



**BORSIG**

**Today, we all think  
and create together.**

In this way, we  
change tomorrow.

**Think.  
Create.  
Change.**

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# Energy. Environment. Future.

Challenges that are now more closely linked with one another than ever before. Together they are doing nothing less than writing the future of humanity.





For generations, people were unaware of any notable sources of energy other than coal, gas and oil. However, resource scarcity, geopolitical issues and climate change, which can no longer be ignored, have led to a process of rethinking on a global scale – an eventful time with a great many opportunities and challenges. New energy solutions have been placed within our reach almost overnight – if the will is there to change and make a difference.

And of course, companies are also part of this transformation, this process of rethinking. These days, success is no longer just about striving for economic gain. Other aspects have become increasingly important. A new understanding of sustainability – the balance between economic, ecological and social goals – is increasingly determining corporate mindsets and activities.

Every company now needs to find its way anew, or consistently continue along its chosen path. Just like BORSIG. For many years, we have been focusing on processes and products that make our customers fit for the future right now. With our slogan **“Think. Create. Change.”** we are making a strong mission statement.

It shows that we are deploying all our knowledge, all our engineering skills, to implement the necessary changes with our range of innovative products. As a company with a long tradition, we not only have the right people for the job, but also a global responsibility – that the entire staff at Borsig are wholeheartedly committed to, as “change”, my dear partners and colleagues, is something that not even we can bring about overnight. But we shall succeed, if we all work together.

**For more sustainable energy.  
For the protection of our  
environment.  
For a better future.**

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**Think.  
Create.  
Change.**



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# Yesterday. Today. Tomorrow.

Our path into the future is every bit as exciting, inspiring and successful as the history of BORSIG.

As with us humans, too, it is the past that has shaped our company, that gave us our initial face and helped shape our character. But, and we must never forget this as a company, we continue to write our own history anew each day and have been doing so for 185 years. We started out as a steam engine and locomotive manufacturing company of world renown, but our product range has always continued to evolve. Today, we are primarily at home in the chemical and petrochemical industries, energy production and environmental protection.

We are proud of our past, but our gaze is rigorously directed towards the future. Even though our range of products is globally leading, we are not satisfied with that. This is certainly in part due to the high standards that all our engineers set for themselves and their company: never standing still and always striving to perform even better than before.

> More to explore



As a provider of highly complex solutions, we are focusing increasingly on the three major challenges of our time: **environmental protection**, the responsible use of our **resources** and the climate-friendly production and use of **energy**.

An exciting future awaits us, our employees and of course you, too. Because when we develop new solutions for waste oil purification, emission protection or sustainable, profitable energy generation, for example, we all benefit in the end.

New topics, new ideas, new solutions – we have both the know-how and the right people. But here, too, we focus on the future. People who work successfully on an international level, who want to make a difference, are very welcome here – people who fit in perfectly with our corporate philosophy **“Think. Create. Change.”** and who want to change the world for the better step by step.

Let us take you on a journey into the new, old world of BORSIG. We will show you innovative projects, ideas and solutions that give you a small glimpse of our common future – better, more efficient and sustainable.

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# A partner for every phase of your project.

When selecting or developing an industrial production process, we support our customers throughout each phase of the project with know-how, technology and comprehensive solutions, thus consistently optimising environmental protection, resource conservation and energy deployment alongside the development process. As our customers, you secure your investments in a sustainable manner and thus achieve your business aims in the long term.

### **Process idea.**

Our innovative products and comprehensive range of services make BORSIG the ideal choice for companies worldwide looking for a reliable partner capable of mastering technologically sophisticated challenges. Our customers trust our tailor-made process solutions and we find the right concepts even for the most unusual of problems and we confirm this trust on a daily basis. This is borne out not only by our good reputation, but also by the large number of successful reference projects we have completed around the globe.

