Large Industrial Plant Engineering Group

VDMA

Status Report 2022/23

Driving the Transformation to Net Zero

Figure 1

Large industrial plant engineering in figures

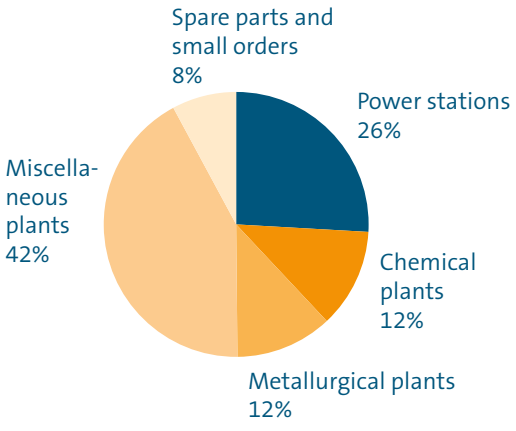
(billion euros)

	2018	2019	2020	2021	2022	Change 2022/2021
Order intake (total)	18.3	18.3	11.9	21.2	21.0	-0.8 %
Domestic orders	3.5	3.6	3.2	3.2	6.6	105.7 %
Foreign orders	14.8	14.7	8.7	18.0	14.4	-19.8 %
thereof						
Industrialised states	4.1	5.1	2.6	3.8	7.2	90.0 %
Asia-Pacific region	2.2	3.7	1.9	3.6	2.2	-38.6 %
Middle East	2.1	1.4	0.6	1.2	1.8	49.8 %
Eastern Europe and CIS	4.3	2.4	2.3	6.9	1.0	-84.4 %
Other countries	2.2	2.2	1.2	2.4	2.1	-11.7 %
Export share (in %)	81.0	80.6	72.7	84.8	68.6	
Revenue	18.6	16.3	16.3	13.3	15.0	13.9 %
Customer countries	111	103	116	118	97	
Employees	54,100	53,800	48,600	50,360	48,900	-2.8 %

Source: VDMA Large Industrial Plant Engineering Group

Figure 2

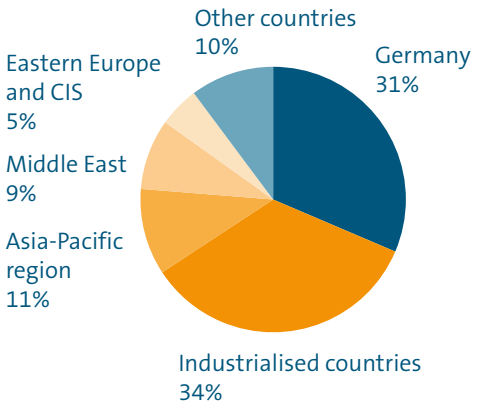
Order intake by segments 2022



Source: VDMA Large Industrial Plant Engineering Group

Figure 3

Order intake by regions 2022



Source: VDMA Large Industrial Plant Engineering Group

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Contents

Status Report 2022/2023 Preface

The year 2022 highlighted more than any other how volatility, uncertainty, complexity, and ambiguity define the environment of the global economy. In this „VUCA world“, several global challenges have made business more difficult: geopolitical upheavals, rising commodity and energy prices, supply shortages, climate change and, finally, Russia‘s war against Ukraine.

Despite these adverse circumstances, the members of the VDMA Large Industrial Plant Engineering Group were able to achieve a turnover of 15.0 billion euros in 2022, an increase of 14 percent on the previous year. Although new orders of 21.0 billion euros were 0.8 percent below the 2021 level, they far exceeded the very low expectations in large plant engineering following Russia’s invasion of Ukraine.

Companies need to respond to the various challenges through innovation, flexibility, and risk diversification. Only in this way, they can shape the transformation that is so urgently needed. In Sweden, for example, the world‘s first climate-neutral steelworks is being built, which will run completely on hydrogen.

However, this is only the beginning. If countries around the world fully implement their project commitments, this will lead to a market for clean energy technologies of around 650 billion US dollars per year by 2030, which is three times the current volume. This offers huge opportunities for large-scale plant engineering to implement new technologies and enable customers to produce in a way that saves energy and resources.

However, political support is needed to secure competitiveness in the long term. The VDMA has been calling for reforms for some time, particularly in the areas of double taxation and export financing. It remains to be seen what form the „transformative supply policy“ announced by the German Minister for Economic Affairs Robert Habeck will take. In principle, the use of incentives instead of sanctions is to be welcomed. The question is which offers will be made and which framework the policy will set. The stated goals of climate neutrality and competitiveness are essential. However, the various paths to this goal must be open to all technologies. This is the only way to release the full innovative power of European large-scale plant engineering.

Frankfurt am Main, April 2023

Chairman

Jürgen Nowicki

Managing Director

Dr. Harald Weber

Executive summary

Business development

- The members of the VDMA Large Industrial Plant Engineering Group registered orders worth 21.0 billion euros in 2022 (2021: 21.2 billion euros).
- Domestic orders increased to 6.6 billion euros (2021: 3.2 billion euros), the highest level since 2011, due to mega orders for the grid connection of several offshore wind farms in the German North Sea with a total value of 4.7 billion euros.
- At 14.4 billion euros, foreign order intake was 20 percent below the level of the previous year (2021: 18.0 billion euros). This decline was due to the collapse of the Russian market and weak business in Asia. In contrast, orders in the US, the UK and the EU rose to record levels. Growth was also reported in the Middle East and in some emerging markets such as Brazil and India.

Environment and market trends

- While demand is stable, supply is having a dampening effect: A shortage of microchips, cost increases for energy and raw materials as well as a lack of skilled workers led to delays in project execution in 2022. The plant manufacturers consider the resulting challenges transparently with their customers and usually find fair commercial solutions for all parties involved in ongoing projects.
- Price fluctuations on the supply markets and high inflation make the calculation of large projects more difficult. Therefore, contract types in which deliveries and services are settled according to their actual expenditure (e.g.: cost plus fee, reimbursable) are gaining in importance; lump-sum fixed-price agreements are no longer accepted by the plant construction industry in the current market environment due to risk considerations.
- The ambitious climate protection policy in Europe and other parts of the world offers opportunities for engineering companies to bring new technologies to the market and enable customers to produce in an energy-efficient way. The industry is thus paving the way for a global energy and mobility transition and making a significant contribution to society's goals of decarbonisation and sustainability.

Trends in the companies

- Large-scale plant engineering increases its productivity in many ways: The companies are strengthening their competencies in project and risk management, in engineering and global procurement, they are focusing on the digitalization and virtualization of workflows, and they are using technologies such as drones and robots to speed up work on construction sites and make it safer.
- Another lever is the modularization of plants and large components. This involves more than just moving work from construction sites to safe places. Changing quatity structures, alternative contract models and new ideas for the division of labour also contribute to the success of efficient modularization concepts.
- Alternative approaches to recruiting skilled workers are being used more and more frequently in large-scale plant engineering. Approaching career changers and working with university dropouts have proved their worth in practice. In addition, artificial intelligence and virtual reality as well as diverse teams offer opportunities for supporting and simplifying decision-making processes.

Political positions

- The high speed of change in the global economy remains a challenge for foreign trade promotion, after all: national and European policy-makers have recognised that the OECD consensus is in great need of modernisation. In particular, the specifications for credit conditions have severely limited competitiveness in project business. However, the high financing requirements for the global transformation to a climate-neutral economy in the face of increasing competition between systems has once again heightened the time pressure for a fundamental reform.

- A new OECD agreement is to be concluded in June 2023. It is about more flexible repayment conditions for loans and about supporting a broader range of climate-friendly transactions through more generous conditions for financing. To this end, the Consensus Sector Understanding on Renewable Energy, Climate Change Mitigation, Adaptation and Water Projects (CCSU) is to be expanded. The CCSU offers large-scale plant engineering projects that fall within this expanded scope the chance to score with more competitive financing.

- VDMA Large Industrial Plant Engineering welcomes the approach to make the OECD consensus more flexible. Since changes in the rules and regulations must also be transposed into EU law, there is no more time to lose. However, the reform of a sectoral agreement can only be the first step. The VDMA therefore supports the EU in its goal of reforming the entire OECD Consensus, as last declared by the European Council in March 2022.

- The profound change in the world of work after the pandemic calls for a new tax framework. Mobile working, which is widely used, entails the risk of unintentionally creating taxable permanent establishments abroad when crossing borders. However, the time-intensive construction sites that characterise industrial plant engineering already lead to a large number of taxable permanent establishments abroad and thus to considerable administrative effort. Additional taxable permanent establishments should therefore only come into being after a certain number of mobile working days abroad have elapsed, in order to avoid further expense due to unwanted wage tax obligations in other states. However, national regulations alone are not sufficient for this. VDMA Large Industrial Plant Engineering therefore urges an internationally coordinated approach – at least within the EU, ideally between the OECD member states.

Outlook 2023

- Most member companies expect sales to remain stable or even increase in 2023 and are optimistic about incoming orders.

- The general confidence is mainly based on the fact, that members can offer their customers innovative technologies for clean energy generation and the decarbonisation of industrial processes. These solutions are particularly in demand in North America, Western Europe, and the Middle East.

- On the other hand, some companies are reluctant about the prospects of the Chinese market, especially regarding large-scale projects and the possiblities for the procurment of components and services. The aim of the industry is to achieve greater diversification in terms of sales channels and procurement opportunities.

Business development

At 21.0 billion euros, the order intake recorded by the members of the VDMA Large Industrial Plant Engineering Group in Germany in 2022 was 0.8 percent below the level of the previous year (2021: 21.2 billion euros). This marginal decline can be considered as a success in view of a volatile market characterised by inflation, energy shortages and supply bottlenecks. In any case, orders have far exceeded the pesimistic expectations that prevailed in large-scale plant construction after Russia's invasion of the Ukraine in spring 2022.

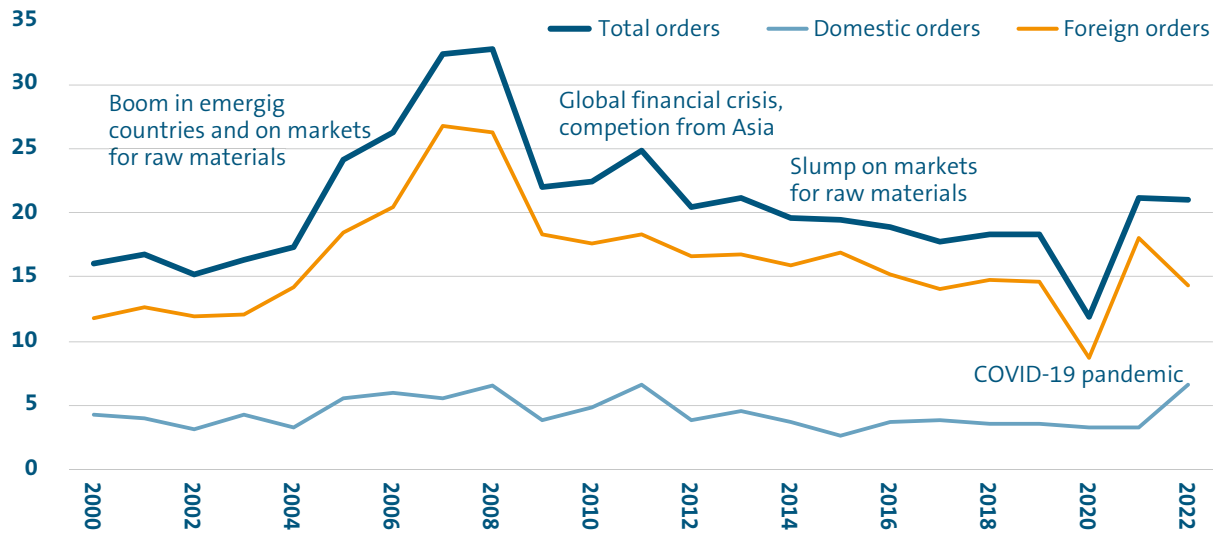
The companies were extraordinarily successful in the domestic market last year. Thanks to a number of large orders from the energy sector, AGAB members in Germany achieved the highest orders since 2011. In contrast, there were declines in foreign business. However, these are exclusively due to the collapse of the Russian market: Adjusted for the Russian business, foreign orders would have increased by 23 percent last year. The VDMA's large-scale plant manufacturers have acted very flexibly and have turned their attention to alternative markets, for example the USA, Great Britain and the EU. The fact that the companies were able to offer their customers technologies for a sustainable energy supply and the decarbonisation of industrial processes, proved to be particularly helpful.

