regas | Energy progress

HyCON

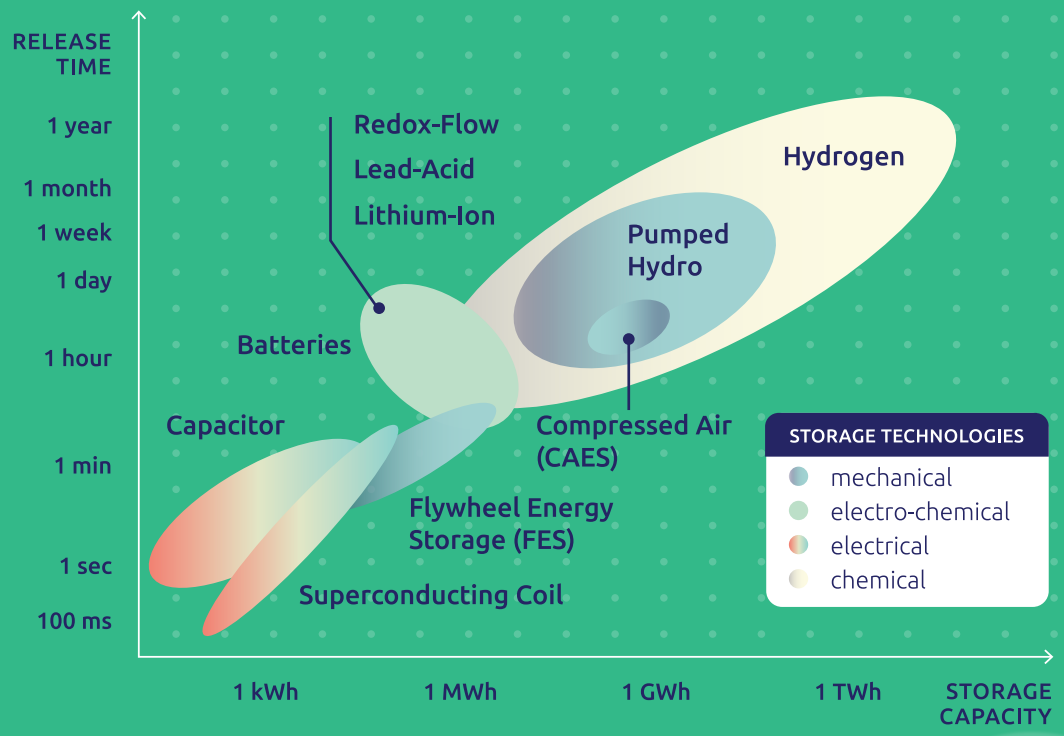
>> **HyCON**: Hydrogen at the service of industry and the energy supply chain towards a green transition

Climate change and atmospheric pollution are the biggest problems of our times. If we don't step in and take drastic and concerted actions to **reduce the GHG emissions**, in 2100 the planet's temperature will rise four degrees, although three suffice to bring about devastating consequences.