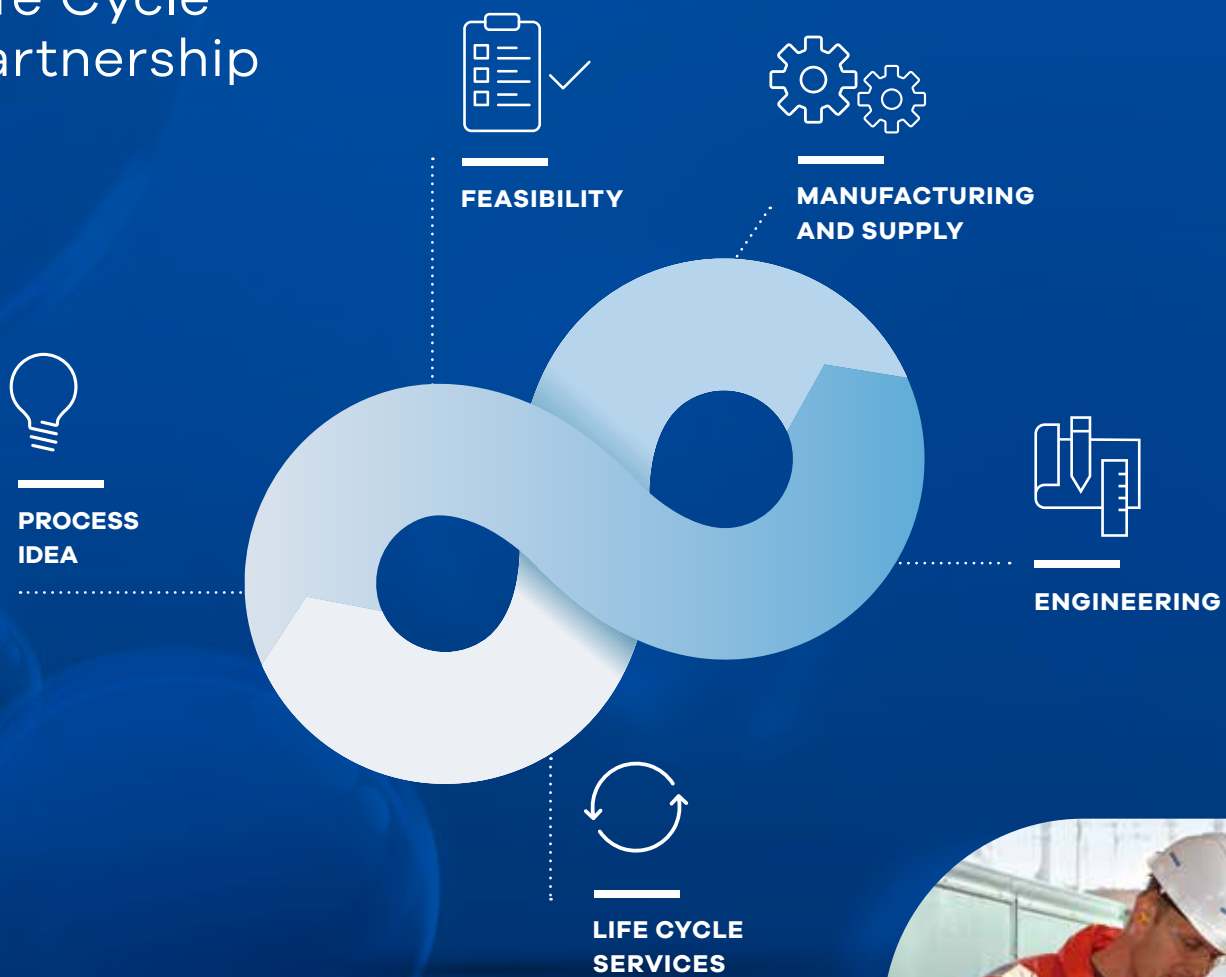
### **Feasibility.**

A good product is defined not only by its quality, it can also be used without restriction and meets both current and future requirements. For this reason, we analyse the solution together with you in advance for technological feasibility and cost-effectiveness. We run through a range of alternative approaches before deciding on the optimal solution for your requirements. A combination of laboratory tests, pilot trials and process simulations helps us jointly assess not only the feasibility, but also the technological and commercial constraints.

### **Engineering.**

When implementing projects, BORSIG leverages its comprehensive engineering knowledge and expertise in all technical disciplines. We always deploy state-of-the-art software and simulation tools and comply, of course, with international standards, customer requirements, norms and guidelines in close coordination with our customers.