In 2022, revenues increased by 14 percent to 15.0 billion euros (2021: 13.3 billion euros) as a result of the high order intake from the previous year. In view of the long-term nature of the business, this key figure predominantly reflects past orders from previous years. As such, turnover in large-scale plant construction is unsuitable as an

Figure 4

Order intake in large industrial plant engineering 2000 – 2022

billion euros

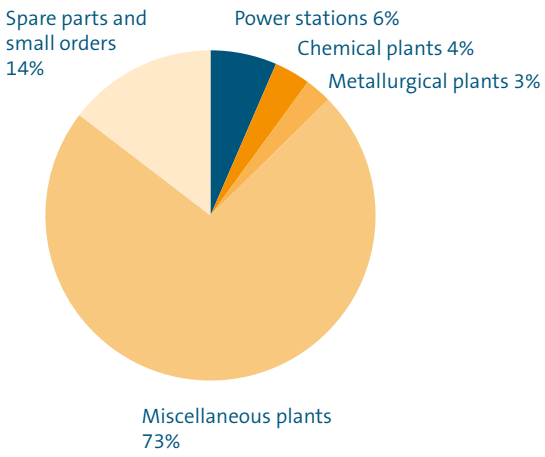


Source: VDMA Large Industrial Plant Engineering Group

Figure 5

Domestic orders by segments 2022

percent



Source: VDMA Large Industrial Plant Engineering Group

indicator for assessing the current market development and is not taken into account in the following.

Domestic orders near historic record levels

Domestic orders rose to 6.6 billion euros in 2022 (2021: 3.2 billion euros), the highest level since 2011. Previously, the level had only been higher in the boom years after the German reunification. At that time, a large number of orders for new power plants and for the refurbishment of industrial plants had filled the order books; the peak value was reached in 1993 with 7.4 billion euros.

The current upswing was triggered by a series of mega orders for the offshore grid connection of several wind farms in the German North Sea with a total value of 4.7 billion euros. All projects combined will enable the transport of 5.8 gigawatts (GW) of green wind power from the sea to the German grid, which could replace the output of several nuclear power plants.

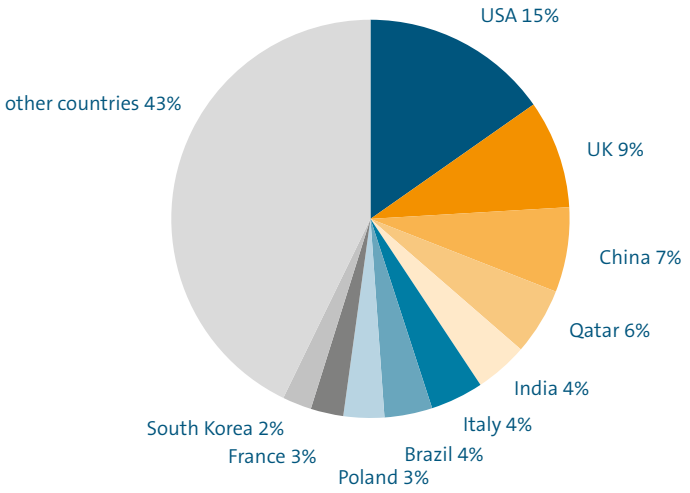
In power plant construction, the development in the reporting year was less spectacular. Although orders rose slightly to 429 million euros (2021: 416 million euros), they were significantly below the average value of the past decade of around one billion euros. The nuclear phase-out that has already taken place, the foreseeable end of coal-fired power generation and uncertainties about the future of natural gas as an energy source are major reasons for the reluctance to invest in the area of domestic thermal power generation.

Several large orders from the petrochemical and the oil and gas industry led to a growth of 47 percent to 234 million euros (2021: 159 million euros) in chemical plant engineering – the highest value in this segment since 2012. In contrast, declining orders were reported from cement (-67 percent), metallurgical (-64 percent) and paper plant engineering (-35 percent).

Figure 6

Foreign incoming orders by countries 2022

percent



Source: VDMA Large Industrial Plant Engineering Group

Foreign business suffers from the loss of the Russian market

Foreign order intake in 2022 was 20 percent below the previous year's level at 14.4 billion euros (2021: 18.0 billion euros). This decline is exclusively due to the almost complete disappearance of the Russian market. By contrast, foreign order intake adjusted for the Russian business – this compares bookings in 2022 and 2021 without orders from Russia – rose by 23 percent.

The VDMA's large-scale plant manufacturers were particularly successful in the industrialised countries last year. For the first time since the record year 2008, the companies booked orders worth more than 7 billion euros there, with the USA and the UK standing out as the most important markets worldwide. Member companies also reported growth from the Middle East (+50 percent) and from emerging markets such as Brazil (+42 percent) and India (+32 percent). Demand from the Asia-Pacific region was weaker. Large orders, such as those placed by customers from China, South Korea and Taiwan in 2021, failed to materialise this time.

Demand from industrialised countries increased significantly

New orders from industrialised countries – by which this report means the countries of Western Europe and North America as well as Australia, New Zealand, Japan and South Africa – rose by 88 percent in the reporting period to 7.2 billion euros (2021: 3.8 billion euros). This sum is significantly higher than the long-term average of 4.5 billion euros and is impressive evidence of the adaptability of VDMA's large-scale plant manufacturers to the changed market conditions.

The most important market region in terms of order intake was Western Europe. Demand here rose from 2.5 billion euros (2021) to 4.2 billion euros (2022). Especially in large countries such as Great Britain (1.2 billion euros; +287 per cent) and Italy (620 million euros; +99 per cent), significantly more orders were placed than in the previous year. The reasons for this were orders for power plant technology and a major contract for the construction of a power link to transport wind power from Germany to the UK.

In North America, demand more than doubled to 2.4 billion euros compared to the previous year (2021: 1.1 billion euros). In the USA, incoming orders even reached a record level of 2.2 billion euros – making the United States the most important market for German large-scale plant construction worldwide in 2022. Projects were spread across a variety of industries, with power plant construction and metallurgical plant and rolling mill construction benefiting in particular from major orders. An order for a steelworks in West Virginia worth several 100 million euros was one of the highlights.

Less business in Asia due to lack of large orders

Orders from the Asia-Pacific region – defined by AGAB as China, Hong Kong, North and South Korea, Mongolia, Taiwan and the ASEAN countries – fell by 39 per cent to 2.2 billion euros in 2022 (2021: 3.6 billion euros).

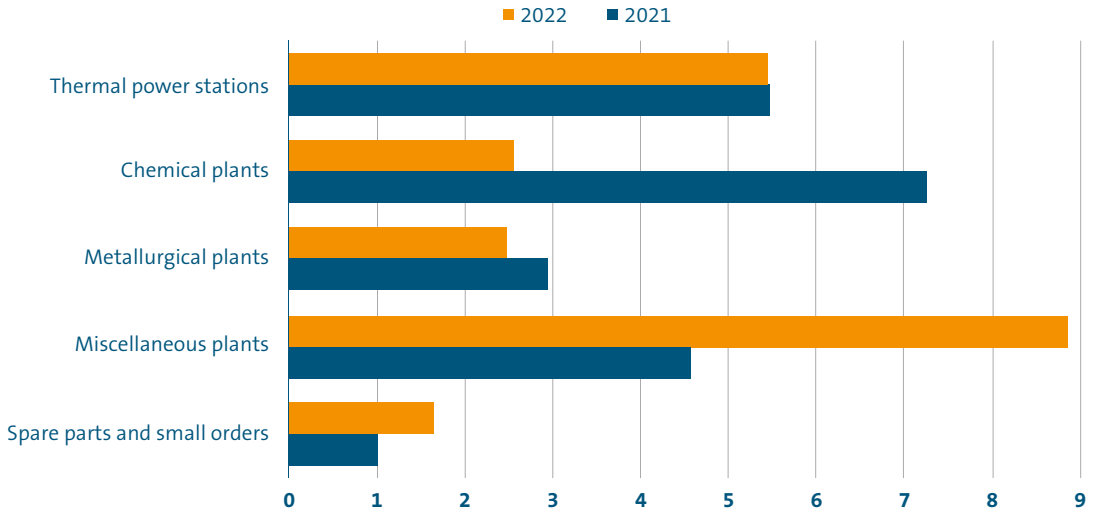
Demand for large-scale projects in China fell by 11 percent to 993 million euros (2021: 1.1 billion euros). This made the People's Republic the third most important foreign market for the VDMA's plant engineering sector. The members benefited much from retrofits driven by sustainability considerations and the expansion of electromobility in China. This led to increased demand for plants for the production of lightweight materials (e.g. aluminium) and battery separator foils, as well as plants for the production and recycling of batteries.

In the other Asian countries, members had to accept declines in orders, some of which were substantial. This was the case in South Korea and Taiwan, where demand was significantly lower than in the previous year due to a lack of large orders. In Southeast Asia, new orders fell by 60 percent to 410 million euros (1.0 billion euros). The most important markets in the ASEAN region were Indonesia and Vietnam with orders of around 150 million euros each.

Figure 7

Incoming orders by segments 2022 and 2021

billion euros



Source: VDMA Large Industrial Plant Engineering Group

Recovery in the Near and Middle East continues

Demand for large plants in the Near and Middle East increased by 50 percent to 1.8 billion euros (2021: 1.2 billion euros). However, order intake is still well below the peak levels of the early 2000ies, not least due to competition from Asian plant manufacturers, as well as unstable political environment in some countries (e.g. Syria, Iraq) and Western economic sanctions (e.g. Afghanistan, Iran).

Nevertheless, there has been a steady upward trend in order intake and project activity for several years. One reason for this is that more countries in the Gulf region are investing in the sustainable transformation of their industries and societies, and – in addition to the still important export of oil and LNG – are increasingly positioning themselves as partners for the supply of renewable energies such as green hydrogen or green ammonia.

This trend opens up good opportunities for members to use their technological expertise in the field of decarbonisation to build new confidence in its capabilities among the solvent customers at the Persian Gulf. An important reference in this context is a contract won last year by a member company to build a large-scale plant for the production of blue ammonia in Qatar. As a result of this project, Qatar has become the most important customer country in the region in 2022 with orders worth 782 million euros (2021: 78 million euros), followed by Iraq with 248 million euros and Oman with 222 million euros.

Dramatic drop in demand in Russia

Due to the almost complete collapse of business in Russia, orders from Eastern Europe and the CIS – these are the Eastern European EU member states, the Balkan countries and the members of the former Soviet Union – fell to 1.0 billion euros in the period under review (2021: 6.9 billion euros). None economic regions has experienced such a sharp decline – a minus of 85 percent in 2022 – since statistical surveys began in 1969.

Following the Western economic sanctions against Russia and Belarus, business with these countries has come to a complete standstill in 2022. Demand from Ukraine has also been severely affected by the war, amounting to only 2 million euros last year (2021: 74 million euros). However, there is no doubt that large investments will be needed to rebuild the country's destroyed industrial infrastructure once the conflict is over. VDMA engineering companies could make an important contribution to this reconstruction efforts. After all, many members are long-standing partners of the Ukrainian economy and have already supplied large industrial plants to the country in the past.

The other markets were far from able to compensate for the drastic slump in orders, even though orders from the CIS states (excluding Russia and Belarus) and Eastern Europe together rose by 71 percent in 2022 compared with 2021. Poland was the most important customer country. Order intake was 477 million euros (2021: 120 million euros). The focus was on several large orders for the construction of power plants as well as air and gas liquefaction plants.

More orders from Brazil and India

The category "Other countries" includes all countries that do not fit into any of the four groups mentioned before. It includes Africa (excluding South Africa), South and Central America, South Asia including India, Turkey and Oceania. Orders in this group of countries fell to 2.1 billion euros in 2022 (2021: 2.4 billion euros).

