Technology Guide Oil – Gas – Petrochemicals

Die Energiewende meistern

Mastering the Energy Transition

5th Edition 2023/24

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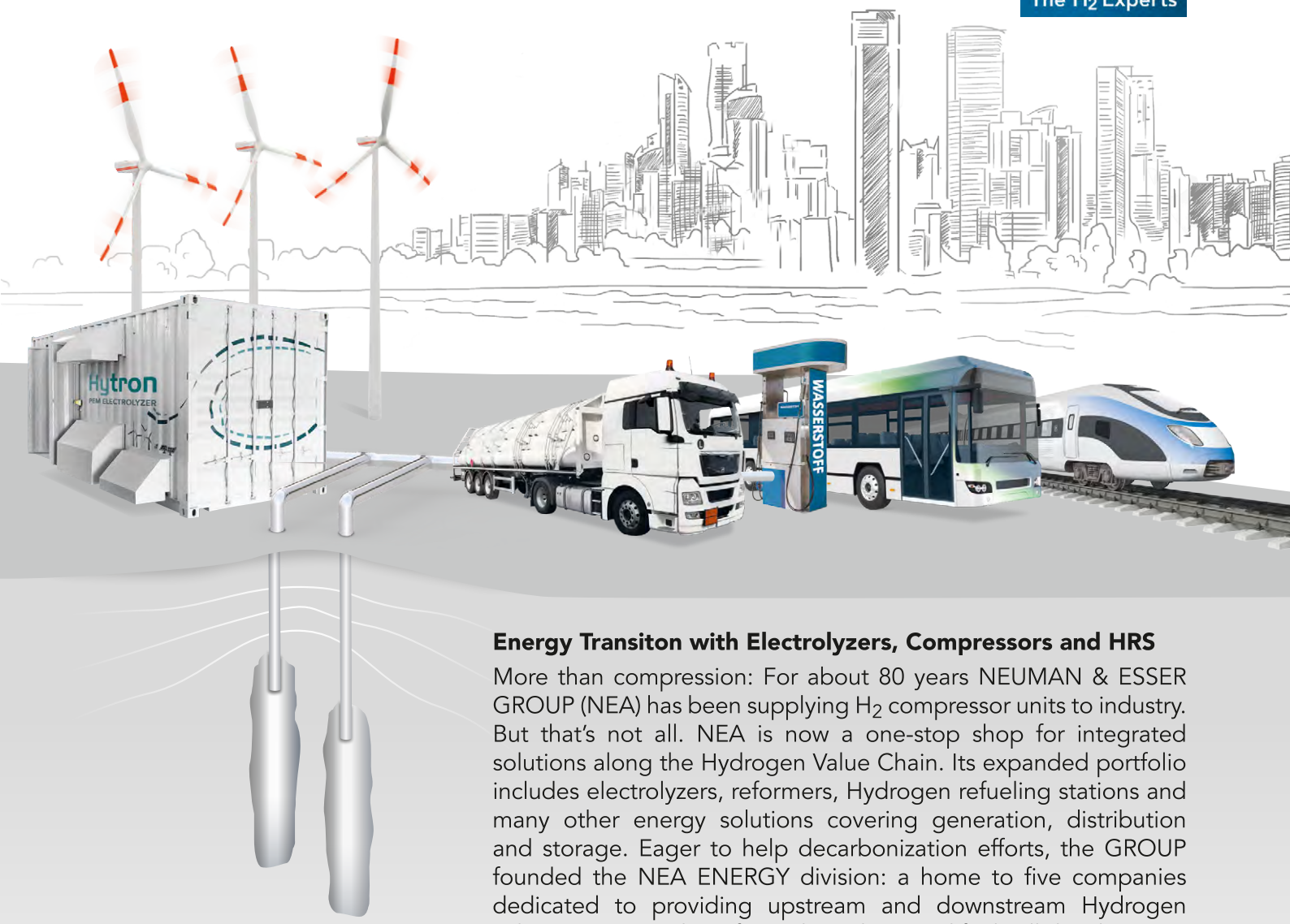

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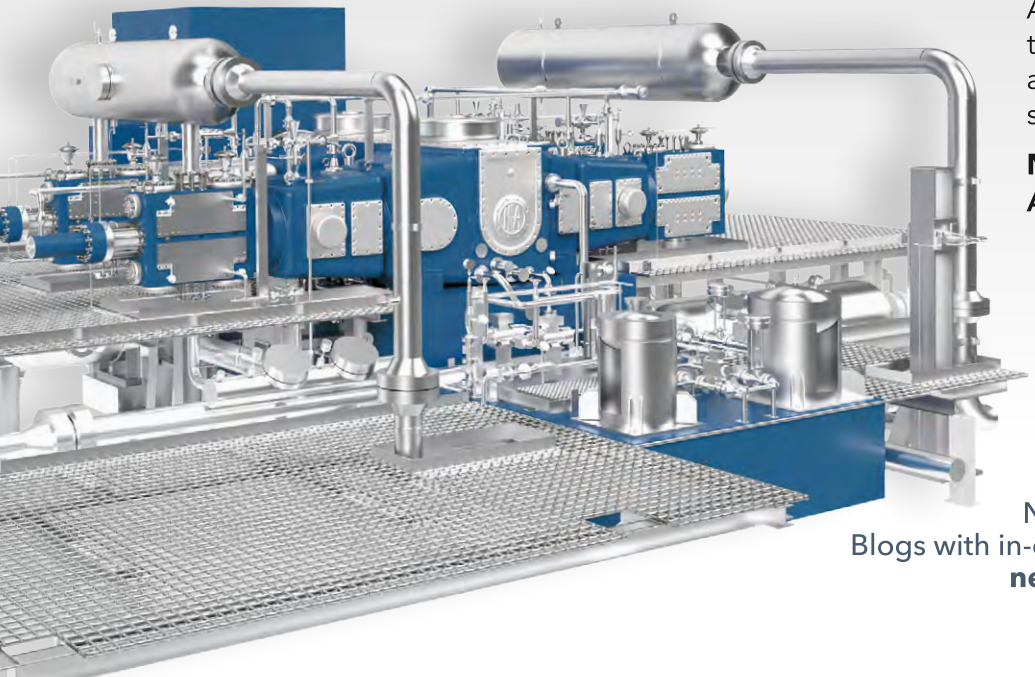

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Die Energiewende meistern
Mastering the Energy Transition

Ragnar Strauch

Sehr geehrte Leserinnen und Leser,

die aktuelle Energiekrise betrifft inzwischen nicht nur Europa. Energieunabhängigkeit und -sicherheit rücken global immer mehr in den Fokus. Aber auch das Thema Klimaneutralität bleibt unverändert wichtig. Wer künftig exportieren will, muss klimaneutral produzieren, sonst droht ihm das Delisting bei seiner Kundschaft.

Zahlreiche VDMA-Mitglieder ebnen mit ihren prozesstechnischen Anlagen und Komponenten den Weg in eine klimaneutrale Zukunft. Sie liefern bereits die Technologien, die eFuels für Lkws und Flugzeuge erzeugen, die Biogas oder Biokraftstoffe herstellen, transportieren und lagern oder grünes Ammoniak oder Methanol produzieren. Der VDMA-Technology-Guide gibt Einblicke, wie das Ziel einer klimaneutralen Zukunft mit Lösungen für die LNG- und Erdgas-Infrastruktur, mit Elektrolyse oder Wasserstofftechnik für den Transport sowie mit Wärmerückgewinnung erreicht werden kann.

Neben vielen Lösungen bleiben auch offene Fragen wie: Welche klimaneutralen Kraftstoffe werden sich in der Schifffahrt durchsetzen? Wie wird künftig grüner Wasserstoff interkontinental transportiert?

Antworten auf diese Fragen finden Sie in der fünften Ausgabe des VDMA-Technology-Guides. Neben redaktionellen Beiträgen zeigt die Publikation die VDMA-Produktmatrix, Firmenprofile sowie die Kontaktdaten von 160 Lösungsanbietern. Der Technology-Guide richtet sich an Fachleute aus Engineering, Procurement and Construction (EPC) sowie an Maschinebauer, aber auch an Laien, die erfahren wollen, wie die Energiewende gelingen kann.

Ragnar Strauch
VDMA Technik für Öl Gas Petrochemie
VDMA Technology for Oil, Gas, Petrochemicals

Dear Readers,

The current energy crisis is not only affecting Europe. Energy independence and security are increasingly coming into focus on a global level. At the same time climate neutrality remains as important as ever. If you want to export in the future, you have to produce in a climate-neutral way, otherwise you risk being de-listed by your customers.

With their process technology plants and components VDMA members enable the way to a climate-neutral future. The mechanical engineering industry already today supplies technologies that generate eFuels for trucks and airplanes, that generate, transport and store biogas or biofuels, or that produce green ammonia or methanol. This publication gives an insight how the goal of a climate-neutral future can be achieved with solutions for LNG and natural gas infrastructure such as power-to-X, with electrolysis or hydrogen technology for transport as well as with heat recovery.

In addition to many solutions, there are still open questions such as: Which climate-neutral fuels will become established in shipping? How will green hydrogen be transported intercontinentally in the future?

Answers to these questions can be found in this fifth edition of the VDMA Technology Guide "Mastering the Energy Transition". In addition to editorial articles, the publication features the VDMA product matrix, company profiles and the contact details of 160 solution providers. The VDMA Technology Guide is also aimed at experts from Engineering, Procurement and Construction (EPC) as well as machine builders, but also to the general public that wants to find out how the energy transition can succeed.

Zukunftsfähig mobil – mit umweltfreundlichen Wasserstofftankstellen

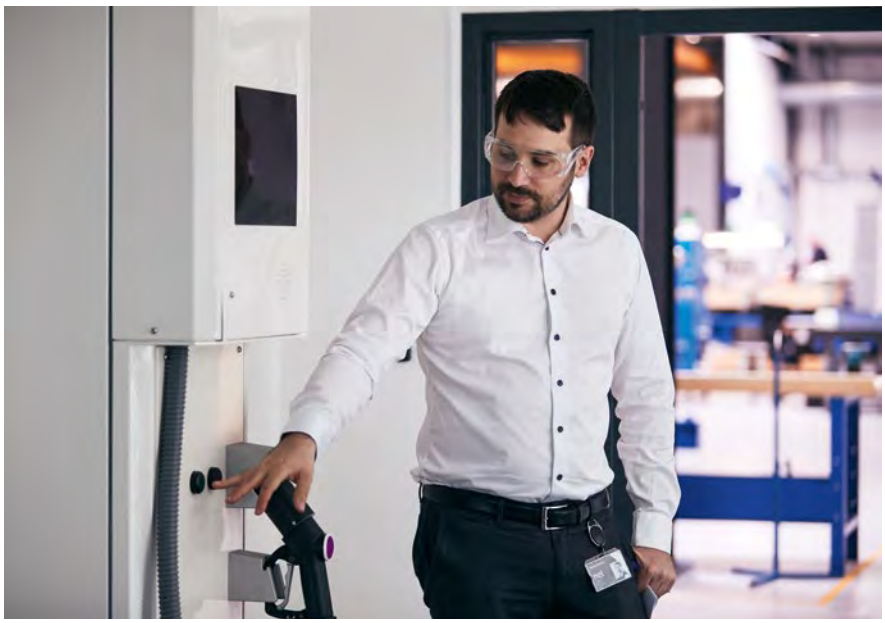
Future-proof mobility – with environmentally friendly hydrogen filling stations

Wasserstoff gilt als Energieträger der Zukunft. Neue Konzepte zur Wasserstoffproduktion können die umweltfreundliche Mobilität voranbringen. Dazu zählen etwa Tankstellen und Zapfsäulen für Pkw, Busse und Lkw. Eine schnelle Echtzeitsteuerung und -überwachung jeder einzelnen Tankstellenkomponente trägt wesentlich dazu bei, die Zuverlässigkeit zu erhöhen und gleichzeitig den Wartungsaufwand zu verringern.

Die Energieumwandlung von Wasserstoff als Kraftstoffquelle ist zwei- bis dreimal effizienter als bei herkömmlichen Motoren: Mit weniger Kraftstoff legen wasserstoffbetriebene Fahrzeuge eine weitere Strecke zurück als konventionell angetriebene. Dabei emittieren sie kein CO_2 oder andere schädliche Gase wie Kohlenmonoxid oder Stickoxide. Als Abfallprodukt entsteht lediglich Wasser. Das Betanken eines Wasserstoffautos dauert nur drei Minuten und eine Tankfüllung reicht für 600 und in naher Zukunft für 1.000 Kilometer.

Hydrogen is regarded as the energy carrier of the future. New concepts for hydrogen production – including filling stations and dispensers for cars, buses, and trucks – can bring about advancements in environmentally friendly mobility. Fast, real-time control and monitoring of each individual filling station component plays a major role in increasing reliability while reducing maintenance.

Energy conversion using hydrogen as a fuel is two to three times more efficient compared to conventional motors. This means that hydrogen-powered vehicles cover longer distances with less fuel compared to conventional drive systems. In the process, they emit no CO_2 or other harmful gases such as carbon monoxide or nitrogen oxides. The only waste product is water. Refueling a hydrogen car takes just three minutes, and one tank of fuel is enough for 600 kilometers – a figure that is set to rise to 1000 kilometers in the near future.



Quelle/*Source*:
Beckhoff

Michael Stefan zeigt die Wasserstofftankstelle, die in drei Minuten ein Auto betankt.

Michael Stefan at the hydrogen filling station, which refuels a car in three minutes.

Die Automobilindustrie denkt um

„Wir erkennen einen Strategiewechsel bei den Automobilherstellern der Welt. Ein erheblicher Teil unserer Tankstellen wird nach Korea verkauft. Asiatische Automobilhersteller verfolgen bei den emissionsfreien Fahrzeugen eine aggressive Strategie“, sagt Michael Stefan, Senior Director of Product Management bei Nel Hydrogen, einem dänischen Unternehmen, das sich auf Wasserstofftechnologien spezialisiert hat. „Die USA wiederum haben den weltgrößten Automarkt, hier besteht eine hohe Nachfrage nach emissionsfreien Autos. Marktprognosen zufolge werden bis 2030 weltweit 20.000 bis 30.000 Wasserstoffzapfsäulen benötigt“, blickt Michael Stefan in die Zukunft.

Rethinking the automotive industry

“We are seeing a change in strategy among the world’s automakers. A significant proportion of our filling stations are sold to Korea. Asian automakers are pursuing an aggressive strategy when it comes to zero-emission vehicles,” says Michael Stefan, senior director of product management at Nel Hydrogen, a Danish company specializing in hydrogen technologies. “The U.S., meanwhile, has the world’s largest car market and is showing high demand for zero-emission cars. According to market forecasts, 20,000 to 30,000 hydrogen dispensers will be needed worldwide by 2030,” says Michael Stefan, looking to the future.

Der kompakte Industrie-PC sorgt für schnelle Signalverarbeitung.
The compact industrial PC ensures fast signal processing.

Quellen/*Sources*: Beckhoff

Wasserstoff ermöglicht CO_2-neutrales Fahren.
Hydrogen enables CO_2-neutral driving.

Echtzeitüberwachung des Tankvorgangs

Die Herausforderung besteht Michael Stefan zufolge darin, in einem relativ unausgereiften Markt zu agieren und Technologien und Lösungen bereitzustellen, die Endkunden beim Tanken von Wasserstoff das gleiche Tankerlebnis wie beim Tanken von Benzin bieten können. Das Tanken müsse einfach und bei in der Regel nur einer Wasserstoffzapfsäule pro Tankstelle rund um die Uhr möglich sein. „Wir wollen Wasserstoff als erfolgreiche Alternative zu Benzin und Diesel etablieren. Nicht nur aus Umweltsicht, sondern auch ganz praktisch. Dafür nutzen wir Steuerungslösungen, die den gesamten Tankvorgang überwachen“, erklärt Michael Stefan. Diese Lösungen erfassen Komponentendaten wie Druck, Temperatur, Durchfluss, Gasdetektion und den Zustand des Fahrzeugtanks und übertragen alle Daten in die Cloud. In Echtzeit werden alle Prozesse und Parameter genau überwacht. Dies ermöglicht eine vorausschauende Wartung und gegebenenfalls schnelles Eingreifen.

„Wir brauchen leistungsstarke Programmable Logic Controller, bekannt als PLC und eine schnelle Signalverarbeitung, um unsere Anlagen genauso ausgereift zu machen, wie Benzintankstellen. Im Jahr 2003 wurde die erste Wasserstofftankstelle entwickelt. Seitdem sind die Tankstellen komplexer geworden. Echtzeitdaten sind

Real-time monitoring of the refueling process

The challenge, according to Michael Stefan, is to operate in a relatively immature market and provide technologies and solutions that can give end customers the same refueling experience when refueling with hydrogen as when refueling with gasoline. Refueling must be simple and possible around the clock with usually only one hydrogen dispenser per filling station. “We want to establish hydrogen as a successful alternative to gasoline and diesel, not only from an environmental point of view but also in a very practical way. To do this, we use control solutions that monitor the entire refueling process,” explains Michael Stefan. These solutions collect component data such as pressure, temperature, flow, gas detection, and vehicle tank condition and transfer all data to the cloud. All processes and parameters are closely monitored in real time, enabling predictive maintenance and rapid intervention if necessary.

“We need high-performance programmable logic controllers (PLCs) and fast signal processing to make our systems as sophisticated as gasoline filling stations. The first hydrogen filling station was developed in 2003, and filling stations have become more sophisticated since then. Real-time data is extremely important today,” says Jacob Svendsen, head of technology and development at Nel Hydrogen. “Collecting the data and transfer-

heute extrem wichtig“, sagt Jacob Svendsen, Leiter Technologie und Entwicklung bei Nel Hydrogen, und ergänzt: „Die Erfassung der Daten und ihre Übertragung in die Cloud – bis das globale Überwachungssystem reagieren kann – ist eine Sache von Millisekunden. Das ist die Stärke der eingesetzten Steuerungskomponenten.“ In Bezug auf die Geschwindigkeit gibt es ihm zufolge kaum Einschränkungen und dank offener Standards werden alle Anschlussmöglichkeiten unterstützt. „Offene Standards, Echtzeitgeschwindigkeit und Flexibilität sind für uns entscheidend.“

Ressourceneinsatz reduziert

Das dänische Unternehmen verfügt über eine eigene Softwareentwicklung. Die Entwickler sind der Überzeugung, dass sich stärker softwareorientierte, statt hardwarebasierte Lösungen durchsetzen werden. „Indem wir die Softwarelösungen

ring it to the cloud – until the global monitoring system can respond – is a matter of milliseconds. That is how powerful the control components are.” According to Svendsen, there are hardly any restrictions in terms of speed, and thanks to open standards, all connection options are supported. “Open standards, real-time speed, and flexibility are critical for us.”

Use of resources reduced

The Danish company has its own software development team. The developers believe that more software-oriented solutions will prevail, as opposed to hardware-based ones. “By developing and implementing the software solutions ourselves, we gain valuable insights and experience. Our German partner supports us in this. Programming is a breeze thanks to the implementation of its automation software and the

Quelle/*Source*:
Beckhoff

Wasserstofftankstellen – komfortabel wie Benzin- oder Dieselzapfsäulen.

Hydrogen filling stations – as convenient as gasoline or diesel pumps.

selbst entwickeln und realisieren, gewinnen wir wertvolle Erkenntnisse und Erfahrungen. Unser deutscher Partner unterstützt uns dabei. Dank der Implementierung seiner Automatisierungssoftware und der Möglichkeit zu objektorientierter Programmierung ist das Programmieren ein Kinderspiel", freut sich Jacob Svendsen. „Wir können Codes von verschiedenen PLC und Codes in verschiedenen Prozessor-Skalierungen wiederverwenden und sparen dadurch Zeit und Ressourcen." Das Unternehmen profitiere von schnellen Abtastraten, um Regelungen, Diagnosen, Reporting und sichere Shutdowns bei Leckagen besser zu steuern. Gleichzeitig werde der Energieverbrauch jeder einzelnen Komponente reduziert und die Funktionalität jeder Komponente optimiert. Das komme den Endverbrauchern und der Umwelt gleichermaßen zugute.

„Heute kann eine Zapfsäule 40 bis 80 Autos am Tag versorgen. Doch schon in naher Zukunft sollten unsere Tankstellen in der Lage sein, mindestens die zehnfache Anzahl pro Tag zu bewältigen", prognostiziert Michael Stefan.

Autor:
Søren Mørk
Sales Engineer
Beckhoff Automation GmbH & Co. KG
Hobro, Dänemark

possibility of object-oriented programming," says Jacob Svendsen happily. "We can reuse codes from different PLCs and in different processor scalings, saving time and resources." The company benefits from fast sampling rates to better manage controls, diagnostics, reporting, and safe shutdowns in case of leakage. At the same time, the energy consumption of each individual component is reduced and the functionality of each component is optimized. This benefits end users and the environment alike.

"Today, one dispenser can supply 40 to 80 cars a day. But in the near future, our filling stations should be able to handle at least ten times that number per day," predicts Michael Stefan.

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Klimaschutz braucht alternative Schiffstreibstoffe
Climate protection needs alternative marine fuels

Die internationale Schifffahrt erbringt den überwiegenden Anteil der weltweiten Transportleistung – 90 Prozent des Welthandels erfolgen auf dem Seeweg. Schiffe sind mit Abstand der effizienteste Verkehrsträger, bei einem Gesamtverbrauch von jährlich rund 350 Millionen Tonnen konventioneller Kraftstoffe. Jedoch sind diese auch für knapp drei Prozent der globalen Treibhausgasemissionen verantwortlich. Der immense Bedarf prädestiniert die Schifffahrt, als Vorreiter das Marktpotenzial synthetischer, klimaneutraler Kraftstoffe zu heben und ihren breiten Einsatz auch in anderen Wirtschaftsbereichen zu ermöglichen. Das macht die Branche zu einem entscheidenden Enabler für den Markthochlauf von Wasserstoff als Basis aller

International shipping accounts for the lion's share of the global transport volume - 90 per cent of world trade is carried by sea. Ships are by far the most efficient mode of transport, but with a total annual consumption of around 350 million tons of conventional fuels, they are also responsible for almost three per cent of global greenhouse gas emissions. The immense demand predestines the shipping industry to be a pioneer in leveraging the market potential of synthetic, climate-neutral fuels and enabling their widespread use in other sectors of the economy as well. This makes the industry a decisive enabler for the market ramp-up of hydrogen as the basis of all synthetic fuels (eFuels) produced by using electric power from water and CO_2 (power-to-X, or PtX or P2X for short).

Klimaneutralität ist im innereuropäischen Schiffsverkehr bis 2045 möglich.
Intra-European shipping can become climate-neutral by 2045.

Quelle/*Source*: Shutterstock

synthetischen Kraftstoffe (eFuels), die durch den Einsatz von elektrischem Strom aus Wasser und CO_2 (Power-to-X, kurz PtX oder P2X) hergestellt werden.

Klimaneutrale Schifffahrt gemeinsam vorantreiben

Um die klimaneutrale Schifffahrt voranzubringen, arbeiten der VDMA und der Verband für Schiffbau und Meerestechnik e. V. (VSM) gemeinsam daran, die Produktion und Nutzung von PtX-Kraftstoffen in den nächsten Jahren auf- und auszubauen. Um die ambitionierten Klimaschutzziele für die Schifffahrt umsetzten zu können, müssen erhebliche Investitionen in Produktion und Infrastruktur für regenerative Kraftstoffe sowie in eine geeignete Flottentonnage fließen. VDMA und VSM möchten dazu beitragen, die sektorspezifische Ausgestaltung des Emissionshandels und Regeln für maritime Kraftstoffe so zu optimieren, dass sich die nötige Lenkungswirkung entfaltet. Die Verbände sind überzeugt, dass die maritimen Klimaziele in Europa schneller erreicht werden können als vorgesehen.

Roadmap für die maritime Energiewende

Aus technologischer Sicht kann der innereuropäische Schiffsverkehr bis 2045 klimaneutral werden, wenn die Europäische Union dafür die regulatorischen Rahmenbedingungen setzt. Dies ist ein ambitionierter Zeitplan, der es der EU jedoch ermöglichen könnte, auf internationaler Ebene eine Vorbildfunktion einzunehmen. Mit der von beiden Verbänden im Juli 2022 vorgelegten PtX-Roadmap macht die maritime Industrie Vorschläge zu den dafür notwendigen Voraussetzungen.

Diese Strategie sieht unter anderem vor, dass die für die Schifffahrt zur Verfügung stehenden Kraftstoffoptionen und Herstellungsverfahren noch in dieser Dekade industriell skaliert werden müssen. Von zentraler Bedeutung dabei ist, dass damit ein erhöhter Bedarf an erneuerbaren Energien einhergeht. Ihr Ausbau sollte nicht wie bislang vorgesehen auf Projektebene, sondern systemisch auf Ebene der Mitgliedsstaaten erfolgen. Damit die eFuels die erforderliche Energiedichte erreichen, ist für ihre Herstellung in der Regel Kohlenstoff nötig. Dieser sollte aus der Luft, aus Biomasse oder anfangs auch aus unvermeidbaren Industrieemissionen stammen.

Jointly driving forward climate-neutral shipping

To bring climate-neutral shipping forward, the VDMA and VSM (Verband für Schiffbau und Meerestechnik) are working together to establish and expand the production and use of PtX fuels in the coming years. To be able to implement the ambitious climate protection targets for shipping, considerable investments must be made in production and infrastructure for regenerative fuels as well as in suitable fleet tonnage. VDMA and VSM would like to contribute to optimizing the sector-specific design of emissions trading and rules for maritime fuels so that the necessary steering effect unfolds. The associations are convinced that the maritime climate targets in Europe can be achieved faster than planned.

