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Cover: Worker in protective clothes in front of melting furnace at mechanical workshop of Friedrich Wilhelm steel works, Müelheim, Germany (Markus Matzel/ullstein bild via Getty Images)

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Executive Summary

The *Zeitenwende*, or "watershed moment"—announced by Chancellor Olaf Scholz in February 2022, days after Russia's invasion of Ukraine—outlined a set of policy shifts, including the development of Germany's first-ever National Security Strategy, that appeared to signal a greater role for Germany in the defense and security of Europe. The German National Security Strategy draws a clear connection between the need for a robust defense-industrial base and the foundation for the capabilities needed to meet North Atlantic Treaty Organization (NATO) defense and deterrence commitments, support Ukraine, and provide for the recapitalization of allies and partners. To date, however, there has been less focus on the extent to which the Zeitenwende galvanized change in Germany's important defense-industrial base. This study assesses the extent to which the strategic shift signaled by the Zeitenwende is reflected and being implemented in Germany's defense-industrial base policy and the implications for transatlantic security.

Russia's full-scale invasion of Ukraine has highlighted the serious deficiencies in the ability of transatlantic allies to quickly surge defense production. The unprecedented expenditures of munitions and other military equipment are indicative of the serious defense-industrial base challenges that face NATO allies as European militaries attempt to recapitalize and rearm after decades of underinvestment, while still maintaining support for Ukraine. It also points to significant industrial challenges in any future high-intensity conflict or crisis with a near-peer adversary. Weaknesses in the transatlantic defense-industrial base threaten NATO's defense and deterrence posture by reducing military readiness and raising questions about NATO's ability to deter future conflict.

Strategists and scholars have also questioned whether the United States can sustain a deterrence strategy in both Europe and the Asia-Pacific beyond 2026. This raises the prospect of heightened risk from 2027–2035, when the United States and its allies may find it necessary to deter or defeat both Russia and China simultaneously. In the event of a conflict with China that absorbs U.S. bandwidth and resources in the Indo-Pacific, European and NATO allies would be vulnerable to Russian opportunism. Europe must be able to defend itself, and a militarily stronger Germany, with a defense-industrial base to match, is a critical ally with the potential to offset risk in Europe and play a far greater role in transatlantic security.

Without a sustained transformation by Germany that appreciably strengthens the European pillar of security within NATO, the burden will fall disproportionately on others, and demand for U.S. engagement in Europe will grow in tension with the strategic bandwidth and U.S. warfighters needed for the Indo-Pacific. To strengthen the transatlantic defense-industrial

ecosystem, the United States should provide consistent bilateral political support for German rearmament; encourage and support the reform of defense-industrial base laws, regulations, and authorities; work to expand defense-industrial cooperation bilaterally and through NATO formats; and work cooperatively to incentivize and expand German defense-industrial base cooperation with Ukraine. By exploring the defense-industrial Zeitenwende from 2022 through 2024, this study contributes to the ongoing debate around the extent of Germany's defense and security transformation; the Zeitenwende; the role of the defense-industrial base as a foundation for defense and deterrence; and a stronger European pillar within NATO.

Introduction

Three days into Russia's full-scale military invasion of Ukraine, Chancellor Olaf Scholz announced a turning point in German foreign and security policy. Speaking to a special session of the Bundestag on February 27, 2022, Scholz called Russia's invasion a *Zeitenwende*—"watershed moment."[1] He also announced a set of policy shifts: the delivery of weapons to Ukraine, the creation of a €100 billion ($107 billion) *Sondervermögen* (special fund) to jumpstart the recapitalization and modernization of the Bundeswehr (the German military), and the intention of growing German defense spending to more than 2 percent of gross domestic product (GDP). These announcements came with support for additional sanctions on Russia, the immediate construction of two new terminals for liquid natural gas to enhance energy resilience, a recommitment to Germany's nuclear role in NATO, and joining other nations in deciding to exclude several Russian banks from the SWIFT financial payment system.[2]

These measures heralded one of the most critical moments for Germany's foreign and security policy since World War II, a strategic reorientation and a signal to allies and partners about the potential for a militarily stronger and strategically active Germany moving forward.[3] Indeed, the first-ever German National Security Strategy acknowledges Germany's special responsibility for security and stability in Europe, and the updated Defense Policy Guidelines (2023) outlines a more robust approach to national defense.[4] As Defense Minister Boris Pistorius has said, "A lot is expected of Germany, and rightly so."[5]

However, Russia's full-scale invasion of Ukraine continues to highlight the serious deficiencies in the ability of transatlantic allies, such as Germany—the largest economy and one of the largest industrial hubs within the European Union (EU)—to surge and expand defense production. Both Russia and Ukraine have relied heavily on artillery fire, precision long-range strikes, and drones as the conflict has settled into a war of attrition. At the height of the fighting, the Ukrainians fired an average of 4,000 to 7,000 artillery shells a day and would have expended many more if the supply had been available.[6] In contrast, Russia fired an estimated 5,000 to 30,000 shells daily. After 11 months of warfare, some estimates suggested that Russia had also launched more than 5,000 missiles and long-range drones.[7] A report by RUSI estimated Ukraine's losses of drones of various types at about 10,000 per month.[8] The unprecedented expenditures of munitions, drones, and other military equipment indicate the serious defense-industrial base challenges facing NATO Allies in support of Ukraine. It also points to significant industrial challenges in any future high-intensity or protracted conflict with a near-peer adversary. The challenge compounds as NATO Allies, including Germany, endeavor to increase defense spending

and modernize their arsenals in ways not seen since the end of the Cold War. These weaknesses in the transatlantic defense-industrial base[9] threaten NATO's defense and deterrence posture by impeding military readiness and calling into question NATO's ability to deter future aggression.[10]

For the United States, the "sustainability of transatlantic security depends on enabling Washington to avoid a strategic choice between Asia and Europe."[11] Given that the United States has the capacity for "one major war," strategists and scholars have rightly questioned whether it can sustain a deterrence strategy in both Europe and Asia beyond 2026.[12] The United States must prioritize its resources and rely on its allies and partners in Europe to improve deterrence with China and Russia and to prepare for risks during the 2027–2035 time frame, which includes a chance for a crisis over Taiwan.[13] Working together, the United States and its allies and partners must be ready to deter and defeat both adversaries simultaneously.[14] In the event of a U.S. conflict with China, Europe would be vulnerable to Russian opportunism that would be detrimental to NATO's integrity.[15] Europe must also be able to defend itself, and a militarily stronger Germany is a critical ally with the potential for a far more significant role in the security and defense of Europe, NATO's eastern flank, and one that should develop greater capacity to offset these risks.[16] Regional allies and partners, too, have long desired for Germany to take on a greater role.

U.S. Secretary of Defense Pete Hegseth has highlighted the transatlantic underinvestment in defense-industrial bases and stated that for NATO to endure, the transatlantic defense-industrial base must be revived.[17] Similarly, the German National Security Strategy draws a clear connection between the need for a robust defense-industrial base as the foundation for providing needed capabilities to the Bundeswehr, meeting NATO defense and deterrence commitments, providing support for Ukraine, and recapitalizing allies and partners.[18] Having the production capacities to deliver military materiel for the generation and sustainment of forces is a key determinant of the outcome in a protracted conflict or war of attrition. As the U.S. scholars Stacie Pettyjohn and Hannah Dennis succinctly point out, "production is deterrence."[19] After all, what is the value of an artillery piece when it runs out of ammunition? Scraping the rust off Germany's post–Cold War industrial base to build and sustain a revitalized rearmament effort would significantly enhance the European military contributions to NATO and strengthen conventional defense and deterrence on NATO's eastern flank. This study assesses the extent to which the strategic shift, and the ambition, signaled by the Zeitenwende is being reflected and implemented in Germany's defense-industrial base policy, and the implications for transatlantic security.

To answer this question, this study begins with an examination of the literature and a framework for analysis, followed by the research methodology, findings, and recommendations.

In addition to a review of German strategic documents, official speeches, and academic literature, more than 50 interviews were conducted with European regional allies; U.S. and German government officials; defense industry executives; and academic officials from the fall of 2023 to the spring of 2024. The findings demonstrate that the German defense-industrial base has experienced only modest attention and reform because of the strategic shift signaled by the Zeitenwende. The German defense-industrial base remains hamstrung by long-standing challenges and barriers that constrain a greater role for Germany and the German defense-industrial base in European security.

While the United States can likely count on a more capable Bundeswehr in the years ahead, the trajectory of the defense-industrial Zeitenwende through 2024 was one of only incremental reform. A new governing coalition and the promise of significant new defense spending from 2025 onward may accelerate progress, but it is not a panacea. Significant constraints will persist and impede a greater role for Germany and its defense-industrial base in European security even if increased defense funding is assured. Without a sustained transformation by Germany that appreciably shifts the European pillar of security within NATO, the burden will fall disproportionately on others, and demand for U.S. engagement will remain elevated even as greater strategic bandwidth and U.S. warfighters are required in the Indo-Pacific. Further, strategic reprioritization before Germany and other European states are adequately prepared may exacerbate risk in the critical years ahead.

Framework for Analysis

For Germany, the Zeitenwende of 2022 was literally a turning point, a fundamental acknowledgment in a moment of strategic shock that the international security environment in which Germany sought to maintain its status quo was gone. It was also a galvanizing moment in which Germany took the first steps in adapting to a world in which Russia was undeniably an acute and protracted threat by shouldering the mantle of greater responsibility for defense and deterrence in Europe. While the Zeitenwende, as outlined by the German Chancellery, encompasses a broad array of policy prescriptions, it directed a significant effort toward the rearmament of the Bundeswehr and support for Ukraine.[20] The early optimism of a German security "awakening" seemed to be supported by an initial investment through the €100 billion ($107 billion) *Sondervermögen* (special fund) to jumpstart the recapitalization and modernization of the Bundeswehr and a commitment to raising defense spending to 2 percent of GDP.[21] The surge and sustainment of defense spending alone was enough to jumpstart a sclerotic defense-industrial base with investment and procurements not seen since the end of the Cold War.

However, the extent to which the German defense-industrial base has evolved in response to the Zeitenwende has, to date, not been well examined. The degree to which the strategic shift signaled by the Zeitenwende is reflected in Germany's defense-industrial base policy has implications for Germany's role as a European security provider and, by extension, for U.S. engagement in Europe. To what extent has Germany taken steps to expand or revive its military-industrial capacity or reform legacy processes? And why has Germany not made greater progress despite a shifting threat perception of Russia, an influx of new resources, and heightened levels of political will?