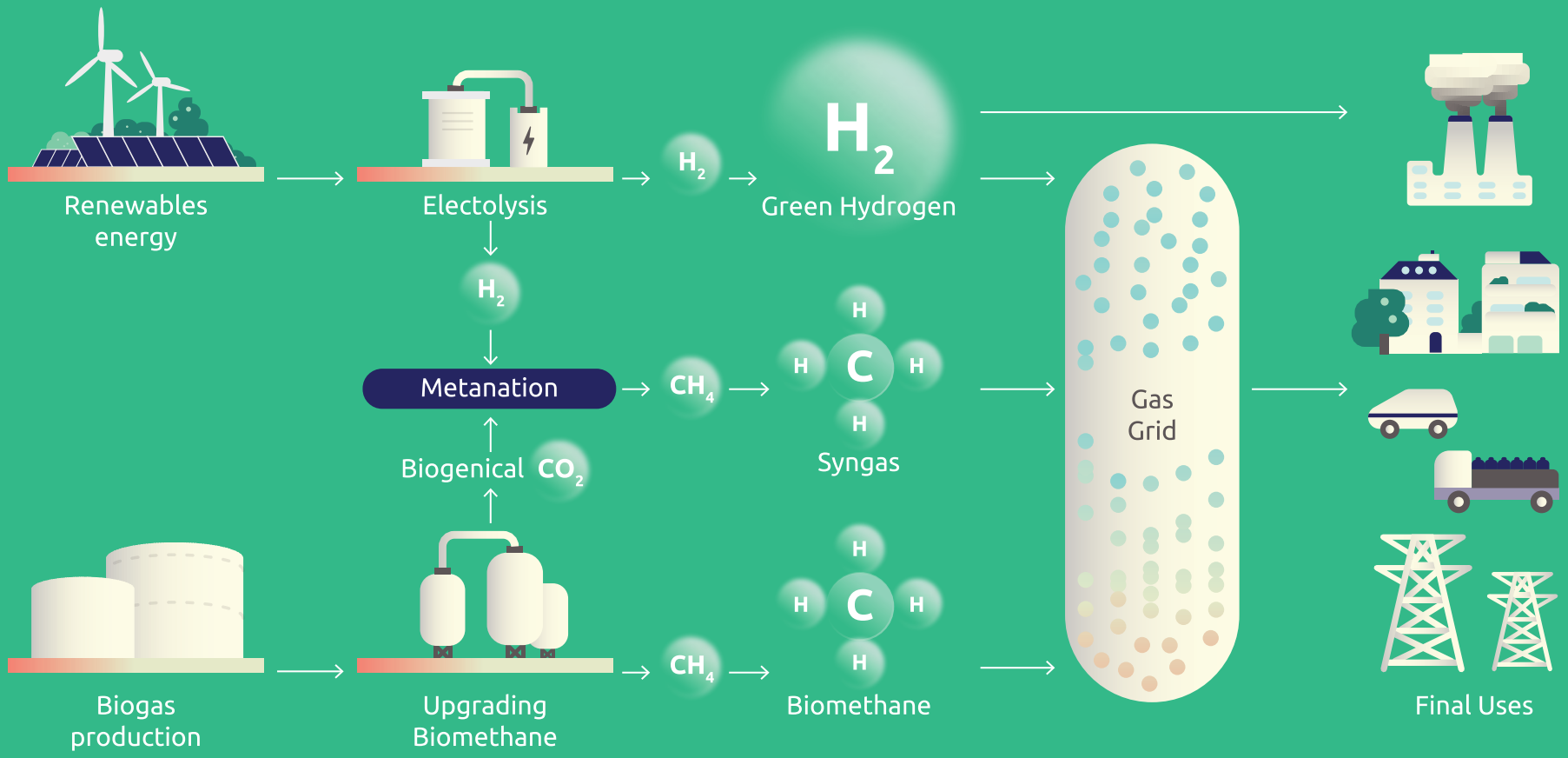
To avoid this risk, a massive international decarbonisation intervention is necessary, taking a **cross-sectoral approach** in the energy industry.

Hydrogen, an extraordinary **energy carrier**, allows solar and wind energy to be transformed into an efficient and easy to transport, store, distribute and use fuel boasting the enormous benefit of being zero-emissions.

AVAILABLE STORAGE TECHNOLOGIES



Among the available energy storage technologies, HyCON is the one with the highest potential in terms of stored energy.



By using the pipelines and **existing infrastructure**, hydrogen can heat our homes and reduce the emissions of the so-called hard-to-abate sectors such as industry and heavy vehicles, where the use of electricity proves difficult.

Hydrogen is also an effective solution for **managing over generation** by renewable energy sources while guaranteeing greater stability and safety of the network and optimising the excess energy. It also serves as an efficient and cost-effective medium for storing energy.

These are the reasons why hydrogen is becoming popular as a **pillar of global environmental and energy strategies**, as it contributes to meeting the energy requirement of an increasingly growing population in a clean manner while favouring prosperity, productivity, and safety.

>> What is HyCON?

HyCON is the **modular Plug&Play solution for sector coupling**. It is designed and made by Regas for decarbonising gas consumption, whether the gases are related to the natural gas transmission and distribution network or to the industrial processes in the hard-to-abate sectors.

HyCON is able to manage the production of hydrogen from renewable sources and/or the power grid and its use by different end users in a single solution marked by a **very compact size and utmost reliability**.

HyCON is a system that offers enormous **flexibility and versatility**. It can be used in pilot projects or in research centres that require just a few cubic metres of hydrogen up to industrial applications or injection into the network that need sizeable capacities of several hundred cubic metres of hydrogen.

>> HyCON, endless applications

1

NATURAL GAS DISTRIBUTORS AND TRANSPORTERS

We offer DSOs and TSOs technologies and devices that are able to manage the production, mixing and injection of hydrogen into the gas network while integrating it with the power grid or with renewable sources. We also monitor the flow of green hydrogen injected into the network and offer essential services such as **odorisation and fiscal measurement of the blend**. HyCON can be used both for pilot projects to test the compatibility of materials and devices in the gas grid and for decarbonising the pre-heating at city gates, replacing the natural gas with hydrogen in the boilers.