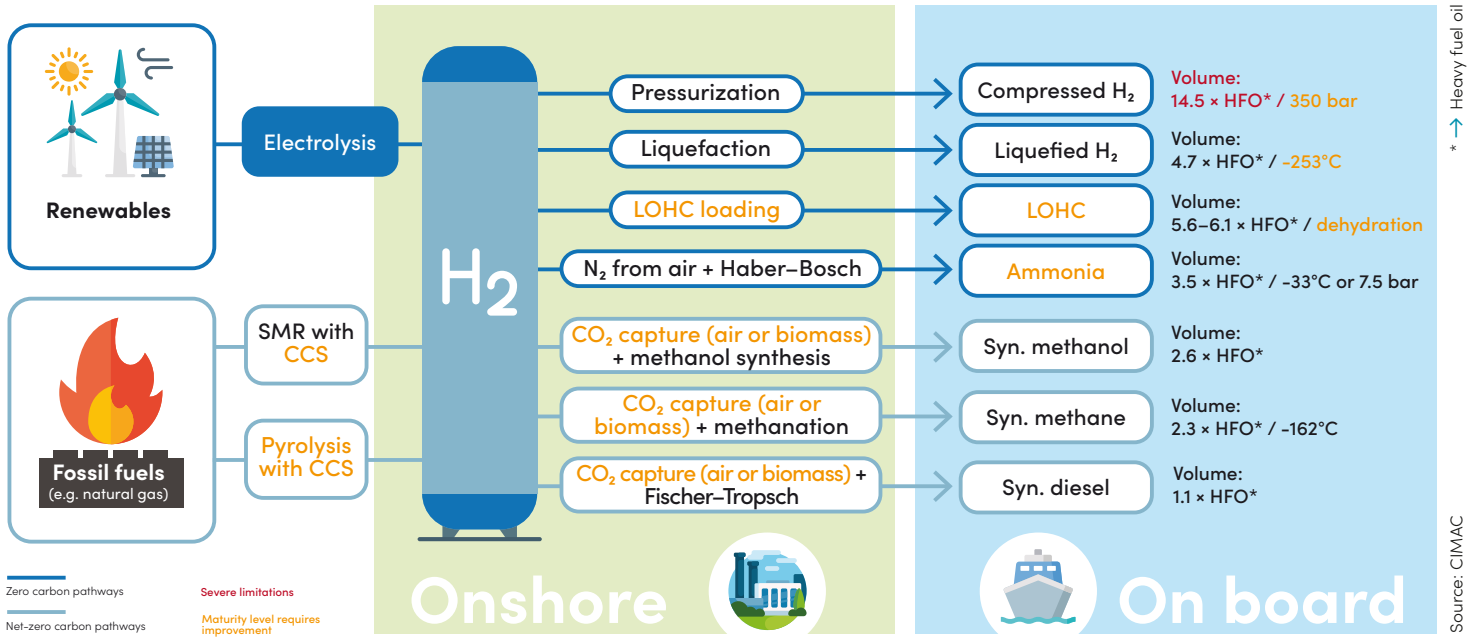
Roadmap for the maritime energy transition

From a technological perspective, intra-European shipping can become climate-neutral by 2045 if the European Union sets the suitable regulatory framework. This is an ambitious timetable, but it could enable the EU to act as a role model at international level. With the PtX roadmap presented by both associations in July 2022, the maritime industry is making proposals on the conditions needed to achieve this.

Among other things, this strategy stipulates that the fuel options and manufacturing processes available for shipping must be scaled up industrially before the end of this decade. It is of central importance here that this will be accompanied by an increased demand for renewable energies. Their expansion should not take place at the project level, as has been the case to date, but systemically at the member state level. In order for eFuels to achieve the necessary energy density, carbon is generally required for their production. This carbon should come from the air, from biomass or initially also from unavoidable industrial emissions.

Creating framework conditions

In addition to scaling up the technologies used, the EU must simultaneously provide a legal framework that creates incentives for the market-wide use of CO_2 and the development of closed-loop



Künftig ist die Produktion einer Vielzahl von Wasserstoffderivaten möglich.
In the future, the production of a wide range of hydrogen derivatives will be possible.

Quelle/*Source*: CIMAC

Rahmenbedingungen schaffen

Neben der Skalierung der eingesetzten Technologien muss die EU einen gesetzlichen Rahmen vorgeben, der Anreize für die marktbreite Nutzung von CO_2 und den Aufbau von Kreislaufsystemen schafft. Damit die EU ihrer Vorreiterrolle gerecht und die innereuropäische Schifffahrt bis 2045 klimaneutral wird, sieht die maritime Industrie diese regulatorische Stellschrauben vor:

- Unterstützung eines ambitionierten (innereuropäischen) Reduktionspfads für flottenweite Emissionen von Treibhausgasen
- Die CO_2-Bepreisung sollte wirksam sein, um die Wettbewerbsfähigkeit klimaneutraler Kraftstoffe zu erreichen.
- Nur ein Well-to-wake-Ansatz, der die Treibhausgase der gesamten Wertschöpfungskette des Kraftstoffs berücksichtigt und auch in der Initiative FuelEU Maritime verfolgt wird, fördert in angemessener Weise den Einsatz klimaneutraler Kraftstoffe.
- Um notwendige Investitionen anzukurbeln, sollte die Zielquote für erneuerbare Kraftstoffe nichtbiologischer Herkunft für das Jahr

systems. To ensure that the European Union lives up to its pioneering role and that intra-European shipping becomes climate-neutral by 2045, the maritime industry envisions the following regulatory levers:

- *Support for an ambitious (intra-European) reduction pathway for fleet-wide greenhouse gas emissions.*
- *CO_2 pricing should be effective to achieve competitiveness of climate neutral fuels.*
- *Only a well-to-wake approach that takes into account the greenhouse gases of the entire value chain of a fuel, which is also pursued in the FuelEU Maritime initiative, adequately promotes the use of climate-neutral fuels.*
- *To spur necessary investments, the target rate for renewable fuels of non-biological origin should be set at 2.6 percent for 2026 and - as formulated in the REPowerEU plan – increased to five percent by 2030.*
- *The Alliance for Shipping should set a minimum quantitative target of five to six gigawatts of generation capacity by 2030 to make the successes of cooperation measurable.*

2026 auf 2,6 Prozent festgelegt und – wie im REPowerEU-Plan formuliert – bis 2030 auf fünf Prozent angehoben werden.

- Die Allianz für die Schifffahrt sollte ein quantitatives Mindestziel von fünf bis sechs Gigawatt Erzeugungskapazität bis 2030 festlegen, um die Erfolge der Kooperation messbar zu machen.

- Auch in einer klimaneutralen Wirtschaft werden Deutschland und andere europäische Länder dauerhaft Energieimporteure bleiben. Um internationale Wasserstoff-Partnerschaften voranzutreiben, unterstützen VDMA und VSM deshalb die Strategie für ein auswärtiges Engagement im Energiebereich im Rahmen von REPowerEU.

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- *Even in a climate-neutral economy, Germany and other European countries will remain energy importers. To advance international hydrogen partnerships, VDMA and VSM therefore support the strategy for external engagement in the energy sector within the framework of REPowerEU.*

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Jedes Jahr werden circa 20 Millionen Tonnen Ammoniak per Schiff transportiert.
Approximately 20 million tons of ammonia are transported by ship every year.

Quelle/*Source*: Shutterstock

Grünes Ammoniak – Potenzial für die Energiewende
Green ammonia and its potential for the energy transition

Ammoniak ist eine der am meisten hergestellten Chemikalien weltweit. Der Bedarf an grünem Ammoniak als Grundchemikalie wird sich bis zum Jahr 2050 mindestens verdoppeln. Denn diese gasförmige Verbindung des Stickstoffs ist ein ideales Transportmittel für Wasserstoff und somit zentral für die grüne Transformation der Industrie und für das Gelingen der Energiewende.

Ammonia is one of the most widely produced chemicals in the world. The demand for green ammonia as a base chemical will at least double by 2050. This is because this gaseous nitrogen compound is ideal for transporting hydrogen and is therefore central to the green transformation of industry and to the success of the energy transition.

Herstellung ohne fossile Ressourcen

Production without fossil resources

Wie Wasserstoff ist grünes Ammoniak farblos. Jedoch besitzt es einen stechenden Geruch und wird je nach Herstellungsverfahren und der dafür eingesetzten Energie als grün bezeichnet: „Im Moment wird Ammoniak vor allem aus Erdgas hergestellt. Aber grünes Ammoniak kommt komplett ohne fossile Ressourcen aus “, sagt Thore

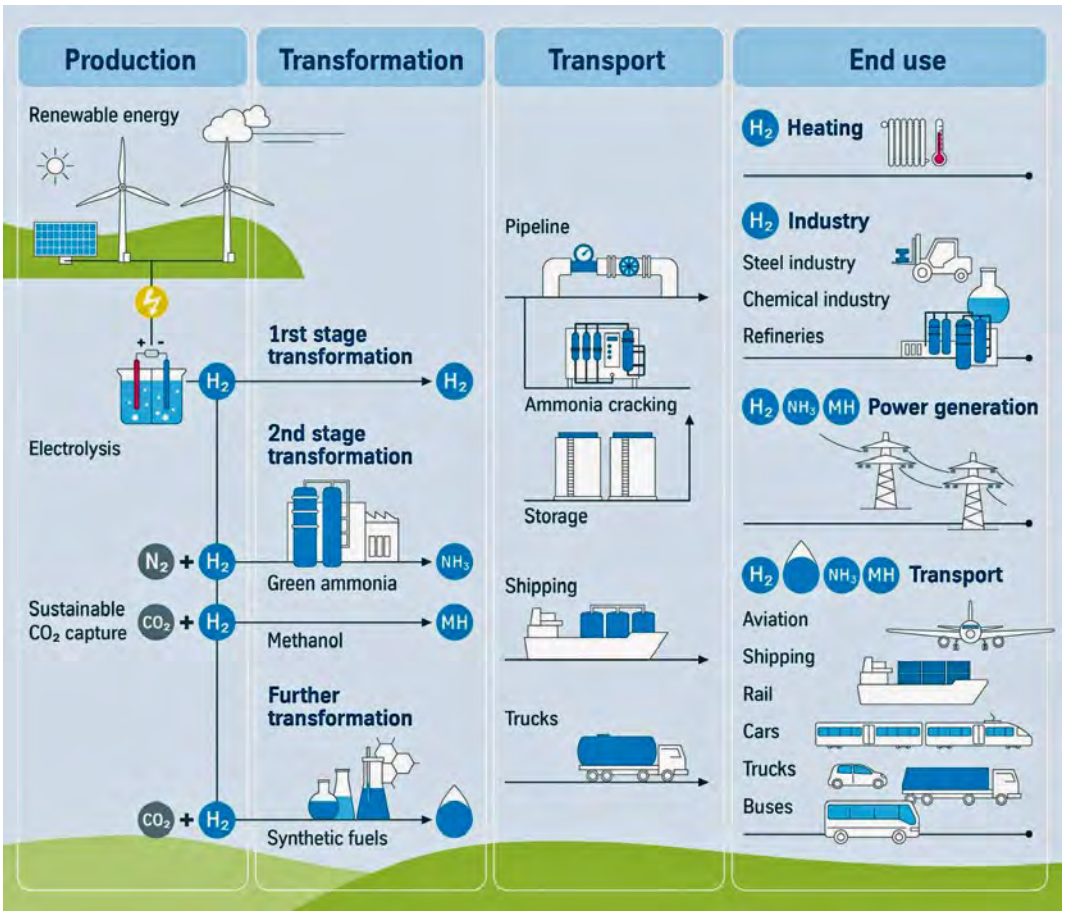
Like hydrogen, ammonia is colorless, but it has a pungent smell. Depending on the production process and the energy used, it can be described as green. “At the moment, ammonia is mainly produced from natural gas. However, green ammonia requires no fossil resources at all,” says Thore Lohmann, Executive Director Fertilizer &

Lohmann, Executive Director Fertilizer & Methanol bei thyssenkrupp Uhde. Dafür braucht man ihm zufolge nur grünen Strom, Luft, Wasser, und das richtige Know-how. Hersteller gewinnen Stickstoff aus der Atmosphäre (N_2), Wasserstoff aus einer Wasserelektrolyse (H_2), und verbinden beides in der Haber-Bosch-Synthese zu grünem Ammoniak (NH_3).

Reines Ammoniak in großen Mengen ist ausschließlich für den industriellen Einsatz mit entsprechenden Sicherheitsstandards bestimmt. In der Industrie übernimmt Ammoniak viele verschiedene Aufgaben und wird vor allem in Düngemitteln eingesetzt. Die sogenannten Stickstoffdünger sind wichtig, um Böden fruchtbar zu halten und die Ernährung der Weltbevölkerung zu sichern. Aber auch als Kältemittel wird Ammoniak eingesetzt, zum Beispiel in Eishallen. Außerdem wird Ammoniak in modernen Kraftwerken zur Entstickung (DeNOx) der Kraftwerksabgase verwendet.

Methanol at thyssenkrupp Uhde. According to him, all you need is green electricity, air, water and the right know-how. Producers extract nitrogen (N_2) from the atmosphere, produce hydrogen (H_2) through water electrolysis and combine the two to make green ammonia (NH_3) by means of the Haber-Bosch synthesis process.

In large quantities, pure ammonia is intended exclusively for industrial use with appropriate safety standards. Ammonia has many industrial applications and is mainly used in fertilizers. These so-called nitrogen fertilizers are important in keeping soils fertile and ensuring enough food can be provided for the world's population. Ammonia is also used as a refrigerant, for example at ice rinks. Furthermore, ammonia is used in modern power plants for the removal of nitrogen oxides (DeNOx) from power plant exhaust gases.



Grünes Ammoniak kann in vielen Industrien zum Einsatz kommen.
Green ammonia can be used in a number of industries.

Quelle/*Source*: thyssenkrupp Uhde GmbH

Quelle/*Source*:
thyssenkrupp Uhde GmbH

Eine Anlage produziert bis zu 5.000 Tonnen grünes Ammoniak pro Tag.

A plant produces up to 5,000 metric tons of green ammonia per day.

Transportmittel für grünen Wasserstoff

In Zukunft wird Ammoniak eine weitere wichtige Funktion in der Energiewirtschaft übernehmen, als Transportmittel für grünen Wasserstoff und als Brennstoff. Damit in Europa und speziell auch in Deutschland der wachsende Bedarf an grünem Wasserstoff für die Transformation emissionsstarker Industrien hin zu nachhaltigeren gedeckt werden kann, müssen Abnehmer dieses aus anderen Ländern importieren. Da gibt es nur ein Problem: „Der Transport von Wasserstoff über lange Strecken ist extrem aufwendig", erklärt Lohmann und ergänzt: „Für den Transport in großen Mengen muss das Gas bei minus 253 Grad Celsius verflüssigt werden." Diese Kühlung erfordert einen extrem hohen Energieaufwand. Zudem verdampft beim Transport unwiederbringlich Wasserstoff, sodass Verluste entstehen.

„Mit Ammoniak können auf weniger Raum viel größere Energiemengen transportiert werden. Denn bezogen auf das Volumen ist die Energiedichte von Ammoniak sehr viel größer als die von flüssigem Wasserstoff", führt Lohmann aus. Ammoniak verflüssigt bereits bei minus 33 Grad Celsius und ist einfach zu lagern und zu transportieren. Flüssiger Wasserstoff hingegen verbraucht durch die extreme Kühlung zusätzlich bis zu 40 Prozent des Energiegehalts, der transportiert werden soll. „Es werden schon heute jedes Jahr viele Millionen Tonnen Ammoniak per Schiff transportiert. Die notwendige Infrastruktur ist bereits vorhanden und der sichere Umgang ist weltweit seit Jahrzehnten etabliert

A means of transporting green hydrogen

In the future, ammonia will take on another important role in the energy sector – as a means of transporting green hydrogen and as a fuel. To meet the growing demand for green hydrogen to transform high-emission industries into more sustainable ones, Europe –and Germany in particular – need to import green hydrogen from other countries. There is only one problem with this explains Lohmann: "Transporting hydrogen over long distances is extremely costly. For transportation in large quantities, the gas needs to be liquefied at minus 253 degrees Celsius." This cooling requires a huge amount of energy. Moreover, hydrogen evaporates during transportation, resulting in irretrievable losses.

"Ammonia can be used to transport much larger amounts of energy in less space because, relative to its volume, the energy density of ammonia is much, much greater than that of liquid hydrogen," explains Lohmann. Ammonia already liquefies at minus 33 degrees Celsius and is easier to store and transport. Liquid hydrogen, on the other hand, also consumes up to 40% of the energy content to be transported due to the extreme cooling. "Many millions of tons of ammonia are already transported by ship every year. The necessary infrastructure is already in place and safe handling practices have been well-established across the globe for decades," says Lohmann. The transportation of green ammonia is therefore not only easier, but also safer and more cost-effective than that of green hydrogen.

und eingeübt“, betont Lohmann. Der Transport von grünem Ammoniak ist also nicht nur einfacher, sondern auch sicherer und kostengünstiger als der von grünem Wasserstoff.

Energie transportier- und speicherfähig machen

Und dies gelingt mit dem sogenannten Power-to-Ammonia-Verfahren. Dabei wird Wasserstoff mittels Elektrolyse aus erneuerbaren Energien hergestellt. Parallel wird Stickstoff mithilfe eines Luftzerlegers aus der Umgebungsluft gewonnen. Dieser Prozess erzeugt grünes Ammoniak – ein klimaneutraler Energieträger.

Diese erneuerbare Energie wird in chemischer Form als Ammoniak gespeichert. Nach dem Transport wird das grüne Ammoniak unkompliziert wieder zu grünem Wasserstoff umgewan-

Enabling energy to be transported and stored

This is achieved by means of the so-called power-to-ammonia process. In this process, hydrogen is produced from renewable energies by means of electrolysis. In parallel, nitrogen is extracted from ambient air using an air separator. These are then reacted to form green ammonia – a climate-neutral energy carrier.

The renewable energy is thus stored in chemical form as ammonia. After transportation, the green ammonia is easily converted back to green hydrogen and can be used as a climate-neutral energy source in numerous industrial processes – for instance in the steel, cement and chemical industries. Its direct use is also possible, for example as a climate-neutral marine fuel or in the turbines of gas-fired power plants. Proper combustion of ammonia produces only water and nitrogen.

delt und kann in zahlreichen industriellen Prozessen als klimaneutraler Energieträger eingesetzt werden, etwa in der Stahl-, Zement- und Chemieindustrie. Auch eine direkte Nutzung ist möglich, zum Beispiel als klimaneutraler Schiffstreibstoff oder in den Turbinen von Gaskraftwerken. Bei richtiger Verbrennung von Ammoniak entstehen nur Wasser und Stickstoff.

Als Brückenlösung wird in Japan sogar die Mitverbrennung in Kohlekraftwerken erprobt. In den Augen vieler Experten ist das ein eleganter Schritt, um die vorhandene Energieinfrastruktur schrittweise auf erneuerbare Energie umzustellen, ohne die Energiesicherheit zu gefährden.

Voraussetzungen für Energiewende schaffen

Weltweit gibt es bereits Anlagen zur Produktion von grünem Ammoniak. Dazu kann die seit Jahrzehnten etablierte Technologie der klassischen Ammoniakherstellung im Großmaßstab genutzt werden: „In einer einzigen Anlage können bis zu 5.000 Tonnen grünes Ammoniak pro Tag produziert werden", sagt Lohmann. Mit Blick auf die Zukunft und die neue Rolle der Chemikalie reichen diese Kapazitäten aber noch nicht, um den stark steigenden Bedarf an Ammoniak auch in Zukunft zu decken. Denn neben dem Transport von Wasserstoff bleibt Ammoniak auch weiterhin für die Düngemittelproduktion wichtig.

Neben dem Bau neuer und der Umstellung bestehender Anlagen müssen in Zukunft sehr viel erneuerbare Energie, mehr Schiffe und Terminals vorhanden sein, damit grünes Ammoniak sein volles Potenzial für die Energiewende entfalten kann.

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As a bridging solution, co-combustion in coal-fired power plants is even being tested in Japan. In the eyes of many experts, this is an elegant step toward gradually transitioning the existing energy infrastructure to renewable energy without compromising energy security.

Creating the prerequisites for energy transition

There are already plants for the production of green ammonia across the globe. In addition, the well-established technology for conventional industrial-scale ammonia production can also be used: "A single plant can produce up to 5,000 metric tons per day of green ammonia," says Lohmann. However, looking to the future and the new role of the chemical, these capacities are not yet sufficient to meet the rapidly increasing demand for ammonia in the future. This is because, alongside its function as an energy and hydrogen carrier, ammonia will continue to play a key role in fertilizer production.

In addition to the construction of new plants and the conversion of existing ones, huge quantities of renewable energy as well as more ships and terminals will be required in the future for green ammonia to develop its full potential for the energy transition.

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LNG – kleine Anlagen für die Energiesicherheit
LNG – small-scale plants for energy security

Die Nachfrage nach kleinen ssLNG-Anlagen wie dieser wird vorrausichtlich steigen.
Demand for small ssLNG plants like this one is expected to increase.

Quelle/*Source*:
TGE Gas Engineering GmbH

Flüssigerdgas oder Liquefied Natural Gas (LNG) bietet immense Vorteile für den Transport oder die Lagerung. Vor allem hilft es dabei, klima- und umweltschädliche Emissionen zu reduzieren. Die Erweiterung bestehender und die Neuentwicklung vieler Großanlagen erhöhen seit Jahren das Angebot von LNG auf dem Markt. Doch seit Februar 2022 ist das Angebot durch die Abkehr vom russischen Gas in Europa drastisch gesunken, die Nachfrage nach LNG aus anderen Quellen stark gestiegen. Heute geht es vor allem darum, auch in Krisenzeiten den weiteren Bedarf an LNG-Applikationen für eine stabile Energieversorgung zu sichern. Daher verwundert es nicht, dass sogenannte smal-scale-LNG-Projekte (ssLNG) auf dem Vormarsch sind.

Liquefied natural gas (LNG) offers immense advantages for transportation and storage. Above all, it helps reduce emissions that are harmful to the climate and the environment. The expansion of existing and the new development of many large-scale plants have been increasing the supply of LNG on the market for years. But since February 2022, supply has fallen dramatically as Europe moves away from Russian gas, and the demand for LNG from other sources has risen significantly. Today, the main concern is to ensure the continued need for LNG applications for a stable energy supply, even in times of crisis. It is therefore not surprising that so-called small-scale LNG (ssLNG) projects are on the rise.

Brückentechnologie für kleine Anlagen

LNG und Erdgas werden weiterhin als Brückentechnologie fungieren. Ein nächster Schritt wäre, fossiles LNG durch CO_2-neutrales Bio-LNG zu ersetzen – in Europa vorranging im Kraftstoffbereich. Die entstehende oder bereits vorhandene Infrastruktur für ssLNG kann langfristig für Biogase weiterverwendet werden und zur Energiewende beitragen. Da hier eine positive Rentabili-

Bridge technology for small plants

LNG and natural gas will be further considered as a bridging technology. A next step would be to replace fossil LNG with CO_2-neutral bio-LNG – in Europe primarily in the fuel sector. The emerging or already existing infrastructure for ssLNG can be reused for biogases in the long term and contribute to the energy transition. Since here a positive profitability of the projects goes hand in hand with the conversion to renewable

tät der Projekte mit der Umstellung auf regenerative Energien einhergeht, ist eine Steigerung der Nachfrage nach ssLNG-Projekten vor allem bei kleinen Anwendungen erwartbar.

Kleine Anlagen erfordern im Vergleich zu Großprojekten geringere Investitionen und bieten dennoch eine tragfähige wirtschaftliche und ökologische Lösung. Bis heute gibt es für sie keine international einheitliche Größendefinition. Viele Marktteilnehmer verstehen LNG-Receiving-Terminals mit einem Jahresdurchsatz von bis zu 0,5 Millionen Tonnen pro Jahr (MTPA) als small scale und somit als ssLNG. Im ssLNG-Bereich sind hier besonders drei Anwendungen im Fokus, ssLNG to Power für die Stromerzeugung, ssLNG-Bunkering als Kraftstofflösung für Schiffe und ssLNG-Produktionsanlagen für die Verflüssigung des LNG.

Unterschiedliche Anlagengröße – gleiche Lieferketten

Die typische LNG-Lieferkette für eine ssLNG-to-Power-Anlage ist vergleichbar mit jeder anderen LNG-Lieferkette. Die ssLNG-to-Power-Anlage erhält LNG von einem LNG-Tanker, der vorher an einem LNG-Export-Terminal beladen wurde. Für

energies, an increase in demand for ssLNG projects can be expected, especially for small applications.

Small-scale plants require lower investments compared to large-scale projects and still offer a viable economic and environmental solution. To date, there is no internationally defined uniform size for them. Many market participants understand LNG receiving terminals with an annual throughput of up to 0.5 million metric tons per annum (MTPA) to be small scale and thus ssLNG. In the ssLNG sector, there are three applications in particular focus, ssLNG-to-power for electricity generation, ssLNG bunkering as a fuel solution for ships, and ssLNG production facilities for liquefaction of the LNG.

Different plant sizes – same supply chains

The typical LNG supply chain for an ssLNG-to-power plant is similar to any other LNG supply chain. The ssLNG-to-power plant receives LNG from an LNG tanker previously loaded at an LNG export terminal. For remote locations where there is no natural gas pipeline network, ssLNG-to-power can be the fuel supply solution for a neigh-

An solchen Tankstellen nehmen Trucks LNG auf.
Trucks take on LNG at such filling stations.