The most important markets in the reporting period were India with orders worth 621 million euros (2021: 471 million euros) and Brazil with 561 million euros (2021: 396 million euros). While VDMA plant manufacturers in Brazil benefited mainly from projects in the energy sector, the focus in India was on investment in metallurgical plants. In total, Indian customers placed orders worth around 400 million euros in this segment in 2022, including the supply of a high-performance cold rolling mill for aluminium wide strip and technology-oriented services.

Demand in most other emerging markets declined, for example in Turkey, Egypt and Pakistan. High inflation rates, the devaluation of domestic currencies, and natural disasters had a negative impact on project business in these countries in 2022.

Market environment and trends in large-scale plant engineering

External shocks are cooling the global economy

The growth of the global economy has slowed down significantly over the past year: according to the International Monetary Fund (IMF), the pace of expansion declined from 6.1 percent in real terms (2021) to 3.4 percent (2022). For 2023, the IMF expects a further slowdown to 2.9 percent – the bottom in the current economic cycle: For 2024, the IMF forecasts a slight pick-up in the global growth rate to 3.1 percent. Reasons for the expected cooling in 2023 are the simultaneous occurrence of several external shocks, such as global inflation and the shortage of microchips, as well as the negative effects of the war in Ukraine, which are mainly reflected in the markets for energy and food. Meanwhile, monetary policy, which has been tightened very quickly by central banks in the face of inflationary pressures, is also having a dampening effect.

Especially the advanced economies in Western Europe and North America are currently facing a phase of weak economic activity despite considerable fiscal support measures. At least the economic prospects in China have brightened due to the end of the zero-covid policy. The IMF forecasts growth of 5.2 percent there (2022: 3.0 percent). Global inflation is likely to have passed its peak by now and continues to decline due to falling commodity prices and decreasing economic tensions. However, the target levels of around 2 percent inflation pursued by the European Central Bank and the US Federal Reserve are not expected to be reached before 2025.

Against the backdrop of rising interest rates and new capital market rules, observers have expressed fears that the global propensity to invest and thus also project activity in large-scale plant construction could weaken. However, extensive economic stimulus packages such as the Inflation Reduction Act in the USA as well as the politically desired restructuring of the energy and industrial sectors in Europe make a contrary development seem conceivable, as rising demand for climate-neutral steel plants in Europe makes clear.

Easing on procurement markets

The situation on the global procurement markets has eased slightly in the past year according to the assessment of the purchasing managers in large-scale plant engineering. This was mainly due to the improved availability of steel, aluminium and other raw materials, as well as falling costs for sea freight since spring 2022. Electronic components, however, remain particularly difficult to procure. The situation is aggravated by a high sickness ratio at many supplying companies, which led to a further shortage of global production capacities in the winter of 2022/2023. In this market environment, disruptions of project execution continue to be the order of the day. The plant manufacturers discuss the resulting challenges transparently with their customers and suppliers and look for mutually acceptable commercial solutions.

Large-scale plant engineering realigns its supply chains

VDMA large-scale plant engineering companies have reacted to the bottlenecks by readjusting its supply chains: Members are increasingly turning to domestic suppliers or suppliers in nearby European countries ("nearshoring"), they are tapping into procurement markets that have received little attention so far to secure alternatives ("second source strategy") and are building up stocks and capacity buffers. This enables them to strengthen the resilience of their supply chains and react flexibly to shortages and price signals in individual markets. At the same time, the issue of sustainability in purchasing workflows is increasingly coming into focus in large-scale plant construction. In addition to new legislation, requirements from customers and from the company's own procurement organisations, which are committed to strict sustainability targets, are acting as catalysts for this development.

Large-scale plant construction facilitates decarbonisation on a grand scale

Large-scale plant construction is a supplier to many energy-intensive industries, such as the chemical, steel and cement sectors, which together are responsible for over 20 percent of global CO_2 emissions. Due to increasingly strict regulations, these sectors are obliged to significantly reduce emissions of climate-gases. In Europe, this is happening against the backdrop of the EU Green Deal, which sets the goal of reducing net greenhouse gas emissions by at least 55 percent by 2030 compared to 1990. By 2050, the EU even wants to become the first climate-neutral region in the world. In the meantime, many economies, including large ones, are following the EU plans: Japan, South Korea, Canada, the UK and the USA, among others, are also planning to be climate neutral by 2050.

This offers large-scale plant engineering companies enormous opportunities to bring new plants and technologies to the market and to enable customers to produce in a way that saves energy and resources. The industry is thus one of the pioneers of the global energy and mobility transition and contributes significantly to society's goal of sustainability. One thing is clear: without significant contributions from the VDMA's large-scale plant engineering sector, many of the ambitious CO_2 reduction targets would not be achievable.

Examples of the industry's performance in decarbonising industrial processes are plants for CO_2-free energy generation, such as hydropower plants, wind power and solar power plants. Furthermore, large-scale plant construction sets standards in the planning of plants for recycling materials. In the construction of refineries for synthetic fuels, in the supply of climate-neutral steelworks and cement plants, and in technologies for the capture and storage of carbon dioxide (CCS), VDMA large-scale plant engineering is also one of the global sustainability pioneers.

By delivering plants for recycling all kinds of materials, large-scale plant construction lays the foundation for the implementation of a circular economy.

Using bridging technologies for the transition to a sustainable economy!

In addition, members also supply plants for hydrogen, which is expected to play a central role the future as an energy carrier as well as a reducing agent in the steel industry. So far, however, there are still no reference plants with which green hydrogen can be produced on an industrial scale. Until this is to be the case, greater acceptance of bridging technologies such as CCS, blue hydrogen and blue ammonia is necessary. Finally, the transition from an economy predominantly based on the use of fossil energies (“grey”) to a model based exclusively on the use of renewable energies (“green”) can only succeed through a mix of green and of fossil energy sources with integrated CCS technology (“blue”).

In this transformation process, the legislative authority must provide economic policy framework conditions that allow companies to establish sustainable business models that can hold their own on competitive international markets. This includes, for example, a forced expansion of infrastructures, the acceleration of approval procedures and the introduction of an EU-wide CO_2 border adjustment scheme, with the help of which fair competitive conditions can be guaranteed, especially for European companies from the energy-intensive industries.

Plant engineering sets itself ambitious sustainability goals

Large-scale plant construction is not only an important partner for its customers in the decarbonisation of industrial processes. Rather, many members also set their own ambitious sustainability goals and thus assume responsibility for society and the environment. The milestones formulated by the companies concern both the head offices and international subsidiaries that are to become climate-neutral and the entire supply chain. Since the share of supplies in large-scale plant construction is over 50 percent on average, there is considerable potential to become more sustainable in the supply chain, for example by purchasing recycled and low-CO_2 materials, making greater use of environmentally friendly means of transport and shortening delivery routes ("nearshoring"). To define the requirements for suppliers, large-scale plant construction uses instruments such as codes of conduct, whereby social goals such as human rights, inclusion, gender equality and fair working conditions are taken into account even more than before.

Easing on commodity markets jeopardises the execution of some projects

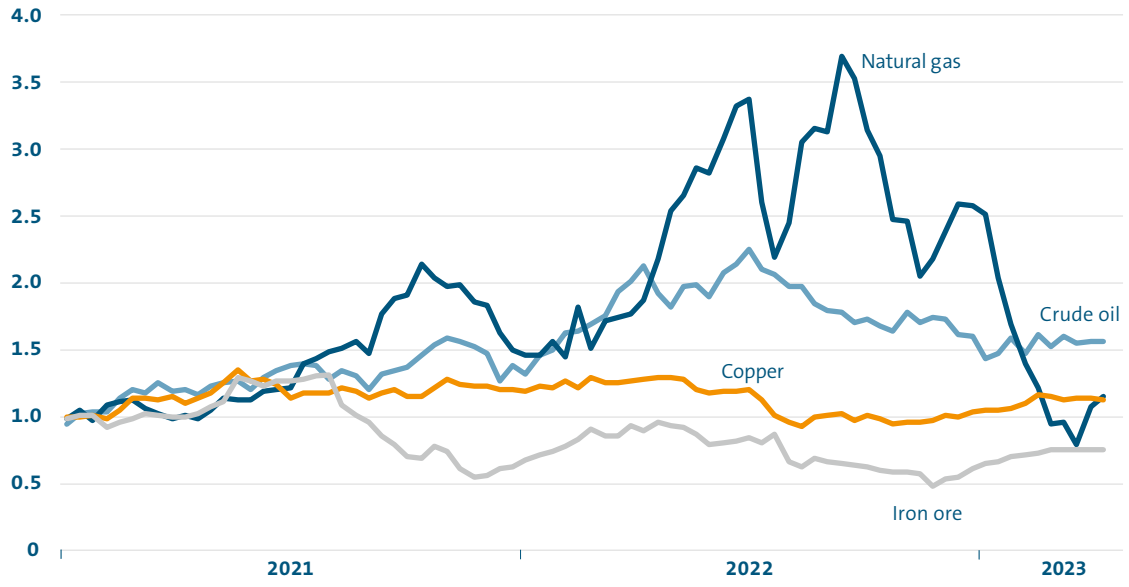
The long-term trend towards rising energy and commodity prices had accelerated again in the wake of Russia's invasion of Ukraine in spring 2022. In the food and energy commodities sectors in particular, long-term peaks were reached or even exceeded. In the meantime, the situation on most markets has eased. For example, the world market price for crude oil (Brent) has fallen by more than 30 percent compared to value in March 2022, and the price for natural gas has even fallen by more than 70 percent since August 2022. The prices of important industrial metals such as aluminium, copper, nickel and tin are also significantly below the level of March 2022 in some cases, mainly due to the weaker global economy.

Due to this market development, some customers, e.g. from the steel industry and the raw materials sector, have already postponed projects. In the area of decarbonisation, however, such effects have not yet been observed, for example in projects related to the expansion of electromobility or renewable energies.

Figure 8

Prices of crude oil, natural gas, iron ore and copper 2021 – 2023

Basis January 2021 = 1



Source: finanzen.net GmbH, own calculations

„Zeitenwende" – New markets are coming into the focus

The markets in large-scale plant construction are in transition more than ever – not only because of the Ukraine war. Rather, the market environment in large-scale plant construction in 2022 was again characterised by pandemic-related catch-up effects and high demand, especially for solutions for the digitalisation and decarbonisation of industrial processes. At the same time, strong price fluctuations on the commodity markets and high inflation have made the calculation of large-scale projects more difficult. For this reason, contract types in which deliveries and services are estimated according to their actual expenditure (e.g.: cost plus fee, reimbursable) are gaining in importance in contract design; lump-sum fixed price agreements, on the other hand, are usually no longer accepted by plant construction in the current market environment for new projects due to risk considerations.

The longer the war in Ukraine lasts, the more obvious it becomes that there will be no new project business in Russia in the foreseeable future. In view of an order volume of almost 20 billion euros awarded by Russian customers in the period 2012 to 2021, the collapse of the market there is a severe damper on the industry. Nevertheless, members have shown flexibility in the past year and set their sights on new markets. For example, the urgently needed restructuring of the energy supply in Europe opens opportunities for plant construction, for instance in the expansion of wind power and LNG infrastructure as well as in the construction of new hydrogen electrolysers and power grids.

In addition, the Inflation Reduction Act could provide a boost for renewable energy projects in the USA. In China, plant construction is benefiting from strict environmental and climate protection laws, which are mainly reflected in orders for the conversion and retrofitting of existing plants. In India, demand for industrial plants is booming due to the high population growth and the rising demand for food and basic materials in many industries. These market trends are also reflected in foreign order intake of the VDMA plant engineering sector, which – adjusted for the Russian business – increased by 23 percent last year.

Digitalisation, automation and artificial intelligence: large-scale plant engineering increases its productivity in many ways

To survive in the currently very challenging market environment and to meet customer expectations, the large-scale plant construction industry is relying on a broad range of measures to increase productivity. For example, the companies are strengthening their competences in project, quality and risk management, in engineering as well as in global procurement, and in doing so they are also relying on the possibilities of digitalisation, which has abruptly gained in importance during the pandemic.