While the literature exploring the challenges facing the German defense-industrial base is broad, Bastian Giegerich and Maximilian Terhalle best encapsulated (in their 2021 book *The Responsibility to Defend: Rethinking Germany's Strategic Culture*) the many persistent aspects in need of reform as a critical element of a larger German foreign and security policy adaptation.[22] Indeed, their diagnoses—outlined prior to the Zeitenwende and Russia's full-scale invasion of Ukraine—were prescient, including the need for more robust coordination between the government and defense industry, reform of the procurement processes, arms exports reform, resilient supply chains, and improvements to the innovation ecosystem. The 2024 German National Security and Defence Industry Strategy acknowledges many of these issues, but given the deep cultural reticence toward the expansion of military-industrial power, it would be significant if observable reform in those areas were to occur.[23]

Writing a little over a year into the Zeitenwende, Franz-Stefan Gady observed that in the decades following the end of the Cold War, "[w]hile Germany just about killed the Bundeswehr, it did not kill the German defense industry."[24] With over 135,000 skilled workers and $30 billion in annual revenue, German defense companies are among the world's most important producers of defense capabilities and military materiel.[25] They include Rheinmetall, Germany's largest defense manufacturer and a global producer of tanks, armored vehicles, and ammunition (in fact, the largest supplier of artillery ammunition in Europe); Hensoldt, a global supplier of defense electronics; and Diehl Defense Group, a producer of air defense systems such as the IRIS-T. There is also German participation in major pan-European companies such as Airbus, MBDA, and KNDS. Beneath the major defense groups, the German defense-industrial base iceberg broadens out to include around 1,350 medium-sized companies that are often primarily suppliers to other European and U.S. defense manufacturers.[26]

Gady suggests that Germany, along with France, Britain, and other defense-industrial powers, could become Europe's arsenal of democracy.[27] He also warned that Berlin is not exploiting its world-class defense industry to the degree that it could.[28] However, as John Helferich

Table. German Arms Industry

SIPRI Rank 2023	Company	Category	Arms Revenue (in bn)
12	Airbus	Trans-European	$12.89
26	Rheinmetall	Germany	$5.48
30	MBDA	Trans-European	$4.76
45	KNDS	Trans-European	$3.34
66	ThyssenKrupp	Germany	$1.99
73	Hensoldt	Germany	$1.85
83	Diehl	Germany	$1.35

Source: SIPRI Arms Industry Database, Stockholm International Peace Research Institute, available at <https://www.sipri.org/databases/armsindustry>.

suggests, for those watching for a significant reorientation at Europe's economic core, it is unlikely that the Zeitenwende, broadly speaking, will become a reality. The Russian war in Ukraine did not fundamentally change Germany's nature as a status quo power, nor did it change any of the domestic factors that have traditionally determined Germany's approach to security and defense policy. Helferich, therefore, concludes that aside from a better-equipped Bundeswehr and a more political approach to the defense industry, reforms will not be transformational or enduring.[29] Other scholars have observed that Germany has powerful incentives to maintain its status quo, a modestly more capable Bundeswehr notwithstanding.[30]

German foreign and security policy often treats defense-industrial issues with a sense of "benign neglect" or ambivalence, and the historical stigmas associated with military-industrial collaboration have had a clear influence on the shape and vitality of the German defense-industrial base. It is a system in which defense-industrial policy instruments tend to be mutually blocking rather than mutually reinforcing.[31] Yet the German National Security Strategy implies a new and proactive approach to reforming the defense-industrial base—an approach that seeks to ensure this base is competitive and fit for purpose.[32] The literature often singles out challenges such as poor communication and the lack of long-term planning that reduce the visibility of future demand. Scholars have also pointed to production capacity diminishing because of overly bureaucratic procurement processes better suited for developing exquisite systems and platforms instead of large production runs.[33]

However, one aspect often overlooked is the evolving relationship between the German defense industry and the government. This interrelationship is critical as the defense industry attempts to gauge long-term investment, interpret government priorities, and provide awareness and feedback. This relationship has also been shaped by the weight of Germany's militaristic

past and a deep skepticism of military-industrial collaboration. Indeed, Germany has a well-understood strategic culture of restraint that emphasizes the rejection of military expansionism, enmeshing action in multilateral frameworks, and prioritizing politics before force.[34] This has resulted in a preference for civilian power (*Zivilmacht*) and incremental change. As Giegerich and Terhalle suggest, it has also meant the loss of a *strategic mindset*—the awareness and ability to plan for a world characterized by power politics and a genuine clash of interests.[35] While strategic culture is intrinsic to many of the constraints visible in the German military-industrial sector today—and part of the reason the German defense-industrial base has been treated with benign neglect—it is beyond the scope of this analysis to assess change in German strategic culture or the adoption of a strategic mindset. However, it is relevant to identify shifts in mindset on defense-industrial issues as a result of the Zeitenwende, where possible.

The German defense-industrial base also remains hamstrung by persistent challenges that have impaired the expansion of military-industrial capacity, and scholars have identified key constraints including access to critical raw materials and technologies, the availability of funding and long-term contracts, and competition over talent.[36] Of course, production capacity is only one side of the coin. On the other, the defense-industrial ecosystem must maintain the capacity for fast innovation in response to rapid changes on the battlefield. Germany has a robust innovation base, but the defense-industrial sector is historically isolated from the larger ecosystem and the literature often omits this structural dimension when considering defense-industrial capacities.

Also critical to expanding industrial capacity and managing defense-industrial base priorities in crisis or war is the degree to which the German government is willing or able to exercise direction over its military-industrial activity when Germany's largely privatized defense-industrial sector is not otherwise willing or inclined to act. The levers of influence at the German government's disposal and its willingness to use defense production authorities or national security exemptions to prioritize critical defense-industrial efforts and infrastructure are helpful indicators of the extent to which the Zeitenwende has galvanized reform in the German defense-industrial base. Meaningful changes in both defense-industrial capacity and control would provide evidence of a more significant, durable shift in security policy.

Finally, an underexamined element of the Zeitenwende—and one with significant defense-industrial implications—is the understanding and expectations of Germany's regional allies and partners as it seeks a greater role in regional security. Indeed, the German National Security and Defence Industry Strategy notes that a globally competitive industrial base is possible only through close collaboration with allies and partners.[37] As many scholars have

observed, however, German leadership remains limited in central Europe, but building trust is the essential foundation.[38] Kristi Raik and Martin Quencez have written previously that the expectations of Germany's partners are high and varied as they evaluate the progress of the Zeitenwende, and Germany is likely to meet these expectations only slowly.[39]

Defense-industrial cooperation and arms exports are key elements of Germany's allied relationships, and defense-industrial cooperation with Ukraine is especially critical. Indeed, highly restrictive export policies and uncertainty over their implementation have weighed on efforts to build trust in a more significant role for Germany in regional security. The German National Security Strategy highlights the need to reform the approach to joint arms projects and the exportability of armaments.[40] Germany's ambition to assume more responsibility for regional security will depend, in part, on its ability to mitigate this trust deficit with allies and partners.[41] Evaluating ally and partner perspectives will also provide a degree of insight into the role that German defense-industrial challenges and cooperation play in Germany's ability to shoulder the mantle of greater responsibility for security in Europe.

The extent to which the Zeitenwende is reflected in the industrial policy, capacity, and capability of Germany and its defense-industrial base remains underexamined and raises the question of whether Germany might play its integral role in bolstering the European pillar within NATO and enhancing defense and deterrence in Europe. To answer the question, this study will examine three broad dimensions of the German defense-industrial base from 2022 through 2024, updating the literature and filling in the gaps on communication and procurement; capacity and control; and multilateral industrial cooperation and arms exports. By evaluating German defense-industrial challenges 2+ years into the Zeitenwende, this study endeavors to contribute to the ongoing debate around the extent of Germany's defense and security transformation, the Zeitenwende, the role of the defense-industrial base as a foundation for defense and deterrence, and a stronger European pillar within NATO.

Methodology and Structure

This study relies on an analysis of German strategic documents, official speeches, and academic literature to assess changes in the relationship between the German government and the defense industry, as well as challenges to expanding industrial capacity and control and evolving regional defense-industrial cooperation. It also relies in part on more than 50 research discussions with officials in the United States, in Germany, and among regional NATO allies in Europe. The author conducted research discussions with civilian, military, industry, and academic officials in Berlin, Germany; at U.S. European Command in Stuttgart, Germany; and in

Washington, DC, virtually and in person. Research discussions included U.S. academic, government, and military officials (35 percent); German academic, government, military, and defense industry officials (52 percent); and representatives of European NATO allies (13 percent).

Discussions with European NATO allies are drawn primarily from embassies in Berlin, Germany, and they include representatives from states in Eastern, Northern, and Western Europe. Critically, German government officials included representatives from the Ministry of Defence (MoD), the Ministry of Foreign Affairs (MFA), and the Chancellery. German industry officials included representatives from large and medium-sized firms headquartered in Germany that supported the modernization of the Bundeswehr and/or are involved in supporting Ukraine. The author solicited research discussions with U.S. officials serving in roles that required functional or regional expertise in Germany. Research discussions were designed to capture official and academic perspectives on the impact of the Zeitenwende on the German defense-industrial base, the primary challenges inherent to expanding defense-industrial activity, and regional perspectives on the role of the German defense-industrial base in supporting defense and deterrence.

If the shift in policy signaled by the Zeitenwende is durable and commensurate with a shift in defense-industrial policy, one would expect to see a change in the relationship between the German government and defense industry—one in which greater two-way communication and space for long-term planning have grown. One might also expect the traditional and well-known structural challenges and barriers limiting industry capacity and control or direction to change. One would also expect to see evidence of a growing use of tools and authorities to direct defense-industrial activity. Finally, one might expect indications of a shift in regional defense-industrial leadership, in which Germany is taking an increasingly assertive role and looking to wield arms exports for greater strategic impact. Given time constraints, access limitations, and the scope of the subject matter, the breadth of research discussions cannot be considered wholly representative. Rather, this study should be considered only as a broad snapshot in time from 2022 through 2024 as Germany attempted to update its defense and security architecture in the wake of the Zeitenwende.

Analysis and Findings

Communication and Procurement

With the announcement of the Zeitenwende and a €100 billion ($107 billion) *Sondervermögen* (special fund) in 2022, expectations were high for a resurgence of defense-industrial

demand in Germany and a new dynamic that would underpin the relationship between the German government and its defense-industrial base. However, a new paradigm was nascent—an industrial call to arms that has struggled to match the potential of the Zeitenwende. While the government's relationship with industry is no longer one of "benign neglect," mismatched expectations—primarily due to an observable lack of productive dialogue and communication between the German government and defense industry—impeded long-term planning for Bundeswehr modernization, regional military-industrial cooperation, and the reconstitution of allies and partners.

The German federal government's attempts to engage industry by the Scholz-led coalition had mixed results. Initially, the Chancellery rallied the defense industry in support of Ukraine and to jumpstart the modernization of the Bundeswehr. The promise of €100 billion in new spending in the near term and the prospect of a defense budget increasing to 2 percent of gross domestic product (or more) seemed to spark a new dynamic between the government and its industrial base. Shortly after the start of the Zeitenwende, the Chancellery hosted an industry summit focused on providing ammunition to Ukraine. This was a promising development, and industry officials attended with high expectations. However, little in the way of planning was accomplished, and no contracts were offered. Despite the supply chain issues associated with production of the Leopard main battle tank and the Leopard-2s sent to Ukraine, a summit to discuss tanks did not occur during the period of this study, nor was there a summit to discuss long-term industry support for Ukraine. For industry, these were missed opportunities to set industrial strategy, which sent signals of uncertainty that reinforced the notion that the German government, overall, had not yet significantly altered its approach to industry. Instead of the government treating the defense industry as a sector that must be engaged with to rapidly and durably expand production capacity—not just for the near-term support of Ukraine, but also for longer-term defense and deterrence in Europe—a distant attitude continued to prevail.[42]

In the words of one industry official, after Chancellor Scholz announced the Zeitenwende in February 2022, the German defense-industrial base "heard the call to arms."[43] But those who took risks in those early days and made investments with their limited capital were left exposed as long-term government contracts failed to materialize. For example, the German government signaled to the domestic maritime industry to be ready for additional submarine production, but 2 years later, contracts had yet to be issued.[44] Further complicating the relationship between the German government and the defense industry was that most of the new defense spending and major procurements went to U.S. systems and capabilities. This included the F-35A fighter jets to replace the aging fleet of Tornado aircraft and reaffirm Germany's nuclear commitment to NATO

and extended deterrence. The U.S. fighters will also enhance interoperability with the other 13 states operating the F-35. Additionally, the Bundeswehr is procuring CH-47F Chinook heavy-lift helicopters (approximately €7 billion), Arrow-3 missiles for aerospace defense, additional reconnaissance ships for signals intelligence, and P-8 Poseidon maritime patrol and antisubmarine warfare aircraft, among other essential equipment, including much-needed munitions and spare parts. Further, the special fund did not offer anything substantially new. The large procurement decisions were primarily programs set aside or neglected in prior years due to lack of funding. These challenges raise serious questions about how Germany views the future of its armed forces, but it also provides an opportunity to make investment decisions now that will shape the Bundeswehr for modern and future war.

Beyond the high-level industry summits, there is also a regular strategic dialogue once a year between the Federal Association of the German Security and Defense Industry (BDSV)—the primary trade group for the German defense industry—and the MoD. This format is important for the industry and the MoD to share concerns and gauge future needs. Since the start of the Zeitenwende, however, the discussions in these fora have not evolved or provided concrete deliverables. Industry is looking for solid indicators of spending stability and a willingness to offer long-term contracts. The format has facilitated minimal planning for longer-term military procurements and little to no planning for Ukraine.[45] Not all remains status quo; guidance and planning assurance was more dependable for the most urgent needs, which included munitions and air defense systems such as the IRIS-T.[46] The German National Security and Defence Industry Strategy also acknowledges the need for "predictable business conditions," including reliable and comprehensive funding.[47] However, Germany was late in recognizing the new strategic environment and has been stuck reacting to near-term concerns and attempting to catch up instead of planning and investing for the longer term.