2

INDUSTRIES IN THE HARD-TO-ABATE SECTORS

HyCON was designed for manufacturers of steel, glass, cement, ceramic, paper and aluminium, and any industry with high temperature involved, with the purpose of decarbonising their production processes hard to electrify. HyCON can **improve the company carbon footprint**, control the price of emissions, and reduce the OPEX coming from the consumption of fossil fuels by using green hydrogen produced on-site.

3

COMPANIES IN THE RENEWABLE ENERGIES SECTOR

HyCON is designed to produce a high energy density carrier suitable for storing the production surplus and **optimising daily or seasonal peaks**. This allows the companies in the FER sector to turn the problem of production non-programmability into a two-fold advantage: on the one hand, the production of a valuable energy carrier and, on the other, the possibility to offer their plants greater programmability and flexibility.

4

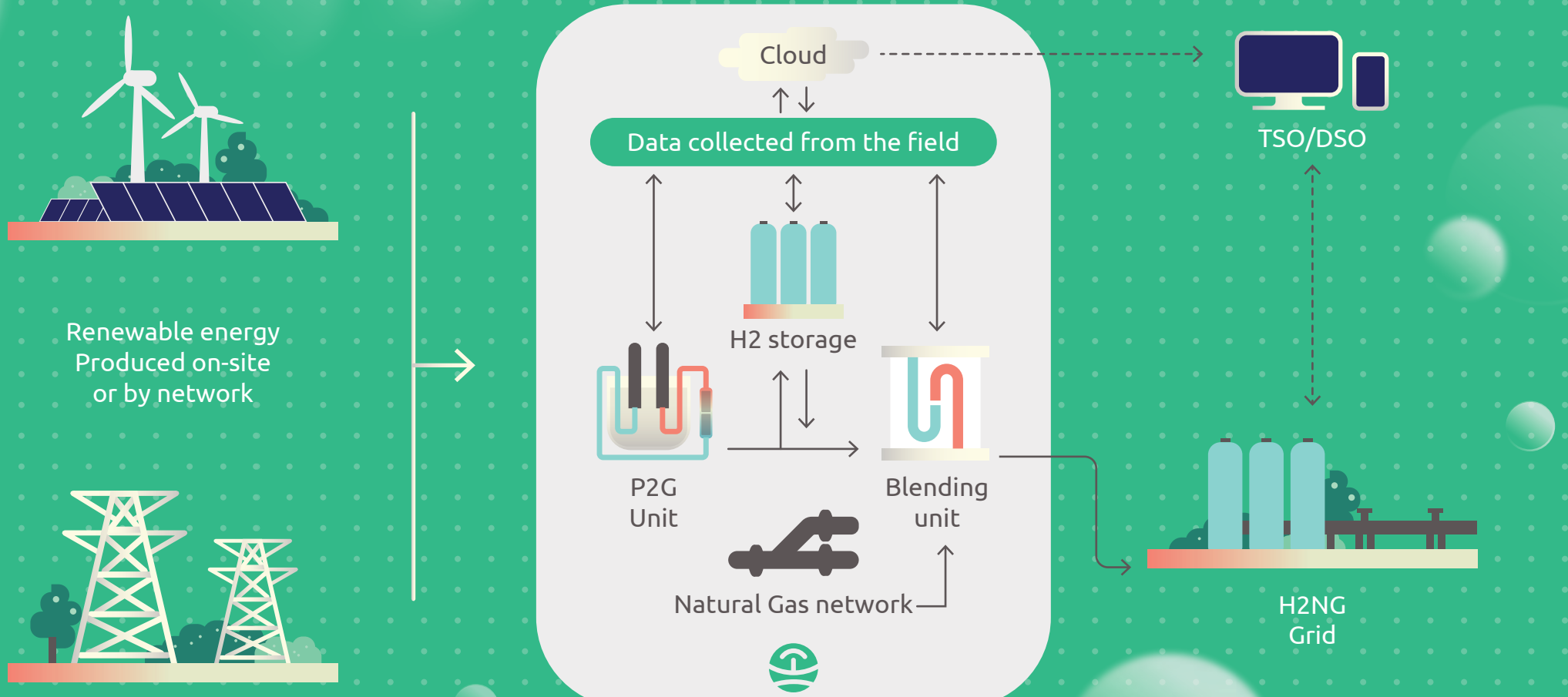
RESEARCH, LABORATORIES AND PILOT PROJECTS

In view of the flexibility and possibility to install small electrolysers, the HyCON systems lend themselves to infinite applications such as **laboratories, universities, and research pilot projects** that aim at studying new uses, applications, and compatibility of the molecule.

