

# Renewable Hydrogen Compression Solutions

Advanced solutions supporting  
a sustainable energy future



# Your partner in hydrogen compression

**Howden is a leading global provider of mission critical air and gas handling products. Based in Glasgow, Scotland, Howden has over 160 years of heritage as a world-class application engineering and manufacturing company with a presence in 90 locations in 35 countries.**

Howden manufactures highly engineered compressors, fans, heat exchangers, steam turbines and other air and gas handling equipment. We provide service and support to our customers around the world in highly diversified end-markets and geographies.

Our reputation as a trusted expert is demonstrated by our application expertise, portfolio of renowned product brands and extensive installed base of reliable technologies.

## Fuelling the future

Compression technologies are a key component in the hydrogen value chain and accelerate the energy transition. A pioneer in the sector, Howden engineering technology supports customers' sustainability goals by enabling energy systems toward reduced and zero carbon emissions.

Our equipment and specialist teams are addressing our customers' challenges across the hydrogen value chain. We minimise the total cost of ownership of operations through our focus on the full lifecycle. We work closely with our customers to engineer the right compression solution for their process, and optimise the pressure profile of the entire plant as well as utility and heat integration.

## Unique knowledge and expertise

We have decades of experience, over which Howden has delivered hydrogen compression solutions across many industries and locations, from the Americas to Asia. Our global coverage brings flexibility and knowledge, which we believe is unique to the entire hydrogen value chain. It is the support and partnership we bring that ensures customers increase the efficiency and effectiveness of their processes, enabling them to improve their own environmental impact.

The combination of our international expertise and on the ground operations enables us to support our customers' energy transition throughout. We bring an approach driven by service and value.

We bring over a century of application knowledge, reliable solutions and partner with our customers across the entire hydrogen value chain.

## Proven solutions

We are proud to support numerous world-leading projects that are currently driving forward the energy transition.

The Howden reputation for high quality, integrity and absolute dependability is crucial in supporting this vital work. This reputation stems from engineering excellence, understanding our customers' operational objectives and our commitment to addressing the most complex challenges.

We know that scale is also important to our customers. Our innovative technology and worldwide engineering expertise across the hydrogen value chain has enabled us to provide compression solutions from

the world's largest centralised hydrogen compression systems to smaller scale decentralised applications. It is the innovation and expertise that we bring that has enabled operators, whatever their project size, to realise reduced total cost of ownership as well as a reduced levelised cost of hydrogen production.

Having built the largest Hydrogen compression solution in the world, Howden has a robust track record in delivering advanced compression solutions to flagship projects, including: the world's largest hydrogen refuelling station; the world's first climate-neutral fuels (efuels); and the world's first green steel project.

## Howden - at the heart of hydrogen

Our hydrogen team, backed by over a century of application knowledge and experience, guarantees that equipment meets safety requirements, customer specifications, application requirements and international codes.

Our technology contributes to reducing carbon emissions, supporting our customers' sustainability goals and increasing energy performance.

Howden provides safe and reliable solutions to handle hydrogen at any pressure, from small to large capacities.

## World first climate neutral methanol project

Chile



Photo courtesy of Siemens Energy

## World's largest hydrogen refuelling station

China



## World's first green steel project

Sweden



Photo courtesy of SSAB

## Europe's largest biofuel project

The Netherlands



Photo courtesy of Shell International Limited © Ernst Bode

## HyPSTER world's first underground storage

France



Photo courtesy of ArcomDesign





### Advanced technologies

Our exceptional manufacturing process and stringent testing ensures our products perform even in the most challenging environments.

Howden technologies can handle and optimise hydrogen across the value chain from production to storage, distribution, transmission and end use such as refuelling stations and Power-to-X applications.

Our global reputation is built on our leading product brands. Howden is home to the most important product brands in its field, including reciprocating (diaphragm and piston) and rotary (screw) technology. Burton Corblin™ and Thomassen technologies are installed worldwide and delivered to API standards that guide traditional processes in refinery, chemical and industrial premises.

Both diaphragm and reciprocating technology are vital in all gas processing. This includes hydrogen in the mobility, industry and energy sectors through the production, distribution, storage and utilisation phases where safety is paramount.

### Our comprehensive innovation roadmap on renewable hydrogen focuses on:

- Extending the performance of Howden equipment to meet growing and challenging demands, without compromising on safety.
- Progressing towards a predictable and viable levelised cost of hydrogen for end-users.

### Research and innovation

For more than a century Howden has engineered solutions to address the challenges faced by our customers worldwide. Today, we continue to challenge, invest, innovate and transform industries through our market-driven research and development program, which enables us to provide the right support and response to any challenge. Our innovation programs are:

- Market driven: we mobilise our engineering expertise and ensure end-users are involved in all critical steps
- Based on collaboration: with partners from the value chain wherever and whenever possible
- Led by product centres of excellence: leveraging Howden global teams and network, combining the best of our fundamental knowledge with dynamic front-end activities

Our program enables us to stay ahead of the development curve, incorporate new innovations and feedback into our continuous improvement process. We remain open to collaborations that enable integration of our solutions in bigger systems to serve the renewable hydrogen market requirements.

### Our global footprint

Howden operates in every region throughout the world. We have offices, manufacturing centres, service centres and research & development teams employing over 6,000 people across these locations.