Quelle/*Source*: TGE Gas Engineering GmbH

abgelegene Standorte, an denen kein Erdgasleitungsnetz vorhanden ist, kann ssLNG-to-Power die Brennstoffversorgungslösung für ein benachbartes Gaskraftwerk sein. Diese Anlagen können optional mit LNG-Verteilereinrichtungen ausgestattet werden. Wesentliche Merkmale dieser Anlagen sind Schiffsentladestationen, ein Lagertank und die Regasifizierung des LNG. Typischerweise haben diese Anwendungen eine Nennkapazität der Stromerzeugung im Bereich von 20 bis 300 Megawatt.

Für die Betankung von Offshore-Carriern und Kreuzfahrtschiffen mit LNG bieten sich ssLNG-Bunker- und Verteilungsanlagen an. Diese befinden sich in Häfen mit emissionskontrollierten Bereichen. Hier geht es darum, SOx- und NOx-Emissionen zu reduzieren. Die Anlagen sind mit Schiffsbetankungsanlagen, einer Schiffsentladestation, einem Lagertank und einer Barge-Beladeanlage ausgestattet. Zur optionalen Ausstattung der Anlage können Onshore-LNG-Verteilungsanlagen gehören, die eine An-Land-Verteilung an lokale industrielle Verbraucher oder Tankstellen für Straßenfahrzeuge ermöglicht.

Wirtschaftlicher Betrieb

Die ssLNG-Produktionsanlagen befinden sich oft im Landesinneren. Sie sind zum Beispiel einer lokalen Biogasanlage nachgeschaltet und umfassen Vorbehandlung, Verflüssigung, Lagerung und Verteilung von LNG. Zur grundlegenden Ausstattung zählen alle erforderlichen Gasaufbereitungs-

boring gas-fired power plant. These plants can be optionally equipped with LNG distribution facilities. Key features of these facilities include ship unloading stations, a storage tank, and regasification of the LNG. Typically, these applications have a nominal power generation capacity in the range of 20 to 300 megawatts.

For refueling offshore carriers and cruise ships with LNG, ssLNG bunkering and distribution facilities are ideal. These are located in ports with emission-controlled areas. The goal here is to reduce SOx and NOx emissions. The facilities are equipped with ship refueling facilities, a ship unloading station, a storage tank, and a barge loading facility. Optional plant equipment may include onshore LNG distribution facilities, allowing onshore distribution to local industrial consumers or vehicle refueling stations.

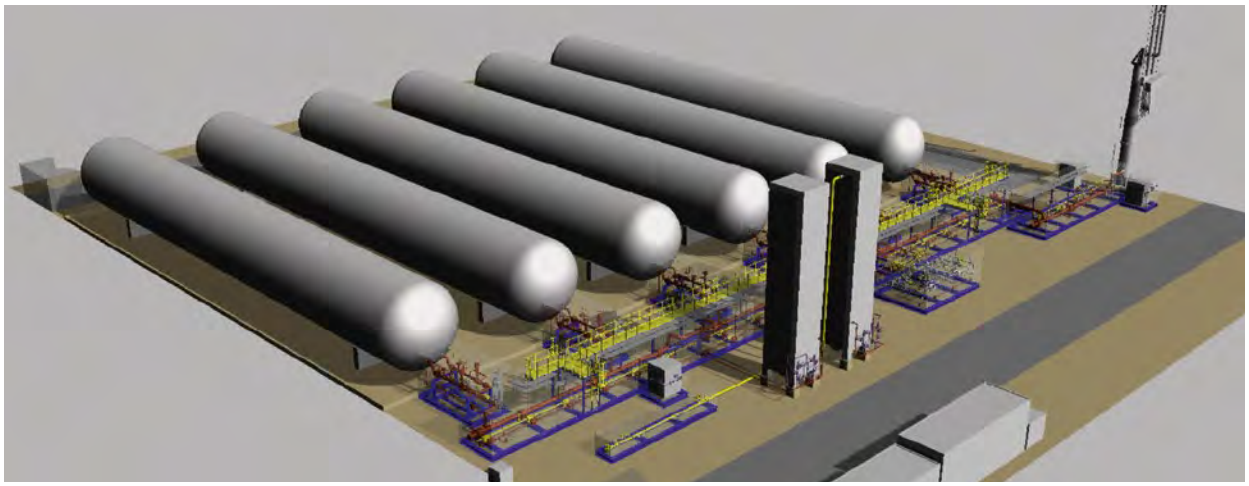
Economic operation

ssLNG production facilities are often located inland, for example downstream of a local biogas plant, and include pretreatment, liquefaction, storage, and distribution of LNG. Basic equipment includes all necessary gas processing equipment, liquefaction, storage, and truck loading stations for LNG. The typical annual throughput is less than 0.25 MTPA of LNG. To ensure economical operations for ssLNG liquefaction, different technologies are used compared to those for world-scale LNG production. They include gas receiving facilities, treatment, refrigerant compression and

Quelle/*Source*:
TGE Gas Engineering GmbH

An abgelegenen Standorten kann ssLNG-to-Power die Brennstoffversorgungslösung für ein benachbartes Gaskraftwerk liefern.

In remote locations, ssLNG-to-power can provide the fuel supply solution for a neighboring gas-fired power plant.



Die Nachfrage nach kleinen ssLNG-Anlagen wie dieser wird vorrausichtlich steigen.
Demand for small ssLNG plants like this one is expected to increase.

Quelle/*Source*: TGE Gas Engineering GmbH

anlagen, Verflüssigung, Lagerung und Lkw-Beladestationen für LNG. Der typische Jahresdurchsatz beträgt weniger als 0,25 MTPA LNG. Um bei der ssLNG-Verflüssigung einen wirtschaftlichen Betrieb zu gewährleisten, werden andere Technologien eingesetzt als bei der LNG-Produktion im Weltmaßstab. Dazu gehören Gasannahmeeinrichtungen, Behandlung, Kältemittelkompression und -kondensation sowie die Handhabung von Boil-off-Gas. Das LNG wird typischerweise modular in mehreren vakuumisolierten kryogenen Tanks gelagert.

Biogas – vielseitig nutzbar

In flüssigem oder komprimiertem Zustand kann auch Biogas als Kraftstoff für schwere Fahrzeuge und Maschinen genutzt werden. Der große Vorteil von Biogas: Es ist nahezu CO_2-neutral und besteht fast vollständig aus Methan. Künftig werden sogenannte ss(Bio)LNG-Anlagen ebenfalls einen nicht zu unterschätzenden Anteil im regenerativen Energiemix haben. Die heutigen ss(Bio)LNG-Anlagen sind darauf ausgelegt zehn bis 65 Tonnen Liquified Biogas (LBG) pro Tag Zu produzieren. Der Trend geht jedoch eher zu größeren Produktionsmengen ab 60 Tonnen pro Tag. Die ssLNG-Anlangen sind in der Lage, kurzfristig Energielücken zu schließen und eröffnen Perspektiven zur Entwicklung neuer Speicherkonzepte.

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condensation, and boil-off gas handling. The LNG is typically stored in a modular way by multiple vacuum-insulated cryogenic tanks.

Biogas – versatile in use

Biogas can also be used as a fuel for heavy vehicles and machinery in liquid or compressed form. The great advantage of biogas is that it is almost CO_2-neutral and consists almost entirely of methane. In the future, so-called ss(Bio)LNG plants will also have a share in the renewable energy mix that should not be underestimated. Todays ss(Bio)-LNG plants are designed to produce 10 to 65 tons of Liquified Biogas (LBG) per day. However, the trend is more towards larger production volumes of 60 tons per day or more. The ssLNG plants are able to close energy gaps in the short term and open up perspectives for the development of new storage concepts.

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Verflüssigtes Erdgas: Explosionsschutz sichert Versorgungskette
Liquefied natural gas: explosion protection secures supply chain

Im Zuge der Energiewende kann verflüssigtes Erdgas (LNG) als Übergangslösung einen wichtigen Beitrag für die Versorgungssicherheit leisten. Dieser Energieträger zeichnet sich durch eine hohe Verfügbarkeit zu wettbewerbsfähigen Konditionen aus. Zudem ist seine Emissionsbelastung im Vergleich zur Verbrennung von Kohle und Öl geringer. Jedoch ist das geförderte Gasgemisch hochentzündlich. Erdgas und LNG fallen gemäß der Zertifizierungssystem ATEX und IECEx unter die Explosionsgruppe IIA, Temperaturklasse T1. Somit muss der Explosionsschutz über die gesamte Wertschöpfungskette gewährleistet sein. Mit explosionsgeschützten Produkten und Systemen für alle Prozessschritte von der Förderung bis zur Einspeisung gelingt dies.

As part of the energy revolution, liquefied natural gas (LNG) can make an important contribution to supply security as a transition solution. This energy source stands out thanks to outstanding availability under competitive conditions. Furthermore, the emissions it produces are lower in comparison with combustion of coal and oil. However, the extracted gas mixture is highly flammable. Natural gas and LNG are classified as explosion group IIA and temperature class T1 according to ATEX and IECEx . This means that explosion protection must be guaranteed across the entire value creation chain, which is achieved with explosion-protected products and systems for all process steps from natural gas extraction to supply.

LNG kann als Schiffstreibstoff Emissionen deutlich senken.
LNG can significantly reduce emissions as fuel for ships.

Quelle/*Source*: Shutterstock

Zunächst durchläuft das geförderte Roherdgas eine Aufbereitungsanlage, die Verunreinigungen und Schadstoffe abtrennt und nahezu reines Methan erzeugt. Für seine Weiterverarbeitung wird das Gas in eine als LNG-Train bezeichnete Gasverflüssigungsanlage geleitet. Dort wird es mittels ein- bis dreistufiger Kreislaufverfahren mit hohem Energieverbrauch, der für die Tiefkühlung und die Wärmeabfuhr anfällt, verflüssigt. Um die für die Wärmetauscher benötigten Pumpen und Ventilatoren anzusteuern, müssen solche Anlagen mit leistungsstarken, explosionsgeschützten Motoransteuerungen und Energieverteilungen ausgestattet sein. Diese Explosionsschutzlösungen können je nach Anlage bedarfsgerecht in verschiedenen Zündschutzarten ausgelegt werden.

The conveyed raw natural gas initially flows through a processing plant, which separates out contaminants and pollutants and generates almost pure methane. For further processing, the gas is fed into a gas liquefaction plant, known as an LNG train. This is where it is liquefied using a single- to triple-stage circulation process with high energy consumption due to the deep-cooling and heat dissipation required. To control the pumps and fans needed for the heat exchangers, these systems must be equipped with particularly high-performance, explosion-protected motor controls and power distribution boards. These explosion protection solutions can be designed using a range of types of protection depending on the needs of the system.

Fehler effizient überwachen

Dabei erlaubt es eine modular aufgebaute Gehäusetechnik, mehrere Schutzarten effizient miteinander zu kombinieren sowie Steuerungen und Energieverteilungen in beliebigen Größen zu konfigurieren, um im Explosionsbereich hohe Leistungen mit vielen Stromabgängen verfügbar zu machen. Um Wartungs- und Instandhaltungskosten des gesamten LNG-Trains gering zu halten, empfiehlt sich eine Verknüpfung der Schutzschalter und Hilfskontakte mit einem Remote-Input-Output-System. Auf diese Weise lassen sich Fehler in der Energieverteilung über das Prozessleitsystem auslesen und überwachen.

Monitoring errors efficiently

The modular enclosure technology enables multiple degrees of protection to be combined efficiently, and control systems and power distribution boards to be configured in a range of sizes; as a result, even high power levels with multiple power outlets are available in hazardous areas. In order to reduce maintenance and servicing costs for the entire LNG train, we recommend connecting the circuit breaker and auxiliary contacts to a remote input/output system, so that the errors on the power distribution board can be read out and monitored via the distributed control system.

Kühlung während des Transport gewährleisten

Den Transport von LNG übernehmen überwiegend Anbieter von Spezialtankern. Diese Schiffsriesen weisen immer größere Abmessungen auf. Trotz ihrer Tankisolierung erwärmt sich das verflüssigte Gas während des Transports und könnte teilweise verdampfen. An Bord eingesetzte Kompressoren sorgen dafür, das LNG wieder herunter zu kühlen. Für die Steuerung der Kompressoren eignen sich explosionsgeschützte Steuerungsstationen für Remote Input Output (RIO), welche die Signale von Sensoren und Aktoren sicher an das dezentrale Leitsystem übertragen. Da für die Installation unter Deck nur wenig Einbauraum zur Verfügung steht, müssen die Maschinen und RIO-Stationen mit Input-Output-Modulen sowie digitalen Anzeige- und Meldeelementen sehr kompakt dimensioniert sein. Systeme mit acht- beziehungsweise 16-kanaligen Modulen mit Zünd-

Ensuring cooling during transport

Special tanker suppliers mostly take on the transport of LNG. These giant ships have larger and larger dimensions. In spite of its tank insulation, the liquefied gas heats up during transport and could partly evaporate. Compressors used on board ensure that the LNG is cooled down again. To control the compressors, explosion-protected control stations for remote input/output (RIO) are ideal, which transmit the signals from sensors and actuators safely to the decentralised control system. Since the available installation space below deck is limited, the machines and RIO stations must be designed to include input/output modules and digital display and message elements in a very compact size. Systems with 8- or 16-channel modules with type of protection with intrinsic safety type of protection (Ex i modules) mean that the station can be extremely compact, reducing the required space and weight.

schutzart Eigensicherheit (Ex-i-Module) ermöglichen einen hochkompakten Stationsaufbau mit deutlicher Platz- und Gewichtseinsparung.

Sicher wieder in Gas umwandeln

Angekommen am Zielort wird das Erdgas in sogenannten Regasification Units wieder in den gasförmigen Zustand gebracht. Alternativ lässt sich dieser Prozess mit kleineren Mengen auch flexibel in schwimmenden Anlagen – Floating Storage and Regasification Units (FRSU) – durchführen. Für die Umwandlung des LNG in den ursprünglichen Zustand wird Verdampfungswärme zugeführt. Aus Gründen der Wirtschaftlichkeit wird diese Wärme meist aus mit Meerwasser gespeisten Wärmetauschern gewonnen. Pumpeneinheiten, die das Meerwasser zum Wärmetauscher befördern, sollten aus Sicherheitsgründen mit Alarmsignalgebern, Klemmenkästen, Sicherheitsschaltern und Lasttrennschaltern mit AC3-Schaltvermögen bestückt sein. Integrierte Sicherheitsschalter trennen bei Reinigung und Reparaturen die elektrische Energiezufuhr sicher von Maschinen und Anlagenteilen.

Da sich die explosionsgefährdeten Zonen über weite Anlagenbereiche erstrecken, sollten Ex-Schutz-Lösungen nicht nur im eigentlichen Verarbeitungsprozess, sondern in der gesamten Infrastruktur zur Anwendung kommen. Entscheidend für die Materialauswahl und Konstruktion

Safely converting back into gas

After arriving at the destination, the natural gas is converted back to its gaseous form in regasification units. Alternatively, this process can be performed with smaller quantities flexibly at offshore plants, known as Floating Storage and Regasification Units (FSRUs). The heat for vaporisation is fed in to convert the LNG to its original state. For cost-related reasons, this heat is typically obtained from heat exchangers supplied with seawater. For safety reasons, pump units, which convey the seawater to the heat exchanger, should be equipped with alarm signal emitters, terminal boxes, safety switches and load disconnect switches with AC3 switching capacity. Integrated safety switches safely disconnect the electrical energy supply from machines and system parts for cleaning and repairs.

Since the hazardous zones cover large areas of the plant, explosion protection solutions should not only be used during the actual processing stage, but throughout the entire infrastructure. As well as explosion protection, the use of seawater-resistant enclosure materials, high-quality sealing materials, a vibration-resistant design, and resistance to electromagnetic influences are all deciding factors when choosing which materials and design to use.

Quelle/*Source*:
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Explosionsgeschützte Lösungen steuern Verflüssigungsanlagen sicher.

Explosion-protected solutions safely control liquefaction systems.

Gehäuse in Leichtbauweise bieten viel Einbauvolumen.
Lightweight enclosures boast a large internal capacity. Quelle/*Source*: R. STAHL

Kompakte Steuerungsstationen lassen sich leicht installieren.
Compact control stations are easy to install. Quelle/*Source*: R. STAHL

sind neben dem Ex-Schutz auch seewasserresistente Gehäusewerkstoffe, hochwertige Dichtungsmaterialien, ein vibrationsfestes Design und die Unempfindlichkeit gegenüber elektromagnetischen Einflüssen.

Vor der Netzeinspeisung wird das Erdgas in einer Kompressionsanlage verdichtet. Die Motorsteuerungen und Energieverteilungen, die unter anderem für die Ansteuerung von Kompressoren und zur Speisung der Wärmetauscher und Verdampfungsanlagen benötigt werden, können mit explosionsgeschützten Gehäusetechnologien leicht und kompakt realisiert werden.

Hauptsächlich wird LNG zur Wärme- und Stromerzeugung sowie als Energieträger für die Prozessindustrie genutzt. Wegen seiner Umweltverträglichkeit und des positiven Effekts auf den CO_2-Ausstoß wächst seine Bedeutung aber auch als Kraftstoff zum Antrieb von Schiffen und Lastkraftwagen.

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Before being supplied to the grid, the natural gas is compressed in a compression plant. The motor control units and power distribution boards, which are required for a number of tasks including controlling compressors and supplying the heat exchangers and evaporation systems, can be made lightweight and compact with explosion-protected enclosure technologies.

LNG is primarily used to generate heat or power, and as an energy source for the process industry. Due to its environmentally friendly nature and positive effect on CO_2 emissions, it is also becoming increasingly important as a fuel source for ships and trucks.

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Kohlenstoff abscheiden und speichern
Carbon capture and storage

Das Tempo des Klimawandels wächst exponentiell. Es besteht dringender Handlungsbedarf, um Kohlendioxid-(CO_2-), Methan- und F-Gas-Emissionen vieler Industriesektoren zu verringern. Dazu zählen auch die chemische Produktion und die Öl- und Gasverarbeitung. Die Nachrüstung bestehender Anlagen mit Kohlenstoffabscheidung und -speicherung – Carbon Capture and Storage (CCS) – ermöglicht deren weitere Nutzung bei deutlich reduzierten CO_2-Emissionen. Zudem kann CCS auch in neue Anlagen integriert werden.

CCS – Zusätzliche Transportinfrastruktur erforderlich

Im Öl- und Gassektor muss das bei der Verarbeitung von Sauergas freigesetzte CO_2 abgetrennt und gespeichert werden, um den CO_2-Fußab-

The pace of climate change is exponential. Urgent action is required to reduce carbon dioxide (CO_2), methane, and F-Gas emissions from many industrial sectors, including chemical production and Oil & Gas processing. Retrofitting existing plants with carbon capture and storage (CCS) enables their continued use with significantly reduced CO_2 emissions. In addition, CCS can also be integrated into new plants.

CCS – Additional transport infrastructure required

In the Oil & Gas sector, CO_2 released during sour gas processing must be captured and stored to reduce the carbon footprint. Capture is already common practice. It allows natural gas to be liquefied and increases the calorific value of pipe-

SMR-Raffinerien mit CO_2-Abscheidung gehört die Zukunft.
SMR refineries with CO_2 capture are the future.

Quelle/*Source*: APCI

druck zu reduzieren. Die Abtrennung ist bereits üblich. Sie ermöglicht es, Erdgas zu verflüssigen und den Heizwert von Pipeline-Erdgas zu erhöhen. Jedoch wird das abgeschiedene CO_2 derzeit in die Atmosphäre freigesetzt. Künftig gilt es, CO_2 als überkritisches Gas oder flüssiges CO_2 zu einem dauerhaften Speicherort zu transportieren oder es für andere Zwecke zu nutzen. Dies erfordert eine zusätzliche CO_2-Transportinfrastruktur.

Auch Raffinerien können mit CCS ihre CO_2-Emissionen verringern, indem sie CO_2 nach der Verbrennung aus Dampfkesseln und befeuerten Erhitzern abscheiden. Zudem entsteht bei der Dampf-Methan-Reformierung (SMR), die zur Erzeugung von Wasserstoff für die Entschwefelung von Kraftstoffen und die Wasserstoffbehandlung eingesetzt wird, CO_2 als Prozessemission. Dieser Abgasstrom ist reich an CO_2, was die Abscheidung vergleichsweise kostengünstig macht.

SMR – Fachwissen einsetzen

Gut bekannt ist die Abtrennung von CO_2 aus SMR-Prozessgasen in der Harnstoffdüngerindustrie. Anlagenbetreiber und Ausrüstungslieferanten verfügen bereits über umfassendes Fachwissen, um die Energiewende zu unterstützen. In diesem Sektor wird die SMR zur Erzeugung von Wasserstoff für die Ammoniakproduktion eingesetzt. Das CO_2 wird dabei aus der SMR abgeschieden und mit dem Ammoniak für die Herstellung von Harnstoff genutzt. Dieselbe Abscheidungsanlage wird künftig für die Dekarbonisierung des SMR-Betriebs in Raffinerien entscheidend sein, um den CO_2-Fußabdruck zu reduzieren.

Neu gebaute Anlagen für die Herstellung von blauem Wasserstoff müssen den größten Teil des CO_2 auffangen, das bei der Reformierung und nach der Verbrennung freigesetzt wird. Die Anlagenkonfiguration wird künftig höchstwahrscheinlich einen autothermen Reformer (ATR) umfassen. Dieser wandelt Erdgas in Synthesegas um, das raffiniert wird, um das gewünschte Wasserstoffgas zu erhalten.

Saline Aquifere nutzen

Trotz der angespannten Erdgasversorgungslage in Europa sind im Vereinigten Königreich und in Norwegen mehrere Projekte zur Erzeugung von blauen Wasserstoff in Vorbereitung. Diese Länder

line natural gas. However, captured CO_2 is currently released into the atmosphere. In the future, it will be necessary to transport CO_2 as supercritical gas or liquid CO_2 to a permanent sequestration location or to use it for other purposes. This will require an additional CO_2 transmission infrastructure.

Refineries can also reduce their CO_2 emissions with CCS by capturing post-combustion CO_2 from steam boilers and fired heaters. Furthermore, the steam methane reforming (SMR) process used to generate hydrogen for fuel desulphurisation and hydrotreating generates CO_2 as a process emission. This waste gas stream is rich in CO_2 making capture comparatively cost effective.

SMR – Using expert knowledge

Capturing CO_2 from SMR process gases is well known to the urea fertilizer industry. Plant operators and equipment suppliers already have extensive expertise to support the energy transition. In this sector, SMR is used to generate hydrogen for ammonia production. The CO_2 is thereby captured from the SMR and used with the ammonia to produce urea. Exactly the same CO_2 capture unit will be vital to decarbonize refinery SMR operations in the future to reduce the carbon footprint.

New facilities built to produce blue hydrogen must capture most of the CO_2 released from the reforming process chemistry and by post-combustion. The plant configuration in the future will most likely include an autothermal reformer (ATR). This converts natural gas into syngas, which is refined to yield the target hydrogen gas.

Utilising saline aquifers

Despite the tight natural gas supply situation in Europe, several blue hydrogen production projects are underway in the United Kingdom and Norway. These countries have access to natural gas reserves in the North Sea and can use depleted oil and gas fields or saline aquifers in the North Sea for underground CO_2 storage.

CCS can also reduce CO_2 emissions from thermal power generation fired with fossil fuels. In respect to new-build thermal power plants, technologies such as the Allam cycle can be considered for this purpose. The technology uses natural gas-fired

Das Technologiezentrum Mongstad ist das global größte Testzentrum für die Entwicklung von CO_2-Abscheidungstechnologien.
The Mongstad Technology Center is the world's largest test center for the development of CO_2 capture technologies.

Quelle/*Source*: Ole Jørgen Bratland
© Equinor

haben Zugang zu den Erdgasreserven in der Nordsee und können erschöpfte Öl- und Gasfelder oder saline Aquifere in der Nordsee für die unterirdische CO_2-Speicherung nutzen.

Auch die CO_2-Emissionen aus der thermischen Stromerzeugung mit fossilen Brennstoffen kann CCS verringern. Für den Neubau von Wärmekraftwerken kommen hierfür Technologien wie der Allam-Zyklus infrage. Die Technologie arbeitet mit erdgasbefeuerten Turbinen oder mit Kohlevergasung. Dabei sorgt die Oxy-Fuel-Verbrennung für ein CO_2-reiches Rauchgas, aus dem CO_2 unter hohem Druck abgeschieden werden kann.

Etablierte Technologie – ausgereifte Komponenten

Abgeschiedenes CO_2 kann genutzt, dauerhaft unterirdisch gespeichert oder durch Mineralisierung zu gefälltem Kalziumkarbonat (PCC) gebunden werden. In jedem Fall ist der Ausgangspunkt derselbe: Die Abscheidung von CO_2 erfolgt aus dem Rauchgasstrom.

turbines or coal gasification. Oxy-fuel combustion ensures a CO_2-rich flue gas from which high-pressure CO_2 can be captured.

Established technology – sophisticated components

Captured CO_2 can be utilized, permanently stored underground or sequestered through mineralisation to precipitated calcium carbonate (PCC). In each case, the starting point is the same: CO_2 is captured from the flue gas stream.

In Europe, more than 20 years ago, Equinor began capturing and sequestering CO_2 at the Sleipner West field in the Norwegian North Sea. The components of this technology have long been mature. In addition, CCS has been used for many years in conjunction with CO_2 utilization for enhanced oil recovery in Canada and the USA.