5

PORTS, AIRPORTS, STATIONS AND MOBILITY

Aviation, sea transport or transport by heavy vehicles find the use of green hydrogen directly or as material for producing synthetic hydrocarbons as an excellent solution for reducing the emissions coming from fossil fuels. Furthermore, the large spaces available adjacent to ports, airports or railway stations are suitable for installing photovoltaic plants, which can cut the costs of producing hydrogen. This is precisely why - with its ability to interface with renewable sources on-site and/or the power grid and thanks to the production of high-purity hydrogen - HyCON is the perfect solution for these applications.



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HyCON, integrated Power-to-Gas and Blending system

The HyCON systems are made up of Power-to-Gas units that can be fitted with electrolyzers made with AEC or PEM technology and blending units able to generate H2NG mixtures with controlled content, odorise them and measure them in order to inject them into the gas distribution network.

The two units are designed to be highly customisable and can be sold separately to meet any requirement the customer may have: from injection into the gas transmission or distribution network for industrial uses or for mobility.

HyCON

POWER-TO-GAS UNIT

The hydrogen generators can be provided with **Alkaline Electrolysis Cells (AEC)** that operate at low temperature and that represent the current market standard with consolidated reliability proven by decades of use and thousands of installations.

As an alternative, HyCON can be provided with **Proton-Exchange Membrane (PEM) technologies**, which also operate at low temperature and are able to offer a quicker dynamic response, greater charge flexibility and enhanced efficiency, but usually with a shorter stack lifetime and higher capital costs than the AEC.

The P2G units produce Hydrogen and Oxygen perfectly separated from each other thanks to the electrolytic dissociation of the water molecule and are produced inside the electrolysis cell at the required pressure, **up to 30 bar**.

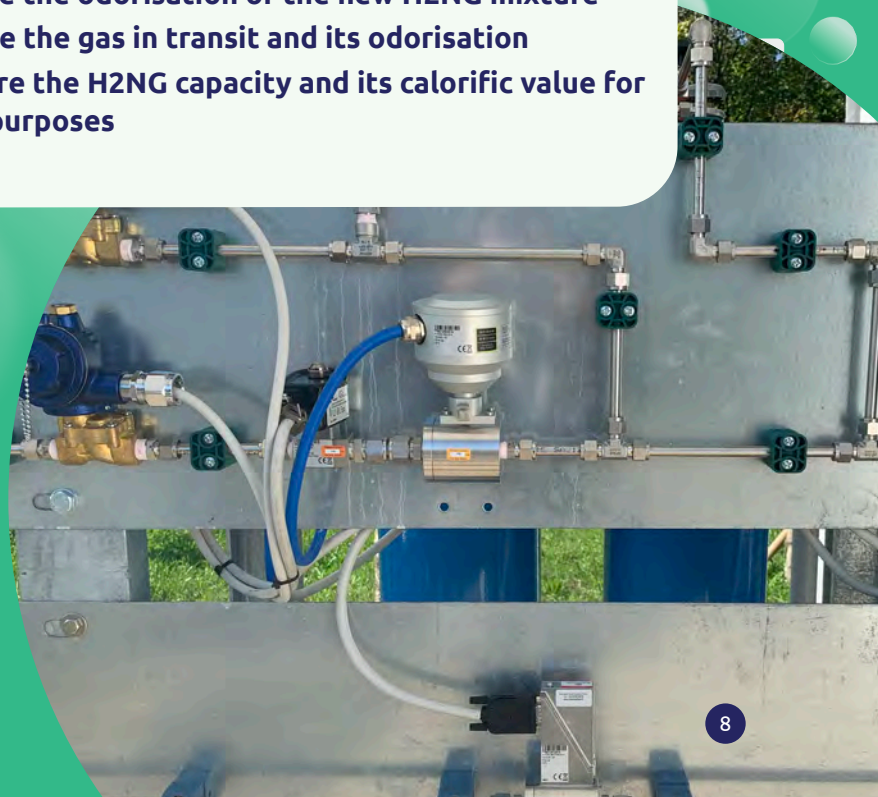
The two gases are kept separated by special membranes and are conveyed to systems for further treatment and dehumidification that allow Hydrogen and Oxygen to be obtained at **any required purity**.