Wherever there is an operation, whatever the level of support required, Howden experts are on hand. The real value we bring is in local support reinforced by our global network. With our experts close by, we can respond quickly and understand local challenges whilst staying ahead of local and international safety standards.

### Collaborating with industry leaders

Howden is an active member in some of the world's most important global and regional hydrogen associations. This enables our experts to collaborate and raise awareness of the importance of the energy transition and the role our industry will play in this journey.

We actively share our expertise with other leaders in the hydrogen space to identify drivers for long-term economic growth, to navigate and de-risk the pathway to the clean hydrogen energy transition.

Our participation with these leading hydrogen associations and drive to address industry challenges reinforces Howden's commitment to accelerating the energy transition towards a cleaner and resilient energy future.

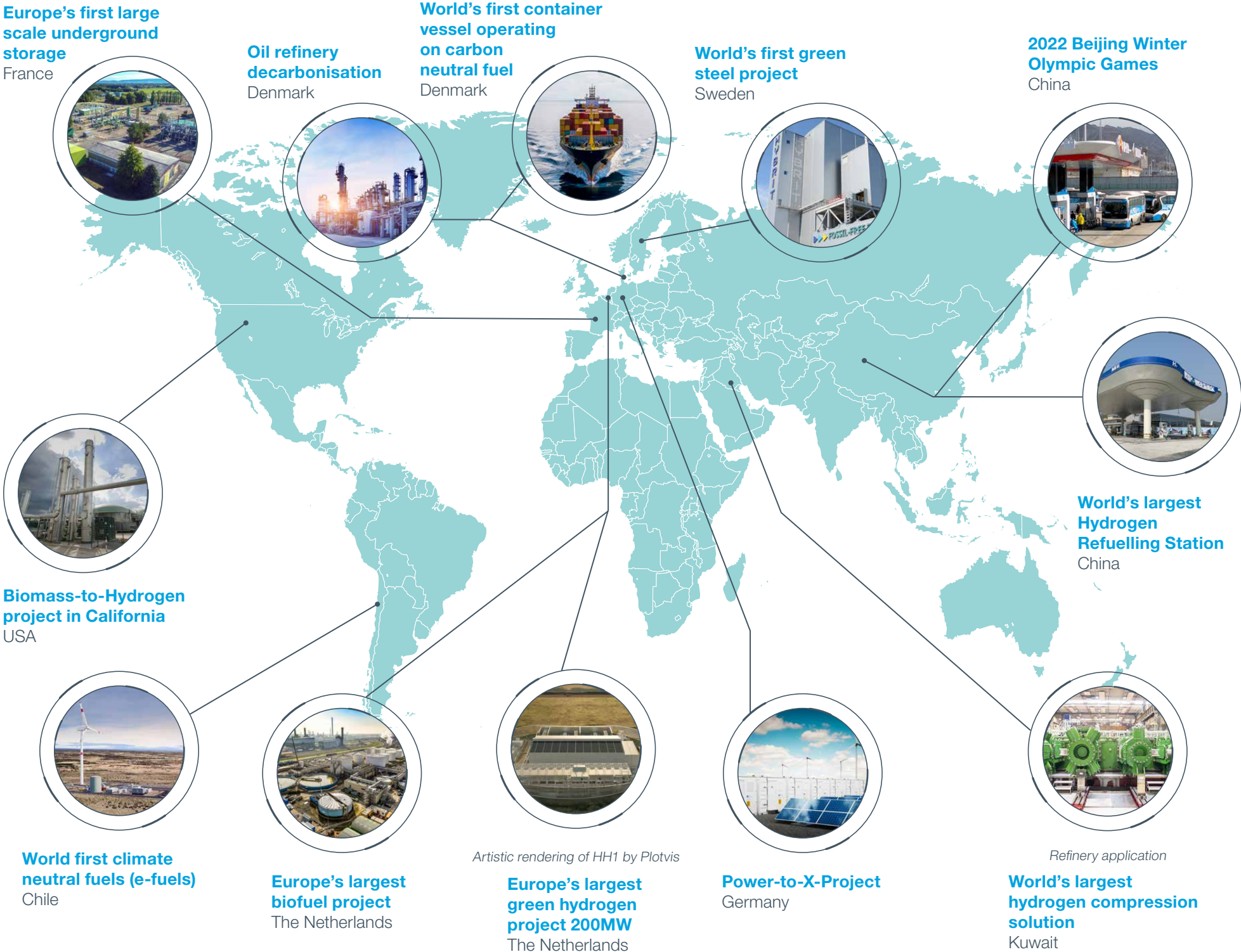
### Hydrogen Council





# Proficient and efficient hydrogen compression solutions

Howden hydrogen solutions have enabled some of the world's most unique and innovative renewable hydrogen projects such as:



Our solutions focus on optimising equipment availability, reliability and installation footprint which reduces the total cost of ownership of our customers operations.



## Planning for success

Being involved at the beginning of a project enables us to work alongside customers throughout their hydrogen journey. This means we can ensure optimisation across the life cycle of the project from both CapEx and OpEx perspectives.

This early involvement also allows our compression solutions to be central to decision-making, particularly where full life cycle includes aftermarket services. If we are part of the decision on the compression requirement, it enables the project team to better understand what its ultimate goals will be and how our solutions can support them.