# Life Cycle Partnership



## Manufacturing and supply.

Our engineers and technicians are not only highly motivated, but also highly qualified. Each of our production sites therefore has its own outstanding qualities, but what they all have in common are state-of-the-art manufacturing techniques, innovative production processes and an independent quality control system. Our foremost priority is, of course, to ensure the highest standards in the manufacture of our products – from preparing the comprehensive and detailed planning documents to the final delivery, installation and commissioning on site.

## Life cycle services.

BORSIG has earned itself a name as a reliable partner for the most challenging projects. But BORSIG is much more than that, as we support our customers with life cycle management services that stretch throughout the entire product cycle, from commissioning and training to inspections and maintenance as well as spare parts deliveries. Many of our customers particularly appreciate our offer of framework agreements, remote service and our 24/7 availability. It goes without saying that these services are individually and optimally tailored to the needs of the product or plant, which means our customers always have a strong partner at their side to answer all their queries.



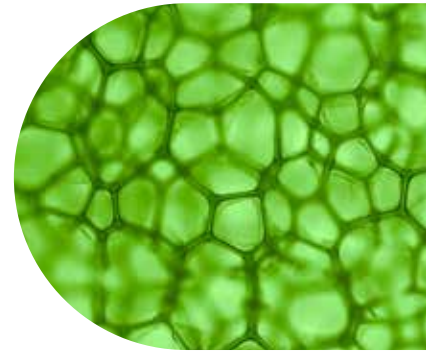
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# Resources. Energy. Environment.

Of all our resources, the future is the most precious. In order not to endanger it, we do everything we can to develop advanced production processes that are ecologically and economically sustainable for our planet.



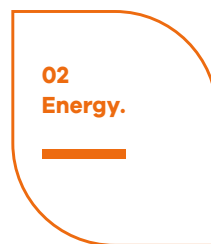




The use of resources and energy and their impact on the environment are closely linked in industrial processes. In our view, therefore, these are also the three biggest issues of the future, to which we want to devote all our know-how and energy. The BORSIG range of products and services covers a broad diversity of state-of-the-art processes and applications that already enable us to optimise processes and meet strict sustainability requirements in close collaboration with our customers.



The way we manage our resources influences all of our lives. They are at the beginning of the value chain and their consumption has an impact on both people and the environment. Their limited nature is soon reflected in rising prices and that's why BORSIG is working on innovative recycling and filtration processes in order to conserve valuable resources and reprocess them to be part of new cycles.



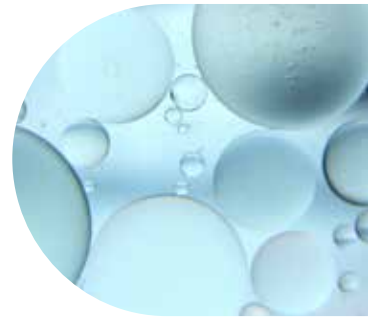
Energy is the lifeblood of our economy and that has rarely been as evident as it is today. And rarely has it been more important to use them as efficiently as possible, from both an economic point of view and with regard to our climate. BORSIG is always looking for ways to operate processes with the lowest possible energy input and to recycle the released energy as efficiently as possible, thus saving energy and preventing secondary emissions.



Our planet is a place worth preserving and protecting for the future – a complex, fascinating ecosystem that should also be a home for future generations. BORSIG is therefore constantly developing and improving processes that reduce the impact on the environment and protect natural habitats. This includes controlling harmful emissions and minimising waste streams.

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# Our engineers are doing everything they can today to make sure we have sufficient for the needs of tomorrow.



Resources are the link between climate change, biodiversity, the environment and economic growth, but only if we also place our focus on resources will we be able to solve many of the challenges we currently face together.


But what does the future of natural resources look like? The fact is, fossil fuels such as coal, oil and natural gas are still crucial for countless processes in the economy and supply around 80% of the world's energy, but they are also the main source of the greenhouse gas emissions we generate. Even though mining and processing are becoming more and more efficient on the back of technological developments – the deposits are limited and will eventually be exhausted.