The systems are modular and integrable with each other in order to get potentially infinite capacities of hydrogen.

BLENDING UNIT

The blending units, which can be customised to manage multiple outlet lines with different uses, are able to:

- **Create a H2NG mixture with controlled and modulable content**
- **Manage the odorisation of the new H2NG mixture**
- **Analyse the gas in transit and its odorisation**
- **Measure the H2NG capacity and its calorific value for fiscal purposes**



>> HyCON Key-Points

1

Partnership with Erredue Spa, which has **40 years of experience** in building alkaline electrolyzers and PEMs

2

Modular configuration for **ultimate flexibility and adaptability** to every network scenario

3

Custom design based on the energy scenario in which it is installed

4

Flexible coupling with the power grid and/or with renewable energies on-site

5

Easy to transport and install Plug & Play solution: the container accommodating all the instruments and auxiliaries of the electrolysis process requires only electricity and water to operate

6

A large number of installations in the useful life, compatible with pilot projects and testing

7

Possibility to **recover the heat** of electrolysis to use for industrial processes or to pre-heat the gas networks

8

Production of Hydrogen up **to 30 bar without compression**

9

Instruments that **can be installed in the ATEX zone**, except for the electric panel

10

IoT sensors that enable monitoring and **remote management of all processes**

>> Programming logics

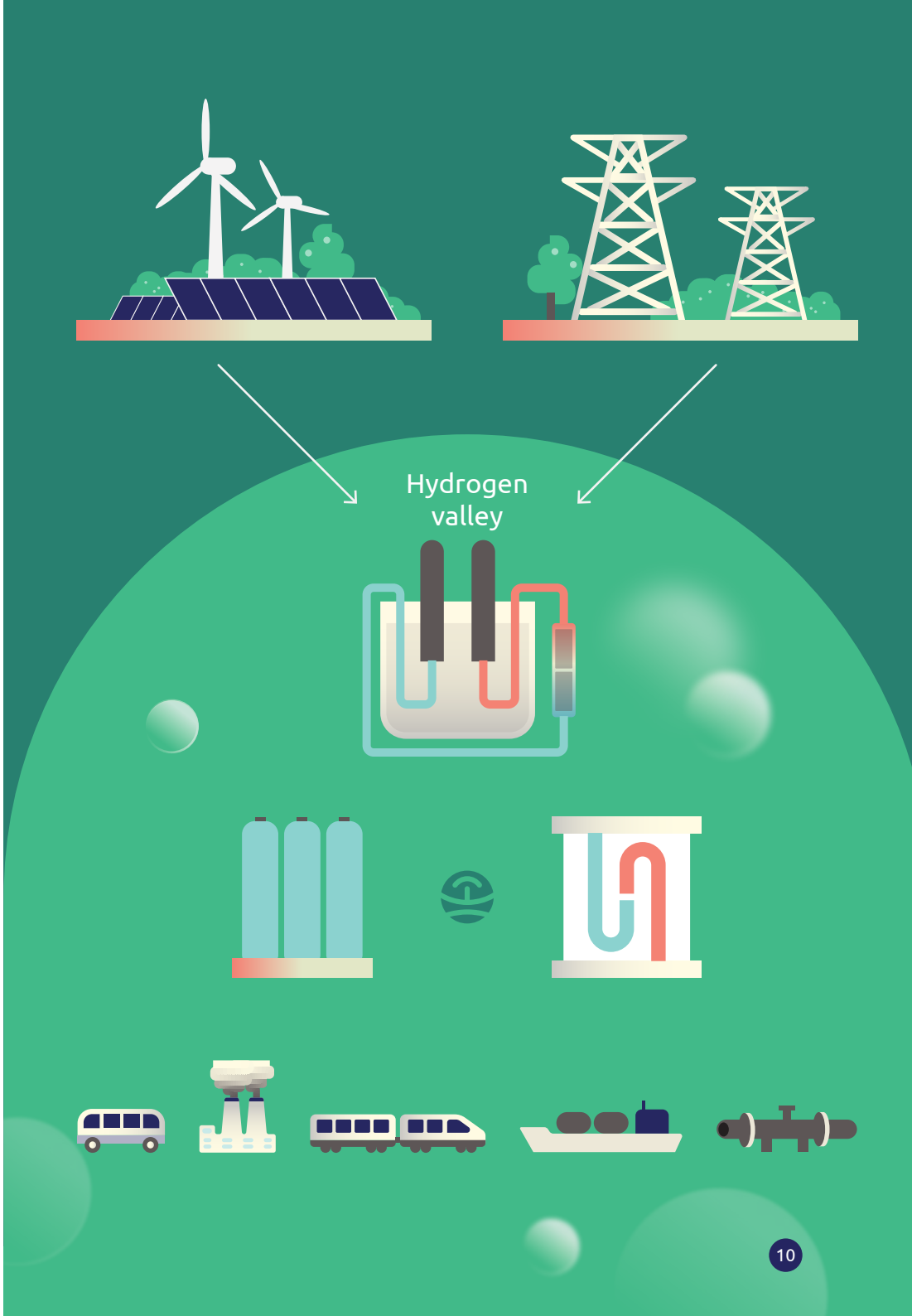
HyCON is an automated Hydrogen production system that can be programmed according to different production, storage and blending logics.