Historically, the German MoD has preferred to take a "hands-off" approach to its defense-industrial base to short-circuit any charges of favoritism. In addition, a deep sense of restraint—even detachment—over all aspects of military-industrial cooperation is rooted in the lessons of Germany's militarized past. While the MoD is endeavoring to engage and communicate more regularly, this development has not yet lessened the persistent struggle with multiyear planning and budgeting. Significant uncertainty for the defense industry remains. Despite the understanding that the traditional fora of interaction between the German defense-industrial base and government have yet to yield substantive results at the strategic and political level, there was some agreement among industry that communication with the ministries overall had marginally improved. One industry official noted, "They will at least pick up the phone now."[48]

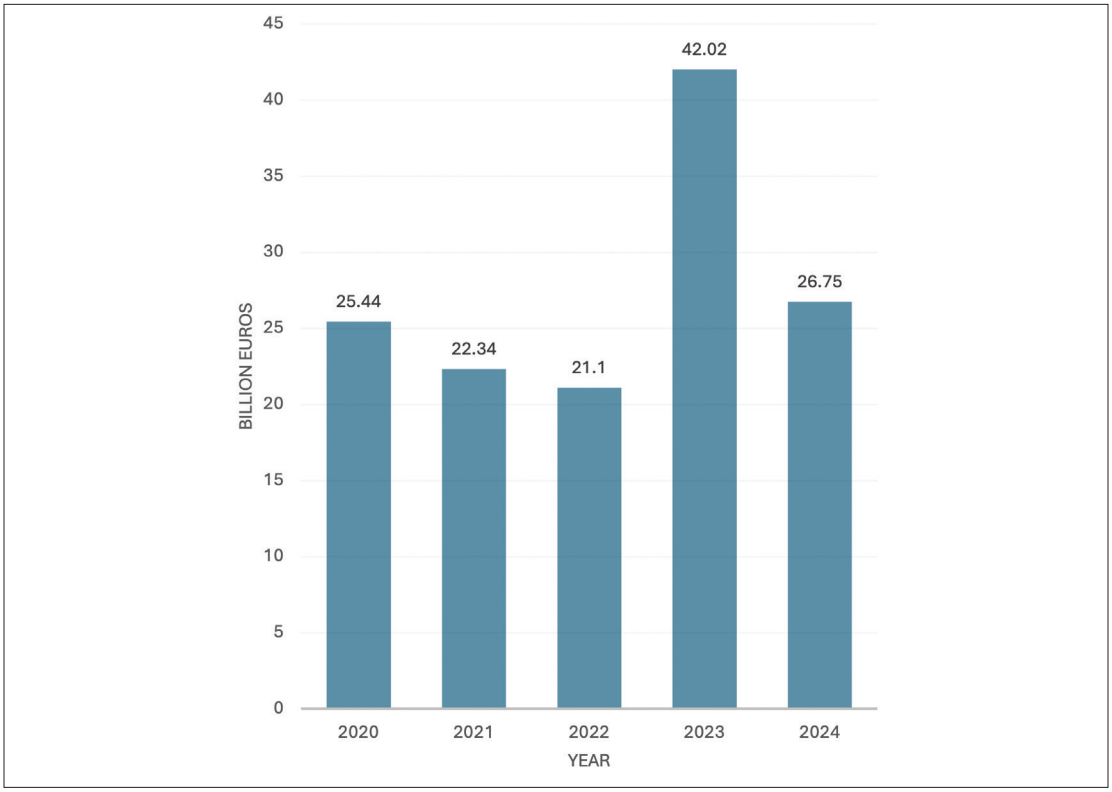
The lack of substantive two-way communication has fostered mismatched expectations. German government officials often expect the defense industry to take more risk and suggest that the mindset among much of the defense-industrial base had not yet shifted.[49] In contrast, industry officials routinely emphasize the need for clear planning, guidance, and stable funding—none of which they believed were in place during the past few years. As of 2024, the €100 billion special fund was set to expire in 2027 and was 100-percent allocated. Further, only minimal increases to the overall defense budget had been discussed. One industry official observed, "The government's political guidance has not been reliable; they change their mind all the time, at any time."[50] As a result, the defense industry remained reticent to take risks, invest, and expand capacity. Regional allies also largely affirmed this view. They continue to view the dynamic between the government and defense industry as an indicator of Germany's intent to see through critical military reforms and support for Ukraine. The initial years of the Zeitenwende, however, demonstrated that the government and the defense industry were not in sync.[51]

At the nexus of the relationship between industry and the MoD is the much-critiqued military procurement system, which has contributed to the Bundeswehr's low-readiness state and the significant shortages of spare parts and ammunition. These shortages have affected the Bundeswehr's ability to supply functional systems to Ukraine from its own stockpiles and have impeded the ability to train rigorously. Indeed, a significant portion of the €100 million special fund was used to ameliorate the shortage of spare parts and munitions. However, the military procurement system is foundational to revitalizing the Bundeswehr, and it is also critical for future joint procurement between Germany and regional allies and partners. Consistency of procurement is also an important signal to industry to take on risk and invest in future capacity.

Structurally, Germany has attempted some reform of the Federal Office of Bundeswehr Equipment, Information Technology, and In-Service Support (BAAINBw).[52] In the summer of 2022, the Bundestag passed a law that aimed to allow procurement officials to award contracts more quickly, speed up review and appeal procedures, and lower hurdles for small and midsized defense companies.[53] Industry officials acknowledged the "limited" process improvements that have yielded faster results.[54] Military procurements subject to a €25 million limit triggering review and approval by the Bundestag are also moving faster. However, most procurement and acquisition projects easily exceed €25 million, which creates routine delays. As of October 2023, there were more than 80 approvals, and more than 100 approvals were expected throughout 2024 (see figure 2). In addition, the rule was amended to allow for spare parts and general equipment for service personnel to be obtained without the need for Bundestag approval.[55] Despite the increase in the speed of review and approval, the process remains time-intensive and bureaucratic.

Within the MoD, efforts already exist to shift away from an acquisitions model that tends toward "gold-plated" and exquisite platforms and capabilities.[56] In 2020, for example, procurement plans for heavy transport helicopters were stalled because of revised requirements that made the helicopters almost impossible to acquire within budget parameters.[57] However, officials also recognize that the BAAINBw needs a change of mindset that permits money to be spent faster and includes greater tolerance for risk.[58] German MoD leadership, the Chief of Defence, Service Chiefs, and the Defence Minister are attempting to inculcate a growing level of risk tolerance. The new defense guidelines state, "In addition to specialist knowledge and skills, the keys to a modern and effective procurement system are the willingness to take action and assume responsibility, resolve, an error culture and a culture of learning."[59] Risk aversion, however, remains ingrained in the civilian layers, where the most significant pushback to institutionalized reform is often from unionized civilians.[60] As a result, it is reasonable to expect a

Figure 1. German Military Orders



Source: Guntram B. Wolff et al., *Fit for War in Decades: Europe's and Germany's Slow Rearmament Vis-à-Vis Russia*, Kiel Report No. 1 (Kiel, Germany: Kiel Institute for the World Economy, September 2024), 34, https://www.ifw-kiel.de/publications/fit-for-war-in-decades-europes-and-germanys-slow-rearmament-vis-a-vis-russia-33234/. Specifically, data was condensed from figure 5.1.

degree of continued incrementalism, where progress will play out over years and only through consistent reform and assertive leadership.

Defense industry officials, however, were more skeptical that any substantive change had occurred and cited little observable difference in the desire for gold-plated solutions, at least not yet.[61] The procurement and acquisition processes remain slow overall, with a "risk-averse" culture in which decision-making responsibility is deliberately diffuse. While there is no procurement process in the world that would move fast enough to satisfy industry in any country, the bigger takeaway is the reform's limited scope and incremental nature. The most significant factor driving the increased speed of procurement has simply been the near-term influx of available money because of the €100B special fund, not any particularly new reform or efficiencies in the system.[62] The overall sentiment was that overly bureaucratic systems in the procurement processes remain the most significant "showstoppers."[63]

While it appears that the Zeitenwende has pushed the relationship between industry and the government into a new phase, the available fora for discussion and communication have been inadequate for facilitating a long-term demand signal or a sense of long-term planning that is critical for industry to take risk, invest, and expand capacity. Procurement processes have also picked up speed and efficiencies in the wake of the Zeitenwende. However, this shift has primarily been due to the influx of new funding and previously sidelined programs or contracts. Significant bureaucratic hurdles remain. Regarding the potential for additional reform, one study participant suggested that while Germany no longer lacks money, it may lack political will.[64] It remains to be seen if the shift in German leadership, and a new governing coalition in 2025, may produce a political environment in which existing military-industry cooperation could be built on. For now, however, the lack of productive two-way communication combined with legacy planning, budgeting, and procurement processes will continue to constrain the German defense-industrial base and impede the speed of German military reform.

Industrial Capacity and Control

If "benign neglect" was the paradigm between the German government and its defense-industrial base for decades, an increasing number of scholars have pointed to the need for reform. Torben Schütz has noted that finding a new equilibrium between government control and laissez-faire economics is far more important for Germany in today's new geopolitical environment.[65] A new equilibrium is critical as Germany grapples with the need to durably expand capacity to meet the needs of allies, partners, and the Bundeswehr, and to bolster defense and deterrence in Europe. However, this equilibrium requires more than production capacity;

it also requires the capacity for rapid innovation and the ability to exercise greater direction of defense-industrial activity with longer-term objectives in mind.

In contrast to the United States, with its hybrid system of control over its defense industry, or many European allies with more direct control and oversight, the German government has far fewer levers with which to direct or guide defense-industrial activity across the spectrum of conflict. Only in a time of war could the German government nationalize or influence industry directly. The legal barriers between the government and the defense industry make it particularly challenging to scale up capacity to support the Bundeswehr and a non-NATO ally such as Ukraine in a time of conflict, but when Germany itself is not at war. It is also difficult for the German government to ensure that industrial capacity and production lines stay "warm" in periods of relative calm. Contracts, supply chain, and workforce challenges constrain the potential to expand capacity. The German government, and the MoD in particular, is having to relearn old muscle movements, cautiously exercising and exploring an expanded array of tools and authorities to better direct, incentivize, and support Germany's defense-industrial base.

Chief among those challenges, and vital to the future of Germany's contribution to defense and deterrence, is expanding defense-industrial capacity. For example, in the 1990s Germany was producing 4 to 5 tanks per week (15 to 20 tanks per month, or approximately 250 per year) with two primary Leopard production lines. Today, however, Germany produces approximately 3 to 4 per month or around 50 tanks per year.[66] Given supply chain issues and competing priorities, Norway's recent order of 120 Leopard tanks would take several years to complete at this rate—and that does not account for future orders from the Bundeswehr or other regional allies and partners.[67] It was not until July 2024 that the Bundeswehr placed an order of 105 tanks for the brigade being deployed in Lithuania, and the primary manufacturer of the Leopard, KNDS Deutschland, is now working to expand capacity to 20 tanks per month.[68] In contrast, as of 2024 Russia was producing or refurbishing up to 130 tanks per month.[69]

The lack of industrial capacity and the long lead time to scale up is not unique to Germany but is a broader transatlantic issue—which has also meant that the cost of key weapons and munitions needed by European militaries and Ukraine have surged. The cost of a 155mm artillery shell, for example, surged from an average of $2,100 per shell in February 2022 to over $8,400 for a time. Demand goes up, but supply and capacity remain constrained.[70] Russia, meanwhile, had fixed the price of its 152mm ammunition at around $1,000.[71]

Mobilizing the defense-industrial base is a somewhat new idea or mindset for Germany in the modern era. During the Cold War, the assumption was that given Germany's frontline status, its manufacturing base would almost immediately be devastated in any conflict between the

Soviet Union and NATO allies. The needs of the West German military were also constrained to narrow operational and regional goals. Further, as the Bundeswehr shrank and defense spending fell in the decades following the end of the Cold War, production capacity also fell and German defense companies looked outward, globally, to survive. The Bundeswehr was often far from their biggest customer. For one member of the German defense-industrial *Mittelstand* (medium-sized firms), in 2023 only 7 percent of sales were related to the Bundeswehr, while 50 percent of sales were exports for the U.S. military.[72] The German National Security and Defence Industry Strategy also acknowledges that the domestic market has proven inadequate for maintaining and expanding value chains and driving innovation in the long term.[73] However, Germany is no longer a frontline state. It has a new opportunity to leverage its defense-industrial base, providing the foundation for a credible Bundeswehr and offering a manufacturing center of gravity for critical munitions and military platforms to regional allies and partners.