Safe, permanent underground CO_2 storage in saline aquifers and depleted reserves is another area where Oil & Gas companies, oilfield service

Schon vor mehr als 20 Jahren Europa hat Equinor mit der Abscheidung und Sequestrierung von CO_2 auf dem Sleipner-West-Feld in der norwegischen Nordsee begonnen. Die Komponenten dieser Technologie sind längst ausgereift. Zudem wird CCS seit vielen Jahren in Verbindung mit der CO_2-Nutzung zur verbesserten Ölgewinnung in Kanada und den USA eingesetzt.

Auch die sichere, dauerhafte unterirdische CO_2-Speicherung in salinen Aquiferen und erschöpften Reserven ist ein Bereich, in dem Öl- und Gasunternehmen, Ölfelddienstleister und EPC-Unternehmen die Energiewende voranbringen können. Denn wie das vorhandene SMR-Fachwissen kann das aus der Exploration und Bohrung nach fossilen Brennstoffen entstandene bei der Erschließung neuer CCS-Lagerstätten einfließen. Zudem erfordert ein künftiges CO_2-Transportnetz Fachwissen im Bereich der Pipelines.

Hub-and-Cluster-Systeme werden komplexer

Die heutigen CCS-Konzepte verbinden meist eine CO_2-Abscheidungsstelle mit einer unterirdischen geologischen CO_2-Speicherstelle. Wahrscheinlich wird dies zu komplexeren Hub-and-Cluster-Systemen führen, bei denen CO_2 aus mehreren Anlagen abgeschieden und in ein Netz eingespeist wird, das mit einer Fernleitung verbunden ist. Dies entspricht den Transport- und Verteilungsnetzen für Erdgas, allerdings mit umgekehrter Flussrichtung für CO_2.

Trotz jahrzehntelanger Erfahrung gibt es immer noch latente Bedenken gegen die unterirdische CO_2-Speicherung. Dabei kann CCS einen wichtigen Beitrag zur Energiewende leisten.

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providers, and EPC companies can advance the energy transition. This is because, like existing SMR expertise, the knowledge gained from fossil fuel exploration and drilling can be incorporated into the development of new CCS reservoirs. In addition, a future CO_2 transport network will require pipeline expertise.

Hub-and-cluster systems become more complex

Current CCS concepts usually combine a CO_2 capture site with an underground geological CO_2 storage site. This will likely lead to more complex hub-and-cluster systems, where CO_2 is captured from multiple facilities and injected into a network connected to a transmission pipeline. This is similar to the transportation and distribution networks for natural gas, but with the flow direction reversed for CO_2.

Despite decades of experience, there are still latent reservations about underground CO_2 storage. Yet CCS can make an important contribution to the energy transition.

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Die sichere CO_2-Speicherung in salinen Aquiferen bringt die Energiewende voran.

Safe CO_2 storage in saline aquifers advances the energy transition.

Quelle/*Source*: Ole Jørgen Bratland © Equinor

CO_2-Abscheidung für eine kreislauforientierte Kohlenstoffwirtschaft
CO_2 Capture for a circular carbon economy

Fortschrittliche Gasreinigungssysteme ermöglichen es, mehrere Schadstoffe zu entfernen und NOx zu reduzieren.
Advanced gas purification systems make it possible to remove multiple pollutants and reduce NOx.
Quelle/*Source*: GEA Group Aktiengesellschaft

Kraftwerke, die fossile Brennstoffe einsetzen, Müllverbrennungsanlagen sowie die Stahl-, Aluminium-, Glas-, Düngemittel- und Zementindustrie haben eines gemeinsam: Sie alle sind Branchen mit einem hohem CO_2-Ausstoß. Ein Großteil der globalen CO_2-Emissionen resultiert aus der Energiegewinnung und stammt aus der Verbrennung fossiler Brennstoffe. In einigen Industriezweigen gehen diese energiebedingten CO_2-Emissionen mit prozessbedingten aus der Umwandlung des Ausgangsmaterials einher. Die Abscheidung von Kolendioxid birgt großes Potenzial, um das wichtige Ziel der Eindämmung der globalen Erwärmung zu erreichen.

Technologien für die Emissionsreduktion

Investitionen in Energieeinsparungen und die Verringerung von CO_2-Emissionen werden nicht nur Wettbewerbsvorteile angesichts der künftig steigenden Kosten für CO_2-Emissionen erbringen. Sie können auch dazu beitragen, die Umwelt für künftige Generationen zu erhalten. Emissionskontrolltechnologien helfen dabei, dieses Ziel zu erreichen. Dazu zählen beispielsweise Anlagen,

Fossil fuel power plants, waste incineration plants, as well as the steel, aluminum, glass, fertilizer and cement industries all have one thing in common: they are all industries with high CO_2 emissions. A large proportion of the global CO_2 emissions result from the energy production due to the combustion of fossil fuels. In some industries, these energy-related CO_2 emissions are accompanied by process-related emissions from the conversion of the feedstock. Carbon capture holds great potential for achieving the important goal of mitigating global warming.

Technologies for Emissions reduction

Investments in energy saving and CO_2 emissions reduction will not only provide competitive advantages in the face of rising CO_2 emissions costs in the future, but they can also help preserve the environment for future generations. Emissions control technologies help achieve this goal. These include, for example, plants that recover the waste heat from exhaust gas streams or gas cleaning technologies that treat gases before they reach the CO_2 capture equipment and solutions

die Abwärme aus Abgasströmen rückgewinnen. Auch Gasreinigungstechnologien, die Gase behandeln bevor sie auf die CO_2-Abscheidungsanlagen treffen, und Lösungen für die CO_2-Abscheidung selbst dienen der Kohlendioxidreduktion. Diese Technologien unterstützen insbesondere Branchen mit hohem CO_2-Ausstoß beim Übergang von einer fossil befeuerten zu einer kohlenstoffarmen Wirtschaft.

Rückgewinnung von Abwärme

Überschüssige Wärme aus industriellen Prozessen etwa der Glas- und Zementherstellung zu nutzen, ist der erste Schritt, um die globalen Klimaschutzziele zu erreichen. In vielen Fällen stammen die dabei entstehenden Rauchgase aus Schmelzöfen oder anderen Hochtemperaturquellen. Lösungen für die CO_2-Abscheidung, die Anwender häufig am Ende des Prozesses einsetzen, beruhen auf Niedertemperaturverfahren wie der Absorption. Diese Verfahren arbeiten typischerweise bei Temperaturen im Bereich von 30 bis 80 Grad Celsius. Das heißt, im Prozess müssen die Eingangsgase gekühlt werden. Hierfür eignen sich Anlagen für die Abwärmerückgewinnung, sogenannte Waste Heat Recovery Units (WHRU).

Anwender können die zurückgewonnene Abwärme zum Beispiel nutzen, um den internen Wärmebedarf zu decken oder für die Erzeugung anderer Produkte wie Dampf oder Strom durch einen Organic Rankine Cycle (ORC) einsetzen. Zudem können diese Anlagen Druckluft erzeugen.

for CO_2 capture itself also help reduce carbon dioxide. These technologies are especially helpful for industries with high CO_2 emissions as they transition from a fossil-fueled to a low-carbon economy.

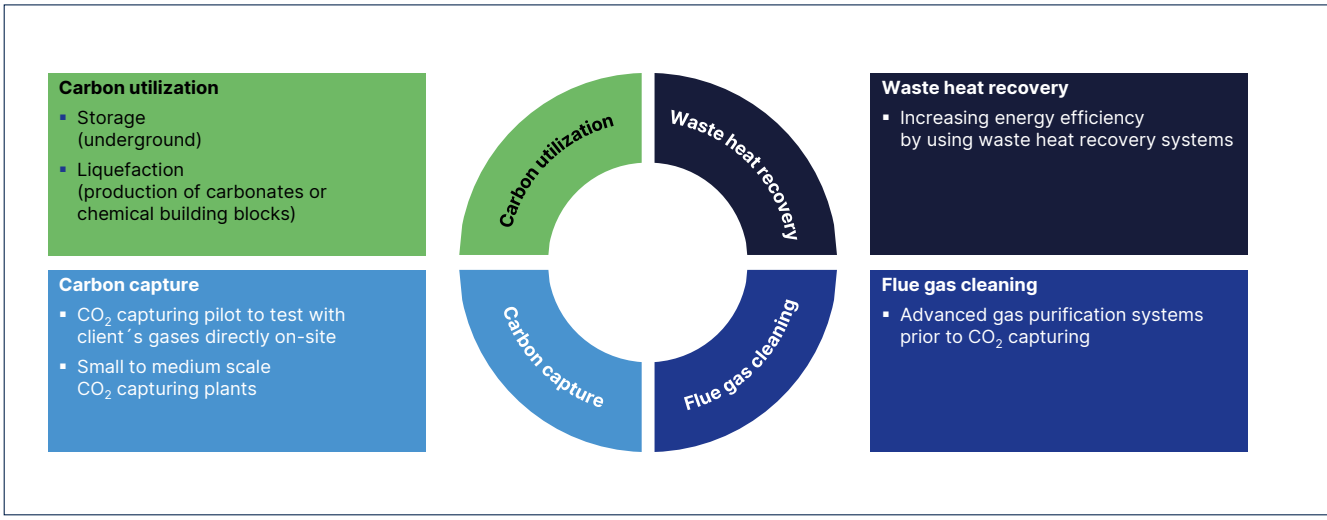
Waste Heat Recovery

Utilizing excess heat from industrial processes such as glass and cement manufacturing is the first step toward meeting global climate change goals. In many cases, the resulting flue gases come from smelting furnaces or other high-temperature sources. Solutions for CO_2 capture, which users often employ at the end of the process, rely on low-temperature processes such as absorption. These processes typically operate at temperatures in the range of 30 to 80 degrees Celsius. This means that in the process, the input gases must be cooled. Waste heat recovery units (WHRU) are suitable for this purpose.

Users can employ the recovered waste heat to, for example, cover internal heat requirements or to generate other products such as steam or electricity through an Organic Rankine Cycle (ORC). In addition, these plants can generate compressed air.

Pretreatment and capture of CO_2

The pretreatment of the exhaust gas is the next step to reduce CO_2 and ensure the long-term stability and performance of the amine scrubber



Die Grafik zeigt mögliche Wege zur Reduzierung, Abscheidung und Nutzung von CO_2.
The graphic shows possible ways to reduce, capture and use CO_2.

Quelle/*Source*: GEA Group Aktiengesellschaft

Vorbehandlung und Abscheidung von CO_2

Die Vorbehandlung des Abgases ist der nächste Schritt, um CO_2 zu reduzieren und die langfristige Stabilität und Leistung des Aminwäschersystems zu gewährleisten. Hierfür gibt bereits verschiedene Lösungen, die Schadstoffe wie Staub, Aerosole, Schwefelverbindungen oder Stickoxide entfernen. Sobald das Abgas sauber ist, kann die CO_2-Abscheidung beginnen. Neue Technologien zur Abscheidung von Kohlendioxid entwickeln sich rasch. Die Industrie setzt bereits ein Vielzahl von Methoden erfolgreich zur Abscheidung von CO_2 aus verschiedenen Quellen ein.

Die Erfassungstechnologien können in drei Hauptkategorien eingeteilt werden :

- Oxyfuel-Verbrennung
- Vorverbrennung
- Nachverbrennung

Es empfiehlt sich, die CO_2-Abtrennung am Ende des Abgasreinigungsprozesses einzusetzen, um vorgelagerte Produktionsprozesse so wenig wie möglich zu beeinflussen.

system. Various solutions are already available for this purpose, removing pollutants such as dust, aerosols, sulfur compounds or nitrogen oxides. Once the exhaust gas is clean, CO_2 capture can begin. New technologies for capturing carbon dioxide are developing rapidly. The industry is already successfully using a variety of methods to capture CO_2 from different sources.

Capture technologies can be divided into three main categories:

- Oxyfuel combustion
- pre-combustion
- post-combustion

It is recommended to use CO_2 capture at the end of the flue gas cleaning process to minimize the impact on upstream production processes.

The current industrial process for capturing CO_2 from large flue gas streams is chemical absorption with amine solvents. Users of CO_2 capture systems can thus capture CO_2 with varying degrees of purity from very different flue gas compositions.

Quelle/*Source*:
GEA Group Aktiengesellschaft

Die Anlage minimiert den Energiebedarf durch Nutzung von Abwärme und Umwandlung in Strom, Dampf oder Fernwärme.

The plant minimizes energy demand by using waste heat and converting it into electricity, steam or district heating.

Das derzeitige industrielle Verfahren zur Abscheidung von CO_2 aus großen Rauchgasströmen ist die chemische Absorption mit Amin-Lösungsmitteln. Anwender von CO_2-Abscheidungsanlagen können damit CO_2 mit unterschiedlichen Reinheitsgraden aus sehr unterschiedlichen Abgaszusammensetzungen abscheiden.

Abscheidung erproben

Um die CO_2-Abscheidung zu erproben und zu demonstrieren können Anwender eine mobile Pilotanlage nutzen. Die Anlage ist in einem 20-Fuß-ISO-Container untergebracht und somit der einfache Transport, die schnelle Installation und Inbetriebnahme möglich.

Das implementierte Quench- und Gasvorbehandlungssystem enfernt SOx- und NOx-Stickoxide. Die Anlage bewältigt Vorlauftemperaturen von bis zu 400 Grad Celsius und ist mit einem zweistufigen Partikelfiltersystem ausgestattet, um die Lebensdauer der Lösungsmittel zu maximieren. Die Anlage arbeitet mit der Amintechnologie und ist mit einem Absorptions-Desorptionssystem ausgestattet, das CO_2 energieeffizient rückgewinnt. Die Pilotanlage ermöglicht es auch, unerwünschte Emissionen von Amindämpfen im Abgas zu reinigen, bevor sie in die Umwelt gelangen.

Speicherung oder Wiederverwertung

Anwender sind angelhalten die erneute Emission des geförderten CO_2 zu vermeiden. Dies können sie, indem sie CO_2 unterirdisch speichern oder es für andere Produkte nutzen. Es gibt Lösungen, die CO_2 vor der Anlage verflüssigen und Verwertungsmöglichkeiten anbieten, um unter anderem karbonatbasierte Produkte wie Natriumbikarbonat aus dem abgetrennten CO_2 herzustellen.

Künftig wird es darum gehen, die Energieeffizienz bei Produktions- und Emissionsprozessen zu steigern und effiziente Lösungen einzusetzen, die die Abscheidung, Speicherung und Nutzung von Kohlenstoff erleichtern.

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Ettlingen

Testing Capture

To test and demonstrate the CO_2 capture process, users can implement a mobile pilot plant. The plant is housed in a 20-foot ISO container for easy transport, quick installation and commissioning.

The implemented quench and gas pretreatment system removes SOx and NOx nitrogen oxides. The plant handles feed temperatures of up to 400 degrees Celsius and is equipped with a two-stage particulate filter system to maximize the life of the solvents used. In addition, the plant uses amine technology and is equipped with an absorption-desorption system that recovers CO_2 from flue gas streams in an energy-efficient manner. In addition to the CO_2 capture system, the pilot plant also allows unwanted emissions to be cleaned from amine vapors in the flue gas before they are released into the environment.

Storage or recycling

Users are encouraged to avoid the re-emission of the extracted CO_2 to protect the environment. They can do this by storing the CO_2 underground, for example, or by using it for other products. There are solutions that liquefy the CO_2 upstream of the plant and offer recycling options to produce carbonate-based products from the captured CO_2 such as sodium bicarbonate or sodium carbonate, among others.

For the industry to successfully contribute to reaching climate targets, the future will be about increasing energy efficiency in production and emission processes and using efficient solutions that facilitate carbon capture, storage and utilization.

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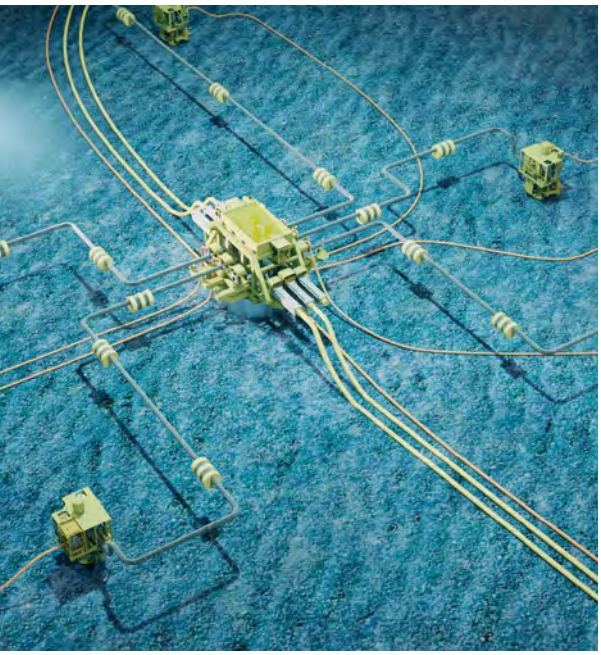
Prozessanlagen – sauber und sicher unter Wasser
Process systems – clean and safe in the subsea

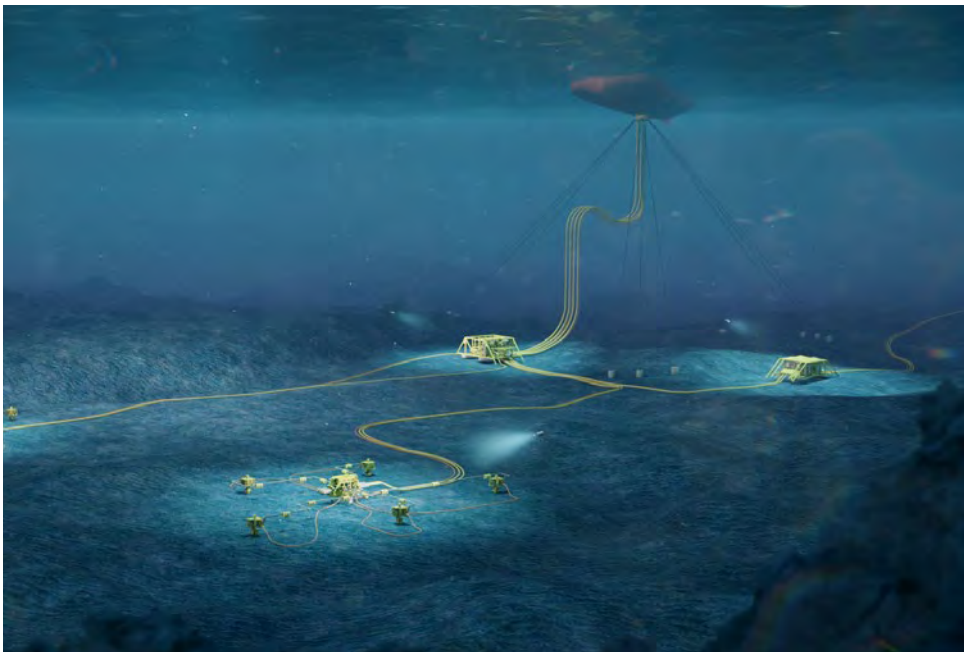
Die Prozessindustrie sucht derzeit intensiv nach Möglichkeiten, nachhaltiger zu produzieren. Es gilt, Ressourcen so umweltverträglich wie möglich zu fördern. Dies spielt ganz besonders bei Förderstätten in empfindlichen Ökosystemen wie der Tiefsee eine zentrale Rolle. Hier setzen Betreiber von Prozessanlagen bislang vorrangig auf Hydraulikzylinder, um Ventile unter Wasser mit einer Viertelumdrehung und definierter Kraft zu öffnen und zu schließen. Offshore-Installationen müssen diese Zylinder allerdings von einem zentralen Hydraulikaggregat aus mit mehreren Kilometer langen Hydraulikleitungen versorgen. Kompakte elektrische Subsea Valve Aktuatoren können künftig herkömmliche Hydraulikzylinder auf gleichem Bauraum und gepaart mit bewährter Sicherheitstechnik ersetzen.

Betreiber, die Zylinder in Offshore-Prozessanlagen von einem zentralen Hydraulikaggregat aus über mehrere Kilometer lange Hydraulikleitungen versorgen, benötigen sehr viel Energie, um die kumulierten Verluste zu kompensieren. Zudem kann diese Lösung die Bewegung nur grob steuern. Anlagenhersteller und Betreiber setzen bisher

The process industry is looking closely at ways of manufacturing products more sustainably. The aim is to extract resources in the most environmentally friendly way possible. This applies in particular to production sites in sensitive ecosystems such as the deep sea. Here, the operators of process systems have mainly relied on hydraulic cylinders in order to open and close subsea valves with a quarter turn and a defined force. With offshore installations, these cylinders must be supplied by a central hydraulic power unit with miles-long hydraulic pipes. In the future, compact electric subsea valve actuators will be able to replace conventional hydraulic cylinders. They take up no additional space and can be combined with proven safety systems.

Operators who supply cylinders in offshore process systems from a central hydraulic power unit via miles-long hydraulic pipes require a great part of energy to compensate for the cumulative losses. What is more, this solution cannot control the movement precisely. To date, system engineers and operators have still relied on





Bei Unterwasserfabriken entfallen künftig kilometerlange Hydraulikleitungen.
In the future, miles-long hydraulic pipes will no longer be needed.

Quelle/*Source*: Bosch Rexroth AG

dennoch auf Hydraulikzylinder, weil nur sie die bewährte Sicherheitstechnik mit mechanischer Feder auf kompaktem Bauraum gewährleisten. Die bisher verfügbaren elektrischen Aktuatoren bieten keine entsprechende Sicherheitsfunktion, da diese bei dem vorgegebenen Bauraum und Gewicht nicht realisiert werden können. Ansätze, die Sicherheit über Unterwasser-Batterien zu gewährleisten, können ein sicheres Schließen über die geforderte Lebensdauer von bis zu 25 Jahren nicht zuverlässig sicherstellen.

Sicher und umweltfreundlich

Diesen Herausforderungen tritt ein neuer Subsea Valve Actuator entgegen, der Ventile in der Unterwasser-Prozessindustrie elektrisch betätigt. Der Aktuator wurde in Zusammenarbeit mit mehreren Ausrüstern und Betreibern von Offshore-Installationen sowie internationalen Universitäten entwickelt. Die neuen Module bestehen aus einem druckkompensierten Behälter, in dem ein elektrischer Antrieb, eine Motion Control und eine Sicherheitsvorrichtung integriert sind. Durch Condition Monitoring und Sicherheitsfeder erreicht der Aktuator das sogenannte Safety Integrity Level (SIL) 3 nach den internationalen Normen IEC 61508 und IEC 61511. Darüber hinaus trägt diese Lösung auch dazu bei, die CO_2-Emissionen von Prozessanlagen sowie Umweltrisiken erheblich zu senken. Weitere Einsatzgebiete sind zukünftige Prozessanlagen zur Herstellung von grünem Wasserstoff, bei denen beispielsweise Offshore-Windanlagen erneuerbaren Strom erzeugen und vor Ort Wasserstoff herstellen, der über Pipelines an Land transportiert wird. Auch kann der Aktuator künftig bei der Kohlenstoffabscheidung aus der Atmosphäre und der Kohlenstoffspeicherung in erschöpften Lagerstätten unter Wasser eine Rolle spielen.

Standardisierung der Unterwasser-Prozessindustrie

Der Unterwasser-Aktuator basiert auf Komponenten aus der Großserienproduktion. Die Elektronik der Motion Control stammt aus dem Automotivesegment, ist robust und zuverlässig. Die Lösung ist für Einsatztiefen bis 4.000 Meter unter Wasser und auf eine Lebensdauer von 25 Jahren ausgelegt. Der durchgängige Einsatz international genormter Schnittstellen ermöglicht Herstellern, Betreibern und Offshore-Dienstleistern weitere Standardisierungen in der Unterwasser-Prozessindustrie.

hydraulic cylinders because they are the only components to offer proven safety systems with a mechanical spring in a compact design. The electric actuators which are currently available do not have such a safety function as this is not possible given the size and weight requirements. Approaches designed to ensure safety using subsea batteries cannot guarantee the reliable closing of valves over the required operating life of up to 25 years.

Safe and environmentally friendly

A new Subsea Valve Actuator which operates valves in the subsea process industry electrically meets these challenges. The actuator was developed in partnership with a number of suppliers and operators of offshore installations as well as international universities. The new modules comprise a pressure-compensated enclosure which contains an electric drive, a motion control system and a safety device. Thanks to condition monitoring and a safety spring, the actuator is able to satisfy the so-called Safety Integrity Level (SIL) 3 in accordance with the international standards IEC 61508 and IEC 61511. The solution is also helping to significantly reduce not only CO_2 emissions from process systems but also environmental risks. Other areas of use include future process systems for the production of green hydrogen where for example offshore wind energy plants generate renewable energy and hydrogen on site which is then transported ashore via pipelines. The actuator may also play a future role in carbon capture from the atmosphere and carbon storage in previous subsea production facilities.

Standardization of the subsea process industry

The subsea actuator is designed for series production. The electronics for the motion control system are from the automotive sector and is highly robust and reliable. The solution is designed for depths of up to 4,000 meters subsea and is designed to operate for 25 years. The use of internationally standardized interfaces throughout enables plant engineers, operators and offshore service providers to achieve further standardization in the subsea process industry.

Nur ein Kabel für Stromversorgung und Kommunikation

Die Lösung kann bisher verwendete Hydraulikzylinder eins zu eins ersetzen und benötigen nur ein Kabel für die Stromversorgung und die Kommunikation. Mit der Umstellung auf kompakte und sichere elektrische Aktuatoren entfallen die kilometerlangen Hydraulikleitungen mit den dazugehörigen Aggregaten und Steuerungen. Die bereits installierten elektrischen Versorgungsleitungen für Sensoren reichen für den zuverlässigen Betrieb der Aktuatoren aus.