Its standard version is supplied complete with two logics already integrated in the PLC:

- **Blending Oriented Logic**: this logic adapts the charge of the electrolyzer in order to always guarantee the Hydrogen content required in the gas network. Electricity consumption is covered by the renewable production only if it is present simultaneously with the production of Hydrogen. Otherwise, there is a withdrawal from the network.
- **Renewable Oriented Logic**: this logic minimises the withdrawals from the network as it activates and modulates the production of Hydrogen by tracking the availability of a renewable source on-site. This logic is designed to meet the peak-shaving needs typical of the large renewable energy plants.

As an alternative, HyCON can receive Hydrogen production or consumed electrical power programming from the outside. Operation programming enables HyCON to:

- Optimally adapt to the customer's use requirements;
- Interface with the electricity market to provide balancing services;
- Fit inside the multi-energy systems.



>> Real-time Monitoring and Control

HyCON monitoring is simple, intuitive and made easier by a user-friendly interface able to summarise all parameters and KPIs of the system. From this interface, the system start/stop, Hydrogen content injected and odorisation set point of the H2NG mixture can be controlled.

- Simple
- Intuitive
- User friendly

>> The case of the gas network: possibility to digitally manage the hydrogen in the network

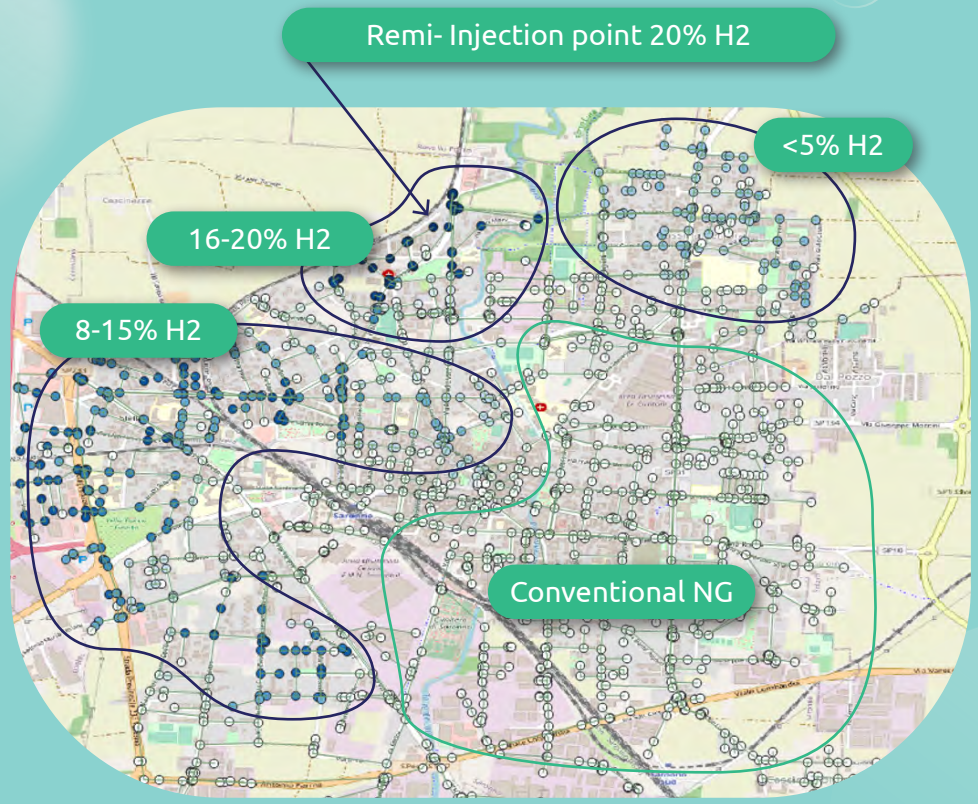
RegaSPHERE, the software platform totally designed and developed by Regas for the digital management of gas grids of the future, represents an actual paradigm shift that enables switching from a sporadic and low-performance control of the gas network to an advanced, efficient and smart management.