The future therefore lies in the development of new technologies in the use of resources. Conservation and recycling are commonly acknowledged as measures, but the reuse of substances already released – such as VOCs or CO<sub>2</sub> – is equally crucial and offers a great deal of potential.

The challenges are huge, but there is a willingness to change. They exist, the initiatives and efforts of governments as well as companies that want to do their part and we at BORSIG definitely count ourselves among them.

Our engineers can and will contribute to this change with their knowledge and their drive for research to develop further solutions that ensure a better future for us all. We at BORSIG will therefore continue to follow the path we have already consistently trodden in recent years: to use existing resources as efficiently as possible and thus conserve them, to recover them and to preserve them more and more through the deployment of new technologies.



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- The image shows an industrial facility with several large, white, cylindrical OSN (Organic Solvent Nanofiltration) membranes. These membranes are mounted on a metal structure and are connected to a complex network of white pipes and valves. The facility is well-lit, with a bright light source visible in the upper right corner. The overall scene is clean and organized, highlighting the advanced technology used in the process.
- New OSN technology for recovery of organic solvents
  - OSN membranes compatible with organic solvents
  - New OSN processes to save energy and resources
  - Product concentration and purification
  - Fuel and Oil upgrading



› Get more information  
on the BORSIG OSN  
Membran



# Organic Solvent Nanofiltration.

## Small membranes with great potential

BORSIG's innovative technologies in the field of solvent-resistant polymer membranes offer an energy-, raw material- and cost-efficient alternative to thermal separation processes.

Nanofiltration is an established water treatment process. However, behind Organic Solvent Nanofiltration (OSN) is a completely new, innovative technology with a great deal of potential. The availability of solvent-resistant polymer membranes now makes it possible to separate liquids that could previously only be separated using conventional and thermal processes such as distillation or that could not at all be processed economically. The advantages of OSN: non-thermal separation with reduced raw material and energy input and simplified yet reliable processes. With its in-house developed polymer membranes, BORSIG is among the leading suppliers of this technology.

### **The solution: pressure-driven separation processes.**

OSN has opened up a whole host of new possibilities. One example is the use of OSN membranes in the waste oil recycling process. Waste oils contain numerous components, including the valuable and reusable base oil (60–70%), which offer a high potential in terms of value creation. As the process using OSN membranes is pressure-driven and not thermal, energy consumption and thus the generation of CO<sub>2</sub> can be reduced and the waste oil recycled in a cost-efficient manner.

However, the possible applications of OSN extend far beyond this and make OSN attractive for the entire (petro-) chemical industry, the pharmaceutical and life sciences industries and the food sector, among others.

### **The process: life cycle partner for long-lasting membranes.**

An OSN polymer membrane does not function like a conventional membrane filter with defined pore sizes, as it is closed. Instead of screening, solution diffusion takes place through the layers of the membrane. In this pressure-driven process, the special properties of the membrane allow certain molecules to pass through the membrane faster than others. This enables the BORSIG polymer membranes to separate dissolved molecules within the range of 200 to 1000 g/mol.

In close collaboration with its customers, BORSIG develops tailor-made solutions for every application. It is always important for us to understand our customers' processes as accurately as possible in order to present them with the best possible and most efficient solution. The feasibility is then tested in the laboratory and verified in a pilot test for large-scale use. Our engineering teams then develop the plant in accordance with customer and international standards. BORSIG also takes care of commissioning (a matter of hours with OSN, by the way) and maintenance (also significantly reduced, due to the durability of the membranes, which can last for years).

BORSIG therefore not only helps to recover valuable resources and save energy, but also relieves the burden on its customers.



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**Our energy solutions are getting better every day.**  
Enabling future generations to use them, too.



Our energy transfer and energy recovery products not only help maintain a healthy level of corporate profitability, they are our contribution towards making the key ecological and social goals of the energy transition a success.



It's about nothing less than transforming the largest economic sector in the world – the energy industry – into one that is sustainable, secure and affordable for everyone. Even now, the global energy landscape is rapidly changing and both the energy and climate policy goals demand a fundamental transformation of the current energy system. The actions of governments and major corporations are therefore crucial and have a serious impact on every sector. The economic investment decisions alone will amount to hundreds of billions of euros.