Through innovative technologies such as robots and drones on construction sites or virtual realities and artificial intelligence in plant engineering and services, large-scale plant construction is succeeding in constantly increasing its productivity.

Covid was the ultimate trigger for establishing already existing but rarely used forms of virtual cooperation as global standard and for fundamentally restructuring processes. Examples include the enormous possibilities of predictive maintenance, virtual audits, and 3D-tours with opportunities for interactive exploring production facilities. These measures have led to avoiding travel costs, optimising maintenance cycles and significantly reducing the risk of occupational accidents. They will therefore also be important for productivity improvements in a post-Covid world.

The Covid-19-pandemic has also highlighted the need to operate construction sites more autonomously to reduce health risks for employees. In this context, robots, drones, autonomous machines and the potential of artificial intelligence (AI) and virtual reality (VR) play an important role. These technologies can take over tasks such as the welding of pipelines, the creation of progress reports and the monitoring of warehouses, thus helping to reduce construction costs and effectively relieve construction site personnel. As construction often accounts for more than 30 percent of total costs in large EPC-projects, the possible savings are significant.

Further levers for more productivity are prefabrication, preassembly and modularisation

Another lever for reducing costs and increasing productivity that is now established throughout the industry is the prefabrication, pre-assembly and modularisation of plant components in the company's own workshops or at qualified suppliers. This involves more than simply shifting work from construction sites to safe locations. Changed quantity structures, alternative contract models and new ideas in the division of labour also contribute significantly to the success of efficient modularisation concepts.

Although these efforts are limited by the individuality of the business, large-scale plant construction has already achieved significant successes in the past and will continue to exploit potential in the future. According to a VDMA study, savings of up to 15 percent in engineering and lead times can be realised through consistent modularisation. Depending on the scope of the project, this can help to shorten execution times by several months – while at the same time significantly increasing the reliability of schedules. Furthermore, by applying intelligent modularisation concepts, large-scale plant construction has managed to reduce the number of construction site accidents as well as quality costs.

Shortages of skilled workers are slowing growth in large-scale plant engineering

In the course of demographic change, the recruitment and long-term retention of skilled workers is becoming a task that will determine the future viability of entire industries in almost all sectors of the economy. This is especially true for the business of large-scale plant construction, which is more dependent than other industries on the experiential know-how of its employees. Meanwhile, the lack of highly qualified specialists in almost all disciplines is proving to be a stumbling block for the entire industry and is preventing the handling of additional orders. This trend is exacerbated by vacant professorships and declining student numbers – for example in the field of chemical engineering.

To be successful in recruiting the urgently needed experts, various strategies are used in large-scale plant construction. In addition to classic approaches such as in-house training and cooperation with universities, some companies also use alternative methods successfully. Addressing lateral entrants or cooperation with university dropouts ("second chance") have already proven successful in practice. In addition, technical solutions are also coming into focus: the use of AI, VR and the automation of workflows on construction sites create opportunities to support workers. In addition, the potentials of silver agers, refugees and people with disabilities could be used better than before through the formation of diverse teams.

Basically, the leading position of VDMA large-scale plant engineering in decarbonisation is a trump card in the war for talents. As a pioneer in environmental and climate protection, the large-scale plant engineering sector is well placed to be perceived as an attractive employer in the competition between companies for the best talents, as the industry satisfies the need, especially of the younger generation, for a sense of purpose in their own work.

Knowledge management becomes more important in demographic transition

Knowledge is a complex resource that contributes significantly to a company's success. The topic of knowledge management has accompanied large-scale plant engineering for decades, and AGAB already presented its own thoughts on the subject in the early 2000ies. Against the background of the current demographic transition, knowledge management is gaining more and more relevance. Many companies are already using digital tools to facilitate the transfer of knowledge between generations and international teams and to avoid the loss of knowledge due to the retirement of experienced employees.

It should be noted that the higher the share of deliveries and services configured specifically for the customer is, the more difficult it is to prepare this specific knowledge. In industrial plant engineering, this aspect is particularly relevant because most projects are tailor-made. Abstraction and documentation of experiences gained there are much more difficult than in batch production. The implementation of management techniques that reduce complexity and help to use knowledge are therefore an essential success factor in large-scale plant engineering.

Large-scale plant engineering relies on sustainable political framework conditions

Large-scale plant engineering has successfully mastered the difficult business year 2022. In addition to digitalisation and automation of many workflows, the companies' focus on sustainable technologies has paid off. A drastic slump in orders, as it was seen in 2020, was avoided despite the Ukraine war, the energy crisis, shortages of skilled workers and galloping inflation.

In addition to its own efforts, however, large-scale plant construction is also dependent on support from politicians, especially when it comes to establishing a secure framework for the implementation of sustainable business models and fair competitive conditions on international markets. The comments on pages 23 to 28 highlight the economic policy environment for the sector and provide information on important areas for action in foreign trade, tax policy and labour market policy.

Positions of VDMA Large Plant Engineering on foreign trade policy

How can one look back on a year that brought the brutality of war into daily awareness with full force and at the same time, on the basis of the economic situation of VDMA plant engineering, point to its special challenges and derive and address political positions from them? In critical retrospect, however, this war had been smouldering for a long time, and other armed conflicts in the world have also been part of the VUCA world for years, the manifestations of which everyone ultimately has to come to terms with. What is challenging is the simultaneity of crises that are highly topical in the short term as well as those that are creeping up and will probably dominate only in the medium and long term, like

- the climate issue, which is decisive for many other questions about the future and is coming to a head,
- the dramatically increasing geopolitical tensions with the war of aggression on Ukraine in 2022 and the increasingly open competition between political and economic systems, and
- the accompanying undermining of the rule-based order and fragmentation in globalisation.

This complex crisis and conflict situation can, however, only be tackled with the cooperation of business and politics, despite all understanding for current political priorities, so that we can then look to the medium and long-term future together with confidence.

The contribution of large-scale plant engineering with its innovative technological solutions to the so-called Transition to Net-Zero is outlined exemplarily in the industry reports (cf. pages 29ff).

In the process, the companies have been able to hold their own, grosso modo, in the past year. Why? Apart from the companies' own efforts and external factors such as the projects triggered in the USA by the Inflation Reduction Act, the annual statistics show an overall trend of increasing order intake in the industrialised countries. However, the entire world must be brought along on the path to sustainable economic activity.

However, the predominantly international project business of the VDMA plant engineering sector has always depended on a reliable and practicable political framework, especially in this VUCA world. Within this framework, companies should be able to compete fairly with each other on an equal footing for customer projects in global competition. However, this so-called level playing field has not existed for years – both in terms of national, European and international regulations for exports and in terms of corresponding requirements in the world's target markets.

The following therefore identifies areas of action in foreign trade, tax and labour market policy that would significantly improve the framework conditions for companies in the large-scale plant engineering sector and thus pave the global way to Net Zero.

It is high time for a modern framework for officially supported export credits. The VDMA's Large Plant Engineering sector therefore generally welcomes the approach of making the OECD Consensus much more flexible. However, since changes in the regulations must also be transposed into EU law for European companies, there is no time to lose.

OECD Consensus: Return to competitive strength expected

In recent years, national and European policymakers have recognised that the OECD Consensus is in great need of modernisation. In particular, the specifications for credit conditions have severely restricted competitiveness in the project business. For example, VDMA Large Plant Engineering had long pointed out with concern that the high rate of change in the global economy was being countered by a development of the regulatory framework for export credit insurance and project finance that was clearly too slow. The recent announcement by the OECD Export Credit Division that it will finally conclude a new agreement in June 2023 therefore gives cause for hope.[1] This is both about more flexible repayment terms for credits and about supporting a broader range of climate-friendly transactions through more generous financing conditions. To this end, the OECD Consensus Sector Understanding on Renewable Energy, Climate Change Mitigation and Adaptation and Water Projects (CCSU)[2] is to be expanded to include new areas of application. This could also give large-scale plant engineering in particular, with its leverage effect, the chance to contribute even more to the transformation of the global economy.

The VDMA also notes positively that the European Council on 15 March 2022 declared that the modernisation of the entire OECD Arrangement on the part of the European Union will be pushed ahead further, so that the framework for officially supported export credits regains its former importance within the OECD and can then also contribute to securing competitiveness.

European Industrial Strategy: Increasing the competitiveness of EU companies' offers

The EU Commission also intends to integrate export credit guarantees into the industrial strategy on the Green Deal. This initiative focuses on financial aid and facilitation for investments in "green" technologies, especially in production capacities. To this end, rules for state aid by member states are to be relaxed for a limited period until 2025.[3] In this context, the EU is examining the possibility of a European Export Credit Facility to complement the national offers of ECAs at member state level and thus increase the EU's overall clout in this area. According to the EU Commission, such a facility would help to create a level playing field for EU companies and thus facilitate their participation in infrastructure projects. The VDMA welcomes this initiative, especially in connection with infrastructure projects, but it does not go far enough. Why?

A corresponding declaration of intent by the EU Council was already available in March 2022 and a feasibility study was even carried out at the end of 2022. However, the hurdles for a European export credit insurance will lie in the implementation and the VDMA Large Plant Engineering sector lacks concrete measures in this regard.

1 cf.: https://www.oecd.org/trade/morenews/agreement-to-expand-export-credit-support-for-climate-friendly-and-green-projects.htm

2 cf.: Annex IV of the Consensus: The Renewable Energy, Climate Change Mitigation and Adaptation and Water Projects Sector Understanding (CCSU)

3 cf.: https://commission.europa.eu/system/files/2023-02/COM_2023_62_2_EN_ACT_A%20Green%20Deal%20Industrial%20Plan%20for%20the%20Net-Zero%20Age.pdf.

Thus, an EU facility needs sufficient funding, which must come either directly from the EU budget or from the member states. However, both approaches are likely to meet with great resistance. Merely announcing the coordination of EU financial tools without naming the institutions to be involved is not enough. In the VDMA's view, linking export credit guarantees for infrastructure projects with the European investment banks and the European Bank for Reconstruction and Development would be crucial in this regard.

German climate strategy:
Create active funding opportunities

Euler Hermes has been carrying out project-related environmental and climate assessments for contract values of 15 million euros or more for many years. The EU taxonomy has now been established as a criterion for a climate strategy and has since been evaluated by Euler Hermes. However, it has been shown that this criterion is not applicable to the majority of the funded projects.

In the European initiative "Export Finance for Future", the exclusion of fossil energy from export credit guarantee support was announced, with a few exceptions. For the German climate strategy of export credit guarantees, it would therefore be important to pay less attention to rigid rules and more to individual project circumstances when assessing projects. For example, the modernisation of an old coal-fired power plant in an emerging or developing country should at least be eligible for support if it reduces emissions per unit of production.

The focus of the climate strategy should therefore rather be on attractive incentives. However, new incentives in coverage policy require changes in the OECD consensus, EU state aid law and also national handling. It is therefore all the more important to exploit the already existing scope for promotion at the national level, e.g. in the form of the 5 percent down payment for projects with state guarantees and the co-financing of higher local cost shares.

China:
Attention to current value chains

The German government has announced a "more robust trade policy" towards China. However, restrictive intervention by the federal government in the export business with China would have considerable consequences. Like many other industries, large-scale plant engineering is closely involved in China's value chains, also as a project partner. Decoupling from China cannot be the goal; rather, its relevance as a sales and investment location should be reassessed. Against this backdrop, deliveries from China for Hermes-covered exports as well as China projects should continue to be taken into account in new cover.

The VDMA advocates that supplies from China for Hermes-covered exports and China projects continue to be taken into account in new cover.

Digitalisation:
Solutions sought for new forms of contract

The digitalisation of foreign trade also affects large-scale plant engineering. Increasingly, the customer no longer buys just the plant, but a holistic system solution with a multitude of digital services around the use of the plant. The change in value chains will continue to lead to an even greater expectation that value creation will be included at the project locations. The OECD's decision in 2021 to increase the permissible share of local procurement in ECA-funded financing was an important building block here.