By activating the H2 module in the RegaSPHERE cloud platform, we are able to:

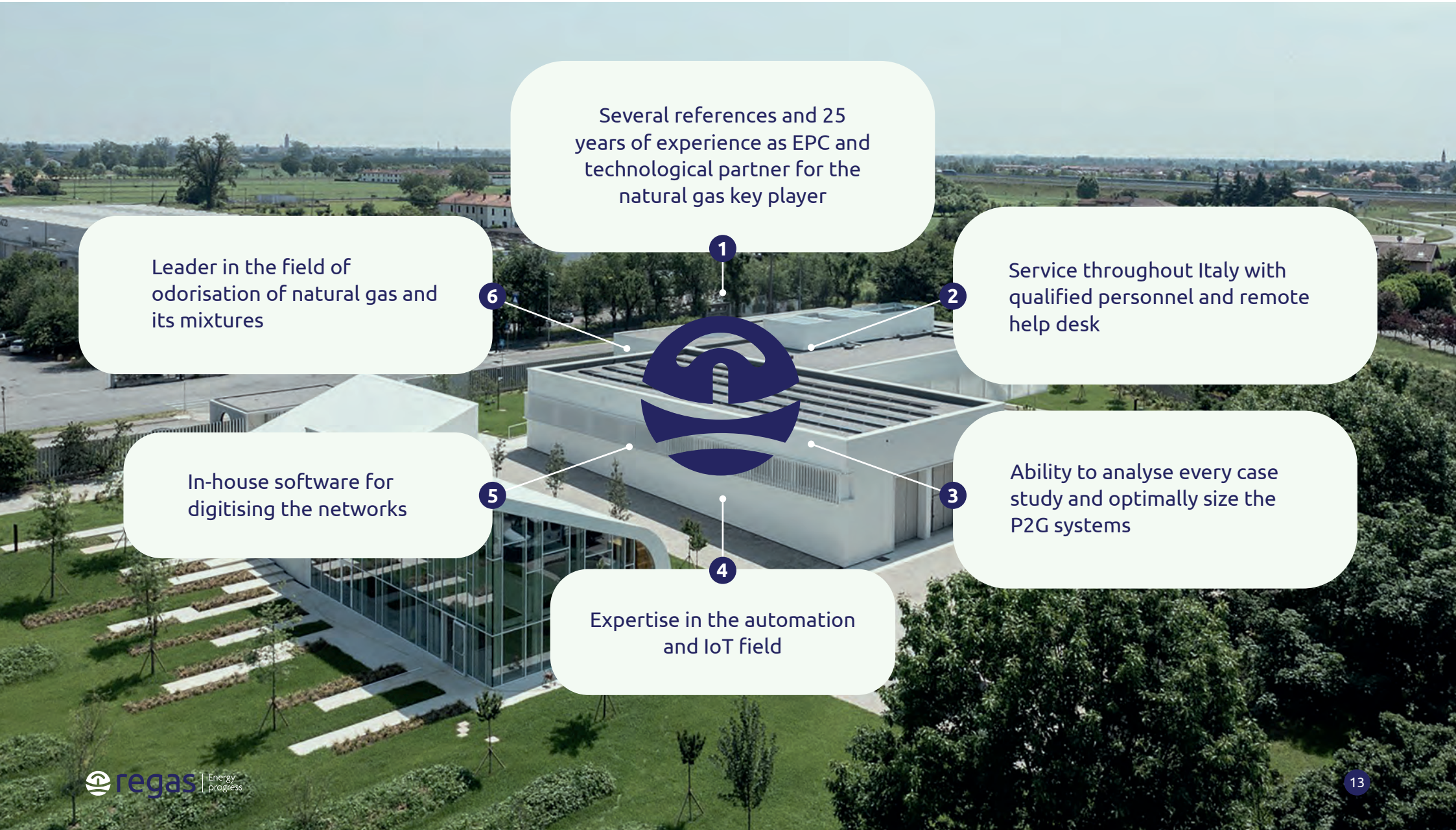
1. Perform dynamic network simulations
2. Analyse the diffusion and monitor the quantity of Hydrogen in the network
3. Simulate and forecast the consumption of gas and H2NG mixtures using AI and an on-line learning infrastructure that improves its accuracy over time
4. Optimise the positioning of the sensors
5. Define an alerting system to identify possible anomalies in the sensors installed in the field
6. Interact and control the instruments installed on the network

RegaSPHERE permits two-way communication between the gas distribution companies and the network, in fact allowing useful information to be found and making automation and control processes easier to improve the reliability and efficiency of the network.

regaSphere



>> Why choose Regas?