### Compression requirements

- Performance
- Scope
- Total cost of ownership



### Long term strategy

- Long term common goals
- Required competences
- Roadmap



### Collaboration

- Capabilities
- Integration
- Fast learning
- Knowledge
- Technologies



### Delivery

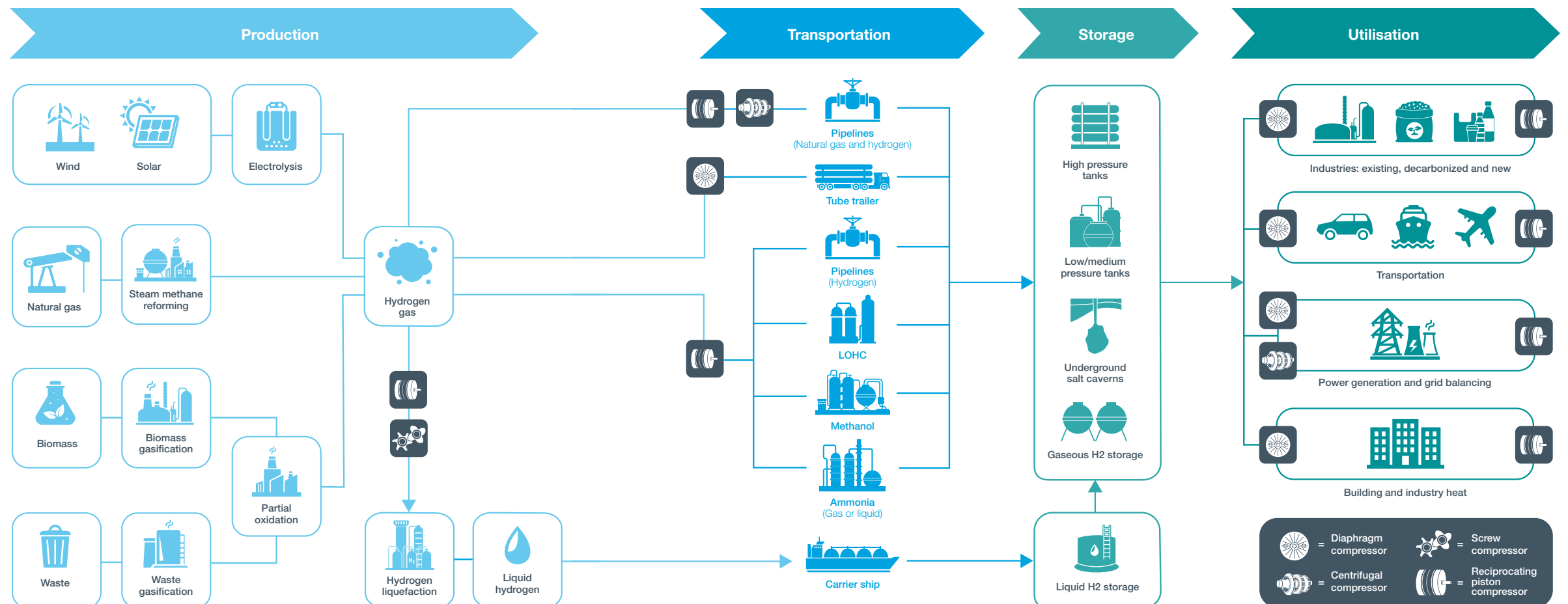
- Innovation product
- Life cycle experience
- Scale-up delivery capabilities

Early collaboration with customers is fundamental to optimise Howden's project development cycle.

## Howden compression solutions in the hydrogen value chain

A range of very diverse applications requiring specific compressor technologies.

Optimise hydrogen across the value chain from production to storage, distribution, transmission and end use.





# Hydrogen applications

**With a range of compression technologies, Howden is able to support applications across the value chain, with varying pressure profiles and flow rates. Through innovative design and strong commercial partnerships, Howden is committed to developing these hydrogen applications.**

Your partner in: **Production**

## Power-To-X

The power-to-X process allows the conversion of renewable electricity into storable hydrogen fuel, thus allowing the beneficial spread of carbon-neutral energy across multiple sectors.

Hydrogen production from electrolysis supplied by renewable power produces a green hydrogen fuel. Electrolyser packages are currently producing at discharge pressures of atmospheric to 30 bar.

Howden provides compression solutions, such as diaphragm and reciprocating compressors, to increase the hydrogen pressure for downstream applications.

Hydrogen transport pressures depend on available infrastructure and consumer requirements:

- Grid connections require hydrogen to reach pressures of 50-80 bar
- Tube trailers require compression up to 500 bar
- For generation at refuelling stations, the pressure requirements can be up to 1000 bar



NEL selected Howden to supply hydrogen compression solutions as well as the development of integrated solutions to lower the life-cycle cost of production and accelerating the adoption of hydrogen as a zero-carbon fuel.





## Blue hydrogen

Building a robust and secure hydrogen market requires the development of a reliable, cost-effective and sustainable supply of hydrogen. Blue hydrogen represents an important step in the low carbon hydrogen market development, allowing the renewable hydrogen supply to develop, with lower CapEx and OpEx costs. Compared to other hydrogen production methods (with current carbon tax rates), blue hydrogen can help to develop this supply.

