grz: TECHNOLOGIES

HYCO

METAL HYDRIDES HYDROGEN COMPRESSOR

POWERED BY HEAT

COST-EFFECTIVE

PLUG-AND-PLAY

POWERING THE FUTURE OF HYDROGEN SOLUTIONS

APPLICATION #1

The HyCo is a groundbreaking solution powered by GRZ Technologies' patented metal hydride technology. Designed to deliver unparalleled efficiency and reliability, the HyCo leverages thermally driven processes to compress hydrogen, effectively replacing mechanical compressors.

THERMALLY DRIVEN HYDROGEN COMPRESSION

GRZ's HyCo–short for Hydrogen Compressor–leverages waste heat to drive compression efficiently, significantly minimizing operational costs.

APPLICATION #1: HYDROGEN COMPRESSION IN INDUSTRIAL SURROUNDINGS

Hydrogen is a cornerstone of modern industry, fueling essential processes across diverse sectors. Whether used as a feedstock or an energy source, hydrogen often requires compression to elevated pressure levels to meet demanding industrial needs.

AMMONIA PRODUCTION

Hydrogen compression is critical for the Haber-Bosch process, where pressurized hydrogen combines with nitrogen to produce ammonia.

METHANOL AND SYNFUEL PRODUCTION

Pressurized hydrogen is vital for creating methanol and synthetic fuels, supporting sustainable energy solutions.

STEEL PROCESSING

Hydrogen is crucial in steel production where thermally-driven compression can substantially reduce operating costs of the plant.

PETROLEUM REFINING

Hydrogen compression enables refining processes, such as hydrocracking and desulfurization, to meet modern energy demands.

APPLICATION #1

These industrial processes often require hydrogen to be pressurized to specific levels, which can result in significant energy consumption and maintenance demands when using conventional mechanical compressors.

The HyCo offers a transformative solution by replacing mechanical compressors with an advanced thermochemical system powered by waste heat. This approach not only reduces operational and energy costs but also enhances system reliability with minimal maintenance requirements.

By leveraging available heat sources, such as excess steam from ammonia synthesis, the HyCo ensures substantial value creation for industrial users through a lower Levelized Cost of Compression (LCOC).

APPLICATION #1

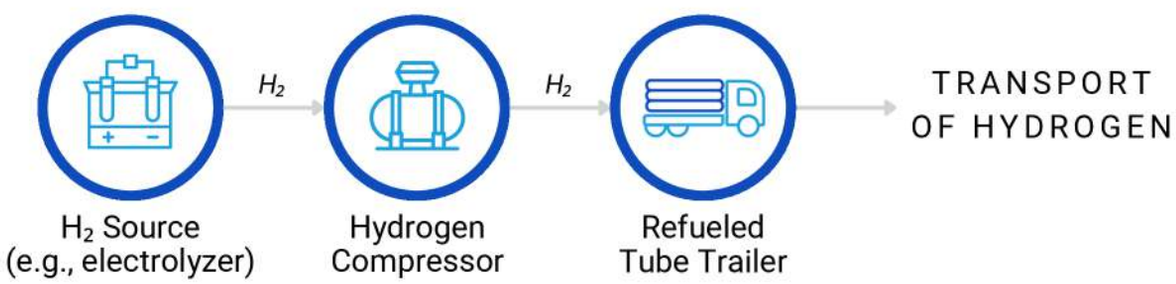
PARAMETER	TRADITIONAL SOLUTION: MECHANICAL COMPRESSOR	GRZ SOLUTION: HYCO
Inlet Pressure	10 bar	
Outlet Pressure	220 bar	
Nominal Capacity	30kg H_2/h	
Operating Hour Per Year	8000 h	
Cost of Electricity	0.10 EUR/kWh	
Electrical Consumption	3.0kWh/kg H_2	< 0.2kWh/kg H_2
Cost of Heat	0	
Lifetime	10 years	
Discount Rate	5%	
Levelized Cost of H_2 Compression	0.55€/kg H_2	0.38€/kg H_2
Cost Savings	–	-31%

APPLICATION #2: REFUELING OF HYDROGEN TRAILERS

The conventional method of transporting hydrogen relies on pressurized tube trailers, typically operating at pressures between 200 and 350 bar. These trailers are refueled directly at hydrogen production sources, such as electrolyzers, using specialized refueling stations that include compressors, filling panels, control systems, and safety features.