However, the various energy scenarios can only describe a possible development and are not forecasts. Oil is therefore likely to retain its role as the economically most important source of energy in the coming decades, but which alternative will “win the race” going forward is simply not foreseeable. In a greenhouse gas-neutral energy system, for example, electricity generated from renewable sources will be the most important form of energy.

The electricity can be used directly (e.g. for electric mobility or heat pumps) or converted into electricity-based sources of energy (such as synthetic energy sources like power-to-gas or power-to-liquid).

Whatever answers we find to the question of energy, huge efforts are required. As an international company, we are keenly aware of our role in finding these answers – and have been for many years. Our engineers, workers and managers are working together to play our part in making the economy more sustainable.

We, too, need to keep learning and making progress step by step – we will not depart from the path we have already been following for a long time and continue helping to make the world a little better within our means.

# MegaLyseurPlus research project.

## Getting the energy transition into the tanks.



The transition to a green hydrogen industry is currently being driven forward at full speed, but before hydrogen can be used on the desired scale, a number of technical challenges still need to be resolved. These issues are the key focus of the MegaLyseurPlus joint research project, in which BORSIG is involved. The aim of the project is to optimise the individual components of an electrolysis plant in order to make them fit for economic use in large-scale plants generating several megawatts of power. One of the focal points of MegaLyseurPlus is to develop an oil-free compressor for hydrogen. It serves as an interface to end applications, such as the refuelling of fleet vehicles, and to protect the new, eco-friendly propulsion systems, such as fuel cells.

Hydrogen is set to play a pivotal role in the energy mix of the future. With the development of a new, oil-free compressor, BORSIG is helping to create the required infrastructure.

### **The challenge: oil-free fuelling.**

In many compressors, lubricant oils are used in the gas chamber, some of which get into the gas. However, hydrogen may not be contaminated if it is to be used in sensitive fuel cells. Therefore, up to now, oil-free membrane compressors and, more rarely, hydraulic compressors have been deployed. The disadvantage of membrane compressors is that they are prone to malfunction when operated irregularly, a process that is also difficult to predict. Maintenance is very time-consuming and cost-intensive. Hydraulic compressors, on the other hand, are very small and only capable of processing small amounts of hydrogen. The task for BORSIG was to develop a new type of compressor that would meet the requirements of larger hydrogen tank and transport systems in terms of both wear and performance.







**The solution was found in an almost forgotten technology.**

Instead of using membranes or hydraulics, BORSIG opted to develop a piston compressor, which is based on technology known from the natural gas sector and that has now been implemented on an oil-free basis and thus hydrogen-compatible for the research project. In the course of development, BORSIG also increased output pressure from the originally envisaged 350 bar to 450 bar. The advantages of the oil-free piston compressor over the current alternatives are quite considerable. The new piston compressor has a slightly higher output than a membrane compressor and a maintenance requirement that is easy to plan. The standardisation of components was also part of the project, which promises further savings potential during regular operation going forward. A prototype of the compressor is still undergoing a final series of measurements until the end of 2022. After that, nothing will stand in the way of its deployment in the transformation to a green hydrogen economy.

R&D projects and tailored process design

- Customised heat transfer systems for hydrogen and syngas projects
- Compressors for process gases, CO<sub>2</sub> and hydrogen
- Compressors for electrolyser projects
- Membrane systems for hydrogen separation
- Fuel cell membranes

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# We are always looking for ways to create a better today and tomorrow.



As a company, we have a major responsibility to protect the environment. That's why we are always working on new and more effective solutions that promote ecological protection.

Again, the buzzword here is efficiency. With our product solutions, we want to help companies and industries become more sustainable, greener and cleaner – because doing nothing or too little is something no one can afford in the long run. As part of society, we want to make our contribution to this common mission.

We take our responsibility seriously so that change is not just propagated, but can become a lived reality. That's why we are constantly researching new environmental technologies and developing products that will function for decades thanks to outstanding service and regular upgrades.

When planning and introducing new processes, BORSIG is always focused on the current state of the art and deploys energy, raw materials and consumables in a responsible manner. Our environmental policy is to consistently refine

already established and proven corporate guidelines, which also aim to ensure the environmental compatibility of products, production materials and processes.