Blue hydrogen production is the conversion of a hydrocarbon feedstock into a hydrogen product with CO<sub>2</sub> capture for storage and usage. The conversion mechanism can be one or more of: steam methane reformation; autothermal reformation; or partial oxidation. The resulting syngas is further processed in a shift reactor and finally purified.

Blue hydrogen requires compression at a number of stages throughout the process:

- Hydrocarbon gas compression for import of feedstock
- Hydrogen export compression
- Carbon dioxide export compression

Howden supports customers across all of these compression processes, with a range of compressor types suitable for these requirements.

With an extensive range of compressor solutions and experience in conventional hydrogen applications, Howden is the ideal partner for blue hydrogen projects.



## Hydrogen pipelines

Gaseous hydrogen can be transported in pipeline networks in the same way that natural gas is transported currently. Pipeline operators are looking at various options:

- Blending hydrogen directly into the natural gas network at levels. This is the lowest CapEx option with upgrades required for hydrogen compression and blending, but minor pipeline and user upgrades may be needed.
- Repurposing existing natural gas grid infrastructure to dedicated hydrogen transport. This is a low cost option for dedicated hydrogen, with upgrades required for the compression, booster compression and potential refurbishment of pipeline sections. It represents a low cost mechanism for hydrogen transport, as high pressure compression is not required. Downstream application users who were utilising natural gas will need to make modifications – e.g. kiln burners.
- New pipeline development for hydrogen transport. This represents a customised solution for hydrogen distribution. It is expensive as the entire network will need to be developed, and the challenges of planning and development are significant. These may be viable initially for hydrogen cluster development where hydrogen users and producers are being developed as part of new hydrogen micro economies.

As pipeline owners and developers seek to either repurpose their existing pipelines for hydrogen delivery, or as they expand and develop new pipeline networks, the right cost-effective compression solutions are needed to ensure the viability of this industry. Howden can provide compressor solutions to inject hydrogen into the grid from low pressure production sources, as well as large flow rate booster compression throughout the pipeline network.

Hydrogen distribution is central to the value chain. Howden has the technology to support pipeline, bottle, tube trailer and liquefaction projects.



Your partner in: **Transportation** and Storage

### Hydrogen bottle filling

Large quantities of compressed hydrogen can be delivered to different remote sites to serve a variety of applications via tube trailers or even manifolded cylinder packs (MCPs). The tube trailer usually contains approximately 300 kg of hydrogen at a pressure of 180 to 500 bar. Hydrogen MCPs are typically bundled together into packs comprising a number of hydrogen cylinders and their outlets manifolded together. MCPs can be

delivered with a wide range of pressures, from 10 bar to 900 bar.

Howden diaphragm and hybrid compressors have been safely serving gas high pressure bottling solutions for decades. The technology prevents any gas contamination within a sealed compression chamber. This ideal solution, developed by Howden, is widely used for compression with high cleanliness level gas preservation.

Your partner in: **Transportation** and Storage

### Hydrogen liquefaction

The increasing demand for hydrogen's use across diverse and growing industrial sectors will require construction of new large-scale hydrogen production and distribution infrastructure. Liquid hydrogen supply is often desired due to its higher energy density compared to gaseous hydrogen and lower per kilo transport costs at higher volumes. Liquid hydrogen is important for developing hydrogen fuelled aviation, maritime transport as well as long distance road distribution.

The conventional hydrogen liquefaction process operates at efficiencies of 30 – 35%. Improvements in the process efficiency are likely to come from thermal management systems, ortho to para hydrogen converters, and better heat integration systems.

The refrigeration cycles require the compression and expansion of refrigerant gases. Howden can support these compression technologies and help customers' select optimum refrigerant solutions.

Your partner in: **Storage**

### Hydrogen storage

Hydrogen storage (whether in metal vessels, underground, including salt caverns, or liquid storage in liquefaction) is a key enabler for the advancement of hydrogen and related fuel cell technologies throughout the world. Creating a buffer capacity of hydrogen reduces the risk in fluctuating renewable power supplies for green hydrogen generation.

Cost effective hydrogen storage is required to support the use of hydrogen in current and future industrial applications, including transportation, portable and stationary power. While hydrogen has the highest energy per mass of any fuel, its low ambient temperature density results in a low energy per unit volume. This makes it important to develop advanced storage methods that have potential for higher energy density.

Physically, hydrogen can be stored as either a gas or a liquid. Storage of hydrogen as a gas typically requires high-pressure tanks (350–1000 bar tank pressure), or underground cavern storage (at pressures below 350 bar). Storage of hydrogen as a liquid requires cryogenic temperatures because the boiling point of hydrogen at one atmosphere pressure is  $-252.8^{\circ}\text{C}$ .

Howden has extensive experience in offering cost-effective compression solutions for hydrogen storage across different applications. These offer exceptional performance, high availability and reliability, which result in reducing the total cost of ownership of their operations, while supporting the development of a green hydrogen infrastructure and underground hydrogen storage.

Howden has been appointed to support the important development of a green hydrogen infrastructure project in Etrez, France: HyPSTER - the Hydrogen Pilot Storage for large Ecosystem Replication.