Refueling hydrogen trailers is a demanding process, often requiring extended operation times of 5-10 hours per trailer. During this period, compressors run continuously at full capacity, accumulating over 5,000 operational hours annually. This intensive usage often results in high energy costs, frequent maintenance needs, and significant operational noise and vibration.

HYDROGEN TRAILER REFUELING PROCESS



APPLICATION #2

The HyCo provides a transformative alternative. By utilizing waste heat, the system achieves greater efficiency while reducing the need for electricity. Its low-maintenance design ensures minimal downtime, and the absence of noise and vibration simplifies integration into industrial settings.

When powered by waste heat, the HyCo substantially lowers the Levelized Cost of Compression (LCOC) compared to a traditional mechanical compressor, as shown below.

PARAMETER	TRADITIONAL SOLUTION: MECHANICAL COMPRESSOR	GRZ SOLUTION: HYCO
Inlet Pressure	10 bar	
Outlet Pressure	220 bar	
Nominal Capacity	30kg H_2/h	
Operating Hour Per Year	4500 h	
Cost of electricity	0.10 EUR/kWh	
Electrical consumption	3.0kWh/kg H_2	0.2kWh/kg H_2
Cost of Heat	0	
Lifetime	20 years	
Discount Rate	5%	
Levelized Cost of H_2 Compression	0.68€/kg H_2	0.37€/kg H_2
Cost Savings	–	-46%

MESSER STREAMLINES HYDROGEN TRAILER OPERATIONS

Messer Gas, a leader in industrial and medical gas solutions, sought an efficient and sustainable solution for its hydrogen trailer refueling operations in Visp, Switzerland. Faced with high operational costs and increasing energy demands, Messer partnered with GRZ to implement the HyCo 10-220, a thermally driven hydrogen compressor.

KEY DETAILS

CLIENT	Messer Gas Schweiz AG
LOCATION	Visp, Switzerland
PROJECT TYPE	Refueling of Hydrogen Trailers
PRODUCT USED	HyCo 10-220

CONTINUOUS HYDROGEN FLOW

Achieves continuous hydrogen compression using four single metal hydride stacks for uninterrupted industrial processes.

CHALLENGE

At its Visp facility, Messer encountered challenges with energy-intensive and maintenance-heavy hydrogen compression systems. High electricity costs and operational inefficiencies underscored the need for a solution that could reduce expenses, increase reliability, and align with the company's sustainability goals.

SOLUTION

GRZ implemented the HyCo 10-220, a thermally driven hydrogen compressor powered by waste heat from existing processes. Its compact and modular design allowed seamless integration into Messer's setup while minimizing energy consumption and maintenance requirements. The system also featured simple installation and site preparation needs, enabling a swift deployment with minimal disruption to Messer's ongoing operations.

BENEFITS

By replacing traditional electrically powered compressors with the waste heat-powered HyCo 10-220, Messer significantly reduced electricity consumption. The reliable design, free of moving parts, minimized maintenance needs and downtime while ensuring consistent performance. Additionally, the system's scalability provided the flexibility to meet growing demand, supporting Messer's goals for both efficiency and sustainability.

HYCO COLLECTION

Powered by innovative metal hydride technology, the HyCo system delivers efficient, two-stage hydrogen compression while maximizing performance through waste heat utilization. Its compact and modular design ensures seamless integration into industrial operations, even in space-constrained environments.

The HyCo collection features four standardized models tailored to meet a range of pressure requirements. Each model name reflects its specific inlet and outlet pressures in bar(g), ensuring flexibility for diverse operational needs.

METAL HYDRIDE COMPRESSOR SYSTEM

The HyCo system integrates four metal hydride compressor vessels—two low-pressure and two high-pressure—for optimized performance. Hydrogen lines and flow control valves are positioned on one side of the container, while steam and cooling water systems occupy the other.

