **Fuel Cell**

We are partners for the hydrogen industrial players:

- **Producers** and operators
- **Engineering** and EPCs
- **Integrators**, equipment manufacturers and OEMs



H2 EXPERTISE

ENGINEERING CAPABILITIES

SYSTEM/ BOP

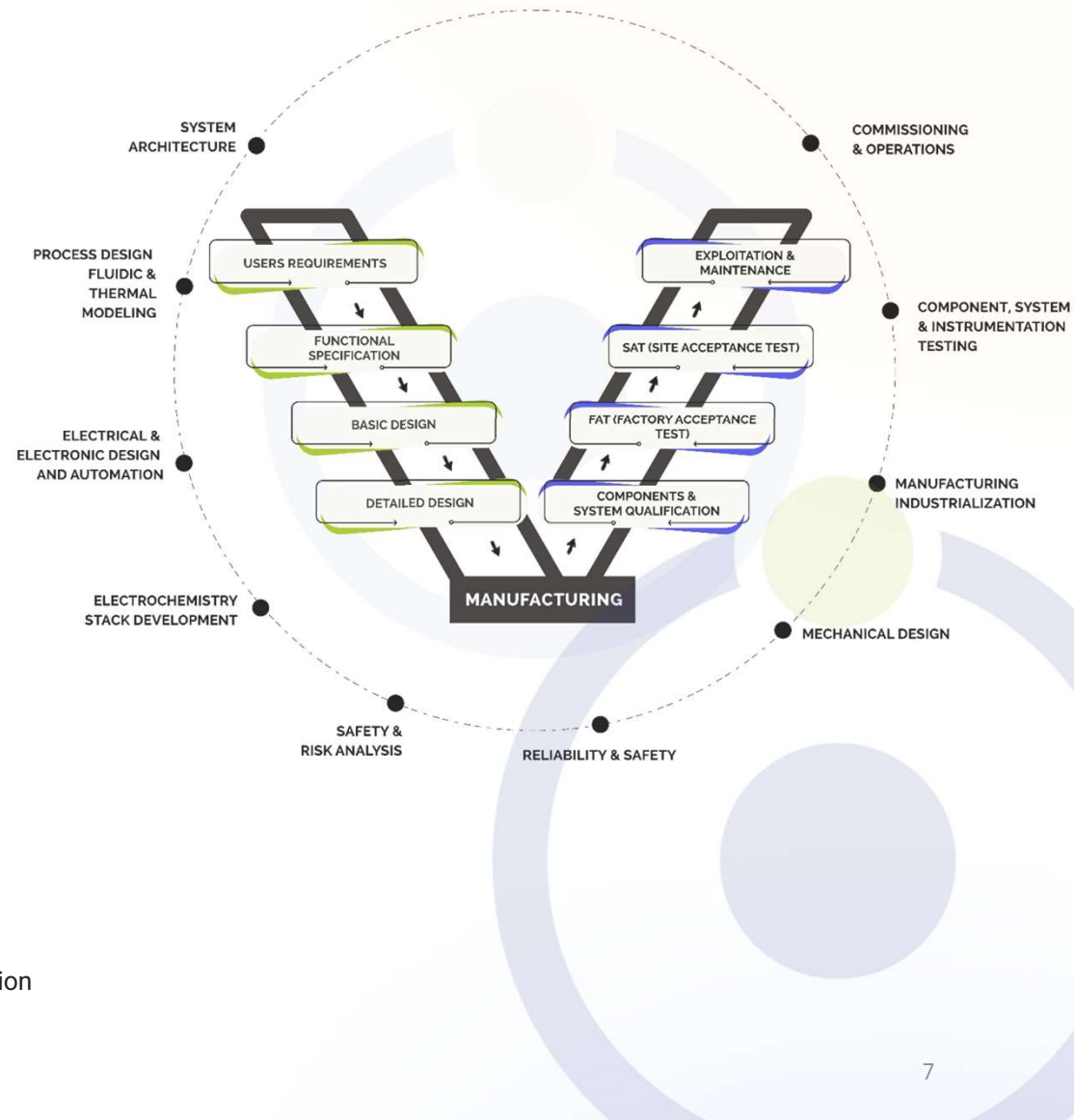
- Process engineering (H₂ Line, Air Line, etc.)
- System architecture
- System modeling
- Tests & commissioning (safety, functional, etc.)
- Automation and control
- Electrical system engineering
- Safety engineering
- Mechanical engineering (calculation, CAD)

STACK

- Multiphysics modeling/ components
- Stack development
- Electrochemical component tests