Despite the surge in demand, the German defense industry has not had the required capacity, and through 2024, had not yet expanded in a significant way.[74] Ramping up production is a serious challenge; it requires skilled labor, uncommon materials, financing that private banks are reluctant to provide, and long-term contracts to mitigate the risk. Supply chains are also complicated. For example, munitions need powder, explosives, warhead casings, and so on. The challenges of surging production, or investing in expanding capacity for the longer term, can be significant even for larger defense companies.

Complex systems take still more time. For example, Diehl Defense, the maker of IRIS-T air defense systems, has had to scale production from 10 to 50 missiles a year in 2022 to more than 500 missiles a year.[75] This increase includes surging capacity for the launchers, radar systems, and command modules. Similarly, Hensoldt managed to scale from producing 2 radar units in 2021 to being on track to deliver 18 units in 2025.[76] Additional work shifts, automation, and other efficiencies go only so far. Eventually, new infrastructure needs to be constructed to expand capacity. Waiting to expand the defense-industrial base in a peer conflict until after exquisite systems have been exhausted will be costly, slow, and likely too late. Further, retooling capacity to accommodate the need for masses of precision weapons and low-cost, combat-proven defense articles requires a significant shift in mindset.[77]

For industry, long-term contracts and financing to durably expand capacity remain a source of frustration. For example, building a new ammunition factory can cost up to €500 million, and it may take 4 to 5 years to construct and achieve full functionality. As an investment, it may take 10 to 15 years to pay off.[78] Only the relatively few and large German defense manufactures with capital on hand have been able to expand so far. Rheinmetall, for example,

announced the construction of a new €300 million factory in Unterluess (Unterlüß) in northern Germany in February 2024 with a production capacity of 200,000 artillery shells, 1,900 tons of RDX explosives, and potentially rocket engines and warheads. The project is being financed entirely by Rheinmetall with no government involvement. The factory will primarily service the needs of the Bundeswehr, and it will significantly enhance domestic capacity.[79] In total, Rheinmetall has the capacity to produce 700,000 shells a year in 2025 and it expects to be able to produce 1.1 million shells by 2027. It is a dramatic increase from 70,000 artillery shells in 2022.[80]

This process has taken 3 years to unfold and remains significantly behind Russian capacity, which was estimated in April 2025 to be 250,000 artillery shells per month, or 3 million shells per year.[81] Expanding production at home will also allow the German government and arms producers to ensure unrestricted transfers to partner nations. Germany learned this lesson while trying to export ammunition for the Gephardt self-propelled anti-aircraft platform from a Rheinmetall facility in Switzerland, which—as a neutral country—did not permit the export.[82] Fortunately, the intellectual property to manufacture these 35mm rounds was available elsewhere, but this incident created a significant delay in a system that was demonstrably effective in Ukraine until alternative production could be brought online.

Expectations that the German government would provide long-term contracts (8 to 10 years) have also not yet materialized. Further, the German government often continues to operate with the assumption that long-term contracts will close off competition and create a type of "vendor lock."[83] The longest contracts currently being signed are around 7 years, and there have been few. The MoD is working toward 10-year contracts.[84] However, they remain challenging to implement given short-term budgeting and a long-standing reluctance to "lock in" subsequent political governing coalitions. The German government's willingness to issue these contracts will be a vital signal to the defense industry, which has a far more limited customer base than standard commercial sectors.

There has been some success with larger framework contracts for tanks and military munitions, and these are positive developments, but they are still relatively rare. Provisions for spare parts, logistics, and maintenance are also now usually included in contracts, after previously having been required to be handled separately.[85] In addition, the speed and frequency of contracts have increased. As with procurements, industry officials attribute this to the availability of increased funding through the special fund, which allowed existing needs that remained unfunded in prior years to finally be addressed. However, the current set of framework contracts do not include provisions to pay producers to maintain extra capacity to keep a production line for critical defense products warm—which would allow for additional surge capacity.[86] In

short, Germany had a significant known backlog of neglected and unfunded needs ready to be addressed given the influx of money. The next challenge will be for Germany to move beyond playing catch-up and to think strategically about investments in critical new capabilities and industrial capacity for the future.

In addition to the limited use of long-term contracts, supply chain issues have worked to constrain capacity. After the Cold War, many countries, including Germany, believed that large European wars that would demand tanks, artillery, and mass amounts of munitions were a thing of the past. However, as demonstrated by the Russia-Ukraine war, large-scale future conflicts will be extraordinarily resource-hungry. Sustaining stockpiles requires a robust defense-industrial base and the ability to surge and scale up supply chain capacity quickly. If the industrial base fails during heightened military conflict, European NATO allies would encounter rapidly dwindling stockpiles and have significant difficulty sustaining forces in a crisis or war. Russia has also developed a wartime industrial economy and surged production of nearly all munition, including precision-guided glide bombs, air defense interceptors, and Tsirkon hypersonic missiles. As a result, Russia will likely have substantial munitions stores in any post-conflict interlude.[87] If Germany is expected to act as a NATO hub—a logistical nexus with corridors for follow-on forces and sustainment—the supply chains that link the German industrial base and regional allies likely to be on the frontline are critical.

As demonstrated in the race to ramp up production for Ukraine and to ensure that the Bundeswehr and ally and partner militaries maintain sufficient national stockpiles, munitions supply chains have continued to be hamstrung by shortages of fuses and energetics (propellant and explosives). Gallium, a soft metal useful for military sensors and advanced microelectronics, has also been in short supply. Subsidizing the import of gallium would be difficult under EU law.[88] Titanium has also been susceptible to disruption, and specialty metals like military-grade steel, used to produce armored vehicles, have been difficult to obtain at times because of limited supply and sudden surges. German arms manufacturers such as Rheinmetall dealt with perpetual shortages of nitrocellulose for explosives and sought to source steel from Sweden or Norway because domestic production was scarce as a result of decades of declining or minimal demand.[89] Additional regulation and the low volume of orders for hardened or ballistic steel meant that steel producers have often focused on making steel for automotives, even though military-grade steel is more profitable. Further, for many critical materials, the defense industry is restricted from purchasing ahead of time. A contract must be in hand, often creating delays and protracted production runs.

In 2023, seeking to alleviate supply shortages of cast-steel parts for armored vehicles and Leopard tanks and to preserve domestic capacity, KNDS bought a controlling stake in a foundry near Duisburg capable of producing over 1,000 metric tons of military-grade steel per year.[90] While the KNDS purchase is emblematic of supply chain issues, it does not necessarily mean that the demand signal for domestic military equipment is high or exceeding capacity. Illustrative of the slow, uneven, and inconsistent pace of procurement and production overall, in April 2024—2 years after the start of the Zeitenwende—ThyssenKrupp announced plans to restructure and reduce production capacity at its own Duisburg steel plant.[91]

While the MoD works to build better visibility over supply chain activity related to Ukraine, it still does not have the needed visibility over the larger defense-industrial base and the associated supply chains.[92] Industry officials claimed to have continually raised the issue of supply chains with the German government but to little effect. Industry officials noted that in the early stages of the Zeitenwende, State Secretary Sven Giegold of the Ministry for Economic Affairs and Climate Action provided a letter to German suppliers requesting their help in prioritizing the needs of the defense industry. However, the appeal had a negligible impact.[93] It is a notable example of the German government's limited ability to direct suppliers to support critical defense-industrial efforts—the government instead had to rely, to an extent, on the suppliers' goodwill. The vicious cycle at play, however, is that slow contracting, regulatory burdens, and unclear funding and long-term planning prevent suppliers from delivering on that goodwill and assuming risk to expand capacity, just as it does the major producers. Suppliers often expand their order books but do not invest in expanding capacity. Even with the best intentions, this dynamic can create conflict with suppliers over competing priorities. As other scholars have concluded, market-led defense-industrial bases have generally not fared as well as government-directed ones in responding to the conflict, at least in the near term. In contrast, governments that can direct companies to service the defense industries in key areas have been able to significantly expand output.[94]

Attracting and retaining skilled labor was another commonly cited challenge for expanding capacity. It can take up to 4 years to train a worker to make a tank gun barrel and 3 years to train a welder.[95] Long-term government contracts are essential in this context, to allow industry to invest in a skilled workforce. The limited supply of skilled workers also affects the ability of the German defense industry to scale up quickly. Instead of building out new facilities and production lines or investing heavily in automation, the German defense industry has relied primarily on increasing the number and length of work shifts. Proposals in the 2025 draft government budget allow for overtime shifts to be tax-free, perhaps providing new incentives for the limited pool of skilled workers.[96] This limited pool of skilled labor will likely continue to act

as a constraint moving forward. It also highlights the fact that not all constraints on expanding industrial capacity are material; a critical factor is the ability to incentivize, expand, or retrain a pool of skilled labor for defense-industrial purposes.

However, the downturn in the German automotive industry did provide a silver lining for the defense-industrial base, allowing firms such as Rheinmetall to attract a portion of that skilled labor force. It has also helped that the defense sector is not perceived as negatively as it was before 2022. This change in perception has made working in the industry more palatable—an incremental cultural shift sparked by a new threat perception of Russia. A survey in 2024 found that nearly 70 percent of respondents favored expanding Germany's defense capabilities. In addition, two-thirds of respondents, who originally believed investment in major arms companies was morally dubious prior to the war in Ukraine, have shifted their stance or were reevaluating their prior view. This a notable departure from the past, in which a majority found private investment in defense firms to be morally reprehensible.[97] Despite these shifts, resistance remains and cultivating a skilled workforce to support an expanding defense industry will take time, investment, and the further reduction of cultural and institutional barriers.

Rebuilding the Bundeswehr for conventional conflict and expanding industrial capacity, or adapting that capacity, also requires leveraging Germany's robust technological and innovation base. In any future high-intensity conflict, the capacity for rapid innovation will be a critical advantage, requiring not just a defense industry that invests in its own research and development (R&D), but also a technology and innovation ecosystem that permeates the commercial, academic, and defense sectors. A recent market survey conducted by the Ministry for Economic Affairs and Climate Action found that more than 6,600 artificial intelligence (AI) startups employing 149,000 people have been established in Germany since 1995.[98] These include new companies like Helsing, which develops AI for real-time sensor data processing, and Traversals, which develops AI for open-source intelligence analysis and real-time monitoring of battlespaces.