Your partner in: **Utilisation**

### Refuelling stations

Decarbonising transport is key to the energy transition, with hydrogen offering an important decarbonisation pathway for heavy vehicles and long distance mobility. Hydrogen fuel cell vehicles in operation only emit water vapour, thus producing zero greenhouse gases. Furthermore, when renewable energy is used to produce the hydrogen, driving a hydrogen fuelled vehicle is nearly emission-free, through the whole fuel production to consumption cycle.

To support these hydrogen fuel cell vehicles, hydrogen fuelling stations are being built, forming networks of fuelling coverage around the world – supplying gaseous hydrogen to the

mobility sector. Hydrogen vehicles store energy in the form of compressed hydrogen fuel and take only a few minutes to refill. Hydrogen compressors are critical in order to achieve this rapid refuelling, safely and reliably. Heavy mobility, including ferry boats, forklifts, trains, trucks and buses require fuelling at 450 bar above, with light mobility users requiring up to 850 bar pressure.

Howden provides both bareshaft and fully skid mounted hydrogen compression solutions for hydrogen refuelling stations, optimising performance to minimise power consumption, package footprint and refuelling times. Howden provides compression solutions for

downstream of the import facility, and downstream of the hydrogen production package if produced on site – thereby needing compression from lower pressures.

Howden compression solutions have been deployed in a large number of hydrogen refuelling station across the globe, including the largest hydrogen refuelling station in the world, located in China.

With demonstrable project experience in this sector, Howden can offer engineered to order or off the shelf solutions that can be deployed at scale, supporting the fast development of station networks.







Howden provided a hydrogen storage compression solution for HYBRIT, the world's first fossil-free steel plant, in Svartöberget, Sweden.

Your partner in: **Utilisation**

#### Green steel

Steel production is a carbon intensive process, with global emissions of CO<sub>2</sub> for this sector contributing 9% of all direct fossil fuel emissions. With global steel demand set to increase by around 6% by 2030, transitioning the steel industry towards carbon neutrality is essential for the world energy transition.

Replacing coking coal with hydrogen to act as a reducing agent by removing oxygen from the iron ore, can greatly reduce CO<sub>2</sub> production

from the steel making process. If this hydrogen is generated from a low carbon production method it would become possible to generate deep decarbonisation of the industry. Steel production via this pathway results in CO<sub>2</sub> production of approximately 90-240kg / ton of steel produced as opposed to 1,800 – 1900kg / ton of steel by traditional methods. Hydrogen when used in steel making is usually compressed and then stored in large volumes before being used in the steel plants furnaces.

Your partner in: **Utilisation**

#### Green ammonia

Green ammonia is produced via the Haber process but with a hydrogen feedstock derived from the electrolysis rather than steam methane reformation. The produced ammonia can be used within the fertiliser industry or as a one way energy carrier within the hydrogen energy system.

Within the green ammonia process Howden compressors are used to compress the produced hydrogen from the electrolyser to the

operating pressure of the Haber process reactor.

As an energy carrier, ammonia can be stored as a liquid at much higher temperatures than hydrogen: -33°C compared to -252.8°C. This offers a much less energy intensive route for transporting hydrogen and for fuelling sectors like marine mobility, where large ammonia stores can be kept on vessels before being converted back to hydrogen and consumed in a fuel cell.

Your partner in: **Utilisation**

#### Green fuels (eFuels)

eFuels (or green synthetic fuels) are generated when hydrogen that can be produced using renewable energy is combined with carbon dioxide, either from industrial exhaust gases or directly from the air. This green hydrocarbon fuel produces no additional greenhouse gas emissions when it burns. eFuels are expected to play an important role in decarbonising the transport system and would therefore make a notable contribution to climate protection.

eFuels come in a variety of forms such as eMethanol, ethanol ammonia, biogas and biofuels. The liquefaction energy costs of hydrogen are significant with up to 30% of the stored energy being used to liquefy the gas. eFuels can help solve this problem as they are carriers of hydrogen in liquid form which makes a significant difference in lowering the infrastructure requirements.

Howden's compression solutions are used for compressing the hydrogen gas from the hydrogen generation package (electrolyser) for use on the fuels plant.

Howden delivered a hydrogen compression solution to the world's first methanol plant to harness energy from the wind, in Patagonia, Chile.