DESIGN OFFICE

- **Task force:** 15 to 20 Engineers and PhDs
- **Softwares:** Solidworks, Matlab, Simulink, Simscape, Visio, AutoCad
- **Project typology:** feasibility study, basic design, detail design, realisation
- **Project methodology:** V-cycle and EPC



OUR BUSINESS LINES

SERVICES



ENGINEERING

Design, Sizing,
Integration



CONSULTING

Process, System,
Mechanical,
Electrical, Safety,
Commissioning,
Project management



R&I

Fuel cell, storage and
electrolysis integrated
demonstrator, TRL
approach



TRAINING

H₂ Fundamentals to
Expert modules

PROJECT REFERENCE

H₂ STORAGE

🔍 Design and commissioning of a 700 bar H₂ storage unit for aeronautic application

Context:

- Safety-critical context,
- Pre-commissioning and commissioning
- Specific regulations

Scope:

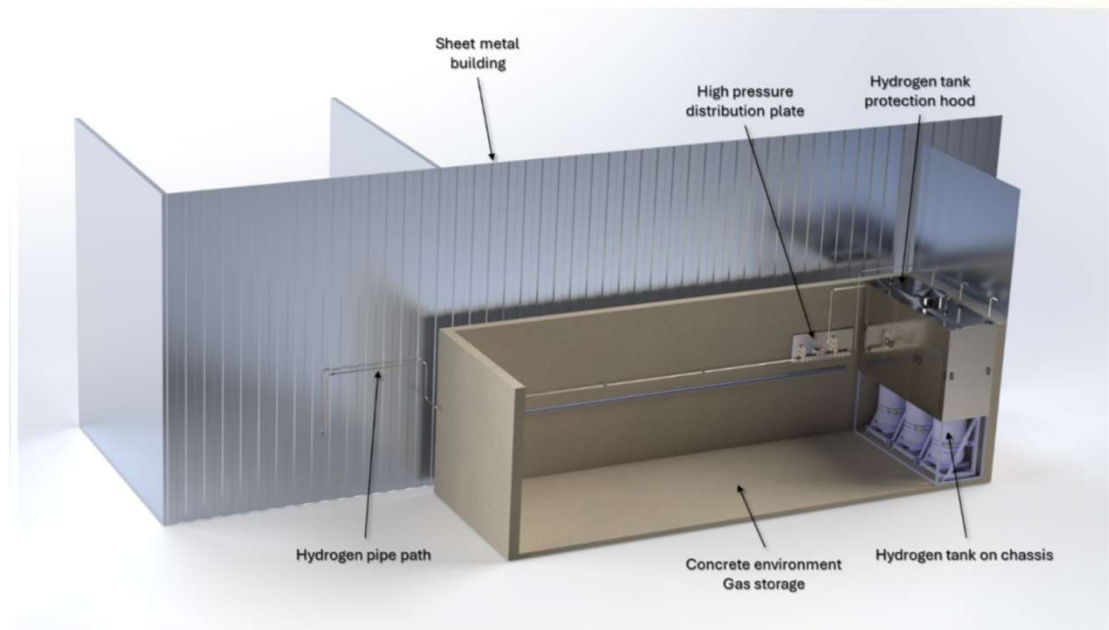
- Process and system design
- Technical specification drafting
- Pre-commissioning and vendor validation
- Safety engineering (HAZOP)

Results:

- Qualified and tested high-pressure H₂ storage system
- Delivered with compliance and performance validation

Business line:

- Engineering



PROJECT REFERENCE

H₂ FUEL CELL

🔗 Design, realization and qualification of a Fuel Cell system for confined environment with optimized purge and water management

Context:

- Anaerobic operation
- Strict space constraints
- 5-10 kW power range

Scope:

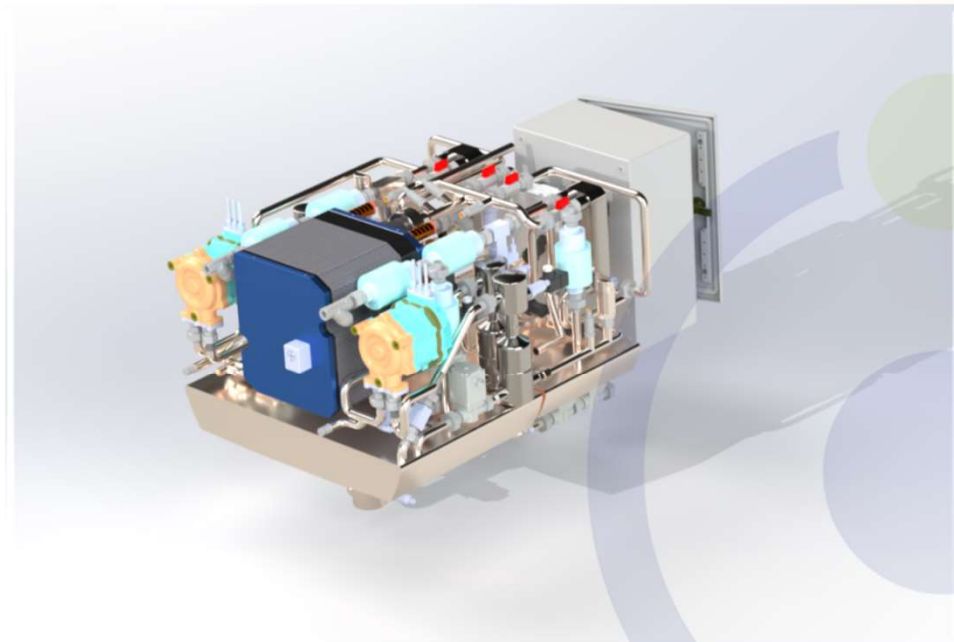
- System architecture & integration
- Electrical design (efficiency & footprint)
- Water and gas purge strategy development
- Mechanical adaptation to carrier shape

Results:

- Efficient, compact FC system with no external discharge
- Full functional prototype with custom components
- Optimized TRL progression

Business line:

- Engineering



PROJECT REFERENCE

ELECTROLYSIS TEST BENCH

Design and realization of CO₂ Electrolysis tests bench

Context:

- Test bench for components characterization
- Cells' scale: 250 cm²

Scope:

- Process design (P&IDs)
- Electrical design
- Updating the control of actuators and measurement/safety sensors
- Integration study within a fume hood: bill of materials (piping, frame, bench interfacing, cell connection)
- Assembly work
- Commissioning and on-site training

Results:

- Tests benches delivered
- 24/7 operation of electrolysis cell components

Business line:

- Engineering



PROJECT REFERENCE

H₂ ELECTROLYSIS PRODUCTION UNIT

Development and improvement of a Electrolyzer production unit (up to 16 MW)

Context:

- Process engineering coordination and support
- Alkaline technology

Scope:

- Ongoing monitoring and review of process engineering regarding efficiency, functionality and quality
- Providing support for detailed design and specification for industrialization and adaptation to project
- Preparation of associated plant documentation such as P&I and process diagrams for manufacturing and procurement
- Providing necessary support for preparation of layout drawings and detailed design for projects
- Support to sales and manufacturing as well as technical support for procurement

Business line:

- Consulting

McPhy

PROJECT REFERENCE

HySEA – AUTONOMOUS ENERGY SYSTEM

🔗 Develop an autonomous hybrid energy solution integrating electrolysis, storage, and fuel cell

Context:

- Focus on system autonomy and safety

Scope:

- Process design and modeling
- Electrical and safety engineering
- System architecture for Ely, storage & FC integration

Results:

- Fully integrated R&I demonstrator
- Custom control architecture and validation tools
- Enhanced energy self-sufficiency

Business line:

- R&I
- Engineering



OUR TRAINING APPROACH



Our "specification-based" training approach allows us to design targeted learning solutions. We also address the training needs of hydrogen through a variety of available modules.

H2_BASICS

4h module

Optional +3h Safety/Regulatory

- Intended for Executives, Sales Managers and Institutions
- ✓ Introduction to the fundamentals of hydrogen (context, market, technologies, uses)
- ✓ Optional: safety and regulation fundamentals

H2_SAFE

1 day module

- Intended for EHS, Process and Operation Engineers
- In-depth knowledge of:
 - ✓ Hydrogen and its industrial implementation, Hydrogen safety from design to operation Facilities
 - ✓ Rules and operational maintenance Methodological tools
 - ✓ REX and Case study Regulations/Standards Emergency situation - Situation exercise

H2_ENGINEER

2 to 5 days module (customized)

- Intended for project managers and engineers
- Adapted to the client's needs and field of activity, client case study:
 - ✓ Theoretical approach
 - ✓ Systems and process engineering: sizing method and rules in the architecture and definition phase
 - ✓ Safety/Regulation Implementation & integration rules Operation & Maintenance

WHY CHOOSING HYDROGAIN

ENGINEERING HYDROGEN WITH CONFIDENCE

- 🕒 Multidisciplinary team of 40+ hydrogen experts
- 🕒 End-to-end project support from feasibility to commissioning
- 🕒 High value deliverables and safety-first culture
- 🕒 Active contributor to R&I and standardization
- 🕒 Customized training organization



LET'S TALK HYDROGEN!



ENGINEERING



CONSULTING



R&I



TRAINING

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