Germany also has a world-class system of universities and technical institutes that represent a deep well of research, innovation, and human talent. However, the capacity for the Bundeswehr to tap into and benefit from private and academic sector innovation at speed is a challenge because of the bifurcation of this innovation ecosystem. More than 70 universities and technical institutions adhere to a voluntary civil clause that prevents them "from engaging in defense research and cooperating with the defense industry."[99] Some German scholars have observed that the civil clause is "out of tune" with the current geostrategic reality, and the German National Security and Defence Industry Strategy indicates that the German federal

government will initiate a discussion about these clauses to better facilitate broader research efforts. However, the impact of that effort may not be felt for some time.[100] Despite the accelerating innovation cycle observed in Ukraine and the need for Germany to reinvigorate its defense-industrial enterprise as a foundation for the Bundeswehr, German industry officials reported no change in the interaction between the defense industry and the German university system.[101] As one defense industry official said, "Ninety percent of German universities won't work with the defense industry."[102]

Germany also only recently began developing and investing in the types of dedicated innovation hubs and incubators more common in the U.S. defense and innovation ecosystem. This includes the Bundeswehr Cyber Innovation Hub (CIH) in 2016; the joint Centre for Digitisation and Technology Research (dtec.bw) at the Bundeswehr Universities in Hamburg and Munich in 2020; and the Federal Agency for Disruptive Innovation (SPRIND) in 2019.[103] The Bundeswehr Universities in Hamburg and Munich received €500 million from the special fund to expand the dtec.bw research and technology center, which is intended to advance defense digitalization.[104] This nascent ecosystem is meant to jumpstart a culture of government-driven innovation outside the standard procurement and R&D pipelines.[105] It remains unclear, however, the full extent to which this ecosystem has benefited from increased defense funding.[106]

The German National Security Strategy also acknowledges the need not only to invest in R&D, but to protect critical technologies. Indeed, the subsequent German National Security and Defence Industry Strategy identifies several key national defense technology areas that are likely to receive special domestic consideration, including communications technology, naval shipbuilding, artificial intelligence, sensors, and electromagnetic warfare technology, among others.[107] Following through is difficult given the reluctance to interfere in the private market. Interestingly, however, the German government has been acquiring stakes in companies with key technologies. The German government has taken what will likely be a stake of more than 25 percent in TKMS, and it has taken a similar stake in Hensoldt. These stakes do not provide influence over operations. Rather, they are intended to protect sensitive intellectual property related to submarine development, sensors, and artificial intelligence.[108] This step represents another method by which the government is cautiously attempting to interface with industry in ways that it has not been willing to do in the past. While buying local and protecting key technologies have come under renewed focus, some have cautioned that favoring domestic capacity in these areas may undercut transatlantic defense cooperation. Finding a balance will be critical.[109]

As Germany seeks to revitalize the Bundeswehr and support allies and partners, the need to invest in autonomous systems and technologies is well understood by the MoD. Still, the

current level of ambition varies from service to service and does not go much beyond plans to integrate AI into Command, Control, Communications, and Computer (C4) networks and Intelligence, Surveillance, and Reconnaissance (ISR) systems. The German Army has expressed the greatest level of ambition; the Luftwaffe is taking what some scholars term "baby steps." For the German Navy, budget constraints have limited its capability development despite the fact that Navy leadership is attempting to "lead a conceptual turnaround," which includes the ambition to have one-third of the fleet composed of autonomous or semiautonomous systems by 2035.[110] Long-term financing is needed for projects that jumpstart human-machine teaming and fully autonomous ground vehicles, a space where Germany has many advantages and which could be a potent new opportunity. Defense industry officials suggested that the Bundeswehr should be spending at least €1.5 billion a year on drones.[111]

The German MoD is still deliberating about how it wants to incorporate drones and use AI.[112] The current focus is on incremental evolution, often tied to large procurement projects.[113] However, given the resources available, a populace that is currently more accepting of the Bundeswehr and defense priorities, and demographic challenges, there is a rare opportunity for German leadership to sensitize the public to the use of AI and autonomous systems in conflict—a unique case for more radical automation.[114] Further, despite industry's having the technology, there is little long-term thinking about the need for mass on future battlefields. While lessons from the conflict in Ukraine have yielded an understanding that future conflicts will necessitate thousands—even tens of thousands—of drones, for example, the scale of a future protracted conflict would be far more demanding. Strategic planners should be thinking about the capacity to manufacture and field hundreds of thousands, perhaps millions of drones based on platforms that are rapidly adaptable.

Despite the opportunity, more than 2 years into the Zeitenwende, there remains evident a cultural and political reticence toward innovation for the purpose of enhancing the lethality and speed of the Bundeswehr on the battlefield. The Bundeswehr will likely be a late mover when it comes to lethal autonomous technologies and will continue to struggle to directly benefit from its formidable defense technological base as it attempts to keep up with key facets of modern warfare, including integrated AI, data-sharing, and military automation. It is not that Germany will not have access to world-class technological innovation or adopt and incorporate emerging and innovative technologies (such as the loitering munitions that have become ubiquitous in Ukraine); it will likely just do so at a slower and more deliberate pace. In the game of competitive adaptation, however, this pre-2022 legacy is a liability.

Despite the need to move faster and proactively define defense-industrial priorities, the legacy of Germany's militarized past continues to predispose its leadership to a hands-off approach and incremental reform. The challenge of durably expanding capacity, both in the production of military hardware and the capacity for defense innovation, remains significant. Long-term contracts, supply chains, and a limited skilled workforce constrain expansion of the defense-industrial base. Further, Germany has moved cautiously in exercising its legal authorities to better prioritize defense-industrial activity, R&D, and expanding capacity and the volume of material produced. While Germany does not have the equivalent of the U.S. Defense Production Act, it is a point of reference for officials involved in German armaments policy.[115] The German government is also working to update its strategy paper on the security and defense industry.[116] However, efforts to expand capacity and exercise greater direction of the defense-industrial base remain ad hoc.

Multilateral Cooperation and Arms Exports

The Zeitenwende was a pivotal moment for Germany's foreign and security policy, and it signaled to allies and partners the potential for a militarily stronger and strategically active Germany moving forward. Germany's regional allies are observing the progress of the Zeitenwende with interest. While each NATO ally has its own view of the Zeitenwende, and unique interests and considerations, a few common threads emerge, including a desire for greater regional cooperation with shared benefits and reformed policies on arms exports.

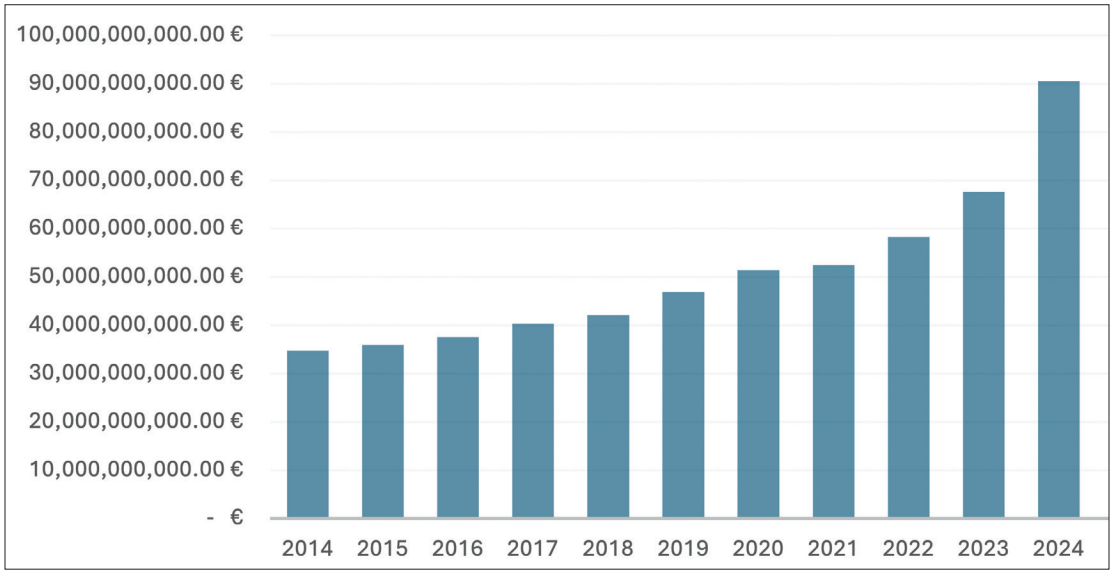
Indeed, NATO allies are looking to Germany for greater defense-industrial cooperation, but it did not begin on the right foot. The defense-industrial bases of NATO countries, including Germany, could not replace military equipment at the rate at which it was being consumed in Ukraine's defense and, therefore, cannot resupply NATO stockpiles that are gradually being depleted.[117] Many allies that gave from their own national stockpiles did so expecting replacements with German equipment as part of the so-called "ring exchange" (*Ringtausch*) program. This program had the virtue of allowing many regional allies to divest their militaries of older and mostly Soviet-era equipment for newer NATO-standard and Western-produced equipment. However, the friction and slowness in this program degraded trust among Germany's regional allies. Low national stockpiles negatively impact readiness and deterrence in their own militaries, and they bottleneck support for Ukraine. The German National Security Strategy acknowledges that the ability of the defense-industrial base to engage in cooperation must be improved, and the German National Security and Defence Industry Strategy sets out a goal for

the government to establish more joint European armament and procurement projects.[118] Yet regional defense-industrial cooperation led by Germany remains limited.

However, there have been bright spots. The recent joint procurement framework for Leopard main battle tanks (MBTs) was a positive example of regional military-industrial cooperation led by Germany.[119] When Germany agreed to send Leopard-2 MBTs to Ukraine in January 2023, it required immediate consideration of their replacement. Regional allies that had provided tanks were in a similar situation. It was an opportunity for common or joint procurement and the re-establishment of the Leopard-2 as the main European tank platform. The idea was spearheaded by Czech decisionmakers who rallied other regional partners to emphasize the operational, economic, and strategic benefits. An important part of making the case was Poland's decision to procure tanks from the Republic of Korea; Germany risked losing regional market share if it did not act.

The resulting framework deal has led to orders for approximately 400 Leopard-2s. Notably, the Czech Republic expects to host a production line for its orders and those of Lithuania. Italy also plans to host a production line that will further expand and distribute regional capacity. This initiative benefits the German defense industry and nearly every participant's defense-industrial base. In the long term, it will enhance interoperability with other regional NATO allies operating the Leopard. Allies would also benefit from higher overall order numbers. Regional

Figure 2. German Defense Spending



Source: *Defence Expenditure of NATO Countries (2014–2024)* (Brussels: NATO, 2024), available at <https://www.nato.int/nato_static_fl2014/assets/pdf/2024/6/pdf/240617-def-exp-2024-en.pdf>.

allies pointed to the initial success of this framework contract, facilitated by Germany, and emphasized the need for more industry consortia and regional production frameworks.[120]

By far, however, the most critical element of building trust among Germany's regional allies and partners and its defense industry players, during the initial years of the Zeitenwende, was its commitment to and sustainment of at least 2 percent of GDP spending on defense per its NATO defense investment pledge.[121] Two percent is a hard metric by which Germany can be held accountable.[122] Despite meeting the 2-percent target in 2024, Germany had to be pushed by regional allies and the United States to make progress and sustain spending.[123] Domestic frustration over energy prices and a broader economic slowdown put significant pressure on the German budget and threatened defense spending beyond the period of 2026 through 2027. These factors contributed to the significant uncertainty of defense companies when considering long-term capital investments. Regional allies noted that the United States has a special relationship with Germany, and there is a desire to see the United States engage more directly with the German Chancellery on defense modernization and industrial cooperation. Indeed, discussions about a new NATO defense spending target of up to 5 percent of GDP in 2025 will pose a challenge for the new Christian Democratic Union of Germany–led governing coalition, but it promises to be transformational for Germany and the Bundeswehr if an agreement can be reached.

Taking on greater responsibility for security will depend, to a significant extent, on Germany's ability to build trust with its neighbors. Greater industrial cooperation is viewed as an effective method for building trust, confidence, and credibility. Germany has an opportunity to play an increasingly integrative role in regional security, thereby strengthening the European pillar of NATO and conventional deterrence on NATO's eastern flank. The central challenge, however, may be the potential mismatch between the expectations of regional allies, which seek greater German *leadership*, and Germany itself, which appears to want to take on greater *responsibility* for shouldering regional defense and deterrence. Leadership includes setting an agenda, aligning perspectives, and representing the interests of its regional allies—things Germany does not yet seem willing or able to do.

In the early phases of the Zeitenwende, there were expectations that Germany would be the "motor" behind a similar watershed moment for the EU.[124] The relationship between Germany and France was specifically highlighted by Chancellor Scholz in his February 2022 speech, and he raised it in the context of their collaboration on next-generation tanks and aircraft.[125] However, France and Germany initially took different lessons from Russia's invasion of Ukraine. For Germany, Russia's invasion confirmed the existing view that the United States and NATO

were most vital to German security. Germany was careful not to embrace policy that could be perceived as undermining NATO's primacy in the European security architecture. For France, however, the invasion re-emphasized the need for greater strategic autonomy and a strengthened role for the EU.[126]

The tension manifests in Franco-German defense-industrial cooperation, particularly on the two most future-forward projects: the Franco-German Main Ground Combat System (MGCS) and the French-German-Spanish Future Combat Air System (FCAS). The MGCS program is intended to eventually replace the German Leopard-2 and French Leclerc MBTs. One concern is that Rheinmetall's Panther MBT program, envisioned as a stopgap, will siphon resources from and interfere with the eventual rollout of the MGCS program. Similarly, Germany's purchase of F-35s has been criticized by some defense analysts as undermining the FCAS project. Germany is expected to take possession of the first batch of F-35s in late 2025 and early 2026, with the final batch to be received around 2029. The F-35 platform will be expected to play an integral role in German air power for the next several decades, well into the 2040s. In addition, U.S. sixth-generation fighters will be entering service in the 2030s. Therefore, by the time FCAS is anticipated to roll out in the 2040s (along with the MGCS), it will be potentially a generation behind and redundant given rapid advancements in uncrewed systems.[127]

Franco-German friction also mars the European Sky Shield Initiative (ESSI), a multilayer air defense system coalition announced by Scholz in August 2022. It has attracted 21 European partners, but France remains aloof. Among the many acquisitions attributed to the €100 billion special fund has been the Arrow-3 missile from Israel. When integrated, the exo-atmospheric Arrow-3 missile will become the highest-altitude layer of the ESSI, which will also incorporate the U.S. Patriot and German IRIS-T systems. France would have preferred a European system instead of the Arrow, likely the Franco-Italian SAMP/T, noting the missed opportunity to build up European missile defense expertise.