Classically, however, export promotion is based on the pillars of export and investment. However, these concepts are already too narrow for today's project business. Thanks also to digitalisation, a completely new interplay of classic physical and digital products as well as services of all kinds has emerged. To ensure the competitiveness of the project business, companies therefore need the appropriate support from the OECD consensus as well as from the promotion benchmarks in national coverage in line with these new realities.

From the point of view of VDMA large-scale plant engineering, it is therefore fundamentally necessary to make the eligibility criteria for export credit guarantees more flexible by including business services.

Positions of VDMA Large Plant Engineering on tax and labour market policy

With the intensification of globalisation in recent years, the regulations on international taxation of the export industry's foreign activities in particular have become increasingly important. The companies in the VDMA plant engineering sector are particularly affected by this due to their high average export quota and the associated longer-term assembly and construction activities typical of the project business. In addition to the considerable extra administrative work involved in even intra-European assignments, they have to cope with significant extra tax burdens, above all due to the increasing double taxation of the pro rata profit in the case of assembly and plant construction permanent establishments.

The VDMA Plant Engineering Industry therefore draws attention to the following developments:

Europe:
Implementation of the global minimum taxation

On 12 December 2022, the Czech Presidency of the Council announced that political agreement had been reached by all EU Member States on the introduction of a global minimum tax of 15 percent. The Council was recommended to adopt the directive proposal on global minimum taxation already published by the European Commission on 22 December 2021. The Czech Minister of Finance, as Chairman of the Council of Ministers, welcomed the agreement as a clear and strong message to businesses. However, the directive must now be quickly transposed into the respective national law of the individual EU member states by the end of 2023, as the new regulations must already be applied from 1 January 2024.

Thus, the EU continues to take the lead in applying the global agreement of the G20/OECD on this matter. The global minimum taxation is to be applied to large groups of companies that report an annual consolidated turnover of at least €750 million. This turnover limit is also relevant in connection with other reporting obligations, such as those relating to country-by-country reporting. VDMA Large Plant Engineering will therefore constructively accompany the implementation of the global minimum taxation into national law.

New Work:
Legal certainty for mobile working abroad

The profound change in the world of work after the pandemic calls for a new tax framework. Why? The solution of mobile working, made popular by New Work and the increasing shortage of skilled workers, entails the risk of unintentionally creating taxable permanent establishments abroad when crossing borders. However, the time-intensive construction sites that characterise large-scale plant engineering already lead to a large number of taxable permanent establishments abroad and thus to considerable additional administrative work - compared to many other sectors and the competition outside the OECD. Additional taxable permanent establishments should therefore only come into existence after a certain number of mobile working days abroad have elapsed, in order to avoid further administrative expenses due to unwanted wage tax obligations in other states. However, national regulations alone are not sufficient. The VDMA Large Plant Engineering Industry therefore urges an internationally coordinated approach – at least within the European Union, ideally between the OECD member states.

Reporting requirements for EU labour deployments: The signs are pointing to tightening

The VDMA Plant Engineering Industry naturally welcomes the goal of preventing social dumping in labour deployments - but this must not be done at the expense of the EU single market. In the course of implementing Directive 2014/67/EU on the Posting of Workers Directive, however, completely different reporting obligations were introduced in the EU member states for foreign assignments of employees. Companies can only cope with this patchwork of national regulations with additional staff or by commissioning external, fee-based service providers.

With its intensive deployment of personnel on the construction sites of the target countries, large-scale plant engineering is particularly affected by this juxtaposition of different regulations. The different extension of the EU reporting obligations regarding mobile working in other European countries again significantly increases the already intensive additional administrative workload compared to the competition outside Europe.

The Large Plant Engineering Industry therefore supports the VDMA's call for harmonisation of the notification requirements in all EU member states, whereby the first 10 days of a work assignment should generally be possible without a notification. The VDMA also calls for an unbureaucratic, transparent and practical implementation of the Posting of Workers Directive. It must be clearly evident which wage has to be paid and which law must be applied.[4]

4 cf.: https://www.vdma.org/eu-work-assignments

Business outlook and sector reports

Quantitative forecasts of order intake in large-scale plant construction are often not reliable in view of the heterogeneity of the industry and a project business characterised by few, irregularly awarded large and mega orders. Assessing the prospects of the industry, which supplies plants for about 20 different industrial sectors, is therefore sensibly done in qualitative terms or as trend statements.

Large-scale plant construction looks optimistically to 2023

The large-scale plant construction industry mastered the difficult year 2022 successfully and demonstrated remarkable resilience. The companies reacted flexibly to the fundamental changes in the project environment and opened-up alternative markets. Record-breaking order intakes, for example from the USA, the UK and the EU are impressive evidence of this. The member companies are confident that this positive trend will continue in the current year. According to a VDMA survey from February 2023, most of the companies expect constant or even rising sales and the majority is also optimistic in terms of incoming orders. Only regarding the Chinese market there is a certain degree of tentativeness, particularly regarding major projects and procurement opportunities, which are to be more diversified due to risk considerations.

Industry well prepared for the future

A major reason for the general confidence is the fact that VDMA large-scale plant manufacturers can offer their customers solutions for an effective decarbonisation of industrial processes. In addition, the service business continues to be the focus of many companies. As part of strategic corporate development, some members have also identified new business areas:

They develop software programmes for their own fields of application, such as supplier onboarding or logistics on construction sites, and offer these to third-party customers. They are successfully transferring proven technologies to new fields of application, for example in port logistics and modular house construction, and finally they are actively participating in the development of a circular economy in Europe by building facilities for the recycling of materials such as paper, wood and metal.

Growth prospects in large-scale plant engineering

As a result of the current geopolitical tensions, the environment in large-scale plant construction is very volatile, uncertain, complex and ambiguous. The members are therefore realigning their risk management in order to avoid cluster risks and to be able to react even more flexibly to short-term market fluctuations than in the past. In addition, companies are increasingly using digital tools in sales as well as in project management and deploying innovative technologies such as robots, drones and autonomous machines on construction sites to become more productive.

In combination with technological knowledge, broad methodological expertise and a high degree of internationality, large-scale plant construction is well prepared to seize growth opportunities. However, the prospects can vary greatly depending on the segment. For a specific analysis, we therefore recommend reading the following market reports, which reflect the industry-specific assessments of the members of the Large Plant Engineering Group in the VDMA.

Chemical plants

Order intake in VDMA chemical plant construction – this means plants for the production of organic and inorganic chemicals as well as air separation plants and plants for the production of industrial gases – had reached an all-time high of 7.3 billion euros in 2021 due to pandemic-related catch-up effects and a number of mega projects. In 2022, orders fell to 2.5 billion euros and thus to the average level of the years 2015 to 2020. Orders from abroad amounted to 2.3 billion euros (2021: 7.1 billion euros), while domestic orders totalled 235 million euros (2021: 159 million euros).

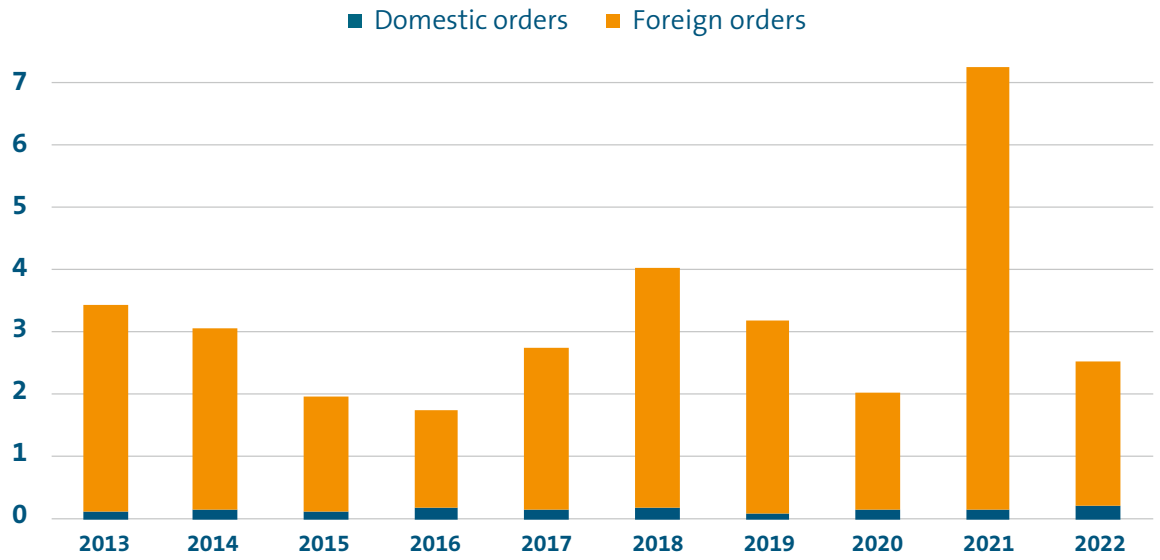
New markets come into focus for chemical plant engineering

The decline in order intake is mainly due to the collapse of the Russian market, which accounted for more than half of all orders in the VDMA chemical plant sector on average in the past decade. Many projects had to be stopped or cancelled last year due to the war in the Ukraine and the economic sanctions triggered by this and new projects are not expected in the short and medium term.

Figure 9

Order intake for chemical plants 2013 – 2022*

billion euros



* organic and inorganic chemical plants, air seperation plants, gas processing plants

Source: VDMA Large Industrial Plant Engineering Group

On the other hand, the urgently needed realignment of the energy supply in Europe is creating market opportunities that can partially compensate for the lack of orders elsewhere. In the past months, project activity has increased in Germany and Great Britain, for example. The construction of LNG terminals and the planning and construction of electrolysers for green hydrogen played an important role. In addition, a significant increase in the demand for gases for microchips is expected in the course of the intended expansion of the semiconductor industries in Asia and Europe. The European Chips Act recently specifies an investment volume of 43 billion euros by 2030 for this purpose. Suppliers of plants for gas generation and air separation could benefit greatly from these plans.

Germany will continue to be dependent on energy imports on a large scale after the end of the fossil fuel era. Renewable energies, synthetic fuels as well as green and blue ammonia and hydrogen play an important role here. Partnerships with countries that have favourable conditions for sustainable energy sources are therefore increasingly in the focus of German and European energy policy. In its National Hydrogen Strategy, the German government is deliberately focusing on cooperation – among others with sun-rich countries in Africa as well as in the Middle East. Countries rich in raw materials, such as Australia and Canada, could also come more into focus of VDMA chemical plant engineering in the context of the strategic reorientation of European energy policy.

Market shifts were already reflected in the statistics in 2022. While orders for chemical plant construction in Eastern Europe (including Russia) fell by more than 90 percent, there were some significant increases in North America, the Middle East and East Asia. Growth last year was particularly remarkable in the USA (220 percent), the Middle East (160 percent) and China (95 percent). In this upswing, major orders were reported from Qatar for a mega-plant for the production of green ammonia, and from the USA for the construction of a world-scale plant for blue ammonia.

Digitalisation improves productivity in chemical plant engineering

During the pandemic, the digitalisation of workflows in chemical plant construction has gained in importance. Covid-19 has made a significant contribution to establishing existing but rarely used forms of virtual collaboration as a new global standard. Examples of this are the growing possibilities of remote operation of plants, for predictive maintenance and virtual commissioning as well as for VR tours with the possibility of interactive exploration of chemical plants. All these measures have led to avoiding travel costs, optimising maintenance cycles and significantly reducing the risk of occupational accidents. They will therefore also be an important starting point for further improving productivity in chemical plant construction in a post-Covid-world. In addition, new products such as the digital twin and algorithms that continuously optimise the productivity of plants with artificial intelligence were further developed and brought to market during the pandemic.

Chemical plant engineering enables efficient decarbonisation

VDMA chemical plant engineering is an indispensable partner in the transition to sustainability. The portfolio of the companies includes efficient technologies and innovative plants and combines these solutions with the ability to gradually scale-up technologies from laboratory scale to an industrial format. This creates the conditions for producing and transporting the enormous quantities of green chemicals, fuels and energy sources needed in the market at low cost and making them available to end customers. The industry's supply includes, for example, electrolysis plants, hydrogen liquefaction plants, electrically heated steam cracker furnaces, refineries for synthetic fuels, large-scale plants for blue and green ammonia, and processes for capturing and storing carbon dioxide (CCS). With the help of these technologies, entire industries, but also parts of the transport and energy sectors, are to be gradually decarbonised.