Many years ago, we recognised that a change is also a great opportunity – namely to relieve the pressure on our environment by modernising our economy and making it a little more liveable day by day. The future is challenging the smartest minds. In addition to thought leaders, it also needs people who lead the way and set an example. If we take advantage of all our opportunities, we will make a genuine difference as a company.

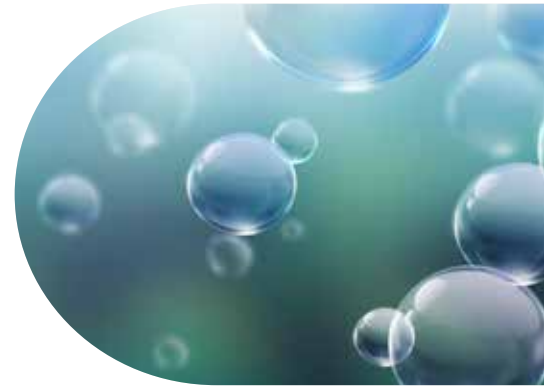


Environment

# Product Storage & Handling.

VOC Emission control:  
recovery instead of burning.

- VOC emission control systems
- Flare gas recovery solutions
- Carbon capture and compression
- Complying to worldwide standards
- Highest lifetime reliability



Oil is set to remain an important industrial raw material going forward. For decades, BORSIG's innovative Vapour Recovery Units have ensured that no product loss and no VOCs and CO<sub>2</sub> secondary emissions occur during processing, storage and handling due to emissions and that air pollution control standards are met.

Crude oil is a versatile raw material. Apart from manufacturing petrol and other fuels, it is also used to produce the basic components for plastics, for example. It is therefore all the more important that environmentally harmful gases generated during the processing, storage and distribution of crude oil are reduced to an absolute minimum.

In the meantime, international emission protection laws have been enacted. In Germany, the topic has been relevant for a long time and BORSIG has been one of the leading suppliers of emission control systems for decades, which enabled petrochemical products being stored, transshipped and loaded without any harmful emissions to the environment.

**The challenge is to prevent emissions of volatile organic compounds.**

Volatile organic compounds (VOCs) are formed whenever organic liquids are stored or filled into tanks or transport vehicles, such as vessels, barges, rail cars or trucks. Without emission control systems the VOC gas is displaced and VOCs produce ozone, which contributes to summer smog and global warming. The toxic and carcinogenic emissions, e.g. of benzene, are a significant health risk.

A common way to eliminate these harmful gases is to purchase supposedly inexpensive activated carbon filters or exhaust gas flares. However, they are expensive to operate due to the regular maintenance they require and can generate further emissions. With its Vapour Recovery Units (VRU), BORSIG is very successfully taking a different approach that not only requires less maintenance in operation, but also recovers valuable resources and complies with all national and international emission limits.

**The solution: a 99.9% recovery rate. 99% availability.**

The BORSIG VRUs combine three stages: absorption, condensation and membrane separation. Membrane technology is one of the few solutions that can efficiently and safely process all the substances contained in VOCs. BORSIG solutions not only achieve filter rates of up to 99.9%, they also recover the retained organic compounds. BORSIG is a project life cycle partner from the development of the system to its implementation and maintenance, and puts customer requirements into practice in a tailor-made manner. By implementing redundant systems, the availability of the VRUs can be increased to over 99%.

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# **BORSIG.** Products & Services.

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- **Waste heat recovery systems**
  - **Transfer line exchangers**
  - **Scraped surface exchangers**

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- **Control and shut-off valves for extreme conditions**
  - **Hydrogen, LNG, process and natural gas**

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- **OSN membrane systems**
  - **VOC & Monomer Recovery Units**
  - **Carbon capture**
  - **Flare gas recovery**
  - **Membranes & membrane modules**

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- **Industrial and power plant service**
  - **Service for waste-to-X applications**
  - **Integrated energy projects**

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- **Reciprocating & integrally geared centrifugal compressors**
  - **Compressors for CO<sub>2</sub> and hydrogen**
  - **Compressors for “green hydrogen” projects**
  - **Valves and spare parts**



# BORSIG

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Create.  
Change.**

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