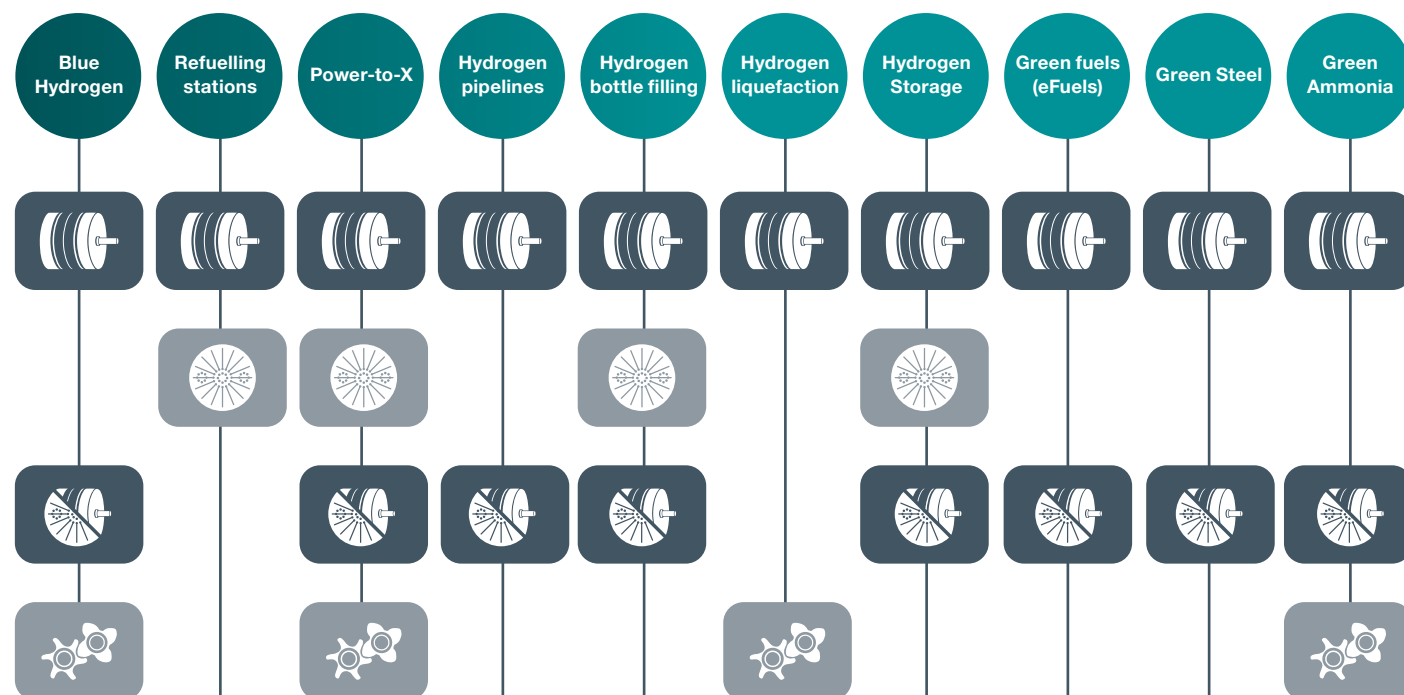



Howden's hydrogen compression solutions are supporting a range of industries in their energy transition journey.

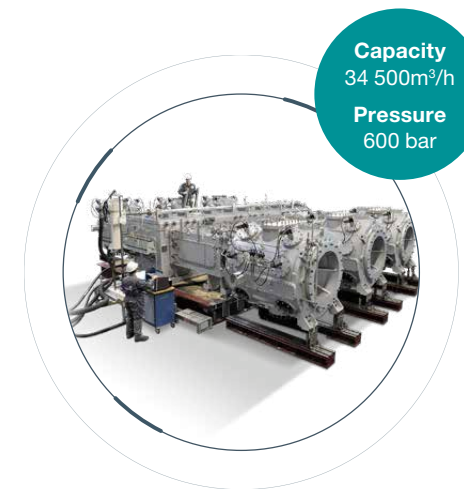




# Hydrogen compression solutions



 = Reciprocating piston compressor
  = Diaphragm compressor
  = Hybrid compressor
  = Screw compressor



**Capacity**  
 34 500m<sup>3</sup>/h  
**Pressure**  
 600 bar

## Reciprocating Piston Compressor

Howden's wide reciprocating compressor portfolio presents a comprehensive compressor range, capable of addressing hydrogen piston compressor application requirements.

All Howden reciprocating compressors are supplied as fully integrated solutions, including process equipment, pressure vessels and piping, control and auxiliary systems, either as skid-mounted packages or concrete-mounted units.

Howden continues to be at the leading edge of reciprocating compressor innovations. Over the past decades, Howden's innovative approach to reciprocating compressors has led to

market-leading technology advancements.

Continual extension of the C-series compressor line has allowed upscaling of hydrogen compression systems and has culminated in delivering the largest hydrogen compression systems ever built. The Free Floating Piston (FFP™) enables a breakthrough in mean time between maintenance for non-lubricated compressors by eliminating rider ring wear and significantly reducing piston ring and piston rod packing wear. By extending rider ring life to over 100,000 operating hours, scheduled maintenance interventions are significantly reduced and improve availability and operating costs.

Howden's innovative approach to reciprocating compressors has led to market-leading technology advancements.

### Key features

- Power up to 33 MW
- Pressures up to 600 bar
- Rod load up to 1,800kN

### Benefits

- The patented Free Floating Piston technology eliminates rider ring wear and extends maintenance intervals in non-lubricated application
- Howdens Uptime digital solutions provide predictive maintenance insights and reduces scheduled and unscheduled downtime

### Typical plants / application

- Hydrogen – Large-scale hydrogen production plants, pipeline compression, storage
- Oil & Gas - Refining – Hydrocracking, hydrotreating, continuous catalyst regeneration reformers
- Petrochemicals - Hydrocracking, hydrotreating





## Diaphragm Compressor

Henri Corblin invented the diaphragm compressor in the early 20th century. As part of Howden's portfolio, it has remained the optimal solution for high pressure compression of gasses ever since. Howden continues to be at the leading edge of diaphragm compressor innovation, constantly improving compressor safety, availability and performance.