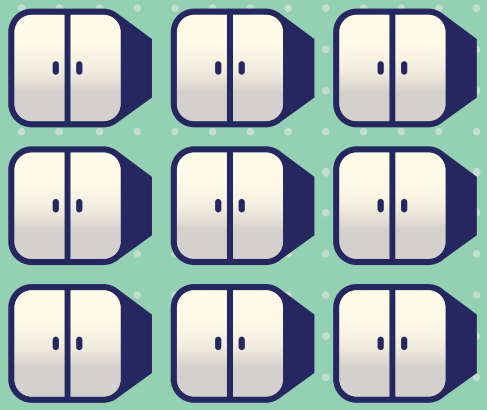


1. Several references and 25 years of experience as EPC and technological partner for the natural gas key player
2. Service throughout Italy with qualified personnel and remote help desk
3. Ability to analyse every case study and optimally size the P2G systems
4. Expertise in the automation and IoT field
5. In-house software for digitising the networks
6. Leader in the field of odorisation of natural gas and its mixtures

>> HyCON, sizes available

Modular Plug&Play System

	SMALL	LARGE
H2 capacity	6.5 Sm3/h	85,2 Sm3/h
Electrical power	32 kW	460 kW
Dimensions	10 ft	40 ft
H2NG capacity, with 5% blend	130 Sm3/h*	1704 Sm3/h*



Able to meet any production requirement

>> Main technical characteristics of the blending unit:

FUNCTION	DEVICE	DESCRIPTION
H2 injection control	Natural gas flow meter	• Rangeability: 1:100 • Repeatability: <0.5% • Accuracy: +-1% Rd • Response time: 1s
	Hydrogen flow rate controller	• Rangeability: 1:50 • Repeatability: <0.2% • Accuracy: +-0.5% Rd • Response time: 1s
H2NG and calorific value fiscal measurement	Volume flow meter	• Working fluid: H2NG (fiscality up to 10% H2) • Rangeability: 1:160 • Repeatability: <0.1% • Accuracy: Class 1
	Gas chromatography	• Measurement of: 1. H2 0-20% (up to 5% with OIML/PTB Certification) 2. CO2, N2, hydrocarbons from C1 to C6 3. Calorific value 4. Wobbe Index • Repeatability: <0.005% for all properties calculated
Odorisation	Ingrid S	• Relaunch of odorisation up to capacities of 0.1 Sm3/h (at 35mg/Sm3)
	Greta	• Measurement of: 5. THT between 1 and 100 mg/Sm3 6. TBM between 1 and 100 mg/Sm3 7. Accuracy +-5% Rd

>> Main technical characteristics of the Power-to-gas unit

Nominal power	From 3.6 to 460 kW in a single container*
Nominal Hydrogen capacity	From 0.66 to 85.3 Sm3/h in a single container
Nominal Oxygen capacity	From 0.33 to 42.6 Sm3/h in a single container
Nominal water absorption	0.6 to 72 l/h in a single container
Hydrogen production pressure	Up to 30 barg
Hydrogen purity	Up to 99.9995% (grade 5.5)
Oxygen purity	> 99.9%
Water dew point	Up to Tdew≤-70°C
System useful life	>=20 years
Dimensions	One or more containers from 10 to 40 feet, depending on the installation

* Sizes of over 1MW per single container contemplated for 2022

regas | Energy progress

Since 1998, Regas has been providing technological solutions for TSOs, DSOs and for energy intensive companies to implement the transition to a cleaner, safer and more efficient energy system.

Our Products

- **EMMA**, which optimises the pre-heating process by reducing gas consumption
- **INGRID**, which injects odorant into the network in an accurate, precise and innovative manner
- **GRETA**, which enables gas chromatographic analyses in real time and advanced remote management of the gas processes
- **REGASPHERE**, digital platform that by using artificial intelligence and fluid dynamic models offers automated and smart management of the gas network of the future
- **REMI-BIOMETANO**, systems for injecting biomethane into the gas network
- **HyCON** modular Plug&Play solutions for Power-to-gas

Our Objective

Our objective is to promote disruptive innovation in the worldwide natural gas industry and in energy companies by developing new technologies that maximise efficiency, safety and sustainability.

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