The critique of ESSI is illustrative of the contrast between Germany, which has been willing to act pragmatically and procure U.S. systems to strengthen transatlantic linkages and fill immediate capability gaps in the near term, and France, which has advocated buying and developing European systems.[128] While the ESSI may eventually be considered a success in terms of German multilateral defense-industrial engagement, the major industrial initiatives of the Zeitenwende through 2024—such as support for Ukraine and major procurements for the Bundeswehr, including joint ammunition procurements—have been in coordination with the United States and NATO. The Zeitenwende, at least through 2024, continued to lack a substantial European dimension. That dynamic is subject to change, however, should the United States significantly

alter the transatlantic security relationship or its engagement through NATO in the process of redirecting resources to the Indo-Pacific, for example. In that case, Germany may shift bandwidth to the EU and other European partners for greater defense and industrial engagement.

The development of a "European preference" in acquisitions and procurement may also drive change in the way Germany engages in defense-industrial base cooperation. The German National Security and Defence Industry Strategy designates certain technological areas as critical for national security, with select areas—such as missiles—open for European and global cooperation. However, the German government will also endeavor to maintain core capability through domestic procurement in areas (such as AI, naval shipbuilding, electromagnetic warfare technologies, and protected and armored vehicles) that are shielded from European and transatlantic cooperation or competition. This approach may throttle the level of potential industrial cooperation, and it may leave Germany with capability gaps for a prolonged period as it develops domestic and European solutions. Prioritization of domestic solutions for key technologies appears to build on prior court cases, such as the selection of Rohde and Schwartz (R&S), a German provider of digital and radio communications, to supply and upgrade the Bundeswehr. The MoD was successfully able to avoid the EU requirement for competitive tendering by invoking the national security exemption. However, the use of the exemption remains rare and subject to prolonged legal challenges, but barring significant change at the EU level, it remains a tool that Germany has signaled it is increasingly willing to leverage.[129]

While the German relationships with France and the EU have offered friction, German industry views NATO as an effective mechanism to expand regional and European industrial cooperation and joint procurement in a tested multilateral format. Through the NATO Support and Procurement Agency (NSPA), contracts have been awarded for munitions, and a coalition of European states placed a joint order for 1,000 Patriot air defense missiles.[130] The order for Patriot missiles is supported by a joint venture between Raytheon and MBDA Germany. Crucially, this will allow MBDA to set up a new production facility in Germany and develop major subcomponent production.[131] However, current contracts and orders are generally lower on the value chain and limited to military equipment that is already in widespread use among NATO allies. Nonetheless, air and missile defense is a priority and Germany is in short supply of missiles. German defense industry players are also supportive of NATO's efforts since the Alliance offers reliable, long-term contracts that bolster transatlantic defense industries. The ability to leverage NATO training and experimentation sites has also been an under-the-radar boon for smaller defense firms that struggle with local and EU regulation or may not have access to experimentation sites critical for testing prototype systems.

One hundred fifty-five–millimeter artillery ammunition manufactured at Rheinmetall, June 6, 2023, Lower Saxony, Unterlüß (Philipp Schulze/dpa)

External mechanisms like the NSPA are appealing because of difficulties in budgeting and planning for Germany and a reluctance to embrace long-term (10-year) contracts that might tie the hands of future governing coalitions. Without the stability and predictability of long-term contracts, significant investments in new infrastructure are risky, and a defense enterprise might struggle with excess capacity that it cannot leverage should short-term contracts expire or national defense spending decline. However, maintaining excess capacity is far more cost-effective than scaling up during a crisis or war. By working through mechanisms such as the NSPA, allies and partners are assured a degree of reliability about the export and distribution of military equipment, bypassing some of the angst over disparate arms-export regulation regimes among allies.

The issue of arms exports is at the nexus of industrial cooperation between Germany and NATO allies. The German National Security Strategy calls out joint arms projects and their exportability as another area of focus.[132] Germany consistently ranks among the top global exporters of military goods and state-of-the-art equipment.[133] Indeed, German arms exports licenses for military equipment in 2023 were valued at €12.2 billion, with a majority earmarked

for Ukraine.[134] In 2024, Germany's arms exports reached a record high of €13.2 billion with €8.1 billion in exports dedicated to Ukraine.[135]

Because domestic demand is historically meager, the German defense industry has had to seek opportunities in the global market. German arms companies routinely feature among the top in international arms sales, and Germany consistently ranks among the highest international arms exporters.[136] Exports have also been the key method by which Germany's defense industry has sustained itself. Rheinmetall, for example, generates up to 70 percent of its revenue abroad.[137] However, the Zeitenwende and increased domestic defense spending have started to affect segments of the industry. The electronics and communications company Rohde and Schwartz relied heavily on exports, to the tune of approximately 90 percent of all products prior to the Zeitenwende. Two years later, 30 to 35 percent of its business was domestic.[138]

While exports are vital to sustaining the German defense-industrial base because of historically weak domestic demand, it has never been enough to significantly expand domestic capacity. The need to seek international markets and collaboration exists in tension with a restrictive regime of controls on arms exports. Close allies such as France and the United Kingdom have previously signaled that the restrictive nature of German arms exports undermines more robust defense collaboration, which remains a stated goal for Germany.[139] Because German parts are used in many European defense products exported by other countries, there is a consistent concern over whether Germany will exercise its power to block sales or throttle exports. While implementation and enforcement of the export regime is inconsistent, and notable exceptions have been made for Ukraine, Germany maintains a far more restrictive approach than most other major arms-exporting countries.[140] Arms exports are also a critical piece of the defense-industrial trust matrix, with one German official noting that the government has learned that arms exports are a way of building trust with allies and partners. This mindset is quite new for the German government.[141]

Despite arms sales breaking records in 2023 and reaching all-time highs in 2024, the German government does not yet have the ambition to use arms exports as a tool of foreign and security policy the way other major arms-producing nations do.[142] The United Kingdom and France, for example, see arms-export relationships as providing political leverage and as a way to aggressively support the commercial interests of their defense-industrial bases.[143] Exports also lead to larger production orders, which allow participants to buy in larger quantities, maintain a skilled workforce and technological capacity, and keep production lines warm. Defense exports also have the benefit of providing greater interoperability with purchasing states. The German

government has traditionally viewed itself as an "industry regulator" only.[144] As a result, the German government does not often play a central role in facilitating arms sales and exports.

The U.S. government, which manages international arms sales through its Foreign Military Sales (FMS) system, can prioritize orders through U.S. European Command and the Defense Security Cooperation Agency (DSCA). Germany does not have a comparable government-to-government system.[145] As a result, it also becomes difficult for Germany to prioritize arms sales, delivery, or production. The German federal government is largely dependent on the motivations of its own private industry. Further, foreign governments often directly approach German industry first instead of the federal government, which decreases the direct visibility of demand. The comparative efficiencies of an FMS-type system also make it far easier for smaller regional allies and partners with greater bandwidth limitations to engage. While it would benefit Germany to institute an FMS-like system, it would likely be too disruptive to the current mode of business at this stage.[146] However, the German National Security Strategy outlines that a more direct government-to-government approach remains a goal: "The Federal Government is endeavouring to improve the parameters of the security and defence industry and will enable government-to-government sales."[147]

Government-enabled and government-led arms sales are just one part of an ongoing discussion over the need for arms export reform. After a slow start, Germany is now among Ukraine's top five providers of heavy weapons.[148] The two most prominent members of the Scholz-led "traffic light coalition"—the Social Democratic Party and Alliance 90/The Greens—generally aligned on arms exports. While the coalition was pragmatic when it came to support for Ukraine and Israel, their inclination—and pre-2022 intent, based on their political coalition treaty—was to restrict arms exports further.[149] It is unclear how parliamentary elections in 2025, with a new coalition led by the Christian Democratic Union, may approach arms exports regulations that had been planned for 2025.

Industrial Cooperation With Ukraine

While Germany adopted a new paradigm when it comes to arms exports for Ukraine, becoming a leading provider of military equipment, there is less consideration and coordination regarding longer-term defense-industrial cooperation.[150] German leaders have long understood that Germany will have a large role in the reconstruction of Ukraine, and there is an opportunity for a defense-industrial Zeitenwende to do just that. Ukraine's own defense industry has grown over the last few years. The drone industry, for instance, has gone from producing a handful of drones in 2022 to manufacturing tens of thousands of them—producing over 1 million "first

person view" (FPV) drones in 2024, and thousands more of various varieties and complexity.[151] As others have noted, Ukraine was also once at the core of the Soviet Union's aerospace industry and a large chunk of the Soviet defense-industrial base writ large.[152]

Ukraine is also one of only seven global suppliers of titanium; in fact, Ukraine holds Europe's largest titanium reserves and one of the largest plants producing titanium ingots is in Zaporizhzhia.[153] Titanium is critical to many defense systems, including missiles, armor plating, maritime vessels, and aircraft parts. Ukraine's substantial mineral wealth could be better harnessed to help alleviate Western supply chain shortages of critical metals and other raw materials and provide a needed boost to the Ukrainian defense-industrial base. Integrated Ukrainian supply chains derived from Ukrainian mineral and metal extraction present a clear opportunity. As a benefit, transatlantic allies and partners will have access to an alternative source of supply not involving Russia or China—or states that can be easily coerced by either—and Ukraine will have access to the multinational investment it needs to rebuild an industry critical to its own defense-industrial base.

An additional opportunity, however, for the defense industry is the chance to engage in a market with assured demand and the chance to test technical innovations. The cycle of adaptation and counteradaptation in Ukraine is incredibly fast. As Guntram Wolff, Senior Fellow at Bruegel, observed, "That's the real business case. It's like a laboratory."[154] Indeed, the German defense industry receives significant feedback and, in some cases, data in real time regarding the efficacy of its systems and the ways in which the Ukrainians are modifying them for the rigors of the current conflict.[155] It remains unclear to what extent the German MoD is receiving this feedback as well, but the Bundeswehr is poised to benefit from a defense industry that is able to field-test and collect data on a wide range of systems.

While there is widespread agreement that Ukraine will need to rebuild its domestic defense-industrial base, cooperation with Western defense industry remains limited. However, there are signs of progress. Rheinmetall established a joint, in-country venture with the state-owned Ukrainian Defense Industry (UDI, formerly Ukroboronprom) in Kyiv to provide maintenance and repair work on military vehicles near Lviv.[156] Eventually, this facility will repair armored vehicles such as the Lynx infantry fighting vehicle and the Panther main battle tank. Rheinmetall is also engaged in a joint venture with Ukrainian partners to build a new 155mm ammunition manufacturing plant in Ukraine.[157] These types of joint ventures are critical nodes to expand Ukrainian capacity and capability and should be built upon. The German government, however, has yet to play a central role in incentivizing German industry, although some initial forays have occurred. In April 2024, German Vice-Chancellor Robert Habeck visited

Kyiv with a delegation of defense and energy executives looking to the future of armaments production and energy grid resilience.[158] There are also important EU-level efforts focused on building up the Ukrainian defense-industrial base, of which Germany is a driver. As the United States reorganizes its priorities in Europe, Germany will need to be a leader on defense-industrial cooperation with Ukraine, which means taking a more direct hand in facilitating joint ventures and other cooperative efforts.