Diaphragm compression is the technology of choice where high discharge pressures and large pressure differentials are required and cleanliness of the process gas is critical, as for refuelling applications for fuel cell electric vehicles (FCEV).

Skid-mounted diaphragm compressors include all process equipment, piping and

auxiliary systems in a single package, ensuring minimal site activities and rapid and flawless commissioning.

Howden diaphragm compressors provide market-leading high-pressure compressor solutions. We carry considerable expertise in high-pressure applications, up to and exceeding 3000 bar discharge pressure. Continual extension of the diaphragm compressor portfolio provides a wide and scalable solution offering, capable of addressing the full range of compression needs. Consequently, Howden's large-scale diaphragm compressor solutions directly enable further scaling up of storage, tube trailer filling and refuelling applications.

### Key features

- No contamination – ensuring absolute cleanliness of hydrogen
- No leakage – 0% leakage of process gas to the environment
- Water cooled heads ensuring longest MTBM and highest reliability
- Pressures up to 3000 bar

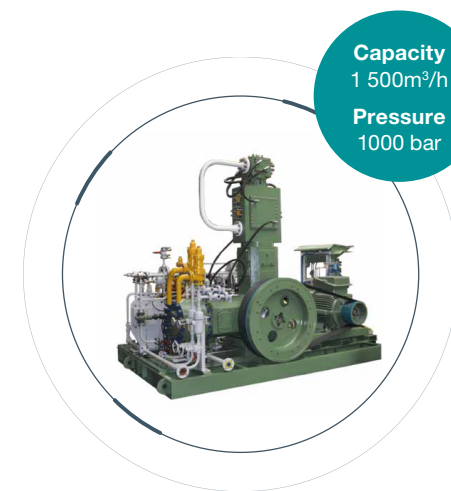
### Benefits

- The Head Integrity Detection System (HIDS) system provides absolute safety in operation by real-time monitoring of head integrity, a fail-safe stop procedure and containment of process gas in the event of a diaphragm breach before process gas is contaminated
- Howden's Uptime digital solutions provide predictive maintenance insights and reduce scheduled and unscheduled downtime
- Compact skid mounted designed to project & site specifications for easy site integration

### Typical plants / application

- Hydrogen – Hydrogen production plants, bottle filling, tube trailer filling, FCEV fuelling, storage
- Petrochemical

Howden continues to be at the leading edge of diaphragm compressor innovation, constantly improving compressor safety, availability and performance.



## Hybrid Compressor

Hybrid compressors unite the strong points of piston and diaphragm compressors in one single compressor. By leveraging the benefits of piston compressors in compressing large volumes of gas at lower pressures and utilising diaphragm capabilities to achieve very high discharge pressures, hybrid compressors are ideally suited to compress low-pressure gas from atmospheric production pressures up to the required process or storage pressure.

These units are suitable for all dry gases including helium, hydrogen and nitrogen.

### Key features

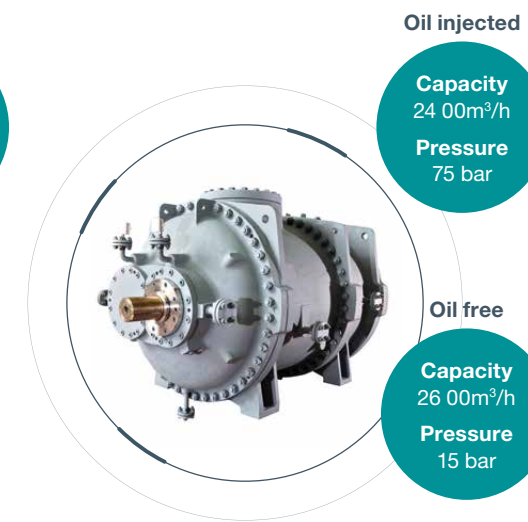
- No contamination – ensuring absolute cleanliness of hydrogen
- Water cooled cylinder and diaphragm heads ensuring longest MTBM and highest reliability

### Benefits

- HIDS system provides absolute safety with real-time monitoring of head integrity, delivering a fail-safe stop procedure and containment of process gas in the event of a diaphragm breach before process gas is contaminated.
- Howden's Uptime digital solutions provide predictive maintenance insights, reducing scheduled and unscheduled downtime
- Compact skid mounted designed to project & site specifications for easy site integration

### Typical plants / application

- Hydrogen – Tube trailer filling, FCEV fuelling, storage



## Screw Compressor

Howden manufactured the world's first operational screw compressor and further developed the technology in the 1960s with the introduction of the oil injected twin-screw compressor. This has revolutionised designs of refrigeration and gas handling plants worldwide. In thousands of global installations, our oil injected screw compressors provide high integrity, low maintenance solutions for liquid chilling, direct refrigeration and gas compression applications.

### Key features

- Double wall construction and utilise white metal, sleeve type journal bearings with pressurised shaft seal
- A full range of Vi options from 2.1 to 5.8 is offered for each compressor
- Slide valve capacity control is a standard feature on all compressors

### Benefits

- Plain-shell type journal bearings for long operational life span
- Double wall construction suitable for high pressure application
- Optional Material of Construction assuring flexibility to match project specification (e.g. API 619)
- Oil injected seal/bearing construction with high quality gas seal from simple construction

### Typical plants / application

- Mixed refrigerant pre cooling section of Hydrogen Liquefaction Plants

Howden technology can be found at the core of many critical processes. We are supporting our customers to harness and optimise the potential of hydrogen to decarbonise and meet their operational goals.