HYCO SYSTEM	UNIT	10-220	30-220	10-380	30-380
Min. Inlet Pressure	bar (g)	10	30	10	30
Max. Outlet Pressure	bar (g)	220	220	380	380
Nominal Capacity	kg H_2/h	30	30	30	30
Number of Stages		2	2	2	2
Cooling Fluid (External)		Water			
Cooling Fluid Temperature	°C	20	20	15	20
Heating Fluid (External)		Steam			
Heating Fluid Temperature	°C	135	135	145	135
Internal Thermal Fluid	°C	Pressurized water			
Product Shape [1]		Skidded construction			
Skid Size	m	2.5 x 6.2			
System Weight	kg	20,000			
Ambient Operating Temperature [2]	°C	5 to 40			

[1] *Container available as optional add-on (see page 10)*
[2] *Cold operation package is available as optional add-on (see page 10)*

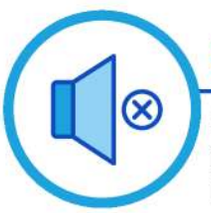
KEY FEATURES

The HyCo system combines patented metal hydride technology with innovative design to deliver unmatched performance. From utilizing waste heat for energy efficiency to ensuring a compact and modular layout for seamless integration, every feature is crafted to meet the demands of industrial hydrogen compression with precision, reliability, and safety.

LOWER LEVELIZED COST OF COMPRESSION ACHIEVABLE COMPARED TO MECHANICAL COMPRESSORS AS A RESULT OF WASTE HEAT RECOVERY.

POWERED BY HEAT

Efficiently utilizes waste heat as its energy source, reducing reliance on electricity and minimizing operational costs.



SILENT OPERATION

Noiseless and vibrationless, making it an ideal solution for urban and suburban environments where quiet operation is crucial.

NO MOVING PARTS

Solid-state design with no mechanical components ensures enhanced reliability and long-lasting performance.

ZERO DOWNTIME

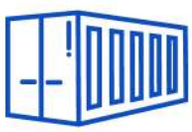
With minimal maintenance requirements, the HyCo system delivers consistent performance, reducing operational interruptions.

READY-TO-DEPLOY

Plug-and-play modular system designed for easy integration into existing systems with minimal installation time.

OPTIONAL ADD-ONS

The HyCo system offers a range of optional enhancements designed to optimize performance across diverse environments and applications:



FULLY EQUIPPED CONTAINER

Durable 20' ISO enclosure designed to protect the system from harsh environmental conditions.

COLD OPERATION PACKAGE

Ensures reliable operation in sub-zero environments with temperatures as low as -20°C.

FIRE, SMOKE, AND HUMIDITY DETECTOR

Optional with containerized system to detects fire, smoke, and humidity with both audible and visual alarms.

INTEGRATED AIR COMPRESSOR

Guarantees fully autonomous operation when on-site compressed air is unavailable.

LIGHTNING PROTECTION

Provides robust lightning protection for the container to ensure secure operation.

HYDROGEN MASS FLOW METERS

Includes mass flow meters at inlet and outlet to monitor hydrogen flow accurately.

PREVENTATIVE MAINTENANCE

Our comprehensive support offerings are designed to keep your HyCo system running reliably and efficiently:

ON-SITE ASSISTANCE

Expert assistance during setup for optimal system functionality.