Of course, there are challenges. Some within the German defense industry will point to lingering corruption as well as concerns about building up a long-term competitor as deterrents to investment in Ukraine.[159] The greatest concern, however, is simply the risk to property and personnel because of the ongoing warfare. There are serious concerns about which personnel are considered noncombatants. The practical effect is that obtaining insurance for any investment in Ukraine becomes very difficult. In the case of Rheinmetall, the German government stepped in to underwrite the risk and the initiative, which will rely heavily on training local technicians.[160] Rheinmetall is also among the largest of Germany's defense companies with the resources to take on the additional risk, so it remains an exception, not the rule. While the government's support for Rheinmetall was a positive step, the approach to cultivating defense-industrial cooperation with Ukraine while the country is in a state of conflict remains ad hoc and needs efforts to broaden the scope beyond the largest industry players.

The United States and Germany must be key players in any defense-industrial strategy for Ukraine. If Ukraine is ever to join NATO, it will be essential for it to have a robust defense industry that produces interoperable equipment and joint capabilities. It will also be an immediate boon for allies and partners. For now, Germany has prioritized meeting urgent and immediate needs, but planning for longer-term defense-industrial cooperation with Ukraine must accelerate. Indeed, Germany's role in Ukraine becomes more important if U.S. support fundamentally decreases, in which case Germany cannot afford just to take on greater responsibility but will need to take on a new leadership role in a multilateral context. Bolstering Ukraine's industrial capacity through cooperation is critical not only for battlefield success in the near-term, but for the eventual reconstruction of Ukraine, the preservation of Ukrainian autonomy, and a stronger European pillar of NATO.

Policy Recommendations

Speaking in Munich in February 2025, Secretary of Defense Pete Hegseth highlighted the criticality of expanding defense-industrial base capacity on both sides of the Atlantic.[161] Indeed, one of the most important aspects of allied deterrence is the strength and diversity of

the transatlantic defense-industrial ecosystem, and the U.S. National Defense Industrial Strategy calls for collaboration and cooperation between the U.S. Government, private industry, and allies, and partners abroad.[162] Among the major allies and European powers, Germany has significant potential to enhance conventional defense and deterrence given its chronic military underinvestment in recent decades and its military-industrial ecosystem that—though it remains intact—is not adequately mobilized and structured for the current geostrategic reality.

The Zeitenwende of 2022 was a critical moment in German foreign and security policy. It is, however, also an ongoing window of opportunity in which U.S. support can make a long-lasting contribution to defense and deterrence in Europe. Enabling Germany to take on a more prominent role in European defense will allow the United States to redirect strategic bandwidth and resources for the Indo-Pacific. By prioritizing defense-industrial base cooperation and German rearmament and defense-industrial reform, the United States can deepen the sinews of cooperation among European allies and partners, support the European pillar of NATO, and enable allies and allied warfighters to take on a greater share of the burden for conventional defense and deterrence in Europe.

The sense of urgency is palpable as scholars anticipate a window of risk from 2027 through 2035 in which the risk of a crisis over Taiwan is elevated. With U.S. strategic bandwidth and resources devoted to the Pacific theater in the event of a conflict with China, European powers would be required to contend with a reconstituted and revanchist Russia that may be inclined to exploit any security or deterrence gap. In many ways, Russia is already waging a hybrid conflict in Europe. German intelligence chiefs warned in October 2024 that there has been a "quantitative and qualitative" increase in Russian-sponsored espionage and sabotage in Germany and also noted that by the end of the decade (2030), Russia could be in a position to attack NATO, to test the "mutual defense clause" in Article 5.[163] It will take time for Europeans to reconstitute their militaries and backfill equipment provided to Ukraine. This is especially true for Germany, which has underfunded its military and underleveraged its defense-industrial base for decades.

The potential for a second round of significant defense spending after the lifting of the constitutional "debt brake" in 2025 is a positive development, but it will take time to deploy, and structural constraints will work to impede the efficient use of those funds. In addition, there are large capability and personnel gaps in German and European militaries that will not be easily mitigated in the near term, and a U.S. reorientation to the Indo-Pacific too quickly may leave Europe more vulnerable to Russian pressure or military aggression. Indeed, Germany and other European allies may have little time to fundamentally reimagine how they achieve conventional defense and deterrence in Europe. For the United States, recommitting

and reinvesting in defense-industrial and technological cooperation with one of Europe's most important economies is an opportunity to jump-start European defense and deterrence in the near term while building European capability in the longer term.

To strengthen the transatlantic defense-industrial ecosystem and Germany's role in defense and deterrence during a critical inflection point, the United States should consider the following recommendations:

- Provide bilateral political support and dialogue for German rearmament. Konrad Adenauer, the first West German Chancellor after World War II, understood that the armed forces were vital to consolidating the Atlantic Alliance (NATO) and were essential to Germany's recovering its sovereignty. He successfully convinced the German public to accept rearmament and U.S. nuclear weapons on German soil, something two-thirds of the German public opposed at the time. This success was due to forward-leaning leadership and, in part, to strong backing from the United States. The United States should once again be engaged in consistent bilateral dialogue and public support that demonstrates U.S. interest and backing for German rearmament and military reconstitution. This support would include shared dialogue, the continued reform of defense procurement and acquisitions processes, and effective and sustained defense spending. Ultimately, German rearmament and durable change in foreign and security policy will require determined leadership willing to advocate for that change. However, regional allies and partners have noted the Chancellery's traditional responsiveness to U.S. leadership and have encouraged the United States to use its influence to help drive rearmament, defense-industrial base reform, and security leadership.

- Encourage and support the reform of defense production laws and authorities. European defense-industrial bases, including Germany's, have diminished since the end of the Cold War. The result is an ecosystem that supports the production of complex and exquisite systems at a limited scale. Further, European defense-industrial bases remain highly fragmented along national lines, with differing levels of state authority to direct or support their defense industries. The German defense-industrial base is largely private, and the government remains hesitant to direct or provide support in a way that may distort the free-market system or garner even the perception of interference or favoritism. The authorities to direct industrial activity are particularly difficult to exercise outside of a narrowly defined state of war. Indeed, Germany does not have legislation or authorities

comparable to the U.S. Defense Production Act (DPA), and a bilateral discussion of the DPA would be beneficial to provide the MoD with a sense of what is possible and to maintain the urgency and necessity of reform. It should be a priority to encourage the discussion, cultivation, and reform of defense production laws and regulations that would allow the German industrial base greater authority to protect key innovations, prioritize armaments orders, support critical supply chains, and speed the development of infrastructure that will expand industrial capacity.

- Expand bilateral co-production and co-development of critical munitions and precision weapons. Munitions in critical areas such as air defense and long-range strike, including Patriot and PrSM missiles, or the Joint Air to Surface Standoff Missile (JASSM) may benefit from expanded or new co-production initiatives.[164] The production of F-35A fuselages as part of a joint effort between Lockheed Martin and Rheinmetall is another example of what may be possible. Also warranting consideration is the expansion of co-production in Germany of vital components and maintenance supplies for aircraft that will be in use in Europe and in the Indo-Pacific for decades. A priority should also be placed on U.S. systems, armaments, and subcomponents in the German and European inventories that may be in demand in both theaters to avoid a simultaneous draw on U.S. domestic production capacity in the event of a crisis or war. In addition, existing flexible funding programs such as JUMPSTART, which allowed for a country like Germany to leverage U.S. production capacity to meet Ukrainian equipment needs, should be preserved. Co-production arrangements, shared industrial infrastructure, and resilient supply chain priorities are important precedents in bolstering a German defense-industrial base that will be relied on to surge the production of key munitions and equipment that expands the range of interoperable systems and drives an expansion of the transatlantic defense-industrial base ecosystem.

- Expand defense-industrial cooperation through mechanisms such as the NATO Support and Procurement Agency (NSPA). Both U.S. and German officials note that NATO offers an increasingly effective mechanism to expand industrial cooperation in a multilateral format. Hidden away in the Vilnius Summit Communiqué (2023) was an endorsement of the NATO Defense Production Action Plan (DPAP).[165] Chief among the action areas of the DPAP was the aggregation of demand to accelerate joint procurement, which has seen some success. These types of joint efforts bolster interoperability and

common standards, allow for the purchase of larger orders, and generate cost savings for the purchasing governments. They also incentivize the expansion of industrial capacity. As NATO allies increasingly discuss "crisis resilience," they must go beyond operational readiness and societal will. NATO allies must also be looking to build resilience into their defense-industrial bases, allowing for rapid scaling of production, flexible funding, demand aggregation, and rapid innovation from the start. Leaning into the work of the NSPA and expanding the range of military equipment jointly procured, and building on the DPAP, and the more recent NATO Industrial Capacity Expansion Pledge to build a more complete NATO defense-industrial strategy for Europe, with U.S. involvement, will incentivize the development of a stronger European pillar within NATO.[166]

- Expand direct collaboration among small and medium-sized firms with Ukrainian defense industry through co-production and co-development in-country. The war in Ukraine has revealed the critical state of NATO's defense-industrial base as allies attempt to supply Ukraine while replenishing their own stocks, and in the case of Germany, modernizing as well. Ukrainian forces have sought to work around supply bottlenecks and source alternate equipment in part because the U.S. and European defense-industrial bases do not have the capacity and ramping up production has been painfully slow.[167] The United States and Germany should collaborate more directly with Ukraine's defense industry, fostering the co-production and co-development of munitions and military equipment and expanding access to agile small and mid-sized defense companies. The United States and Germany must provide the legal support, financial incentives, and risk insurance that will allow for broader collaboration across defense-industrial ecosystems. There is an imperative for Germany to be a key player in any such effort, both bilaterally and by driving greater defense-industrial base collaboration with Ukraine through the EU.[168] In the post-Brexit environment, Germany is an increasingly important interlocutor for the United States on EU industrial policy. Co-development and co-production through multinational joint ventures offer opportunities to expand military-industrial capacity in Ukraine, diversify sources of supply, and plant the seeds for another allied arsenal in Europe.

Conclusion

The extent to which Germany can modernize the Bundeswehr, recapitalize allies and partners, support Ukraine, and ultimately take on greater responsibility for conventional defense and deterrence in Europe will depend in large part on having the industrial strength to meet

these demands. Yet the German industrial base has received comparatively little attention as a key feature of the Zeitenwende, which promised a significant new direction for German defense policy. Why has Germany not made more progress on defense-industrial base reform despite a surge in resources and political will? There is a clear through line: a mindset that continues to constrain the government's relationship with industry and results in systems that disadvantage the defense-industrial base in financing, planning, capacity, and innovation. The instinct for incrementalism remains strong at a time when rapid change is needed to adapt to new modes of warfare and a new geostrategic reality. Instead, a continued tension exists between the need for greater defense-industrial capacity and the peace dividend of prior years. In contrast, Russia has adopted a wartime mindset and firmly moved its industrial base onto a wartime footing. One German official suggested: "We started 2 years too late to get into a wartime production mode."[169]

The German defense-industrial base did experience incremental change in the years following the strategic shift signaled by the Zeitenwende. However, it remains hamstrung by long-standing challenges and barriers that constrain a more significant role for the German defense-industrial base in European security. The relationship between the government and its defense-industrial base remains mired in political, cultural, and regulatory barriers that prevent important two-way communication. Further, this relationship lends itself to creating mismatched expectations that inhibit long-term planning, responding to crises, and maintaining capacity. While benefiting from some reform, the Bundeswehr procurement system also remains problematic. Legacy processes will continue to impede the speed of German military reform, and there is not yet the political will to substantially alter these bureaucratic systems.

Furthermore, persistent structural challenges regarding long-term contracts, supply chains, and skilled labor combined to create an environment in which the defense industry is largely unwilling to take risks or significantly expand capacity. When it comes to industrial infrastructure and expanding capacity, the lead times are long. Supporting Ukraine while attempting to recapitalize allies and modernize the Bundeswehr has already strained German industrial capacity. Germany will be challenged to scale up quickly to support the demands of high-intensity conflict in crisis or war tomorrow.

The German government is also struggling to work out a new equilibrium with its defense-industrial base, one in which it must retrain the muscle memory needed to better direct military-industrial activity. The traditional barriers between the government and private defense industry remain strong, and a new mindset has yet to be fully adopted. Further, a cultural and political reticence toward technology for the purposes of making the Bundeswehr more lethal on the battlefield remains, and the capacity for the Bundeswehr to tap into and benefit from

private-sector innovation at speed is challenged because of the bifurcation of the defense innovation ecosystem. This reticence to employ military autonomous technologies will also likely limit the speed with which the Bundeswehr is able to adapt, or support allied adaptation, in any protracted high-intensity conflict.