On behalf of DECHEMA, the consultancy FutureCamp has calculated what it would mean if the goal of a greenhouse gas-neutral chemical industry in Germany were to be achieved as early as 2050: One consequence would be that new technologies would increase the electricity demand of the German chemical industry to 685 terawatt hours (TWh) annually from the mid-2030ies onwards – more than the total German electricity production of 2022 amounting to 507 TWh.

In this respect, the availability of renewable electricity in large quantities and at affordable cost is proving to be a critical success factor on the road to climate neutrality, without which this goal cannot be achieved by 2050. Large plants for the production of green hydrogen are also still lacking: plant sizes of 25 to 50 megawatts (MW) are common on the market and capacities of up to 200 MW are under construction. However, gigawatt-plants needed to meet the climate targets do not yet exist. The commercial risks that have to be managed in the construction of such prototypes are still high hurdles for project realisation. To accelerate the desired development towards a hydrogen economy, government guarantees and (time-limited) start-up financing could therefore be useful aids for plant construction.

In this respect, it is indispensable to plan for intermediate steps. Until sufficient wind and solar power is available at competitive prices and the challenges of building large-scale electrolysers are solved, CCS and blue hydrogen / ammonia will be important bridging technologies. To put it in a nutshell: The transition from an economy based on the use of fossil energies ("grey") to a model based exclusively on the use of renewable energies ("green") can only succeed via a mix of green and fossil energy sources with integrated CO_2 capture and storage ("blue").

Favourable prospects thanks to new markets and industrial transformation

Despite a challenging market environment, the VDMA chemical plant engineering sector is looking to the future with optimism. After all, the industry can score with comprehensive technological competence on one of the most important issues of the day – climate change – and offer customers solutions for greater resource efficiency in their plants. The need for investment in climate protection projects and the sustainable conversion of large plants is enormous: experts speak of more than 4.5 trillion US dollars by 2030 alone. A significant part of this sum will flow into plants for sustainable energy production and storage, for green chemicals and in technologies for capturing carbon dioxide.

With the largest investment programme, the world has ever had to realise in such a short time, VDMA members have promising prospects on the world market. Another favourable factor is that some companies have more negotiating power again and are able to exclude unfavourable conditions in their contracts. First signs of a seller's market can thus be seen in chemical plant construction – a situation that was last observed during the boom of the years 2006 to 2008.

The past year has led to a fundamental change with regard to the markets in chemical plant engineering. While the dominant market of the past decade – Russia – will probably be absent for years to come, the industrialised countries as well as the Middle East, Southeast Asia and China are gaining in importance. The drivers of this development are the accelerated decarbonisation of industry in these regions as well as the construction of plants and infrastructures for the export of sustainable energies.

Growth in chemical plant construction is currently being held back by a lack of skilled personnel worldwide. Many projects can therefore only be completed on schedule through a clever international division of labour and the use of domestic resources released by the war in Ukraine. In the future, there is no relief in sight on the labour market for engineers and skilled workers; in view of the retirement of the baby boomers a further shortage is rather to be expected. The use of artificial intelligence and virtual realities, the digitalisation and automation of workflows on construction sites create opportunities to support workers on a significant scale, especially in the areas of engineering, construction as well as in services and in plant operation. In addition, the potential of silver agers, migrants and people with disabilities could be even better utilised than before through the establishment of more diverse teams.

All in all, the prospects for the industry are very promising. Chemical plant engineering plays a key role in the transformation of the industry to climate neutrality, which should ensure full order books in the medium and even in the long term. The common goal of all companies is: Net Zero!

Metallurgical plants

Green steel has arrived with full force onto the global marketplace as a term quickly becoming commonplace in the steel industry. Green steel represents a focus on decarbonization and a transformation of production routes toward eco-friendly methods and processes. As the industry transforms, producers are adopting new technologies to change their production routes and move away from fossil fuels. Yet, no single solution can immediately solve the industry's challenges, but the stepwise adoption of innovations will define the new era of green steel.

Facing the reality of climate change, 153 countries worldwide have pledged their commitment to net-zero carbon emissions following the most recent U.N. Climate Change Conference, COP27, in Sharm el-Sheikh, Egypt. While COP26 in Glasgow, U.K., focused on a commitment to phasing out coal subsidies, reducing methane leakage, and halting and reversing deforestation, the steel industry's immediate impact is reducing energy consumption and moving away from fossil fuels. COP27 achieved progress on a stepwise phase-out of coal and agreed on a global fund to compensate the global south for loss and damage caused by climate change, with funding conditions for contributions and beneficiaries postponed until COP28.

When discussing carbon emissions and their impact on the steel industry, one must look no further than to the publication of the European Green Deal from 2019/2020. The European Green Deal proposes financial mechanisms to help cut greenhouse gas emissions by 55 percent by 2030 compared to levels in 1990 and to reach climate neutrality by 2050. Similar agencies worldwide will play a decisive role for producers on the road to decarbonization. In 2022, amidst increasing energy prices, Europe also saw an increase in the cost per ton of CO_2 emissions, reaching nearly

Source: https://www.statista.com/

Figure 10: E.U. Carbon Permit Pricing according to the E.U. Emissions Trading System from 2005–2023

100 euros per the Emissions Trading System (ETS). With almost two tons of CO_2 produced for every ton of crude steel, the price per ton of CO_2 will play a significant role for steel producers as more countries adopt carbon-pricing schemes. In Europe, introducing the new ETS and the Carbon Border Adjustment Mechanism will play an essential part regarding imported carbon emissions as the "free allocation" period is phased out.

Meanwhile, the steel industry is currently confronted with a contribution of nearly eight percent of all global CO_2 emissions. Simultaneously, steel demand is set to rise—especially in India and Southeast Asia, as well as in the renewable energy, infrastructure, and e-mobility sectors. How the industry will respond to a decrease in emissions while meeting market demands will be determined by a series of breakthrough technologies and a flexible approach toward sustainable steel production.

Sustainable technologies

While the steel industry faces tough challenges, engineers, suppliers, and specialists are paving the way toward carbon neutrality with sustainable technologies. These innovations reduce carbon emissions, contribute to the circular economy, and will define a sustainable future. For producers, increased electrification, more scrap-based production routes, and direct reduction of virgin iron ore using natural gas and later hydrogen will become the norm. Additionally, adjacent infrastructures will also see increased development to meet these needs—for example by expanding the renewable energy infrastructure and developing hydrogen and CO_2 ecosystems. Key technologies and cooperation will be crucial to the future of a sustainable society.

Technologies, such as direct reduction, electric arc furnaces, smelters, and endless strip production, define green steel and provide the opportunity to immediately reduce carbon emissions by replacing traditional, largely coal- or fossil-based process steps that emit increased amounts of CO_2, including coke batteries, agglomeration plants, blast furnaces, LD converters, and the fossil-fired reheating of slabs for downstream processing. Taking these processes one step further, hybrid mills that operate blast furnaces, LD converters, and electric arc furnaces will become a significant trend for transitioning stepwise to fully electric steelmaking. Integrating a smelter also provides further opportunity to replace the blast furnace, the most carbon-intensive portion of steel production, particularly for low-grade iron ore.

Electric arc furnaces will play an integral role in transforming the steel industry with the capability of offering comparable capacities as LD converters and the ability to be powered by renewable energy.

Digitalization and scrap supply

While producers begin to transform their production routes and impact adjacent sectors, the focus on the supply chain is an essential component of the success of this transition. One of the most valuable raw materials for producers looking to reduce carbon emissions is scrap. Scrap-recycling is a highly efficient means of reducing the carbon footprint of steelmaking. However, current scrap supplies are limited and insufficient when producing high-grade steels due to contaminants like copper, phosphorus, or nitrogen. Suppliers have begun to develop digital scrap-cleaning solutions to create “crafted scrap,” often termed “design scrap.” Crafted scrap enables the production of more advanced steel grades with a higher share of scrap in the charge mix.

Increased scrap rates can immediately reduce CO_2 in the steelmaking process, but a 100 percent scrap charge in an electric arc furnace demonstrates the highest potential for low CO_2 emissions.

However, even solving the issues regarding the scrap quality to meet metallurgical demands, global scrap supplies will be unable to keep pace with the rising demand for scrap during this transition. Thus, iron reduction solutions based on natural gas and hydrogen will provide producers with the necessary materials without additional emissions.

Hydrogen-based direct reduction

The MIDREX direct reduction process is the best known direct reduction process worldwide. Using natural gas, a MIDREX direct reduction plant can reduce carbon emissions by around 65 percent when combined with a renewable-powered electric arc furnace, compared to the conventional integrated route. Producing DRI or hot-briquetted iron (HBI) based on pelletized high-grade iron ore with natural gas is a transitional building block to reduce CO_2 emissions quickly. Alternatively, these plants can operate entirely on hydrogen, which brings emissions down even further when using renewable energies.

Yet, global supplies of high-grade iron ore also present another problem. The blast furnace is the most efficient route to produce liquid hot metal using low-grade iron ore. For the processing of low-grade iron ore and avoidance of the need for iron ore pelletizing, suppliers have begun to explore efficient means of fluidized- bed-based fine ore reduction processes utilizing 100 percent hydrogen. While large-scale hydrogen production has traditionally been slow, efforts from the steel and the energy sector suggest that the price of green hydrogen may drop to less than two dollars per kilogram. However, a complete hydrogen ecosystem remains challenging. It requires investments in long-distance logistics like compression, conversion and shipping of hydrogen or the construction of ammonia crackers that add additional costs.

Inexpensive green hydrogen means decarbonizing steel production by shifting toward hydrogen-based direct reduction may occur sooner rather than later. Furthermore, a smelter can also produce an alternative green hot metal or pig iron for producers looking to utilize existing LD converters. For many producers, a commitment to direct reduction and electric steelmaking is already in the cards, the transition is underway.

MIDREX direct reduction plant located in Corpus Christi, Texas, U.S.A.

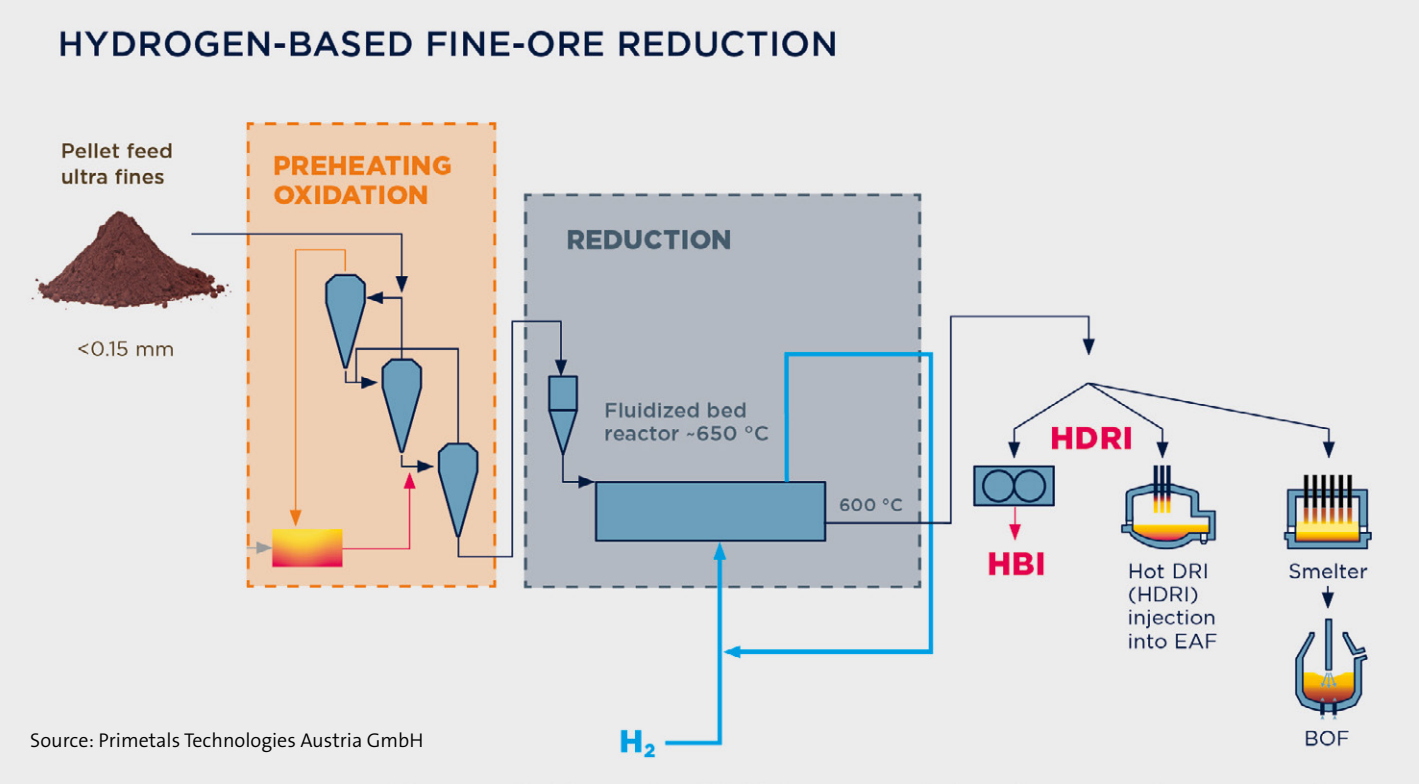


Figure 11: Hydrogen-based fine-ore reduction can revolutionize direct reduction and offer viable solutions for processing all qualities of iron ore using fines.