Niedriger Energieverbrauch

Gezielt für sensible Ökosysteme ausgelegt, minimiert der Aktuator den Energieverbrauch. Gleichzeitig reduzieren sich die Installations- und Betriebskosten für Anwender. Der Aktuator befindet sich derzeit am Ende der Qualifikation für den technischen Reifegrad TRL 4 gemäß API 17. Prototypen in realer Größe absolvierten bereits erfolgreich Funktions- und Sicherheitstests auf einem normengerechten, für Unterwasser-Anwendungen gebauten Teststand. Die ersten Piloteinsätze in Unterwasseranlagen werden in Kürze starten.

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Only one cable for the power supply and communication

The solution can replace the hydraulic cylinders previously used on a 1:1 basis and requires only one cable for the power supply and communication. Switching to compact and safe electric actuators means that the miles-long hydraulic pipes along with the associated hydraulic power units and hydraulic controls are no longer required. The electric supply pipes which are already installed for sensors are adequate to ensure the reliable operation of the actuators.

Low energy consumption

Geared to sensitive ecosystems, the actuator minimizes energy consumption. At the same time, the installation and operating costs for users are reduced. The actuator is currently at the end of the qualification for technical maturity level TRL 4 according to API 17. Full scale prototypes performed functional and safety tests according to API and ISO standards on a specially built test bench for subsea applications. The first pilot tests in subsea systems will start soon.

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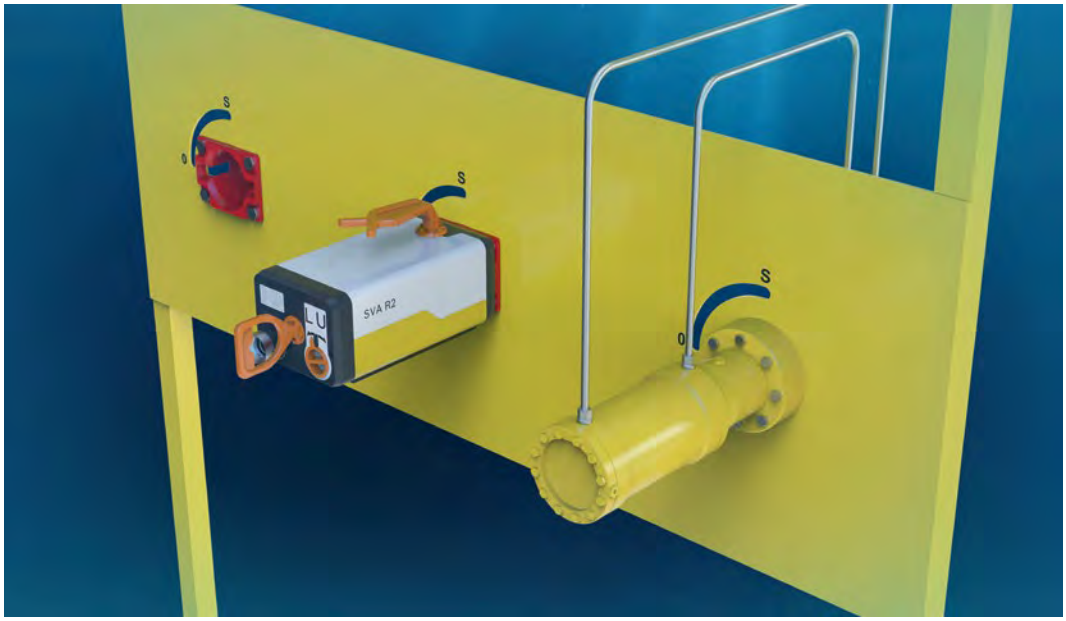

Quelle/*Source*:
Bosch Rexroth AG

Der Aktuator ist für Einsatztiefen bis 4.000 Meter unter Wasser geeignet.
The actuator is suitable for subsea use at depths of up to 4,000 meters.

Das Steuerungssystem für die Prozessautomatisierung: PC-based Control

Vollumfängliche Automatisierung aller Prozesse und Anlagen

- Integration aller Steuerungsfunktionen auf einer Hard- und Softwareplattform
- Steuerungs- und Kabelredundanz erhöht die Anlagenverfügbarkeit
- umfangreiches Portfolio an Komponenten für den Explosionsschutz
- EtherCAT-Module mit eigensicheren Schnittstellen für den direkten Anschluss von Feldgeräten bis aus Zone 0/20
- Unterstützung branchentypischer Standards wie NAMUR, HART und FDT/DTM
- nahtlose Einbindung von MATLAB®/Simulink® und Labview in TwinCAT
- TwinCAT MTP zur Modularisierung von Anlagen

Scannen und alles über PC-based Control für die Prozessindustrie erfahren

New Automation Technology **BECKHOFF**

Mit solchen Anlangen wird es möglich, Wasserstoff zu industrialisieren.
These approaches and structures will make it possible to produce industrial quantities of hydrogen.

Quelle/*Source*: Weidmüller

AquaVentus – ein Bündnis für die Energiewende
AquaVentus – an Alliance for the Energy Transition

Die Mitglieder des im Jahr 2020 gegründeten Fördervereins AquaVentus engagieren sich für das Erreichen der Klimaschutzziele und wollen die Transformation des europäischen Energie- und Wirtschaftssystems voranbringen. Bereits zwei Jahre nach seiner Gründung gehören dem Förderverein über 100 Mitglieder aus unterschiedlichen Organisationen, Unternehmen und Forschungseinrichtungen an. Die Initiative setzt sich für die Erzeugung von grünem Wasserstoff auf See ein und fokussiert diesen als zentralen Bestandteil der Energiewende. Regenerativer Wasserstoff soll einen erheblichen Beitrag zur CO_2-freien Energieversorgung leisten und gilt als Hoffnungsträger für eine nachhaltige Energiepolitik. Zentral für die Vision von AquaVentus ist das Projekt AquaDuctus, der Transport des Grünen Wasserstoffs per Pipeline an Land. Zeitgleich gerät der nach dem Zertifizierungsstandard Green Hydrogen hergestellte Wasserstoff durch den ansteigenden Weltmarktpreis für Erdgas zunehmend in den Fokus der Energiewirtschaft.

The members of the AquaVentus association, founded in 2020, are committed to achieving climate protection goals and to advancing the transformation of the European energy and economic system. Just two years after its founding, the association already has over 100 members from various organisations, companies and research institutions. The initiative advocates the production of green hydrogen at sea and focuses on it as a central component of the energy transition. Renewable hydrogen is anticipated to make a significant contribution to the CO_2-free energy supply and is seen as a beacon of hope for a sustainable energy policy. Central to the AquaVentus vision is the AquaDuctus project, which transports green hydrogen by pipeline from offshore to land. At the same time, hydrogen produced according to the Green Hydrogen certification standard is increasingly coming into the focus of the energy industry due to the rising world market price for natural gas.

Dekarbonisierung mithilfe von Offshore-Windenergie

Die Herausforderung der nächsten Jahre besteht darin, eine Dekarbonisierung in Bereichen zu realisieren, die sich nicht elektrifizieren lassen, beispielsweise die Grundstoffindustrie. Hier soll klimaneutraler Wasserstoff künftig eine Schlüsselrolle spielen. Ziel von AquaVentus ist es, dafür bis 2035 eine Million Tonnen grünen Wasserstoff zu erzeugen. Deshalb initiiert der Förderverein eine Vielzahl aufeinander abgestimmter Produktinnovationen wie die Entwicklung großskaliger Offshore-Elektrolyseure. Ein wichtiger Meilenstein dabei: Bis 2035 muss hierfür eine netz- und systemdienliche Produktion von zehn Gigawatt Erzeugungsleistung aus Offshore-Windenergie in der Nordsee realisiert werden. Zum Vergleich: Allein in der Stahlindustrie könnten 2,2 Millionen Tonnen klimaneutraler Wasserstoff pro Jahr zum Einsatz kommen. AquaVentus strebt außerdem an, eine entsprechende Transportinfrastruktur sowie einen Zeitspeicher für Elektrizität zu etablieren.

Die Nordsee – Voraussetzungen für Windenergie schaffen

Um eine Versorgungssicherheit im Sinne der Bundesnetzagentur zu gewährleisten, ist ein hinreichender Anteil heimischer beziehungsweise europäischer Produktion von grünem Wasserstoff ausschlaggebend. Deshalb fordert der Förderverein eine entsprechende Flächenausweisung in der Nordsee. Als grünes Kraftwerk eignet sich die Nordsee ideal, um große Energiemengen aus Windenergie sicherzustellen. Das Bundesamt für Seeschifffahrt und Hydrographie (BSH) könnte

Decarbonisation Using Offshore Wind Energy

The challenge of the next few years is to realise decarbonisation in sectors that cannot be converted to electrical energy, such as the primary industry. This is where climate-neutral hydrogen shall play a key role in the future. In order to achieve this, the production of one million tonnes of green hydrogen by 2035 has been set as an objective by AquaVentus. For this reason, the association is initiating a number of coordinated product innovations, including the development of large-scale offshore electrolysers. An important milestone: by 2035, ten gigawatts of generation capacity from offshore wind energy in the North Sea must be realised for this purpose. By way of comparison, the steel industry alone could use 2.2 million tonnes of climate-neutral hydrogen per year. AquaVentus also aims to establish a corresponding transport infrastructure as well as a time storage facility for electricity.

The North Sea – Creating the Conditions for Wind Energy

A sufficient share of domestic and European production of green hydrogen is crucial to ensure security of supply as defined by the Bundesnetzagentur (Federal Network Agency). The association therefore calls for a corresponding area designation in the North Sea. As a green power plant, the North Sea is ideally suited to secure large amounts of energy from wind power. The Bundesamt für Seeschifffahrt und Hydrographie (BSH) (Federal Maritime and Hydrographic Agency) could create further conditions for the required offshore construction in this respect. To ensure that the five projects carried out under the umbrella of AquaVentus can be planned in a targeted manner, the initiative is calling for:

Quelle/*Source*: AquaVentus

Grüner Wasserstoff: AquaVentus will zehn Gigawatt Erzeugungsleistung bis 2035 erreichen.

Green hydrogen: AquaVentus aims to achieve ten gigawatts of generation capacity by 2035.

hier weitere Voraussetzungen für den benötigten Offshore-Zubau schaffen. Für eine zielgerichtete Planbarkeit der unter dem Dach der Initiative durchgeführten fünf Projekte fordert AquaVentus deshalb:

- die Förderung von Offshore-Wasserstoff zu definieren, um eine zielgerichtete Planbarkeit zu schaffen sowie
- ein eigenes Offshore-Wasserstoff-Ziel in der nationalen Wasserstoffstrategie des Ministeriums für Bildung und Forschung zu verankern.

In dem Gehäuse werden Daten aus Elektrolyse-Stacks und Brennstoffzellen erfasst.

Data from electrolysis stacks and fuel cells is recorded in the housing. Quelle/*Source*: Weidmüller

Zehn Gigawatt Erzeugungsleistung ermöglichen

AquaVentus hat bereits erste Grundlagen geschaffen, um die Vorhaben der Initiative zu erreichen. Der Verein ist dabei seinem großen Ziel, zehn Gigawatt Leistung für grünen Wasserstoff aus Offshore-Windenergie zu erzeugen, bereits ein großes Stück nähergerückt. Das BSH schreibt dieses Jahr das Windvorranggebiet „SEN-1“ aus. Betreiber und Hersteller errichten dort den global ersten, großskaligen Off-Shore-Wasserstoffpark mit einer Leistung von circa 300 Megawatt.

Die neu entstehende Wertschöpfungskette gibt auch Industrien einen bedeutenden Wachstumsschwung: „Der Bereich der erneuerbaren Energien ist geradezu prädestiniert für zukunftsweisende, datengetriebene Geschäftsmodelle von der Anlagenerrichtung über den Betrieb bis hin zu modernen Servicekonzepten“, sagt Dr. Timo Berger, Vertriebsvorstand des Elektronikherstellers Weidmüller, eines der Gründungsmitglieder von AquaVentus.

Autor:
Dirk Bauerkämper
Head of Market Management New Energies
Weidmüller Interface GmbH & Co. KG
Detmold

- *a production definition of offshore hydrogen in order to create structured planning capability and*
- *the integration of a separate offshore hydrogen target in the national hydrogen strategy of the Ministry of Education and Research.*

Achieving Ten Gigawatts of Generation Capacity

The first foundations for achieving AquaVentus' goals have already been laid. The association has made substantial progress in this major objective of generating ten gigawatts of power for green hydrogen from offshore wind energy. This year, the BSH is putting the wind priority area "SEN-1" out to tender. Operators and manufacturers are building the world's first large-scale offshore hydrogen park there, with a capacity of around 300 MW. The emerging value chain is also providing industries a significant boost to growth: "The area of renewable energy is practically predestined for forward-thinking, data-driven business models, from plant construction to operation to state-of-the-art service concepts," says Dr Timo Berger, Chief Sales Officer of electronics manufacturer Weidmüller, one of the founding members of AquaVentus.

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BARTEC

Global Safety Expert BARTEC is Ready for Hydrogen

BARTEC is a leading expert in safety, regulatory compliance, and outstanding performance in hazardous areas. The global group provides technology and solutions that protect both people and the environment wherever hazardous substances such as flammable liquids, gases, and dust occur. An expert in many industries, BARTEC has decades of specialist experience with the particularly high demands of the oil and gas industry. More recently, megatrends such as renewables and hydrogen are becoming increasingly important for the company's portfolio.

Many industrial production and transportation processes would be impossible without explosion protection. BARTEC, which operates worldwide and is headquartered in Bad Mergentheim, Germany, offers a full range of products, services, and integrated solutions, including:

- Tablets, phones, cameras, wireless network technology, and IIoT solutions for hazardous zones 1 and 2
- Explosion-proof and flameproof enclosures
- Lighting technology for hazardous areas
- CUI (Corrosion Under Insulation) monitoring
- Trace moisture and hydrocarbon dewpoint measurement
- Physical property analyzers for gases and liquids
- Local control stations with actuators and LED lights
- Panel PC and remote HMI solutions
- Trace heating, including monitoring and control

Proven experience

BARTEC's success story is based on over 45 years of experience in explosion protection and an immaculate track record in safety technology. It all started in 1975 with the development of a switch with a tremendous effect: it prevented explosions at fuel stations. The company's problem-solving success enabled it to open its first non-German European location in 1979, followed by Tokyo in 1987 and the US in 1994. BARTEC is now represented by 1400 employees, 12 production sites, and 52 subsidiaries, and the company is trusted by some of the biggest global players for safety, compliance, and process efficiency. BARTEC also provides expert consulting on complete packages and turnkey solutions.

The special challenges of hydrogen

BARTEC's experts know that every hazardous application is unique, and their almost five decades of knowledge in explosion-proof equipment is constantly being adapted to emerging technologies. Safety risks inherent in the production, storage, transportation, and conversion of hydrogen include permeation and hydrogen embrittlement, leaks, invisible flames, and hydrogen's low ignition energy. BARTEC experts select the perfect materials, enable regular inspections and maintenance with appropriate Ex-protected tools and sensors, and offer highly specialized measuring devices for H_2 applications to prevent explosions in hydrogen-hazardous areas, comply with all regulatory requirements, and run processes efficiently.

As the world keeps changing and energy sources keep evolving, one requirement remains the same: employees and the environment must be protected. BARTEC provides that protection – now and for the future. *Dr. Michael Krüger, Vice President Quality & Certification, BARTEC Top Holding GmbH*

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www.bartec.com

Internationale Messen und Markterschließung
International trade fairs and market development

Quelle/*Source*: Shutterstock.com

Die Unternehmen des Maschinen- und Anlagenbaus nutzen die globalen Messen, um ihre Leistungsfähigkeit zu präsentieren. Als ideeller Träger betreut der VDMA die Leitmesse IFAT. Zudem setzt er sich für die Branche mit Rahmenveranstaltungen auf der IFAT und der ACHEMA ein. Außerhalb Deutschlands organisiert der Verband Pavillons auf internationalen Messen, um seine Mitglieder in besonders anspruchsvollen Märkten zu unterstützen.

Companies in the mechanical and plant engineering sector use global trade fairs to showcase their capabilities. As its conceptual partner, VDMA backs the leading trade fair IFAT. VDMA also supports the industry by organizing framework events at IFAT and ACHEMA. Outside Germany, the association organizes pavilions at international trade fairs to support its members in particularly challenging markets.

AUMA hat Belange des Mittelstands im Blick

Jährlich werden circa 300 neue Messen in das Auslandsmesseprogramm (AMP) des Bundesministeriums für Wirtschaft und Klimaschutz (BMWK) in Abstimmung mit dem Ausstellungs- und Messe-Ausschuss der Deutschen Wirtschaft e.V. (AUMA) aufgenommen. Der AUMA koordiniert die Interessen der Wirtschaft und bezieht stets die besonderen Belange der mittelständischen Industrie mit ein.

Als zuständiger Verband beantragt der VDMA beim AUMA jährlich offizielle deutsche Gemeinschaftsstände für branchenrelevante Messen im Rahmen

AUMA acts in the interests of small and medium-sized enterprises

Every year, approximately 300 new exhibitions are listed in the Foreign Trade Fair Program (AMP) of the Federal Ministry for Economic Affairs and Climate Action (BMWK) in coordination with the Association of the German Trade Fair Industry (AUMA). AUMA represents the industry interests and speaks for medium-sized industries.

VDMA as responsible sector association acts for the industry and applies annually to AUMA for Official German Pavilions at industry-relevant trade fairs within the framework of the AMP. Such participations are officially promoted by the German federal

des AMP. Der Bund fördert die Teilnahme. Dadurch genießen Teilnehmende diverse Vorteil. Sie können zum Beispiel Kosten sparen oder werden bei der Standorganisation im In- und Ausland betreut. Seit Jahren beantragt der Verband für seine Mitglieder aus der Prozesstechnik für Öl- & Gas, Petrochemie, Chemie und Biomasse mehr als zehn Gemeinschaftsstände mit Bundesbeteiligung. Ergänzend organisiert er Gemeinschaftsstände zu weiteren wichtigen Auslandsmessen, die es nicht in das Programm des Bundes geschafft haben. Das regelmäßige Monitoring von Messen ermöglicht es, frühzeitig Marktentwicklungen im Blick zu haben und die Mitglieder darüber zu informieren.

Eine Übersicht zu internationalen Messen und Gemeinschaftsständen in den Sektoren Öl & Gas, Petrochemie, Chemie und Energietechnik bietet die folgende Tabelle. Die Messelisten werden regelmäßig aktualisiert und stehen Mitgliedern zur Verfügung (siehe QR-Code unter Messetabelle).

government. As a result, participants benefit from various advantages. For example, they can save costs or receive support in organizing their stands at home and abroad. For years, the association has applied for more than ten pavilions with federal participation for its members from the oil & gas, petrochemical, chemical and biomass process technology sectors. In addition, it organizes joint stands at other important foreign trade fairs that were not accepted by the federal government's program. Regular monitoring of trade fairs helps to keep an eye on market developments at an early stage and to inform the members about them.

The following table shows an overview of international trade fairs and joint stands in the oil & gas, petrochemical, chemical and energy technology sectors. The trade fair lists are regularly updated and are available to the members (see QR code under trade fair table).

VDMA Internationale(r) Messekalender / Gemeinschaftsstände Chemie, Petrochemie, Öl & Gas, Energietechnik 2023/24

VDMA list international exhibitions / German pavilions Chemistry, petrochemical industry, oil & gas, power technology 2023/24

Termin / *Date*	Event / *place*	Beteiligung / *Type of participation*
16. – 18.01.2023 (yearly)	WFES + Int. Water Summit, Abu Dhabi / U.A.E.	Special Event by Germen Energy Export Initiative
06. – 08.02.2023 (yearly)	India Energy Week, Bangaluru / India	German Pavilion by VDMA India
13. – 15.02.2023 (yearly)	EGYPS, Cairo / Egypt	Official German Pavilion
14. – 16.02.2023 (every 1,5 years)	FILTECH, Cologne / Germany	Europe's leading filtration exhibition
14. – 16.03.2023 (yearly)	Stocexpo, Rotterdam / The Netherland	Leading Sector Show
15. – 17.03.2023 (2 times a year)	FC EXPO, Tokio / Japan	–
17. – 21.04.2023 (yearly)	HANNOVER MESSE incl. ComVac, Digital Factory, Hannover / Germany	Leading Exhibition
01. – 04.05.2023 (yearly)	OTC Offshore Technology Conf. & Exh. Houston, Texas / USA	Official German Pavilion
17. – 19.05.2023 (yearly)	OGU, Tashkent / Uzbekistan	Official German Pavilion
31.05. – 02.06.2023 (yearly)	CIPPE, Peking / China	Official German Pavilion
31.05. – 02.06.2023 (yearly)	Caspian Oil & Gas, Baku / Azerbaijan	Official German Pavilion
05. – 08.09.2023 (yearly)	GASTECH / Singapore	German & Europe Pavilion supported by VDMA
05. – 08.09.2023 (uneven years)	SPE OE Aberdeen / UK	Official German Pavilion
13. – 15.09.2023 (uneven years)	OGA Oil Gas Asia, Kuala Lumpur / Malaysia	Official German Pavilion
26. – 28.09.2023 (each 1,5 years)	POWTECH Nuremberg / Germany	Leading Sector Show
27. – 28.09.2023 (yearly)	Hydrogen Technology Expo, Bremen / Germany	Leading Sector Show
02. – 05.10.2023 (yearly)	ADIPEC, Abu Dhabi / U.A.E.	Official German Pavilion
November 2023 (yearly)	Enlit (formely European Utility Week), tbc / Italy	Europe's leading Power Tech Show
January 2024 (yearly)	WFES + Int. Water Summit, Abu Dhabi / U.A.E.	Special Event by Germen Energy Export Initiative
February 2024 (yearly)	EGYPS, Cairo / Egypt	Official German Pavilion
February 2024 (yearly)	India Energy Week, Dehli/ India	German Pavilion by VDMA India

Termin / *Date*	Event / *place*	Beteiligung / *Type of participation*
March 2024 (yearly)	CIPPE, Peking / China	Official German Pavilion & European Pavilion (VDMA)
04. – 07.03.2024 (even years)	CHEMTECH & Pharma WorldExpo/ WaterEx, Mumbai/ India	Official German Pavilion
15. – 19.04.2024 (even years)	TUBE & Wire, Düsseldorf / Germany	Leading Sector Show
22. – 26.04.2024 (yearly)	HANNOVER MESSE incl. ComVac, Digital Factory, Hannover / Germany	Leading Sector Show
23. – 26.04.2024	Analytica Munich / Germany	Leading Sector Show
May 2024 (yearly)	OGU, Tashkent / Uzbekistan	Official German Pavilion
May 2024 (yearly)	OTC Offshore Technology Conf. & Exh. Houston, Texas / USA	Official German Pavilion
10. – 14.06.2024 (every 3 years)	ACHEMA Frankfurt / Germany	Leading Sector Show
June 2024 (yearly)	Caspian Oil & Gas, Baku / Azerbaijan	Official German Pavilion
26. – 29.08.2024 (even years)	ONS Stavanger / Norway	German Pavilion by AHK
03. – 06.09.2024 (even years)	SMM Hamburg / Germany	Leading Sector Show
September 2024 (yearly)	GASTECH, rotating locations, TBD	German & Europe Pavilion supported by VDMA
September 2024 (even years)	Rio Oil & Gas, Rio de Janeiro / Brazil	German-European Pavilion by AHK/VDMA
02. – 04.10.2024 (yearly)	KIOGE, Almaty / Kazachstan	Official German Pavilion
08. – 10.10.2024 (even years)	CHILLVENTA, Nuremberg / Germany	Leading Sector Show
October 2024 (yearly)	Hydrogen Technology Expo, Bremen / Germany	Leading Sector Show
Oktober 2024 (every 1,5 years)	FILTECH, Cologne / Germany	Europe's leading filtration exhibition
November 2024 (yearly)	ADIPEC, Abu Dhabi / U.A.E.	Official German Pavilion
November 2024 (yearly)	Enlit (formely European Utility Week), tbc / Italy	Europe's leading Power Tech Show
November 2024 (even years)	Valve World, Duesseldorf / Germany	Leading Sector Show

(Last update 08. November 2022)