TECHNICAL SUPPORT

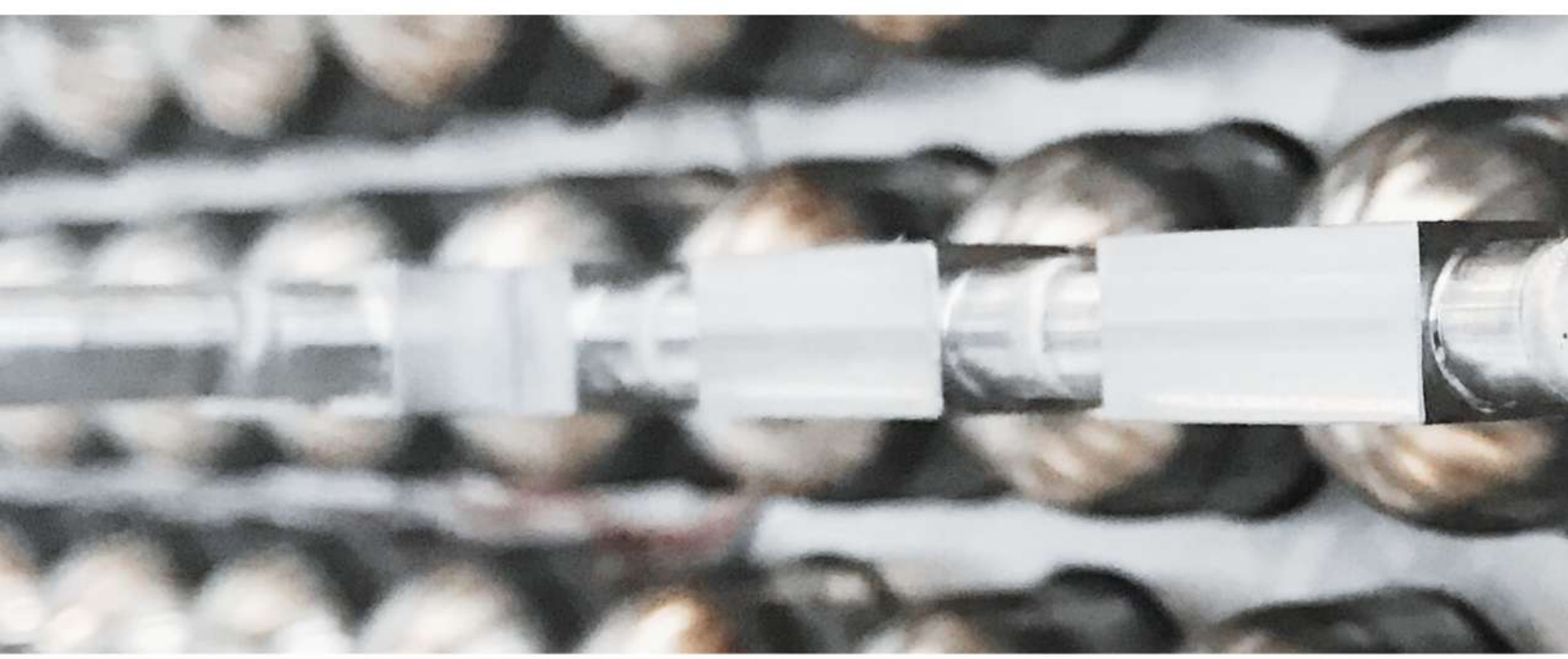
Available remotely or on-site for troubleshooting and preventative maintenance.

SPARE PARTS WARRANTY

Maintain system reliability with warranty coverage for essential spare parts.

WARRANTY EXTENSION

Extend warranty coverage annually when paired with our technical support.



COMPLIANCE

Every HyCo system is based on the strict quality requirements of GRZ with CE certification that meets international safety and performance standards:

ATEX DIRECTIVE 2014/34/EU

Certified for safe use in potentially explosive environments.