Carbon capture and storage

While avoiding carbon-intensive processes using new technologie, there will be many hurdles to overcome for the steel industry to ensure sustainability. Part of this journey will undoubtedly involve the application and implementation of carbon capture and storage technologies. From underground storage to gas fermentation solutions, various technologies typically applied to the energy sector will make their way into heavy industries, including the steel industry. The primary focus of these applications will be the blast furnace top gas, waste gas from reheating furnaces, and flue gas from direct reduction to ensure that all emissions are accounted for accordingly.

Reaching decarbonization

The steel industry's future will rest with those willing to embrace the current transformation and strive toward decarbonization. Whether in a "hybrid" setup, or boldly shifting toward direct reduced iron and scrap, producers worldwide will have to find their own path to decarbonization. For engineering companies and steel suppliers, it is a time to define the future of their industry, by establishing worldwide partnerships to ensure a sustainable future with green steel. It shall be clear that these transition requires financial and regulatory support from governments and the establishment of a reliable market demand for low-carbon emission steel to arrive at the finish line.

Pulp and paper plants

Market environment in the paper industry remains challenging after the pandemic

The market environment for the global paper industry was challenging in 2022. Rising raw material and energy costs, as well as disruptions of global supply chains following the war in Ukraine, placed high demands on companies' flexibility. In addition, resource and energy efficiency moved more into the focus of the industry. Nevertheless, global paper production increased slightly again in 2022. This means that the growth trend of recent years, interrupted only in 2021 by the Covid-19 pandemic, continued.

Long-term trends in the paper industry continued in 2022

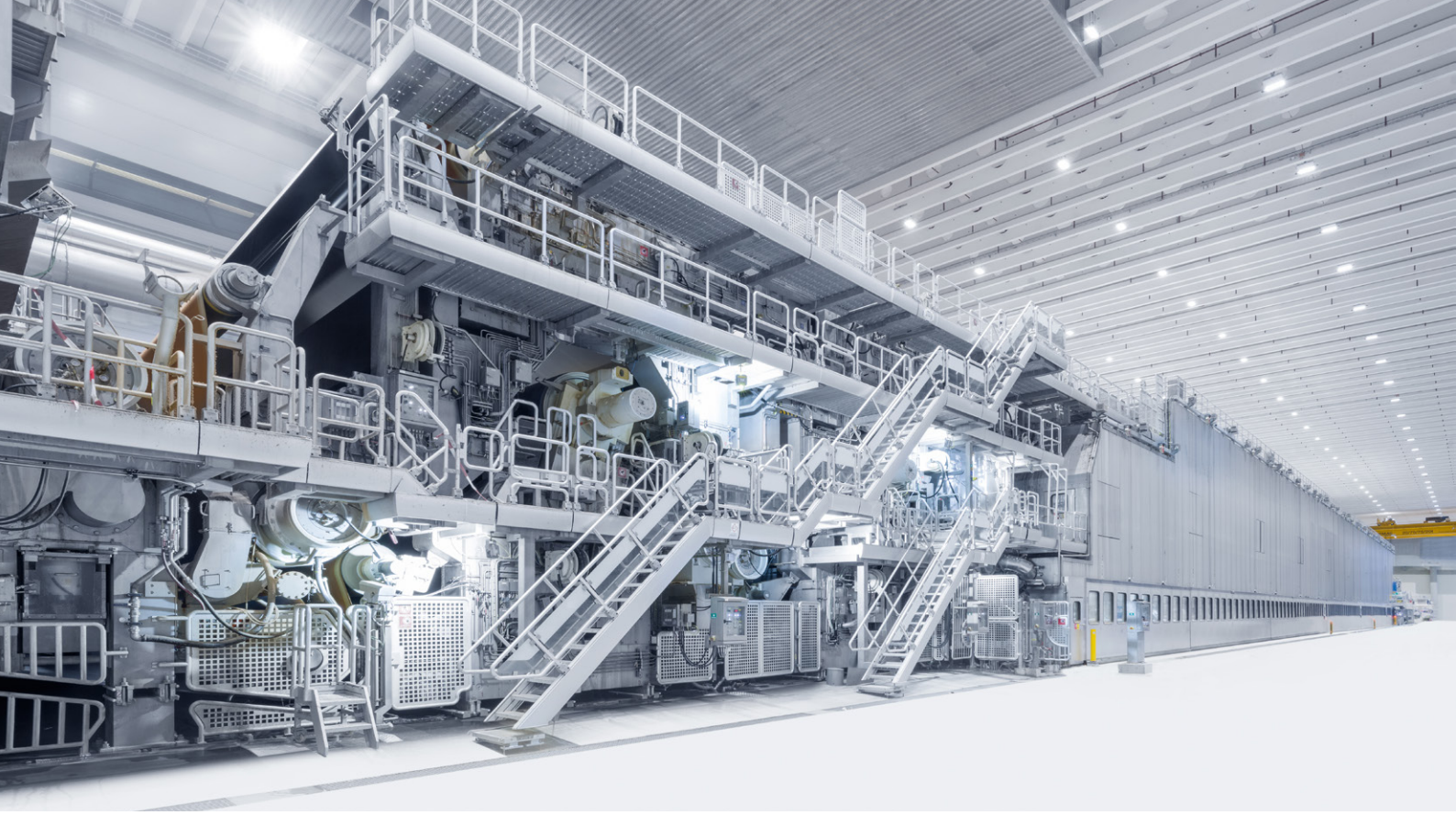
From a global perspective, the largest production growth in 2022 was in the board and packaging paper sector. Booming online trade was a major driver. The tissue segment also continued to grow. Following the gradual lifting of pandemic-related contact restrictions, demand for tissue papers picked up again. The production of speciality papers increased slightly, while the production of graphic papers fell below the level of 2021, due to the increasing digitalisation of many areas of life. These fundamental trends are unlikely to change in the coming years. Market observers expect a slight, steady growth in all market segments except graphic papers.

Slowing investment momentum in the paper industry

In 2022, investment momentum in the global market for paper production machinery and equipment returned to the level of 2020. Investment volumes in almost all segments were well below the reference values of the record investment year of 2021. In absolute terms, there were more new projects than conversions.

The highest investments in 2022 were made in the packaging paper and board machine segment, followed by the tissue and specialty paper segments. Demand for graphic paper plants remained at the same low level as in 2021. The general market trends described here apply in principle to all regions of the world. In some cases, however, country-specific developments have been observed:

Asia was the region with the highest investment volume in 2022 and China was the most important single market. New projects are mainly in the packaging paper segments, followed by board paper. The EMEA region (Europe, the Middle East and Africa) is second in terms of investment activity. Here, too, the focus of new projects was on the packaging paper segment, followed by the tissue market and the specialty paper segment. Most orders for new and the the rebuilding of existing production facilities came from customers in the UK, France, Austria, Portugal, and Germany. Investment in the paper industry in the Americas was significantly lower. Only in the tissue sector some major projects were initiated.



Sustainability and digitalisation continue to be key fields of action in paper manufacturing. The paper plant engineering sector organised supports its customers by supplying new technologies that ensure greater resource efficiency and process stability in paper production.

The paper industry focuses on sustainability – with plant engineering as driving force

The global paper industry is currently facing the challenge of making its production processes even more resource-efficient than they already are. On the one hand, this is a result of legal requirements. For example, the Green Deal adopted by the EU stipulates that greenhouse gas emissions in the Union must be reduced by 55 percent by 2030 compared to 1990. On the other hand, the increasing cost pressure resulting from the energy crisis in Europe is playing a role, too. The changing social relevance of sustainability is also contributing to this development. To achieve sustainability goals, many companies in the paper industry are working closely together with engineering companies organised in the VDMA. Together they develop innovative solutions for a sustainable and energy-saving paper production.

Innovative technologies reduce energy and water consumption and improve fibre yield in paper production

If the paper industry is to play its part in meeting global climate change targets, it will need to look beyond existing technologies and find ground-breaking solutions. In addition to minimising energy consumption, reducing the use of fresh water is one of the major challenges facing the paper industry. A powerful lever is the gradual closing of water loops in production processes. In today's most advanced technologies, the water used is purified using anaerobic treatment techniques and completely reused in the production process. In this way, freshwater consumption per kilogram of paper produced can be reduced to as little as 1.5 litres – 50 years ago, up to 50 litres of fresh water were needed to produce one kilogram of paper in Germany. The anaerobic process also produces a large amount of biogas. This can be used as primary energy, reducing both energy costs and CO_2 emissions. Overall, the fully closed water cycle reduces carbon dioxide emissions by up to 10 percent.

The recycling of paper is another starting point for improving the sustainability of the material. Great progress has been made in this area in recent decades: The European recycling rate for recovered paper was already 71.4 percent in 2021, and a global rate of 50 percent was reached in 2018. In this context, cross-industry initiatives such as the 4evergreen alliance are also working towards sustainability and promoting the spread of recyclable fibre-based packaging. In addition, new technologies are making it possible to recover even higher quality paper fibres from recycled paper with less energy input. The paper plant engineering industry organised in the VDMA is making a major contribution to these successes by developing innovative equipment and new technologies.

In addition, there has been a trend in recent years towards sustainable packaging papers as an alternative to petroleum-based materials. One innovative solution is the versatile barrier paper, which is recyclable and ideally biodegradable. To meet the increasing global demand for tests with barrier papers and flexible packaging solutions, large-scale plant engineering companies are offering their customers the opportunity to carry out pilot trials with different coating variants for all paper grades on so-called trial coating machines. By producing small batches for market tests, customers can put the knowledge they gain directly into practice, giving them a high degree of reliability for future projects.

Increasing importance of digitalisation and artificial intelligence in the paper industry

Virtual networking and innovative technologies such as KI and VR are becoming increasingly important in many industries. Paper manufacturers are also using the potential of digitalisation. Innovative services support the remote monitoring of plants. Thanks to digitalisation and automation, preventive measures are also possible to avoid errors and downtimes. An example of this is a digital solution that automatically detects critical process conditions in paper production, initiates countermeasures and thus prevents web breaks and production interruptions. Another innovation relies on the use of artificial neural networks that learn with the help of expert knowledge to analyse recovered paper already at the beginning of stock preparation and to assign it to the respective grade. The early provision of information on the exact quality of recycled paper enables efficient process control, which reduces fibre losses and facilitates to produce at lower costs.

These examples illustrate that sustainability and digitalisation go hand in hand in the paper industry, thus ensuring the future viability of paper as a key material. In this context, plant engineering is a driving force, supplying the industry with innovative technologies for highly efficient and resource-saving paper production.