Aktuelle Messe-Liste Prozesstechnik
Find here exhibition list Process Technology

Companies, products, services, applications

	Exploration technology, seismic technology, services, analysis	Oil and gas production, transport, storage: Drives, engines, actuators, couplings for engines	Valves	Filling and discharging technology	Vessels, silos, tanks	Drilling technology, oil rigs, equipment	High pressure injection systems	Compressors, vacuum technology, fans	Cranes, tools, handling equipment, loading arms	Laboratory and testing equipment	Process measuring and control technology, sensor technology, automation	Pumps	Risers, tubes, fittings, pig systems, welding technology, pipe handling	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, deep sea supply cable, couplings, electric components	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Power generators, local energy supply	Shipbuilding, offshore platforms; FPSO, FSO, FSU	Deep sea and undersea technology	Cryogenic technology	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Process tec (downstrea: Adsorption plants	Valves
Aerzener Maschinenfabrik GmbH								●																	
Air Liquide Global E&C Solutions Germany GmbH																								●	
Alfa Laval Mid Europe GmbH																●		●	●			●	●		
ANDRITZ Fliessbett Systeme GmbH																									
Andritz Separation GmbH																●							●		
API Schmidt-Bretten GmbH																						●			
APL Apparatebau GmbH					●											●						●			
Apollo Gößnitz GmbH				●			●					●							●						
ARCA Regler GmbH			●																						●
ARI-Armaturen Albert Richter GmbH & Co. KG		●	●																						●
Atlas Copco ENERGAS GmbH								●																	
ATLAS COPCO Kompressoren u. Drucklufttechnik GmbH								●																	
AUMA Riester GmbH & Co. KG		●	●								●														●
AviComp Controls GmbH		●	●					●		●	●	●	●				●		●						●
bar pneumatische Steuerungssysteme GmbH		●	●																						●
Bartec GmbH											●			●			●								
BAUER Deep Drilling GmbH	●				●	●																			
Beinlich Pumpen GmbH		●		●								●													
BHS-Sonthofen Process Technology GmbH & Co. KG																									
BÖHMER GmbH			●																						●
Boll & Kirch Filterbau GmbH																									
BORSIG Process Heat Exchanger GmbH								●			●													●	
BORSIG ZM Compression GmbH								●			●														
Bosch Rexroth AG		●							●	●	●				●		●			●					
Paul Bungartz GmbH & Co. KG				●								●													
Bürkert GmbH & Co. KG			●								●														
Buss-SMS-Canzler GmbH																									
Chemieanlagenbau Chemnitz GmbH																								●	
Contec GmbH																●									

chnology for petrochemical industry am)																													Fields of application by physical state			Fields of application by origin			Engineering			
Vessels, silos, tanks	Distillation plants and apparatus	Pressure Vessels	Evaporators	Power generators, local energy supply	Electrolyzers	Extraction plants and apparatus	Columns and fittings	Compressors, vacuum technology, fans	Crystallisation plants and apparatus	Laboratory and testing equipment	Air-; steam-; heat handling equipment	Process measuring and control technology, sensor technology, automation	Process water and fluids treatment	Pumps	Reaction plants and apparatus	Rectification plants	Pipeline technology, pig systems, tubes; flanges; fittings; cables; couplings	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, couplings, electric components	Re-cooling technology	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Dryers	Vacuum systems	Evaporators	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Solid (basic and fine chemicals, bitumen, fertilizers, cosmetics, pharmaceuticals)	Liquid (oil, LNG, LPG, Ethanol, Methanol)	Gaseous (biogas, natural gas, hydrogen, nitrogen, oxygen, argon, helium)	Biobased (biogas, bio-LNG, bioethanol, biodiesel, algae...)	Fossil (oil, gas, LNG, CNG, shale oil/gas, acid gas, grey hydrogen)	Climate neutral (green hydrogen, eFuels...)	EPC (Engineering, Procurement, Construction)	Components	Units, Skids, Systems	**Services**
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Companies, products, services, applications

	Exploration technology, seismic technology, services, analysis	Oil and gas production, transport, storage																						Process tec (downstrea	
		Drives, engines, actuators, couplings for engines	Valves	Filling and discharging technology	Vessels, silos, tanks	Drilling technology, oil rigs, equipment	High pressure injection systems	Compressors, vacuum technology, fans	Cranes, tools, handling equipment, loading arms	Laboratory and testing equipment	Process measuring and control technology, sensor technology, automation	Pumps	Risers, tubes, fittings, pig systems, welding technology, pipe handling	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, deep sea supply cable, couplings, electric components	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Power generators, local energy supply	Shipbuilding, offshore platforms; FPSO, FSO, FSU	Deep sea and undersea technology	Cryogenic technology	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Adsorption plants	Valves
DICKOW PUMPEN KG												●													
DREHMO GmbH		●	●								●														●
DST Dauermagnet-SystemTechnik GmbH		●																							
DURUM Verschleißschutz GmbH													●												
EagleBurgmann Germany GmbH & Co. KG																							●		
EDUR-Pumpenfabrik Eduard Redlien GmbH & Co. KG												●													
eltherm GmbH				●	●						●								●						
EMW filtertechnik GmbH																							●		
EnviroChemie GmbH																						●			
EXaL Technology GmbH & Co. KG			●																						●
Filtration Group GmbH																●			●			●			
Flottweg SE																●						●			
FLSmidth Wiesbaden GmbH																									
Frenzelit Werke GmbH																							●		
GEA Westfalia Separator Group GmbH																●						●			
GEA Wiegand GmbH								●																	
Geppert Rührtechnik GmbH																									
Grenzebach BSH GmbH																									
GSR Ventiltechnik GmbH & Co. KG			●			●													●		●				●
Güntner AG & Co. KG																									
H+E GmbH																							●		
Hammelmann GmbH							●					●							●						●
HBE GmbH																						●		●	
heat 11 GmbH & Co. KG																									
HENKEL Beiz- u. Elektropoliertechnik GmbH & Co. KG																									
HERMETIC-Pumpen GmbH				●								●													
Herrenknecht Vertical GmbH	●	●				●			●		●	●	●			●									
Hexonik Deutschland GmbH																						●	●		
Hofer Hochdrucktechnik GmbH								●													●				

chnology for petrochemical industry am)																													Fields of application by physical state			Fields of application by origin			Engineering			
Vessels, silos, tanks	Distillation plants and apparatus	Pressure Vessels	Evaporators	Power generators, local energy supply	Electrolyzers	Extraction plants and apparatus	Columns and fittings	Compressors, vacuum technology, fans	Crystallisation plants and apparatus	Laboratory and testing equipment	Air-; steam-; heat handling equipment	Process measuring and control technology, sensor technology, automation	Process water and fluids treatment	Pumps	Reaction plants and apparatus	Rectification plants	Pipeline technology, pig systems, tubes; flanges; fittings; cables; couplings	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, couplings, electric components	Re-cooling technology	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Dryers	Vacuum systems	Evaporators	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Solid (basic and fine chemicals, bitumen, fertilizers, cosmetics, pharmaceuticals)	Liquid (oil, LNG, LPG, Ethanol, Methanol)	Gaseous (biogas, natural gas, hydrogen, nitrogen, oxygen, argon, helium)	Biobased (biogas, bio-LNG, bioethanol, biodiesel, algae...)	Fossil (oil, gas, LNG, LPG, CNG, shale oil/gas, acid gas, grey hydrogen)	Climate neutral (green hydrogen, eFuels...)	EPC (Engineering, Procurement, Construction)	Components	Units, Skids, Systems	**Services**
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Companies, products, services, applications

	Exploration technology, seismic technology, services, analysis	Oil and gas production, transport, storage																						Process tec (downstrea	
		Drives, engines, actuators, couplings for engines	Valves	Filling and discharging technology	Vessels, silos, tanks	Drilling technology, oil rigs, equipment	High pressure injection systems	Compressors, vacuum technology, fans	Cranes, tools, handling equipment, loading arms	Laboratory and testing equipment	Process measuring and control technology, sensor technology, automation	Pumps	Risers, tubes, fittings, pig systems, welding technology, pipe handling	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, deep sea supply cable, couplings, electric components	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Power generators, local energy supply	Shipbuilding, offshore platforms; FPSO, FSO, FSU	Deep sea and undersea technology	Cryogenic technology	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Adsorption plants	Valves
HYDAC TECHNOLOGY GmbH											●					●			●			●	●		
INVENT Umwelt- und Verfahrenstechnik AG																							●		
ITT Bornemann GmbH												●													
ITT Rheinhütte Pumpen GmbH												●													
JAEGGI Hybridtechnologie AG																						●			
KAESER Kompressoren Ges.m.b.H.								●																●	
KAMAT-PUMPEN GmbH & Co. KG			●			●	●				●	●													●
KINKELE GmbH & Co. KG																			●	●					
KLAUS UNION GmbH & Co. KG			●	●								●													●
KLIPPPON Engineering / Weidmüller UK Ltd.																	●								
Klöpper-Therm GmbH & Co. KG																			●			●			
KOLLER Maschinen- und Anlagenbau GmbH			●	●		●			●	●			●					●		●					
Körting Hannover AG								●																	
KÖTTER Consulting Engineers GmbH & Co. KG																									
Krone Filter Solutions GmbH																●									
KSB Aktiengesellschaft			●								●	●							●		●				●
KUGLER Behälter und Anlagenbau GmbH																							●		
LAR Process Analysers AG										●	●														
LECHLER GmbH																							●	●	●
LENSER Filtration GmbH																									
LEWA GmbH												●													
Liebherr-MCCtec Rostock GmbH									●				●												
LIEBHERR-MISCHTECHNIK GMBH											●														
Linde AG Engineering Division			●				●					●									●	●		●	
Maag Automatik GmbH												●				●									
Mahler AGS GmbH																								●	
MainTech Systems GmbH																						●		●	
MAN Diesel & Turbo SE								●										●	●						
MANKENBERG GmbH			●													●									●

chnology for petrochemical industry am)																													Fields of application by physical state			Fields of application by origin			Engineering			
Vessels, silos, tanks	Distillation plants and apparatus	Pressure Vessels	Evaporators	Power generators, local energy supply	Electrolyzers	Extraction plants and apparatus	Columns and fittings	Compressors, vacuum technology, fans	Crystallisation plants and apparatus	Laboratory and testing equipment	Air-; steam-; heat handling equipment	Process measuring and control technology, sensor technology, automation	Process water and fluids treatment	Pumps	Reaction plants and apparatus	Rectification plants	Pipeline technology, pig systems, tubes; flanges; fittings; cables; couplings	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, couplings, electric components	Re-cooling technology	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Dryers	Vacuum systems	Evaporators	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Solid (basic and fine chemicals, bitumen, fertilizers, cosmetics, pharmaceuticals)	Liquid (oil, LNG, LPG, Ethanol, Methanol)	Gaseous (biogas, natural gas, hydrogen, nitrogen, oxygen, argon, helium)	Biobased (biogas, bio-LNG, bioethanol, biodiesel, algae...)	Fossil (oil, gas, LNG, LPG, CNG, shale oil/gas, acid gas, grey hydrogen)	Climate neutral (green hydrogen, eFuels...)	EPC (Engineering, Procurement, Construction)	Components	Units, Skids, Systems	**Services**
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Companies, products, services, applications

	Oil and gas production, transport, storage																								Process tec (downstrea	
	Exploration technology, seismic technology, services, analysis	Drives, engines, actuators, couplings for engines	Valves	Filling and discharging technology	Vessels, silos, tanks	Drilling technology, oil rigs, equipment	High pressure injection systems	Compressors, vacuum technology, fans	Cranes, tools, handling equipment, loading arms	Laboratory and testing equipment	Process measuring and control technology, sensor technology, automation	Pumps	Risers, tubes, fittings, pig systems, welding technology, pipe handling	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, deep sea supply cable, couplings, electric components	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Power generators, local energy supply	Shipbuilding, offshore platforms; FPSO, FSO, FSU	Deep sea and undersea technology	Cryogenic technology	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Adsorption plants	Valves
Mehrer Compression GmbH								●																		
Metzen Industries GmbH					●			●	●			●	●			●			●	●	●	●	●		●	
MONZ – Julius Montz GmbH																●									●	
MTU – Rolls-Royce Solutions GmbH		●																●	●							
NASH – Gardner Denver Deutschland GmbH								●																		
NETZSCH Pumpen & Systeme GmbH				●		●						●								●						
J. D. NEUHAUS GmbH & Co. KG									●												●	●				
NEUMAN & ESSER GmbH & Co. KG Maschinenfabrik	●							●												●		●				
OHL Gutermuth Industrial Valves GmbH		●	●																	●		●				●
Pepperl+Fuchs SE											●						●									
Pepperl+Fuchs Vertrieb Germany GmbH											●						●									
Pfaudler Werke GmbH		●	●		●						●	●										●				●
Phoenix Contact Electronics GmbH											●						●	●	●							
ProMinent GmbH												●											●			
PROTEGO – Braunschweiger Flammenfilter GmbH			●														●									●
Pumpenfabrik Wangen GmbH																										
PURPLAN GmbH																										
REMBE GmbH Safety + Control																										●
R. Stahl Schaltgeräte GmbH											●						●							●		
SAMSON AG Mess- und Regeltechnik			●								●															●
Schenck Process GmbH											●					●										
Schniewindt GmbH & Co. KG														●	●											
SERO PumpSystems GmbH												●							●		●		●			
SICK AG											●						●									
SIEMENS AG		●				●					●	●														
Siemens Energy Compressor GmbH																										
Silica Verfahrenstechnik GmbH																									●	
Spilling Energie Systeme GmbH																										
SPX Flow Technology Norderstedt GmbH												●														

…chnology for petrochemical industry …am)																													Fields of application by physical state			Fields of application by origin			Engineering			
Vessels, silos, tanks	Distillation plants and apparatus	Pressure Vessels	Evaporators	Power generators, local energy supply	Electrolyzers	Extraction plants and apparatus	Columns and fittings	Compressors, vacuum technology, fans	Crystallisation plants and apparatus	Laboratory and testing equipment	Air-; steam-; heat handling equipment	Process measuring and control technology, sensor technology, automation	Process water and fluids treatment	Pumps	Reaction plants and apparatus	Rectification plants	Pipeline technology, pig systems, tubes; flanges; fittings; cables; couplings	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, couplings, electric components	Re-cooling technology	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Dryers	Vacuum systems	Evaporators	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Solid (basic and fine chemicals, bitumen, fertilizers, cosmetics, pharmaceuticals)	Liquid (oil, LNG, LPG, Ethanol, Methanol)	Gaseous (biogas, natural gas, hydrogen, nitrogen, oxygen, argon, helium)	Biobased (biogas, bio-LNG, bioethanol, biodiesel, algae...)	Fossil (oil, gas, LNG, LPG, CNG, shale oil/gas, acid gas, grey hydrogen)	Climate neutral (green hydrogen, eFuels...)	EPC (Engineering, Procurement, Construction)	Components	Units, Skids, Systems	**Services**
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Companies, products, services, applications

	Exploration technology, seismic technology, services, analysis	Oil and gas production, transport, storage																						Process tec (downstrea	
		Drives, engines, actuators, couplings for engines	Valves	Filling and discharging technology	Vessels, silos, tanks	Drilling technology, oil rigs, equipment	High pressure injection systems	Compressors, vacuum technology, fans	Cranes, tools, handling equipment, loading arms	Laboratory and testing equipment	Process measuring and control technology, sensor technology, automation	Pumps	Risers, tubes, fittings, pig systems, welding technology, pipe handling	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, deep sea supply cable, couplings, electric components	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Power generators, local energy supply	Shipbuilding, offshore platforms; FPSO, FSO, FSU	Deep sea and undersea technology	Cryogenic technology	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Adsorption plants	Valves
STAUFF – Walter Stauffenberg GmbH & Co. KG											●		●			●									●
Stelzer Rührtechnik International GmbH																									
TA Roloff GmbH		●	●	●								●												●	
TECALEMIT GmbH & Co. KG			●	●							●	●													●
TGE Gas Engineering GmbH					●																●				
THALETEC GmbH																						●	●		
thermowave Gesellschaft für Wärmetechnik mbH																						●			
ThyssenKrupp UHDE GmbH																									
ThyssenKrupp Industrial Solutions AG																									
TIA Industrie-Abwasser-Behandlung GmbH																							●		
Trelleborg Sealing Solutions Germany GmbH																								●	
Tsurumi (Europe) GmbH																									
URACA GmbH & Co. KG							●					●											●		
Ventilatorenfabrik Oelde GmbH								●																	
VOITH Turbo – J.M. Voith GmbH & Co. KG		●																							
VSE Volumentechnik GmbH																									
WAGO Kontakttechnik GmbH & Co. KG											●														
WEBER Engineering GmbH & Co. KG																									
Weidmüller GmbH & Co. KG																	●								
Wepuko Pahnke GmbH												●							●		●				
WIKA Alexander Wiegand SE & Co. KG											●														
WITT-Gasetechnik GmbH & Co. KG																	●								●
WITTE PUMPS & TECHNOLOGY GmbH												●													
WITTENSTEIN motion control GmbH		●																	●	●					●
WOMA GmbH												●											●	●	
Zeppelin Power Systems GmbH & Co. KG		●										●					●	●	●						

…chnology for petrochemical industry …am)

…chnology for petrochemical industry (…am)																													Fields of application by physical state			Fields of application by origin			Engineering			
Vessels, silos, tanks	Distillation plants and apparatus	Pressure Vessels	Evaporators	Power generators, local energy supply	Electrolyzers	Extraction plants and apparatus	Columns and fittings	Compressors, vacuum technology, fans	Crystallisation plants and apparatus	Laboratory and testing equipment	Air-; steam-; heat handling equipment	Process measuring and control technology, sensor technology, automation	Process water and fluids treatment	Pumps	Reaction plants and apparatus	Rectification plants	Pipeline technology, pig systems, tubes; flanges; fittings; cables; couplings	Heaters, heat tracers, heating-cables, -mats, -hoses, -jackets, isolation mats	Cables, couplings, electric components	Re-cooling technology	Separators, decanters, centrifuges, filter	Safety features, explosion prevention, gas detection, odorizing, leakage systems	Dryers	Vacuum systems	Evaporators	Heat exchanger	Separation and treatment of water, oil, gas and solids, distillation, evaporators	Other parts and components	Solid (basic and fine chemicals, bitumen, fertilizers, cosmetics, pharmaceuticals)	Liquid (oil, LNG, LPG, Ethanol, Methanol)	Gaseous (biogas, natural gas, hydrogen, nitrogen, oxygen, argon, helium)	Biobased (biogas, bio-LNG, bioethanol, biodiesel, algae...)	Fossil (oil, gas, LNG, LPG, CNG, shale oil/gas, acid gas, grey hydrogen)	Climate neutral (green hydrogen, eFuels..)	EPC (Engineering, Procurement, Construction)	Components	Units, Skids, Systems	**Services**
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Source: APL Apparatebau

APL Apparatebau – ein international tätiges Familienunternehmen

Mit 50-jähriger erfahrung gehört die APL Gruppe zu den führenden Herstellern für Wärmeaustauscher und Druckbehälter in europa. In den letzten Jahren hat sich die APL zu einem führenden Komponentenzulieferer für Industrieanlagen auf dem Weg zu einer CO_2-neutralen Zukunft entwickelt.

Innovation, Lösungskompetenz, das Eingehen auf Kundenwünsche, Zuverlässigkeit und Flexibilität garantieren die fehlerfreien Qualitätsprodukte der APL Gruppe. Wir bieten die notwendige Sicherheit in der Projektphase und eine qualitativ hochwertige, maßgeschneiderte Auslegung und Fertigung der Apparate für einen stabilen Anlagenbetrieb in den Branchen Energie-, Umwelt-, Wärme- und Kältetechnik, Chemie und Petrochemie sowie in der Öl- und Gasindustrie.

Die APL Apparatebau stellt Kunden ein großes Spektrum an Wärmeaustauschern und Druckbehältern zur Verfügung. Die Produkte werden individuell auf die Anforderungen unserer Auftraggeber abgestimmt. Zum Einsatz kommen dabei Kohlenstoff-Stähle, Chrom-Nickel-Stähle, Kupfer und Nickelbasislegierungen, Reinnickel und Titan. Durch die hohe Fachkompetenz in der Schweiß-technik können Werkstoffe mit einer Wandstärke bis zu 300 mm verarbeitet werden.

Die APL Gruppe besitzt einen Produktionsstandort in Hopfgarten/Tirol/AT und einen Produktionsstandort in Dormagen/NRW/DE sowie Vertriebstöchter in der Schweiz (ETS), Deutschland (Innex) und Wien (ABH Thermo).

Als sehr gut aufgestelltes und modernes Unternehmen blickt APL Apparatebau optimistisch in die Zukunft. Wir stellen uns der Verantwortung für die Umwelt und wollen mit unserer Expertise im Wärmeaustausch, zur nachhaltigen CO_2-Reduktion, Dekarbonisierung und Ressourcenschonung, gemeinsam mit unseren Kunden einen positiven Teil dazu beitragen.




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At Atlas Copco Gas and Process, we help customers prepare for tomorrow: We do so by designing, building, and servicing turbocompressors, gas screw compressors, turboexpanders, and API 610 centrifugal pumps for the hydrocarbon processing, power generation (both conventional and renewable) and industrial gases industries.
Our passionate people are dedicated to helping customers handle today's pressures while creating a sustainable future.

Source: Atlas Copco Gas and Process

Atlas Copco Gas and Process: Cut the carbon

Gas and Process belongs to the Compressor Technique business area. We are headquartered in Cologne, Germany, with additional production centers in the United States, India, China, Korea and Canada.

Focus on a sustainable tomorrow
The past few years have clearly demonstrated that humankind has no alternative: The world has to push forward the energy and climate transformation. As Atlas Copco Gas and Process, our mission is to help our customers become leaders in the global move towards cutting the carbon and realizing a circular economy. This philosophy suggests that industrial by-products are captured, recycled, then being used as feedstock and monetized, rather than being wasted.

A circular economy requires smart rotating equipment solutions capable of pushing beyond known technological limits, and into uncharted territory. As Gas and Process, we want to play an essential role in this: With our experience, with our technologies, and our ingenuity we want to help our customers leave a lasting footprint in a circular economy.

This move towards a more sustainable future already includes emerging fields such as

- **Industrial Heat Pumps**
  (Picture of a mechanical vapor compressor supporting process heat generation in a PE plant shown bottom left)
- **Hydrogen Liquefaction**
  (Rendering of a turboexpander for hydrogen liquefaction shown top right).
- **Carbon Capture Utilization and Storage**

to name a few areas where our turbocompressors or turboexpanders are used.

In addition, even if fossil-based feedstocks will be utilized less, our compressors, expanders and pumps will be required in many clean energy and renewable hydrocarbon applications of the future – applications that are needed to supply the global economy with consumer and industrial goods. Our goal is to play a leading role in the quest of more sustainable production methods for energy, fuel and feedstock.

Atlas Copco

Atlas Copco Energas GmbH • Schlehenweg 15 • 50999 Köln • Germany
Phone +49 2236 9650-0 • E-Mail atlascopco.gap.marketing@atlascopco.com
Internet www.atlascopco-gap.com

Source: www.pixabay.com

bar pneumatische Steuerungssysteme GmbH

Since 1979 bar GmbH has been a technology pioneer in valve automation involved in development, production, and worldwide distribution of electric and pneumatic actuators as well a wide range of accessories. The special competence of the company lies here in the development of customized and system solutions for diverse requirements. The company including production facilities and warehouse is based in Dattenberg near Bonn in Germany. bar GmbH is DIN ISO 9001:2015 certified.

Industrial applications in manifold areas are the main business in valve automation and guarantee secure processes in production:

- Process/chemical/petrochemical engineering
- Refinery
- Power engineering
- Fire extinguishing systems
- Paper industry
- Mixing plants & color production
- Bitumen & asphalt production
- Shipbuilding, Marine engineering & industry
- Tank farms & tank systems
- Drinking water treatment
- Hot water treatment
- Waste water treatment
- Air technology & drying systems
- Biogas plants

Certified products are the basis for reliable and cost sensitive solutions in all these applications.

- Low maintenance intervals according to EN15714-3
- Compact products and assembly in all positions in confined spaces
- Warranty extension possible through minimized maintenance intervals
- Reliable safety functions to safeguard against process risks
- Certified according to IECEx and ATEX in potentially explosive areas to meet the EX-protection requirements
- Tested protection index to guarantee proper tightness
- Tested humidity and temperature ranges for use in different environmental situations
- C4 standard to option Norsok C5-M for increased corrosion resistance

There are much more igniting ideas in valve automation!

bar
A WATTS Brand

bar pneumatische Steuerungssysteme GmbH
Auf der Hohl 1 • 53547 Dattenberg • Germany
Phone +49 2644 96070 • E-Mail bar-info@wattswater.com
Internet www.bar-gmbh.de

PC-based control from Beckhoff provides customers with a holistic control system for automating their plants. The industrial PC is the core component of PC-based control technology and forms the basis for control and monitoring processes in process plants. Thanks to the precisely scalable portfolio, it is possible to use an industrial PC individually tailored to the task at hand to control the plant: industrial PCs are available in all kinds of form factors. Support for many standards and protocols ensures cross-system data communication at both the higher-level control system and the field level.

Source: Beckhoff Automation

Achieving modern plant automation with PC-based control technology

In addition to flexible topology, explosion protection requirements are a frequent prerequisite for the use of electrical equipment in the field. The greatest challenge for automation here is data acquisition from zone 0/20 via intrinsically safe signals. The I/O modules of the ELX series offer a compact and integrated solution in which intermediate barriers are eliminated and all EtherCAT features can be used, from fast data communication to end-to-end diagnostic options. The portfolio is supplemented by various series of control systems, I/O modules, and control panels for installation in zone 2/22. This enables decentralized control and visualization in close proximity to the process.

The advantages of PC-based control technology come to the fore not only when considering the hardware, but especially with regard to the flexibility of the software used. The TwinCAT automation software has a range of functions, such as visualization or data analysis, but at the same time offers a large number of interfaces to make the data available to other systems. This means that the user is free to choose their preferred software solution, enabling them to use the best possible tools for their application in a future-proof manner.

Redundancy for increased availability

With TwinCAT Controller Redundancy, it is possible to run the industrial PC and thus the control program redundantly. For this purpose, standard components are enabled for redundant operation by the TwinCAT software – which means that special hardware is not required. The controller redundancy ensures that in the event of a failure of one control system, the second one takes over operation. To this end, the two control systems are connected via network lines which enable synchronization and, in the event of a fault, switchover without loss of information.