MACHINERY DIRECTIVE 2006/42/EC

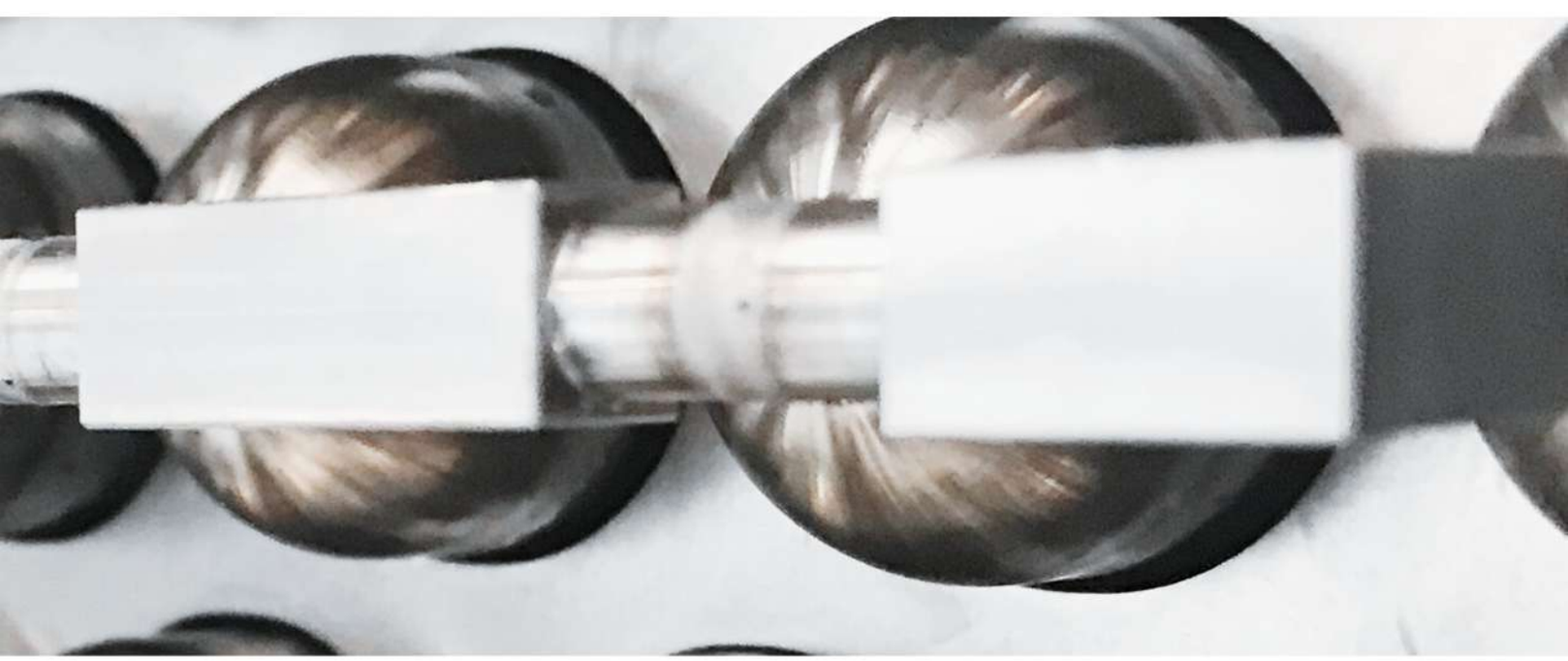
Adheres to required safety protocols for machinery design and operation.

PRESSURE EQUIPMENT DIRECTIVE 2014/68/EU

Guarantees safe design and manufacturing of pressure equipment.