All figures in million euros

Statistical annex

Figure 12

Incoming orders in large industrial plant manufacturing 2013 – 2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total incoming orders	21,195	19,643	19,503	18,880	17,784	18,326	18,303	11,903	21,200	21,021
Tree-year-average	22,213	20,450	20,114	19,342	18,722	18,330	18,138	16,177	17,135	18,041
Domestic orders	4,502	3,733	2,620	3,653	3,750	3,487	3,555	3,249	3,221	6,605
Foreign orders	16,692	15,910	16,883	15,227	14,034	14,839	14,748	8,654	17,979	14,416
Export share	78.8	81.0	86.6	80.7	78.9	81.0	80.6	72.7	84.8	68.6

Figure 13

Foreign incoming orders by group of countries 2013 – 2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Industrialized countries	4,951	4,335	4,243	4,149	4,465	4,134	5,066	2,588	3,798	7,218
Asia-Pacific region	3,552	3,729	2,008	2,180	3,491	2,185	3,733	1,889	3,602	2,211
Middle East	2,165	1,791	2,383	1,765	1,383	2,088	1,379	633	1,208	1,810
Eastern Europe and CIS	2,060	4,062	2,157	1,774	1,794	4,265	2,365	2,342	6,942	1,034
Other countries	3,964	1,993	6,092	5,359	2,901	2,168	2,205	1,202	2,429	2,144
Total foreign orders	16,692	15,910	16,883	15,227	14,034	14,839	14,748	8,654	17,979	14,416

All figures in million euros

Figure 14

Turnover by group of countries 2013 – 2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total turnover	20,828	20,336	20,538	22,807	21,242	18,651	16,255	16,282	13,273	15,074
Domestic turnover	4,394	4,517	6,057	4,540	2,684	3,024	3,125	3,211	2,685	2,854
Foreign turnover	16,434	15,819	14,481	18,267	18,558	15,627	13,130	13,071	10,588	12,220
thereof										
Industrialized countries	4,342	3,958	4,868	4,759	5,407	4,620	4,349	4,184	3,928	4,108
Asia-Pacific region	4,013	3,771	3,178	3,263	3,352	3,246	3,039	2,748	2,370	2,846
Eastern Europa and CIS	1,957	2,020	1,483	1,761	2,485	1,139	1,197	2,833	1,359	2,600
Middle East	3,046	1,943	2,090	2,426	1,868	1,658	1,686	1,523	1,055	949
Other countries	3,076	4,127	2,862	6,058	5,446	4,963	2,859	1,783	1,876	1,727

Figure 15

Domestic incoming orders by segments 2013 – 2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Power stations	2,645	1,351	598	987	622	546	1,002	1,124	416	429
Metallurgical plants	191	189	170	137	257	192	281	128	470	172
Chemical plants	37	65	66	102	84	114	83	121	36	75

All figures in million euros

Figure 16

Foreign incoming orders by segments 2013 – 2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Power stations	6,218	6,679	7,847	7,063	4,224	4,325	4,876	3,050	5,062	5,016
Metallurgical plants	2,551	2,159	1,461	1,287	1,988	2,041	2,203	999	2,450	2,317
Chemical plants	3,336	2,888	1,852	1,554	2,540	3,857	3,084	1,882	1,105	1,210
Cement plants	529	198	306	494	224	156	116	29	136	129

Figure 17

Quarterly incoming orders in large plant engineering 2021 and 2022

2021 Quarter	Domestic orders	Foreign orders	Total orders	Export share
1.	861	2,793	3,654	76.4 %
2.	1,094	2,361	3,455	68.3 %
3.	721	9,005	9,726	92.5 %
4.	545	3,820	4,365	87.5 %
Total	3,221	17,979	21,200	84.8 %

2022 Quarter	Domestic orders	Foreign orders	Total orders	Export share
1.	723	3,135	3,858	81.2 %
2.	707	3,339	4,029	82.8 %
3.	2,087	4,033	6,119	65.9 %
4.	3,080	3,954	7,014	56.4 %
Total	6,605	14,416	21,021	68.6 %

All figures in million euros

Figure 18

Foreign incoming orders by countries 2013 – 2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total 2013 – 2022
1. Russia	884	2,376	1,193	983	1,086	2,351	1,384	1,604	6,298	58	18,217
2. USA	1,888	1,548	1,317	1,008	1,031	914	1,529	617	1,030	2,201	12,155
3. China	1,774	1,000	823	840	1,401	1,243	1,346	786	1,112	993	11,318
4. Egypt	144	51	2,575	3,232	159	213	605	77	244	118	7,418
5. India	1,163	386	693	385	470	390	290	144	471	621	5,013
6. Saudi Arabia	1,004	916	511	549	132	333	129	225	219	203	4,221
7. Great Britain	133	245	227	268	665	604	306	133	328	1,268	4,177
8. South Korea	198	904	352	233	132	192	411	287	647	341	3,697
9. UAE	146	311	719	309	330	620	335	169	110	176	3,225
10. Turkey	400	252	554	206	282	269	196	104	464	152	2,879
11. Brazil	361	152	362	65	68	220	411	117	396	561	2,713
12. Poland	208	875	325	119	151	56	206	60	120	477	2,597
13. Malaysia	463	987	137	135	82	58	86	50	361	51	2,410
14. Italy	196	170	133	152	157	153	199	132	311	620	2,223
15. Taiwan	141	58	124	181	149	132	211	353	618	235	2,202
16. Sweden	167	214	170	243	161	182	425	166	145	325	2,198
17. France	83	246	201	124	177	94	333	155	359	383	2,155
18. Iraq	352	122	135	12	108	234	595	99	237	248	2,142
19. Qatar	65	66	375	269	88	298	39	27	78	782	2,087
20. Austria	118	122	196	128	385	233	157	115	325	268	2,047
21. Hungary	64	69	158	35	42	1,081	48	258	138	55	1,948
22. Netherlands	190	194	244	301	173	207	141	131	164	138	1,883
23. Canada	347	268	174	61	173	222	197	85	74	153	1,754
24. Thailand	232	244	116	114	322	82	91	152	95	51	1,499
25. Belgium	63	95	116	147	277	232	124	85	168	192	1,498

Glossary

CCU/CCS
Carbon capture and utilization (CCU) refers to the capture of carbon dioxide (CO_2), primarily from combustion exhaust gases, and its subsequent use in further chemical processes. The term is closely related to carbon capture and storage (CCS), in which the captured carbon dioxide is stored without a container. In contrast to CCS, the primary goal of CCU is not to remove CO_2 from the atmosphere, but to provide chemical raw materials. Thermal power plants with CCU technology therefore initially supply CO_2 as a raw material for other applications, which is temporarily captured but released again when used for energy. Thus, although the CCU process per se has no climate protection effect, it can play an important role in a circular economy. If the CO_2 used is permanently protected from release, this can be a building block for climate protection.

Double taxation agreement
An agreement to avoid double taxation is an agreement under international law between two states. It governs the extent to which a state is entitled to a right of taxation for the revenues earned in one of the two contractual states or for the assets located in one of the two contractual states. The aim of a double taxation agreement is to prevent natural persons or legal entities that realize revenues in both states from being taxed in both states.

ECA
Export Credit Agency (ECA) is the international term for government export credit insurance in the OECD, which promotes export projects in emerging and developing countries - either through pure credit insurance, or also through direct financing, refinancing and interest rate subsidies. In Germany, Allianz Trade (Euler Hermes) is responsible for the implementation.

EPC
Engineering, Procurement, Construction: In large industrial plant engineering, contracts are frequently awarded as EPC packages. It means that the contract to be awarded comprises engineering, procurement and construction of a plant. The plant engineering company generally carries out an EPC contract as a general contractor or as head of a consortium.

General contractor
Where the contractor acts as general contractor for a project, which is routinely the case for turnkey plants, he is responsible to the client for all deliveries and services arising from the contract received. The pgeneral contractor thus takes the place of the client in coordinating the interfaces between the respective individual trades.

Mega project
The VDMA defines megaprojects as very complex, technically demanding and economically relevant projects with order volumes of at least 500 million euros. Megaprojects are also characterized by many participants and project durations of several years. On the other hand, the VDMA speaks of a major or large-scale project for ventures worth at least 25 million euros.

OECD Consensus
The OECD Consensus is a “gentlemen’s agreement” of the OECD members EU, USA, Canada, Norway, Switzerland, Japan, Korea, Australia, New Zealand, Chile, Iceland, Israel, Mexico and Turkey to grant officially supported export credits only within defined limits. This is intended to largely prevent distortions of competition in the relationship between exporters as well as financing competition at the expense of state budgets. Since this is not a legal act of the OECD, other countries outside the OECD could also join the consensus. However, efforts to include China in particular, have failed so far.

Large Industrial Plant Engineering – Portrait of a global industry

Large industrial plant manufacturers are defined as companies capable of processing one or more large-scale projects a year with a volume of at least 25 million euros each year. They must have the comprehensive expertise necessary to handle all aspects of the entire project, including the planning and engineering of the plant as well as the sourcing of the equipment, along with delivery, installation and start-up. Manufacturers of power stations, steelworks and chemical plants are all good examples for large-scale plant engineering companies. Each project takes an average of between two and three years to complete, with contract volumes frequently over 100 million euros and in exceptional cases even over one billion euros.

The large industrial plant manufacturing industry is a major sector of the European economy with an average annual order volume of 18 billion euros (average 2020 – 2022) and a world market share of roughly 15 percent. The branch has 50,000 high-qualified employees in Germany and Austria, and it generates also valuable impetus for the medium-scale mechanical engineering sector as a whole: subcontracted services and supplied components account for around 75 percent of its total volume and there are more than 100,000 additional jobs at subcontractors depending on the different projects. The large-scale plant engineering contractors in the VDMA maintain business ties with customers in all parts of the world and in recent years they have delivered around four fifths of their value added abroad. China, the US and India are at the moment the key customer countries. Opening up new markets, the large industrial plant engineering industry contributes considerably to the expansion of international economic relations. Frequently, the branch is pioneer as to the emerging markets' industrial development and at the same time pathfinder for the succeeding export industry.

Large-scale industrial plant manufacturers build facilities for many different industries, including the installations upon which we depend for our basic daily needs. These are factories for food, textiles and construction materials, power stations, drinking water plants and sewage treatment plants. Plants for the extraction and processing of the minerals make it possible to make industrial use of raw materials. Modern, high-end infrastructure and industrial manufacturing facilities provide the foundations for economic progress and prosperity. Large-scale plant engineering contractors also build factories for manufacturing advanced industrial products like pharmaceuticals, semi-conductors, energy storages and renewable fuels.

In all industries companies of the VDMA Large Industrial Plant Engineering Group set the standards for productivity and energy efficiency, and for both integrated and end-of-pipe environmental protection. The companies active in this sector all have a strong focus on technology and are highly globalized. They are operating both on markets with constant and with increasing demand. Hence, large industrial plant engineering is – in the long run – a value-creating branch that is influenced only to a minor degree by short-lived trends as frequently observed in the consumer goods industry or on financial markets.

Members of the VDMA Large Industrial Plant Engineering Group

(Status: April 2023)

ABB AG	Mannheim
ACHENBACH BUSCHHÜTTEN GMBH & CO KG	Kreuztal
AIR LIQUIDE GLOBAL E&C SOLUTIONS GERMANY GMBH	Frankfurt am Main
ALD VACUUM TECHNOLOGIES GMBH	Hanau
ANDRITZ AG	Vienna, Linz, Ravensburg
BOSCH REXROTH AG	Lohr am Main
BMA BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT AG	Braunschweig
CATERPILLAR MOTOREN GMBH & CO KG	Kiel
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Imprint

Imprint

The business development and the statistical annex presented in this publication are based on own surveys of the VDMA Large Industrial Plant Engineering Group.

The status report serves as a reference point and provides an overview for assessing the economic situation and political demands of the large-scale plant engineering sector. It does not claim to be complete. Furthermore, the particularities of the respective industries and products of large-scale plant engineering, as well as their different possible applications, must be taken in account. Consequently, many other constellations are conceivable in addition to the assessments and approaches mentioned in this report.

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