BECKHOFF

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Phone +49 5246 963-0 • E-Mail info@beckhoff.com
Internet www.beckhoff.com/process

Source: Braunschweiger Flammenfilter

PROTEGO® Safety Devices

Since 1954, PROTEGO® has built and provided flame arresters, valves and tank equipment, now with the help of more than 600 employees worldwide. We are the technology leader within our area of expertise. We provide global services for our customers which include research and development, application-specific engineering, overall protection system design and safety awareness training. Our customers know they can rely on our research capabilities, engineering expertise and high quality products for the up and downstream oil and gas, petroleum, chemical, pharmaceutical and bio-energy industries.

Customer partnerships are maintained through PROTEGO® after-sales service. In addition to standard spare parts services, we offer on-site maintenance and inspections, overhauls, repairs, and conversions which are carried out on-site, at our headquarters, and at one of our many authorized repair centers (PARCs).

PROTEGO® operates the world's largest research and development center for further development of our products, general research projects, and customized special developments of flame arresters. The world's largest flow test facility of its kind, it is also an indispensable tool for internal research and development to enable correct scientific measurement of flow and meet specific customer requirements. All PROTEGO® valves and flame arresters are flow tested to assure safe operation in service.

PROTEGO® safety devices are developed in close collaboration with end users, technical laboratories, and testing authorities. The product quality is certified in accordance with international standards (e.g., DIN ISO 9001/2008, DIN ISO 14001, and ATEX). In keeping with our motto 'Excellence in safety and environmental protection,' we guarantee the best protection for man and machine.

Braunschweiger Flammenfilter GmbH
Headquarters • Industriestr. 11 • 38110 Braunschweig • Germany
Phone +49 5307 809 0 • E-Mail office@protego.com
Internet www.protego.com

Source: contec

Modern filter solutions for industry, trade and commerce

Contec is a German technology company with products for filtration and level measurement. The globaly operating company has earned its role as a leading solution provider by inventing the first oil mist separator. In addition to air, gas and liquid filters, the company focuses on products for liquid level measurement. The multi-layered experience in process industry and mechanical engineering makes Contec a reliable partner for all its customers.

Contec is a leading company in the field of industrially used oil mist separators. A technology that was invented at Contec in 1987 and is now used worldwide as the most effective filter technology for extracting and filtering oil vapors from lube oil systems.

Contec oil mist separators, known under the brand name COMS (Contec Oil Mist Separators), exceed the requirements for emission limits (TA Luft – clean air). They are used on large engines, compressors, turbines or machines with integrated or external lube oil system – on offshore platforms as well as in waste-to-energy plants. COMS high-performance filters replace simple filters or demisters and ensure guaranteed clean exhaust air.

Contec is equally passionate about air, gas and liquid filters. Contec's solutions in this product area ensure operational reliability and a clean output through high reliability and effective filtration.

The Contec product range level measurement technology includes precise instruments and sensors for monitoring, regulating and controlling liquids. The sensors and gauges are used in oils, fuels, chemical solutions and other liquids.

Contec's customers include medium-sized companies as well as international stock corporations. The products are installed in the most diverse areas of industry: in the oil & gas industry, in chemical plants, in the food industry, in water and waste water treatment, in process engineering as well as in the commercial vehicle industry.

Individual in planning, flexible in design, efficient in operation – this is the development approach of Contec engineers.

contec:
clean solutions on demand®

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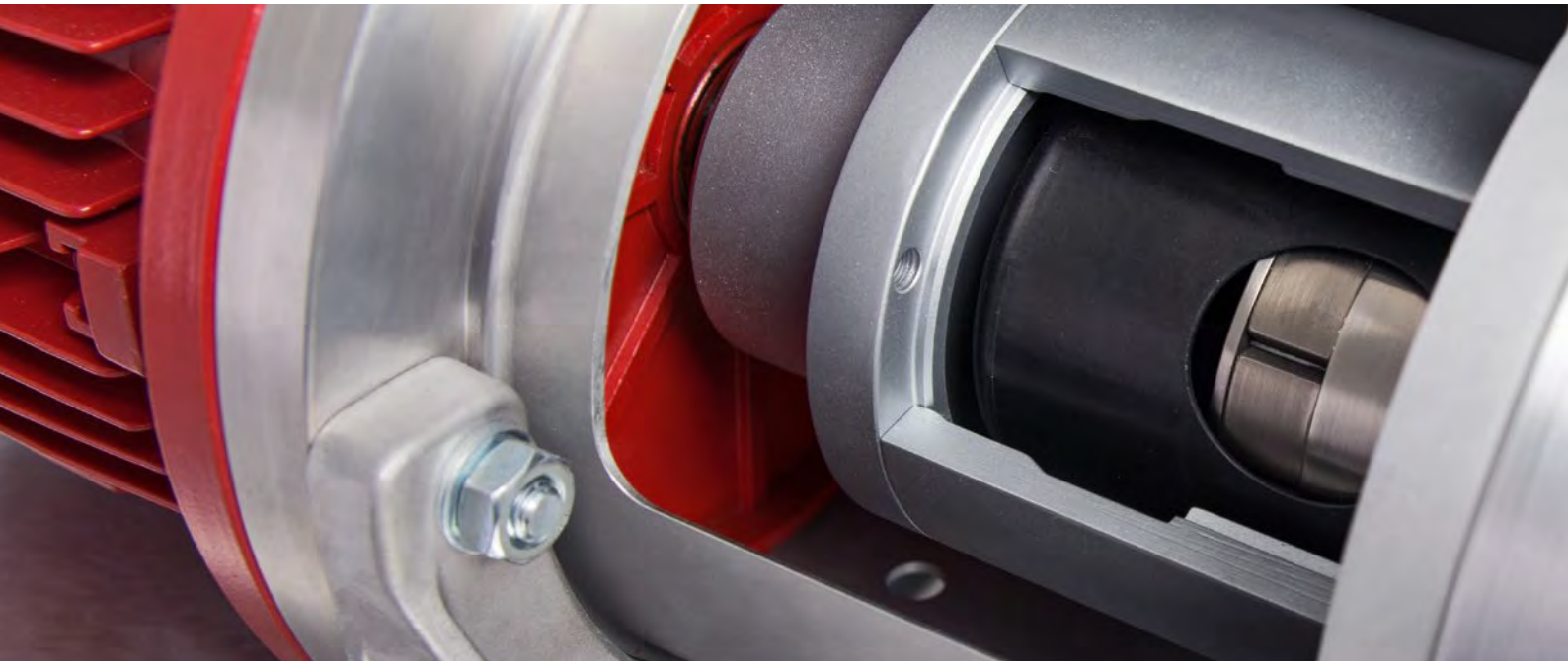
Phone +49 2224 9893-0 • E-Mail info@contec-filtration.de
Internet www.contec-filtration.com

Reliable and eco-friendly permanent magnetic systems for a contactless torque transmission

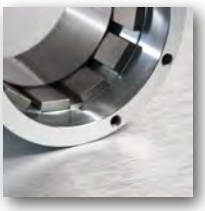


DST Dauermagnet-Systemtechnik GmbH is a leading German manufacturer of high-performance permanent magnet couplings. As part of the German Echterhage Holding Fluid Technology Group and with over 30 years of experience in leakage-free and maintenance-free torque transmission, DST offers the perfect solution for various applications in the chemical, pharmaceutical and bio industries, as well as for petrochemicals, agitators, compressors, hydraulic applications and for numerous other industrial plants where 100 % tight and safe drives are required.

With well over 1,000 existing magnet configurations, DST permanent magnetic couplings are a reliable alternative to conventional mechanical seals and already cover a wide range of 1–1,200 Nm with their standard series.

With many years of application expertise, DST develops individual special solutions to perfectly meet customer requirements with a maximum torque of up to 25,000 Nm.

For this purpose, every inquiry is precisely checked for technical feasibility by trained personnel. Using the latest FEM simulation software and considering the customer's application parameters, DST ensures an optimal and safe design of the individual components. Thus, the customer receives the most efficient and economical material combination of the inner and outer rotor as well as the canister.



A company of
e.holding
FLUID TECHNOLOGY GROUP

Source:
DST Dauermagnet-SystemTechnik

fluid technology solutions

For the replacement of conventional mechanical seals in existing motor/pump units, DST also offers ready-to-connect conversion kit solutions.

To meet the ever-increasing product and customer requirements, DST offers a wide variety of test procedures for validation of the pressure resistance, vacuum tightness, static torque rating and weld quality of the components. Over the years, DST has been able to expand its customer base globally with the aspiration and commitment to the motto “Quality-Designed and Made in Germany”.

There are many reasons why DST is internationally regarded as an innovative and reliable partner for particularly demanding applications.

DST has successfully accomplished numerous projects where the reduction, and in some cases complete elimination, of eddy current losses has helped the customers avoid unwanted heat generation in their application. As a result, the customers have been able to increase the efficiency of their product and achieve substantial savings in energy consumption.

Continuous research and development ensure that DST permanent magnet couplings can also be used in particularly hazardous applications (ATEX), such as hydrogen or LNG applications.

Check out our mag coupling video!

DST magnetic couplings

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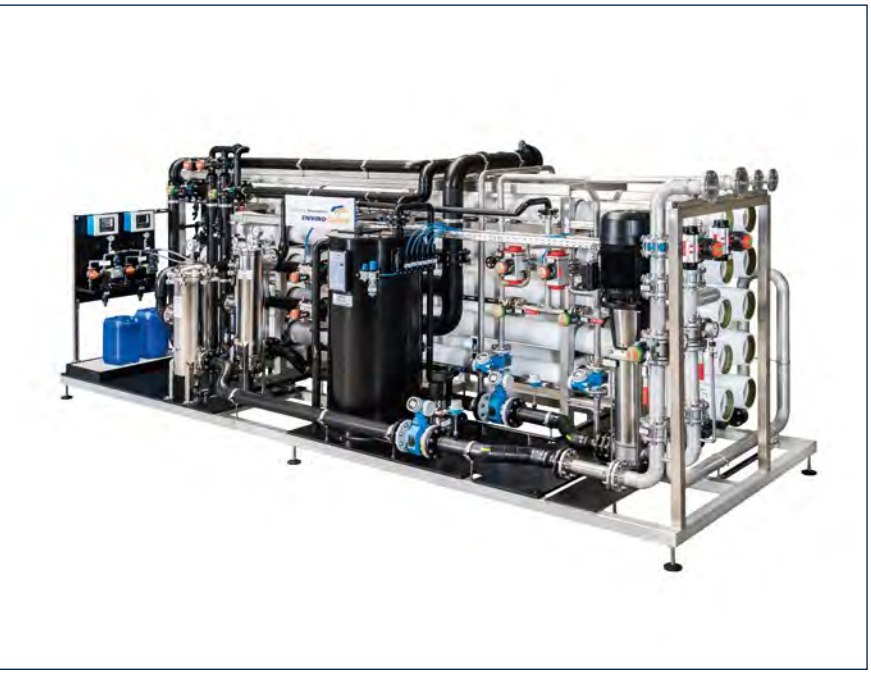
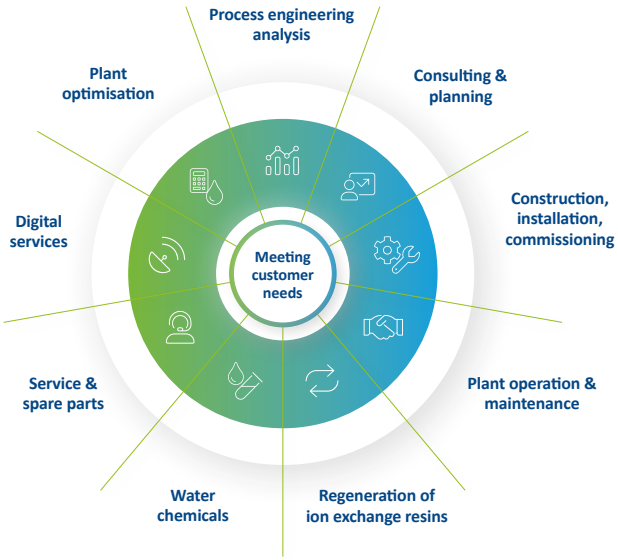
Internet www.mag-couplings.com

Pure water for generating green hydrogen





EnviroWater Group offers sustainable and efficient water treatment solutions
Place your trust in experienced water experts whenever you need custom water treatment plants that reliably generate water in the quality you need for your processes.

Green hydrogen is generated through the electrolysis of water, in which it is broken down into oxygen and hydrogen. Generating green hydrogen through electrolysis requires a reliable supply of pure water, sometimes in great quantities. The EnviroWater Group as a group of companies with experts in water treatment develops plant solutions for water treatment and polishing based on customer requirements.

Ultrapure water is also needed when generating other gases, such as green ammonia. EnviroChemie and EnviroFALK, both members of EnviroWater Group plan customised water treatment systems, build them and commission them on customers‘s behalf.

Ensuring the availability of high water qualities – rely on strong experience
When producing green hydrogen, various water sources can be used for feed water treatment, e. g. sea water, river water, surface water or wastewater. The experts of EnviroWater Group use a range of different technologies and combinations of technologies to reliably supply water in the high qualities required, even for applications such as water recycling (polishing).

Source: EnviroWater Group

- Physico-chemical processes
- Membrane technology such as ultrafiltration or reverse osmosis
- Electro-deionisation (EDI)
- Multi-stage ion exchanger plants
- Regeneration of ion exchange resins (separated into individual resin types) on site or through EnviroFALK's service.

The EnviroWater Group is a group of European companies made up of specialists in a wide range of water treatment technologies and sectors. They provide individual support throughout the entire life cycle of water treatment systems. Together, the experts deliver holistic, sustainable solutions.

The EnviroWater Group is divided into three clusters of experts for.

- EnviroChemie – Treatment of wastewater and cooling water & wastewater recycling (reuse)
- EnviroFALK – Treatment of water, process water & ultrapure water
- EnviroProcess – Water treatment for the pools and spa sector

ENVIROWATER GROUP

EnviroWater Group
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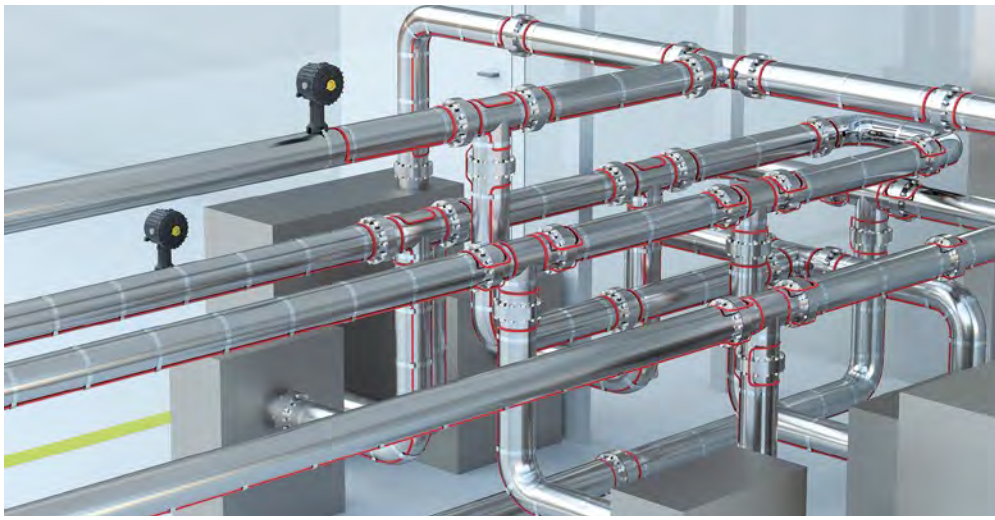
Internet www.envirowatergroup.com

Founded in 1991 in Burbach, Germany, eltherm has developed into a global engineering solution provider with its own production facilities and a one-stop-shop for electrical heat tracing products and systems „Made in Germany“. The company has attained worldwide acclaim as a turn-key partner for engineering, design, installation and commissioning of electrical heat tracing for complex industrial plants and facilities.



eltherm globally – At your Service.

With its own comprehensive production facilities for all types of trace heaters and accessories eltherm has built up the engineering expertise to become one of the leading manufacturers of electrical heat tracing systems in the world.

Besides frost protection and temperature maintenance applications up to 1000 °C, eltherm is the competent partner for complete system solutions like heating whole chemical or other industrial plants. eltherm proved its potential and expertise in different applications for industries such as oil and gas, power plant, construction, automotive and food industries.

Trace Heaters / Constant Wattage Trace Heaters / Self-Regulating Trace Heaters

No matter if pre-assembled or cut-to-length, eltherm Trace Heaters and Tapes are suitable for frost protection as well as for process temperatures up to 1000 °C.

Mineral Insulated Heating Cables

eltherms' Clean Laser Seal technology takes Mineral Insulated (MI) Trace Heater assemblies to the next level. Manufactured and assembled entirely from high quality stainless steel or Alloy 825, eltherm's revolutionary Clean Laser Seal Technology (CLS) guarantees performance and reliability in all industrial operations.

Heated Hoses

Wherever liquids or gases have to be transported flexibly and without any loss in temperature, eltherm offers the perfect solution for temperatures up to 450 °C.

Heated Mats and Jackets

Flexible eltherm heating mats and jackets are the tailor-made and optimum solution for individual requirements. They offer a high level of effectiveness and heat distribution up to 900 °C.

Measurement and Control Systems

Additional to our eltherm controller range, we also produce and supply complete controlling systems for any electrical heat tracing application, thus guaranteeing a trouble-free and economic operation.

Accessories

You will easily find the suitable assembling devices and connection technologies in our wide range of products.

eltherm®

eltherm GmbH
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Internet www.eltherm.com

Source: stock.adobe.com

genua – Excellence in Industrial Security

genua is one of the world's most renowned cybersecurity companies for complex and critical digital infrastructures. With high-quality, certified, and scalable solutions, we secure sensitive networks in public and corporate sectors, for critical infrastructure organizations and industries with an obligation to secrecy.

genua GmbH is a company of the Bundesdruckerei Group. With more than 350 employees, we develop and produce cybersecurity solutions for IT and OT exclusively in Germany. Since the company was founded in 1992, regular certifications and approvals by the German Federal Office for Information Security (BSI) have proven our products' high security and quality standards.

Highly Secure Solutions for the Industry
genua's solution spectrum ranges from firewalls and gateways, virtual private networks, and remote access solutions for mobile employees to internal network security, cloud security, and remote maintenance security. Our integrated product portfolio is certified to the highest security and quality standards, such as Common Criteria (CC) EAL 4+.

Our solutions portfolio for the industry and critical infrastructures includes the following:

- secure remote maintenance
- industrial-grade firewalls for strong protection of IT and production networks
- data diodes for industrial monitoring of plants, machines and critical infrastructure
- advanced internal network security with AI, data analytics, and threat intelligence
- highly secure virtual private networks that utilize the strongest encryption algorithms.

Securing the Quantum Age
genua researches at the forefront of quantum-safe communications to help shape the secure transition to the quantum age. Our solutions feature quantum-resistant software signatures, effectively protecting against quantum computer attacks. Our update mechanism guarantees trusted product updates already today and in the future.

genua.

genua GmbH • Domagkstr. 7 • 85551 Kirchheim • Germany
Phone +49 89 991950-0 • E-Mail sales@genua.de
Internet www.genua.eu

As World Shifts to Renewables, Sustainable, Cost-Efficient Oil Operations Remain Urgent

Source: GEA

Even as the world moves away from fossil fuels, we cannot ignore the continued need to create more sustainable operations in the oil and gas industry. At GEA Separation, Business Unit Oil & Gas and Energy, we have developed centrifugal separation technology that offers substantial efficiencies in separating liquids and solids in oil extraction and refining, reducing waste and creating cleaner up- and downstream production processes.

Oil will remain a significant factor in meeting the world's energy needs over the next two to four decades. Ongoing efforts to create a cleaner industry during the transition period will be crucial in fighting climate change. At the same time, petroleum products such as plastics and fertilizers will be in constant demand in pharmaceuticals, agriculture, and other industries.

With technological roots stretching back to 19th-century engineers who helped Westphalian dairy farmers separate their milk products, GEA has developed cutting-edge, high-speed centrifuges with immediate applications in areas such as offshore extraction and terrestrial refining. We estimate that in some use cases our centrifuges can cut waste by as much as 80 percent and reduce the need for chemical demulsifiers in refining by a similar factor while maintaining output quality.

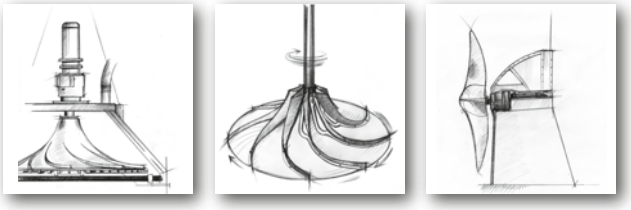
In one example, our centrifuges are compact enough to be used on oil platforms and processing ships, known in the industry as Floating Production, Storage, and Offloading facilities (FPSOs). With the high-speed disk- and decanter centrifuges, creating a g-force equal to about 10,000 G, our centrifuges effectively separate oily waste, water, and solids from ship drains, slop water, and oily sludges. They are also very effective in crude-oil dehydration and desalination and other crucial up- and downstream processes.

In real-world tests at production sites around the world, our centrifuge technology has proven itself to be more efficient than conventional (chemical-based/static) processes for separating various liquids and solids up- and downstream in the oil industry. In addition to the on-site benefits, the centrifugal processes help the oil industry cut its own carbon footprint by reducing the need to transport waste from extraction and production sites to storage and disposal facilities.

Our centrifuges are robust enough to operate in the harshest environments. And now, using the newest digital technologies, in combination with service level agreements, our centrifuges can be monitored, analyzed, optimized, and maintained remotely, adding to their reliability and cost-effectiveness.

GEA is dedicated to engineering for a better world. Our efforts to contribute to a more sustainable oil industry are one part of fulfilling this mission and helping to safeguard the environment for future generations.

INVENT – Excellence in water and wastewater treatment



HYPERCLASSIC® – Mixing- & Aeration Systems in an industrial wastewater treatment plant in Slovakia (petrochemical industry)
Source: INVENT

INVENT became well known through the development and market introduction of energy-saving and multitasking hyperboloid mixers as well as mixing and aeration systems for wastewater treatment.

INVENT offers a wide range of efficient **stirring and mixing solutions** for almost every application in the water, wastewater and processing industry. In the field of **aeration technology** the scope of products includes a variety of membrane aeration systems for biological wastewater treatment which have been developed and optimized for different applications. These are distinguishable by their functional principle, construction and material, so that an optimal solution can be offered for almost all industrial and municipal requirements. The layout and design of an optimum mixing and/or aeration system is a very complex task. It requires a large amount of competence, know-how and experience. In the case of industrial plants e. g. in the oil, chemical or petrochemical industry, it is most important to understand the production process to a certain degree because this significantly influences the wastewater composition.

An INVENT **system solution** comprises, depending on the customer's requirements, the plant design, basic and detailed engineering, project management, delivery of the mechanical components, installation of the plant and the training of plant personnel. The mechanical components, such as mixers, aeration systems, filter, pumps, blowers, fittings and instrumentation, control and automation systems, are carefully selected for an INVENT system solution and coordinated with each other. INVENT takes responsibility for the entire scope of the delivery. This approach reduces the number of interfaces and potential sources of failure.

The recently launched INVENT Granular Sludge Reactor (iGSR®) is the first system that fully exploits the potential of granular activated sludge also for large plants: Reduced process times, higher purification performance with a reduced footprint, low energy consumption and reduced life cycle costs, at the same time delivering high reliability. Its modular concept can be adapted to any plant size. Its design offers a higher level of process stability for hydraulic peaks and load fluctuations than any other system. The iGSR® is already in operation in various plants worldwide, with more facilities currently under construction.

INVENT's **engineering and consulting** services range from fluid mechanical optimization of hydraulic structures or processes (INVENT Think Fluid Dynamix®) to solving chemical engineering problems, flow simulations using CFD or simulations of entire wastewater treatment plants. These tasks are supported by laboratory research, if necessary.

We offer turnkey solutions for your water project in the oil, gas and petrochemical industry!

Check out our brand new iGSR® video

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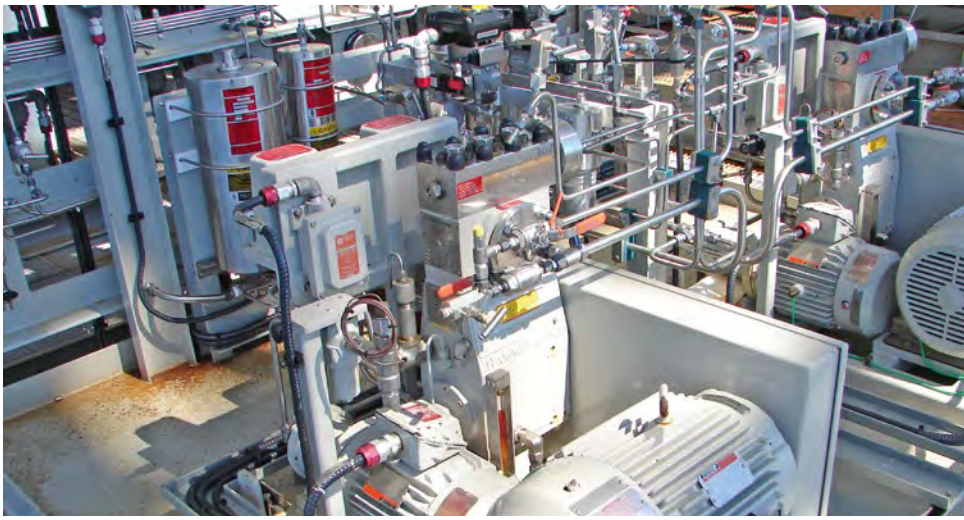

Source: Hammelmann

High-pressure plunger pumps

Hammelmann process pumps prove their worth on a daily basis and in an infinite range of applications. These include the injection of methanol and glycol, pressing in of production water, dosing of co-monomers for producing LDPE, in the fatty alcohol process, in high-pressure extraction, when descaling steel, in fiber meshing and in many other processes. A wide range of different series and performance classes ensure flexibility and perfect adaption to any requirement.