# Tailored solutions

Howden’s compression solutions meet the highest quality and safety standards. With our extensive knowledge of the hydrogen industry and working with our partners, many of whom are leading global companies such as Chart, we are able to develop tailored solutions that generate benefit for our customers’ projects anywhere across the hydrogen value chain.

Howden has access to an extensive network of selected partners who complement our main offerings, have decades of experience and innovative strength. Together with our partners, we bring industry knowledge and experience that enables us to create tailored end-to-end solutions.

These tailored solutions offer state-of-the-art technologies and cost-effective, versatile and scalable solutions that match any hydrogen applications.

### Lifetime performance management

At Howden, product reliability, safety and continuous performance is what we are known for. We pride ourselves in engineering the best products, giving customers peace of mind so that they can focus on core business.

The best way to improve continuous, efficient equipment performance, with minimum downtime over its lifetime, is through a Howden service agreement.

A Howden service agreement enables our experts to be on hand when required, ensuring a quick response with minimal disruption to plant operations. We work in partnership, maintaining equipment performance to keep costs low and downtime minimised.

### Global network, local expertise

Howden’s global network of service centres ensure customers receive the quickest response times, whenever and wherever required.

### Maintenance support services

Howden supports with planning maintenance events, spare part stock management, supervision of maintenance events and local or remote support during unscheduled maintenance, if needed. With our proprietary monitoring platform - Howden Uptime - customers can monitor the performance and health of installed equipment, ordering spare parts as needed and making informed decisions on maintenance intervals. This ensures continuous production with the lowest maintenance costs possible.

### Onsite and remote technical support

With Howden local support service, we respond quickly to support on-site maintenance, trouble-shooting, repairs and training. When time is really tight and something unexpected happens, we can offer remote engineering and troubleshooting via secure digital technology.

The combination of Howden Uptime, remote technical support and our full lifecycle approach optimises performance, availability and cost over the life of the equipment.



# Howden Uptime

## Increasing the reliability and availability of process critical assets.

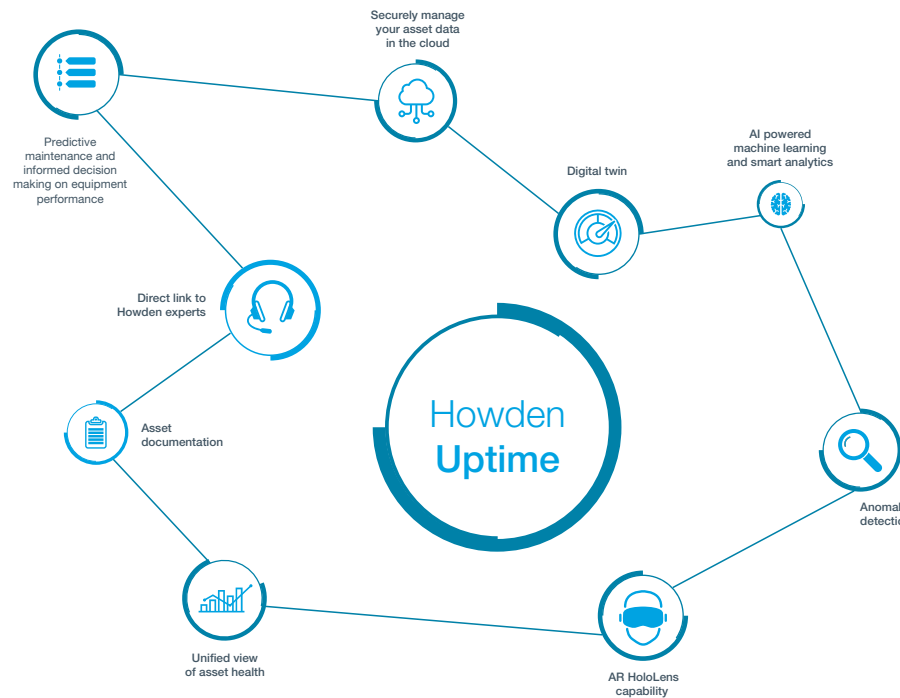
Howden Uptime is a unique digital solution that gathers data from rotating equipment, analyses how it operates and responds using Digital Twin methodology. It is easy to install and can integrate with existing condition monitoring systems on-site. Howden Uptime is designed to deliver valuable insight into asset performance that increases the availability of equipment whilst significantly reducing costs.

Howden Uptime provides a real-time view of equipment’s critical data, through intuitive and customisable dashboards. Our data driven solution enhances our aftermarket services by bringing our customers closer to our experts and providing instant access to equipment service history and documentation.

### Performance upgrades and retrofit

Our performance upgrade offerings keeps pace with changing needs, such as changing capacity demand, reducing emissions and improving energy consumption.

Our wide range of upgrade and retrofit solutions ensure the rotating equipment includes the latest technology and can respond to changing needs.





## Howden

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Old Govan Road  
Renfrew  
PA4 8XJ  
UK

[www.howden.cloud/brh2](http://www.howden.cloud/brh2)

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