LOW VOLTAGE DIRECTIVE 2014/35/EU

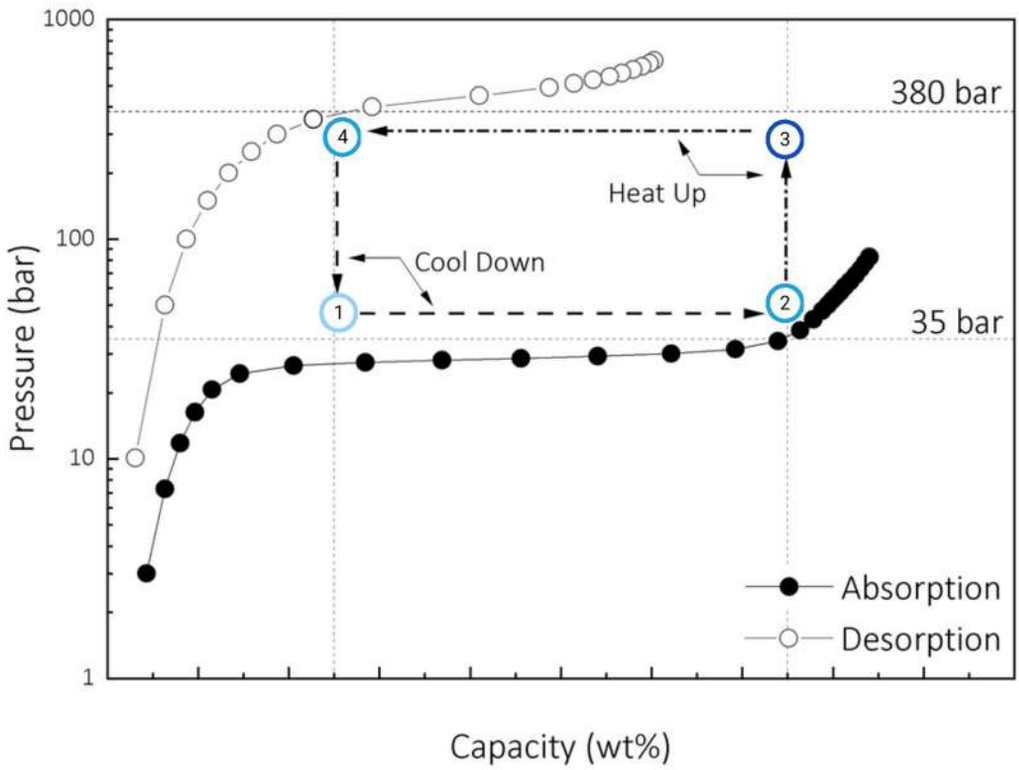
Ensures electrical equipment meets safety requirements for low voltage operation.



OPERATIONAL OVERVIEW

The HyCo system operates through a thermochemical compression cycle, leveraging proprietary metal hydride technology. This innovative process uses controlled heating and cooling to compress hydrogen gas in four key steps, as illustrated below.

TYPICAL HYCO COMPRESSION CYCLE

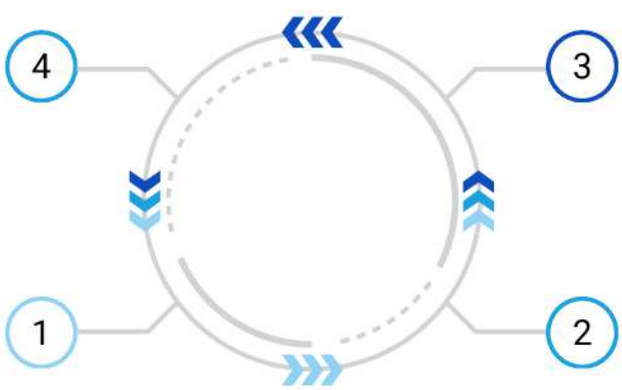


H_2 DESORPTION

At a higher temperature, hydrogen is released from the metal hydride.

COOLING DOWN

The system cools to its original temperature, completing the cycle.



HEATING UP

The system is heated, raising the pressure to the desired output level.

H_2 ABSORPTION

Hydrogen is absorbed at a lower temperature into the metal hydride.

ABOUT GRZ TECHNOLOGIES

At GRZ Technologies, we stand at the forefront of hydrogen innovation, dedicated to reshaping the future of clean energy through our patented metal hydride technology. With decades of research and development, we deliver safe, efficient, and versatile solutions–from compact, high-density hydrogen storage to cutting-edge compression capabilities and beyond–designed for diverse applications, from residential use to large-scale applications.

PARTNERSHIPS

Our partnerships with industry leaders like Hyundai, AMPO, Sabanci, and the fischer group propel us forward, enabling advancements in backup power and renewable energy integration—all while prioritizing reliability and cost-efficiency.

A WORLD FUELED BY RENEWABLE ENERGY – DAY AND NIGHT, SUMMER AND WINTER.

Fueled by a passion for a sustainable energy future, GRZ Technologies is not just innovating; we are revolutionizing the storage, compression, and utilization of hydrogen, setting new benchmarks for excellence in the industry.

CONTACT US TODAY AND BE PART OF THE CLEAN ENERGY REVOLUTION

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Information is subject to change without notice. MAM-3100. Revision 00