The labyrinth seal – unique to Hammelmann pumps – enables continuous duty operation at pressures up to 4500 bar (65k psi). Unavoidable wear at the high-pressure seal components does not lead to an abrupt breakdown of the pump system but rather a gradual decrease in flow rate so that maintenance intervals can be planned well in advance. In its “Zero emission” version the fluid is hermetically sealed within the pump, preventing leakage to the atmosphere during operation. Hammelmann GmbH has been producing high-pressure plunger pumps and application systems for over 70 years. Global subsidiaries as well as 40 agencies, ensure world-wide presence and service.

Performance data

Hammelmann process plunger pumps are designed for continuous operation within the following parameters:

- Flow rates Up to 256 m³/h
- Op. pressures Up to 4500 bar (65k psi)
- Power ratings Up to 1600 kW (2145 hp)
- Viscosities Up to 2000 mPa s
- Fluid temp. –40 to 200 °C (-40 to 390 °F)

Fluids (selection)

Amine, Ammonia, Butane, Carbon dioxide, Caustic soda, Corrosion inhibitor, Crude oil, Diesel oil, Ethanol, Glycol, Hot water, Hydraulic oil, Hydrocarbon, LDHI, MEG, Methanol, Produced water, Salt water, Scale Squeeze, Sea water, TEG, Water soluble oil, Waste water, Xylene

Take a detailed look at the unique pump design

HAMMELMANN®

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The energy transition will not work without process heating transition. Klöpper-Therm is your process heating specialist. The electrical heating systems of Klöpper-Therm assist your energy transformation process to be fit for all future ecological and technological challenges. The systems are mostly tailored to the operator's needs, naturally also for hazardous areas. With nearly 100 years' experience, Klöpper-Therm is the reliable partner for different kinds of industries.

Source: Klöpper-Therm

It's time to change your heating process

Electrical heaters

Whether it's for maintaining stable temperatures in storage tanks, compensating for heat loss in supply pipes, liquefying firm substances such as wax or vaporizing water or thermal oils, electrical heaters by Klöpper-Therm are the answer. They provide optimized, energy-efficient and reliable process control for all kinds of plants – chemical, petrochemical and pharmaceutical – as well as power plants and refineries.

Electric boiler system for steam generation

When it comes to steam generation, electric energy-powered plants offer important advantages over the gas or oil-fired systems at steam volumes up to about 8 to/h. Without local emission, these electric boiler systems impress with high efficiency, compact design and excellent controllability.

Cable Type Heater

Cable type heaters have initially been developed and used for the safe operation in plants of the fertilizer industry. However nowadays, they cover a large application range due to their modular construction. They are suitable for heating up nearly all gases and liquids or superheating steams. They are mainly used in hazardous areas.

Electrical heat tracing

Different purposes, applications and processes require individual made-to-measure solutions. Klöpper-Therm is passionate about designing custom-fitted electrical heating systems for every plant, for the industrial sector as well as for explosion-endangered areas. Heat tracing is used in many industrial sectors to heat products in pipes and vessels to process temperature, maintain such temperatures or keep products from freezing.

Controlling and monitoring

Specially developed heating control and visualization systems and switchgears for indoor and outdoor installation complete the product range and provide reliable solutions for all kinds of applications.

KLÖPPER THERM

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Internet www.kloepper-therm.de



Source: Liebherr

Water content determination WMS II according to ATEX & IECEx



Liebherr started to focus on international business and establish companies outside Germany at the end of the 1950s. The Liebherr Group now comprises over 140 companies in more than 50 countries on every continent. Liebherr sees itself as a pioneer. Based on this attitude, the nearly 50,000 employees play a decisive role in shaping technological progress in numerous industries and are already dedicating themselves today to the challenges that customers will face tomorrow.

The self-sufficient, modular measuring devise for precise water content determination (water cut meter) as well as pressure and temperature measurement in the running process is designed for

- Exploration
- Production
- Refining
- Tank inventory management
- Logistics, ...

in and on

- Platforms
- Loading stations
- Pipelines (pumping stations)
- Refineries (dewatering tanks)
- Oil separators
- Blending processes
- Energy and safety, tank and settling management
- (Petro-) Chemical industry

and many other installation places...

Mediums: Oil, crude, mud, fuel, diesel, bitumen, ethanol, solvents, ...

The full line for the oil and gas industry

Whether for onshore or offshore: Liebherr offers appropriate solutions for each and every operational stage of international pipeline projects. Harbour cranes ensure seamless supply of material for laying vessels, which operate with precision using Liebherr on-board cranes.
Mobiles cranes further assist with assembly work on-shore. For all the associated earthworks, Liebherr crawler excavators and dozers are used. Pipe layers, specially developed for the needs of modern pipeline construction sites, work hand-in-hand to guarantee that work proceeds rapidly and reliably.
Across the board, the reliability of all machines is ensured by Liebherr's own components. Furthermore, Liebherr gas engines supply the energy required for compressor stations.

LIEBHERR

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Mehrer Compression GmbH is one of the world's leading manufacturers in oil-free reciprocating and diaphragm compressor systems. As a family-run company, it has been setting standards in process gas compression for over 130 years thus having many years of experience in handling a wide variety of gases. Through innovative technologies, Mehrer has long been supporting the energy transition for example by compressing and transporting green hydrogen. With solutions that are engineered down to the last detail, Mehrer Compression GmbH is making a significant contribution to advancing sustainable projects all over the world.

Compressors with process reliability for tomorrow's energy

The core elements of the energy transition are the expansion of renewable energies, the increase in energy efficiency and the availability of systems. The gases of the future – hydrogen, carbon dioxide and biogas – can already be compressed today with Mehrer compressor plants and, in particular, the technologies surrounding the processes of power-to-liquid, LOHC, water electrolysis and the production and storage of synthetic fuels can be supported. At the heart of these systems is Mehrer's compressor technology, designed to reduce the transport volume or to provide the pressure required for the subsequent chemical processes.

With modern, efficient and durable reciprocating and diaphragm compressor systems, Mehrer Compression GmbH is significantly involved in driving the energy transition to a higher level. Whether in CO_2 recovery, hydrogen refueling or biogas processing, Mehrer Compression GmbH supplies the essential system components for a more environmentally sound and climate-friendly future.

Mehrer Compression GmbH's broad expertise in dealing with flammable and sometimes toxic process gases enables the oil-free compressors to be used in multiple applications according to customer-specific requirements. With consistent quality and great flexibility in product design, Mehrer Compression GmbH creates turnkey solutions for its customers, helping them to deal with the energy of tomorrow.

The expertise is completed by the Mehrer Field Service team. They look after your system during the entire product life cycle thus guaranteeing high availability and performance. With its worldwide service partner network, Mehrer offers a wide range of services locally. The authorisation of the partners is ensured by the Mehrer Academy program.

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Koch Engineered Solutions: A Sustainable Partnership

Koch Engineered Solutions (KES) is a dynamic network of companies committed to helping customers increase operational efficiency while working continuously to protect people, communities and our planet. Every solution and manufacturing process is developed with the overarching objectives of consuming fewer resources and improving the environmental performance and effectiveness of our products. The global companies of KES are equipping customers to master the energy transition with solutions that include equipment optimized for energy efficiency and reliability, hydrogen utilization for industrial applications, solar energy conversion and carbon capture. Koch-Glitsch/Montz, for example, engineers its dividing wall column systems to reduce energy usage by as much as 50 % compared to conventional distillation.

Sustainability is your goal. Stewardship is our North Star. We're going the same way — toward a more prosperous world with fewer emissions. Our connected companies create environmental solutions that can help get you there faster and thrive. Carbon capture and reduction. Reliability and energy efficiency. Emissions reduction. Renewable energy. Managing water and waste. It's a journey. We partner with you to create superior value for long-term results.

Operational Reliability & Energy Efficiency
Optimization is a never-ending process. That's why across our portfolio of products and services, we continually work to improve energy efficiency and develop innovative technologies that further enhance your assets' operational reliability, performance and greenhouse gas emissions control.

Dividing Wall Columns
Koch Engineered Solutions (KES) applies the extensive distillation expertise of Koch-Glitsch/Montz to provide highly effective dividing wall column (DWC) systems. Leveraging their knowledge and experience, KES delivers DWC systems capable of cutting energy consumption up to 50% and trimming capital costs up to 30 % compared to conventional distillation.

Carbon Capture & Reduction
Carbon capture is about much more than just maintaining compliance. Reducing carbon emissions allows you to optimize your facility performance. From carbon capture and processing to leveraging hydrogen as an alternative energy source, our full range of solutions helps industries across the globe.

Mass Transfer Equipment & Process Knowledge
Leveraging the skills and knowledge of Koch-Glitsch/Montz around process design, thermal separation technology, column internals and services, we are able to provide customers with favorable returns with reliable outcomes.

Koch-Glitsch's complete line of packing and column internals is the result of extensive experience with mass transfer equipment and a superior R&D team that continues to develop new technology and improve correlations to more accurately predict achievable performance. Working on thousands of towers worldwide, Koch-Glitsch has developed industry-leading domain expertise and knowledge you can rely on for solutions to meet your specific needs.

Learn more.

Source: iStock

KOCH ENGINEERED SOLUTIONS

Julius Montz GmbH (a Koch Engineered Solutions Company) • 40723 Hilden • Germany
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From heavy crude oil extraction to injection: Positive displacement pumps cover multiple conveying tasks on oil and gas fields

Positive displacement pumps ensuring stable conveying rates irrespective of consistency, are often used for the smooth transport of abrasive and corrosive mixtures of oil, gas, sand and water. The metal and elastomer materials used are selected to match the anticipated operating conditions to keep wear to a minimum, while simultaneously creating optimal conditions for conveyance. Thereby not only increasing the performance of the systems, but also ensuring a long service life and long maintenance intervals.

Progressing cavity pumps are conveying oil-water-sand-gas mixtures

A underground progressing cavity pump system (ESPCP) is ideal to reliably transport the crude oil to the surface, especially as the medium is a multi-phase mixture with a very high gas content. The medium is pumped continuously, at stable volume and pressure, so that no shear forces and hardly any pulsation occur. The special feature of the ESPCP is that the rotor-stator unit and the motor are sunk into the well. The motor or bearing unit is connected directly to the rotor via a flexible rod. All radial and axial forces of the rotor are absorbed by a special underground bearing housing. The dynamic seal is also located in the well. Thus precluding environmental impact from leaks above ground.

Oil-water-sand-gas mixtures transfer over long distances

Multiphase pumps from NETZSCH are dealing with mixtures of oil, water and gas along with sand content, achieving conveyance rates of up to 600 m³/h. The tiny shear forces and low pulsation mean hardly any emulsion effects occur during transport, so that complex media can also be

conveyed over long distances to collection points. There the phases can be separated in central separators, significantly reducing the cost of infrastructure in the field.

Rotary lobe technology for high volumes in a limited space

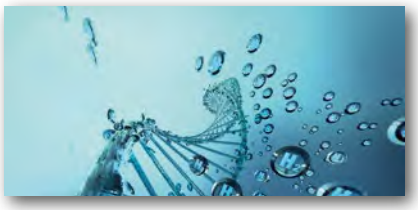
The major special feature of the self-priming, valveless NETZSCH TORNADO® pump is its synchronised gear with belt drive which is extremely resilient and very easy to maintain. The strength of this pump above all is its compact design, still offering high capacity, reversibility and solid matter compatibility. The possible conveyance rates range from 3 m³/h to over 900 m³/h. The pump can be installed in any orientation, and the motor is attached directly above the pump chamber, minimizing its footprint.

High efficiency regardless of viscosity facilitate tank stripping

What is particularly important in the oil sector, too, is the flexibility when it comes to the viscosity of the medium. NOTOS® multi screw pumps operate with excellent rates of efficiency across the entire range of viscosity up to 200,000 cSt. It conveys the medium continuously at stable pressure, almost entirely independent of consistency or viscosity.

And what is more: pump speed and viscosity of the medium affect the NPSHr value. As NOTOS® pumps can be regulated flexibly tanks can be drained fully, even from viscous crude oil derivatives.

Pepperl+Fuchs –
Enabler for Digitization and Energy Efficiency



Source: Pepperl+Fuchs

Pepperl+Fuchs, one of the world's leading companies in industrial sensor technology and intrinsically safe explosion protection, has been considered a pioneer of future technologies in automation for more than 70 years. Today more than ever – because the Mannheim-based company is responding to its customers' need for ways to digitize and achieve energy efficiency. One main topic: innovative products and solutions for safe automated processes along the entire value chain of green hydrogen.

Green Hydrogen

The value chain of green hydrogen already starts with the energy generation for its production from renewable energies. From the wind turbine to the hydrogen filling station, the value chain is full of technical challenges up to the use in industry and transport. Based on its longtime expertise in explosion protection, Pepperl+Fuchs offers a comprehensive portfolio of explosion proof components and sensors covering every step of the value chain.

- Encoders, inductive sensors and inclinations sensors for wind and solar plants in the energy generation
- Products and solutions for gas pressure control and measurement systems and for monitoring valve positions in gas tankers for the transport of hydrogen
- Numerous sensor solutions for valve monitoring, smart glasses for their remote maintenance, interface technology, and identification solutions for AGV for the use in industry
- Products and solutions for safe processes and convenient refueling at hydrogen filling stations.

Digitization

Hydrogen is one of Pepperl+Fuchs' main topics in the context of climate neutrality. For energy-efficient, resource-saving plants, highly functional, efficient products and systems can be used as "enabling technology". In addition to decarbonization, the company focuses strongly on digitization. Digitization and automation are from our point of view the most important levers of energy efficiency. We implement these effectively – for example by setting up and following a "Digital Agenda" and the digitization of the portfolio including our Sensorik 4.0® offerings for Industry 4.0 scenarios.

This includes a comprehensive portfolio for industrial communication with, among other things, intelligent components for linking IT and OT. Through the acquisition of Comtrol Inc. in 2019, communication-enabled sensors were completed by Ethernet-based industrial communication technology to create well-rounded solutions.

Digitization has now also reached the process industry. To this end, Pepperl+Fuchs is working in an international consortium to make Ethernet usable for this market. The digitization of service and maintenance in process plants can already be realized today with intrinsically safe smart devices without any effort.

Source: NEUMAN & ESSER

Integrated Solutions for the Energy Transition

Decarbonization projects, at the pace and scale required, are a challenging matter. In orchestrating all elements of a Hydrogen generation project – from planning, engineering, building to operation – the involvement of the right partners is key. NEUMAN & ESSER (NEA GROUP) is the integrated solution provider answering important questions about tomorrow's energy infrastructure for Hydrogen and green gases.

As an OEM for reciprocating and diaphragm compressors, electrolysers and reformer systems including hydrogen filling stations NEA GROUP is a partner of trust in bringing challenging energy transition projects to life – from evaluating potential sites and project feasibility, through engineering, construction, and commissioning to digitally supported 360° service during operation.

Customers benefit from a century of experience in H2 and H2 mixed gases compression for applications in refinery processes, petrochemical, and chemical industries with API 618 compliant compressor systems.

This expertise plays a central role when we balance all plant components along the value chain for the optimal overall solution from Hydrogen generation to storage and distribution to end users.

Thanks to the continuity of a family-owned company and a worldwide network of production sites, Sales & Application Centers, and Service locations, we have a strong presence to react quickly to individual requirements.

Offering integrated solutions also means that we go in depth together with our customers. Innovative, creative, flexible: The knowledge of our employees and their determination are our biggest asset.

NEUMAN & ESSER is driving the change in the oil and gas-based industry with demanding projects towards a future with sustainable energy from renewable sources.

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Phoenix Contact is your partner for pioneering solutions in the process industry

Phoenix Contact is a global market leader with corporate headquarters in Germany. The group of companies stands for future-oriented products and solutions for the comprehensive electrification, networking, and automation of all sectors of the economy and infrastructure. A global network in more than 100 countries with more than 20,000 employees guarantees the important proximity to the customer. With a broad and innovative product portfolio, we offer our customers future-proof solutions for different applications and industries. This applies in particular to the energy, infrastructure, industry and mobility sectors.

As a technology driver and member of numerous associations, we ensure market-leading solutions and thus lay the foundation for progressive technology. With industry know-how, many years of experience and taking individual requirements into account, we create inspiring industry solutions.

Power-to-X

Make your production energy- and resource-efficient with our open and secure digitalization solutions and innovative products.
Phoenix Contact supports you in automating, electrifying, and digitalizing the processes for solutions in the field of power-to-X.

Asset Monitoring

Whether operating data, energy levels, or alerts, we will create an optimum concept for the acquisition and transmission of your field data, ensuring that the data is available exactly where it is needed. From monitoring emergency showers and production sites to developing a digital map of your production plant, Phoenix Contact offers monitoring solutions for various system areas.

Modular Production

With many years of industry expertise and co-development of the MTP interface standard we support the development and commissioning of process systems in record time. With our flexible module engineering tool MTP Designer you benefit from a reduction of engineering times.

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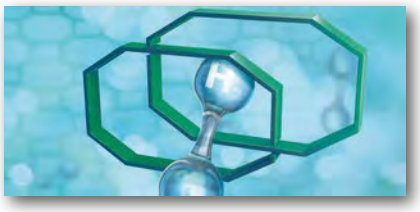
R. STAHL: Pioneering the way into the future



When it comes to safety engineering, electrical explosion protection plays a crucial role, especially in hazardous areas where flammable substances are stored or processed.

Electrical explosion protection is a core aspect of safety engineering. It plays a crucial role in hazardous areas where flammable substances are stored or processed. Therefore industries such as energy, oil & gas, chemicals, pharmaceuticals, and food are heavily dependent on electrical explosion protection due to the presence of ignitable gases or dust in the atmosphere.

Based on our core business, we are advancing the use of alternative energies, such as LNG and hydrogen. Our advanced explosion protection products & solutions are built to last, with a portfolio that covers the entire LNG and hydrogen value chain, from production, through transportation and storage, all the way to end users.

R. STAHL is focusing on the future – especially in the interests of our customers. Based on our core business, we are advancing the use of alternative energies and thereby contributing to a safe, dependable, and affordable energy supply.

Source: R. STAHL

With a wide range of innovative products and sophisticated system solutions, R. STAHL ensures reliable protection and a high degree of safety in potentially explosive environments. We offer customers a basis for their safe handling of flammable gases, vapors, mist or dust.

From a technological standpoint, R. STAHL is a leader in all common types of explosion protection. In cooperation with our customers throughout the world, we rely on one-stop solutions and cover all necessary individual tasks related to electrical explosion protection, from consulting and engineering, systems integration and project management to certification and commissioning.

The advantages for our customers include:

- A wide range of comprehensive explosion-protected products, including automation solutions, energy technology, lighting technology, and maritime-specific vibration-resistant products, tailor-made to our customers' exact specifications.
- Products and systems that can be used in extreme circumstances, and which withstand the harshest ambient conditions.
- Long-term modern solutions for a lasting competitive edge.
- Outstandingly high-quality products for which R. STAHL is known, which correspond to the latest standards and have been granted sector-specific certificates.
- First-class quality management, from the initial product concept to production – and even beyond, to maintenance. Globally consistent quality standards, regardless of production location, are standard practice at R. STAHL.
- 18 subsidiaries as well as 45 international offices in more than 50 countries.
- Collaboration with experts dedicated to innovation and progress. After all, we work on the technology of the future in international committees and research groups.

Source: Schniewindt

Schniewindt – tradition and high-end electric heating technology

Since its foundation in 1829, the family company Schniewindt has developed into a globally recognized partner for designing and supplying advanced electric heating devices, complete heating systems and their controls.

An interesting example is Schniewindt's participation in one of the world's first projects to produce a climate-neutral eFuel, including CO_2-neutral gasoline (eGasoline) and CO_2-neutral LPG (eLG). For this purpose, Schniewindt has developed an 850 kW steam generator, complete with all necessary accessories, which is part of the complex process for filtering and further processing of CO_2.

From simple immersion heaters to heat water to highly complex electrical heating units in the high pressure environment, supplied as complete systems, including electronic controls, pumps, valves and instrumentation: Schniewindt offers a process-optimized solution from one single source as an alternative to heat generation by fossil fuels.

An extensive range of Schniewindt standard and custom designed heaters are certified by IEX Ex, ATEX, CSA, among others certification bodies, allowing their installation and use in hazardous areas.

The advantages of heating with electricity are obvious, and alternative heat sources cannot always fulfil them reliably:

- Outstanding controlling properties
- Clean, quiet, odorless, pollution-free
- A variety of media are heated directly
- Safe and reliable

Whenever you decide to use electric power for heating purposes, remember that Schniewindt will be your reliable source for supplying you with state-of-the-art heating technology.

SCHNIEWINDT THE POWER OF ELECTRIFYING IDEAS

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Internet www.schniewindt.de

Source: TGE Gas Engineering

Gas Terminals of tomorrow

State-of-the-art solutions grounded in 40 years of experience: TGE Gas Engineering is a worldwide leader in the storage and handling of liquefied gases. We provide a comprehensive range of products and services for the energy, liquefied natural gas and petrochemical industries.

From feasibility studies and concepts to complete terminal construction, as well as maintenance and optimization. TGE is active worldwide and maintains a local presence in several strategic locations throughout Europe and Asia. Our goal is simple: To always offer the best solutions, and to provide our customers with the full benefit of our expertise. Constant innovation is a cornerstone of TGE's success. We are always working to optimize our gas engineering solutions with cutting-edge technology. As experts in a complex industry, we keep up with the changing demands and challenges of the market.

Our Solutions:

New EPC Plants

Terminals and storage facilities for liquefied gases are TGE's core business. As an EPC contractor, we construct terminals such as storage tanks and loading stations for ships and trucks, including elements like refrigeration and regasification or liquefaction units. We install large-scale tanks for up to 200,000 m³ of liquefied gases, but also offer innovative tailor-made solutions for smaller plants.

Plant Optimization & Services

TGE updates plants with state-of-the-art technology, ensuring they comply with all regulations and standards while minimizing operational impact. Even complex optimization projects can be carried out during day-to-day operation.

Fuel Gas Supply Systems

In an exclusive co-operation with our sister company CIMC Sinopacific Offshore Engineering (SEO) we create unique synergies and customer values by offering tur n key solutions for Fuel Gas Supply Systems for various applications.

TGE Gas Engineering

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Internet www.tge-gas.com

WIKA: Unlocking value with instrumentation solutions … for a net zero world.

As a family-run business which acts globally, we are known worldwide as a market leader in pressure and temperature measurement, and also in calibration technology. We also set the standard in the measurement of level, force and flow. Our products and services can be found, both onshore and offshore, in numerous up-, mid- and downstream applications in the oil, gas and petrochemical industry. Furthermore, you will find WIKA on all major approved vendor lists in this segment.

We are the reliable & trusted partner for the oil, gas and petrochemical industry on their decarbonisation pathway providing instrumentation solutions and services for applications related to the shift towards hydrogen and its derivatives (Power-to-X), carbon capture, utilisation & storage (CCUS), bio- & e-fuels and LNG.

We will continue widening our offering, and thus make it ever more attractive for our customers. In the meantime, we are active in over 75 countries and in the majority with our own local subsidiaries – thus we can ensure we are close to our customers. With their knowledge and commitment, more than 10,000 highly qualified employees contribute every day to the success of our customers. This is one reason why about 600 million of our measuring instruments are in use worldwide.

Sources:
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WIKA
Part of your business

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Internet www.wika.de

Ultra-High-Pressure Plunger Pumps and Solutions for various applications in Oil & Gas

WOMA GmbH, founded in 1962, is one of the leading manufacturers in ultra-high-pressure technologies with more than five decades experience. Through consequent research and development, WOMA today designs high-pressure water systems with operating pressures up to 3,000 bar/ 43,500 psi. The range of products includes high-pressure plunger pumps, ultra-high-pressure units and numerous water jetting tools and accessories.

Products
- High-Pressure Plunger Pumps
- Ultra-High-Pressure Units and Systems
- Water Jetting Tools
- Accessories

Applications & Solutions
- Cleaning and maintenance On-/ Offshore
- Surface cleaning
- Sieve and filter cleaning
- Heat exchanger cleaning
- Tank cleaning
- Pipe cleaning

Service
- Commissioning
- On-site service
- Training

Quality – Made in Germany
The WOMA GmbH quality management system is certified according to ISO 9001:2015.

WOMA® Kärcher Group

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Zeppelin Power Systems is the official partner of Caterpillar for Cat and MaK engines and a leading provider of drive, propulsion, traction and energy systems. The company offers its customers individual, highly efficient system solutions with comprehensive services for industrial and marine applications, the oil and gas industry, rail vehicles and power generation. Digital products for all segments as well as system components and solutions for ballast water treatment complete the portfolio.

Source: Zeppelin Power Systems

Dual-fuel technology & Dynamic Gas Blending

Solutions for the oil and gas industry

For 70 years, our engines and systems have been used worldwide for petroleum and natural gas production as well as in the offshore sector. High performance and outstanding reliability for drilling and production, gas compression and well service – Zeppelin Power Systems is your partner for the sales and service of Cat and MaK engines ranging from 31 kW to 16,800 kW.

Saving fuel and emissions with our Dynamic Gas Blending engines

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