Finally, expectations among regional allies and partners are still developing, and perceptions are mixed as to whether the Zeitenwende has resulted in a durable shift in German strategic mindset and the ambition for reform. While there is some confidence that German leadership—particularly at the MoD—has adopted a new mindset, there is less confidence that the public will support defense modernization and industrial base reform unless German political leadership makes an active case. Further, without significant reform to the arms export policy, Germany's ability to build capacity among allies and partners, foster interoperability, and reconstitute allied forces will remain constrained. Currently, regional allies and partners are initiating joint industrial projects, but Germany's taking a leadership role and demonstrating ambition in this regard will go some way toward building trust in greater German security responsibility on NATO's eastern flank.

Is Germany able to scrape off the rust and reignite its industrial base? A little over 2 years into the Zeitenwende, the gears are turning, but slowly. Across an array of dimensions—communication and procurement, capacity and control, industrial cooperation, and arms exports—the ambition for reform in the wake of the Zeitenwende has been incremental and did not significantly depart from the pre-2022 status quo. Giegerich and Terhalle once wrote that that Germany cannot afford to make a transition to responsible security leadership at a "gentle, evolutionary pace."[170] Yet from a defense-industrial perspective, this incremental reform signals the limited extent to which one might expect the German industrial base to contribute to greater defense and deterrence in Europe in the critical years ahead.

However, the elections of February 2025 offer the new coalition government an opportunity to accelerate military and defense-industrial base reforms. The prospect of additional major funding—after amending the "debt brake" for defense spending—will provide significant new momentum. While additional defense spending will go a long way toward bolstering the German defense-industrial base, enabling a more stable trajectory for armaments companies and revitalizing the Bundeswehr, it is not a panacea. On its own, increased defense funding will not solve the many challenges with the defense innovation ecosystem, acquisitions, arms exports, defense-industrial base authorities, and long-term planning. It also will not necessarily lead to more joint and multinational procurements or industrial cooperation without German leadership. At the same time, Germany also finds itself continuing to struggle with

economic stagnation and deindustrialization. Political leadership and a new strategic mindset will be needed to enact structural reforms that will unshackle the German defense-industrial base. Indeed, these reforms will have a new imperative given the evolving expectations of the United States, which has emphasized that Europe must collectively play a far greater role in the defense of the continent.

The German industrial Zeitenwende in Europe from 2022 through 2024 was one of incremental progress and cautious reform. While the United States and allies can count on an increasingly capable Bundeswehr in the near and mid-term, potentially accelerated by a second round of defense funding and new leadership beginning in 2025, it will be many years before Bundeswehr reform is complete. As the United States and its European allies and partners prepare for a window of risk from 2027 through 2035 during which U.S. bandwidth is tied up in the Indo-Pacific and Russian opportunism remains likely, Germany remains a critical cog in the ability of Europeans to take on a greater share of defense and deterrence in Europe. Yet the German industrial base is not yet constructed to provide the necessary backbone in a protracted conflict. However, the ingredients are there, and Germany has taken important steps along the way. As with other strategic inflection points, the United States should play a constructive and enabling role by offering new opportunities for defense-industrial cooperation, setting expectations bilaterally and within NATO, and creating the space for Germany to take on greater responsibility—and perhaps new leadership—for defense and deterrence in Europe.

Notes

[1] "Policy Statement by Olaf Scholz, Chancellor of the Federal Republic of Germany and Member of the Bundestag, 27 February 2022 in Berlin," Press and Information Office of the Federal Government of Germany, https://www.bundesregierung.de/breg-en/news/policy-statement-by-olaf-scholz-chancellor-of-the-federal-republic-of-germany-and-member-of-the-german-bundestag-27-february-2022-in-berlin-2008378.

[2] Nicole Koenig, "The Zeitenwende: Germany's Reluctant Revolution," American-German Institute, July 6, 2022, https://americangerman.institute/publication/the-zeitenwende-germanys-reluctant-revolution/.

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[5] "German Defense Minister Says Military Budget Gap 'Annoying,'" DW, July 8, 2024, https://www.dw.com/en/german-defense-minister-says-military-budget-gap-annoying/a-69592452.

[6] Oleksiy Reznikov, Ukraine's Defense Secretary, stated that Ukraine needed about 356,400 shells a month for the successful execution of battlefield tasks. This amounts to 11,800 shells per day. See Andy Bounds, "Ukraine Asks EU for 250,000 Artillery Shells a Month," *Financial Times*, March 3, 2023; Stacie Pettyjohn and Hannah Dennis, *"Production Is Deterrence": Investing in Precision-Guided Weapons to Meet Peer Challenges* (Washington, DC: Center for a New American Security, June 28, 2023), https://www.cnas.org/publications/reports/production-is-deterrence

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[8] Jack Watling and Nick Reynolds, *Meatgrinder: Russian Tactics in the Second Year of Its Invasion of Ukraine* (London: Royal United Services Institute for Defence and Security Studies [RUSI], May 2023), iii, https://www.rusi.org/explore-our-research/publications/special-resources/meatgrinder-russian-tactics-second-year-its-invasion-ukraine.

[9] For this study, the working definition of *defense-industrial base* is the underlying businesses and institutions that support the research, development, and production of military equipment.

[10] Utku Cakirozer (Türkiye), General Rapporteur, "2023—General Report—Ensuring an Allied Defence Industrial Base for NATO's New Deterrence and Defence Baseline," NATO Parliamentary Assembly, Defence and Security Committee, October 7, 2023, 1, https://www.nato-pa.int/document/2023-defence-industrial-base-cakirozer-report-018-dsc.

[11] Jeff Rathke and Theresa Lütkefend, "The U.S. and Europe Must Recalibrate Their Security Partnership," *Defense News*, December 18, 2023, https://www.defensenews.com/opinion/2023/12/18/the-us-and-europe-must-recalibrate-their-security-partnership/.

[12] Rathke and Lütkefend, "The U.S. and Europe Must Recalibrate Their Security Partnership"; Madelyn R. Creedon et al., *America's Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Alexandria, VA: IDA [Institute for Defense Analyses], October 2023), https://ida.org/research-and-publications/publications/all/a/am/americas-strategic-posture.

[13] For more on possible future scenarios and Russian reconstitution, see Katherine Kjellström Elgin, *More of the Same? The Future of the Russian Military and Its Ability to Change* (Washington, DC: Center for Strategic and Budgetary Assessments, March 18, 2024), https://csbaonline.org/research/publications/more-of-the-same-the-future-of-the-russian-military-and-its-ability-to-change/publication/1; Dara Massicot with Richard Connolly, *Russian Military Reconstitution: 2030 Pathways and Prospects* (Washington, DC: Carnegie Endowment for International Peace, 2024), https://carnegieendowment.org/research/2024/09/russian-military-reconstitution-2030-pathways-and-prospects; and Creedon et al., *America's Strategic Posture*, vii.

[14] Creedon et al., *America's Strategic Posture*, vii.

[15] Among the many concerns over Russian opportunism are the threat to undersea cables and energy infrastructure; weaponized migration across the Finnish border; and operations against strategically important islands such as the Åland archipelago at the entrance to the Gulf of Bothnia or the isle of Gotland between Sweden and Latvia. See Jan M. Olsen, "Baltic Sea Nations React Warily to a Reported Russian Proposal to Revisit its Maritime Border," AP News, May 22, 2024, https://apnews.com/article/baltic-sea-russia-security-border-fb9849dd556fa166f1135172c6935c9d; Paul Kirby, "Baltic Concerns Over Russian Plan to Move Sea Borders," *BBC News*, May 22, 2024, https://www.bbc.com/news/articles/c6ppl5v1lwzo; Anna-Sophie Schneider, "What Happens if Russia Attacks Finland's Åland Islands?," *Der Spiegel International*, June 7, 2023, https://www.spiegel.de/international/europe/a-strategic-baltic-archipelago-what-happens-if-russia-attacks-finland-s-aland-islands-a-87f17866-50bf-4b43-b021-23a80939aeeb; David Brennan, "NATO Faces Dilemma Over Baltic Sea Islands Eyed by Russia," *Newsweek*, May 24, 2024, https://www.newsweek.com/nato-dilemma-baltic-sea-islands-eyed-russia-gotland-aland-1904436.

[16] Bastian Giegerich and Maximilian Terhalle, *The Responsibility to Defend: Rethinking Germany's Strategic Culture* (Oxford, England: Routledge, 2021), 9–11.

[17] C. Todd Lopez, "Hegseth Tells NATO Hard Power Provides Deterrence, Defense," *DOD News*, February 13, 2025, https://www.defense.gov/News/News-Stories/Article/Article/4066810/hegseth-tells-nato-hard-power-provides-deterrence-defense/.

[18] "[The] ability to act entails modern, capable armed forces in the EU member states, as well as a high-performance and internationally competitive European security and defence industry that creates the foundations for the armed forces' military capabilities." Federal Government of Germany, *National Security Strategy*, 32.

[19] Pettyjohn and Dennis, *"Production Is Deterrence."*

[20] The Zeitenwende is not exclusively defense related; rather, it encompasses transformation across German security and foreign policy. This study necessarily examines the Zeitenwende through a narrower scope.

[21] See paragraph 14, *Wales Summit Declaration, Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Wales*, NATO, September 5, 2014, https://www.nato.int/cps/en/natohq/official_texts_112964.htm.

[22] Giegerich and Terhalle, *The Responsibility to Defend*.

[23] Federal Government of Germany, *National Security and Defence Industry Strategy* (Berlin: Federal Ministry of Defence and Federal Ministry of Economic Affairs and Climate Action, December 4, 2024), linked from https://www.bmvg.de/en/news/new-security-and-defence-industry-strategy-5876834.

[24] Franz-Stefan Gady, "German Defense Companies Could Be Europe's Arsenal of Democracy," *Foreign Policy*, July 6, 2023.

[25] Gady, "German Defense Companies Could Be Europe's Arsenal of Democracy."

[26] Till Bücker, "Wie die Rüstungsindustrie dasteht" ["How the Defense Industry Is"], *Tagesschau*, February 3, 2023, https://www.tagesschau.de/wirtschaft/unternehmen/ruestungsindustrie-branche-waffen-101.html.

[27] Gady, "German Defense Companies Could be Europe's Arsenal of Democracy." See also "The West is Struggling to Forge a New Arsenal of Democracy," *The Economist*, February 25, 2023.

[28] Gady, "German Defense Companies Could Be Europe's Arsenal of Democracy."

[29] John Helferich, "The (False) Promise of Germany's *Zeitenwende*," *European View* 22, no. 1 (April 2023), https://doi.org/10.1177/17816858231157556.

[30] Rafat Ulatowski, "The Illusion of Germany's *Zeitenwende*," *Washington Quarterly* 47, no. 3 (Fall 2024), https://doi.org/10.1080/0163660X.2024.2398318.

[31] Heiko Borchert et al., "'Unchain My Heart.' A Defense Industrial Policy Agenda for Germany's *Zeitenwende*," *Zeitschrift für Außen-und Sicherheitspolitik* 15 (October 18, 2022), 432, https://doi.org/10.1007/s12399-022-00926-4.

[32] Federal Government of Germany, *National Security Strategy*, 31.

[33] Hannah Aries et al., "The Guns of Europe: Defence-Industrial Challenges in a Time of War," *Survival* 65, no. 3 (June–July 2023), 13, https://www.iiss.org/online-analysis/survival-online/2023/06/the-guns-of-europe-defence-industrial-challenges-in-a-time-of-war/.

[34] Ellis S. Krauss and Hanns W. Maull, "Germany, Japan, and the Fate of International Order," *Survival* 62, no. 3 (June–July 2020), https://doi.org/10.1080/00396338.2020.1763619.

[35] Giegerich and Terhalle, *The Responsibility to Defend*, 16.

[36] Borchert et al., "'Unchain My Heart,'" 432.

[37] Federal Government of Germany, *National Security and Defence Industry Strategy*, 1.

[38] Zdeněk Kříž et al., "Refugees, *Energiewende*, and NATO Deterrence: Limits of German Leadership in Central Europe," *European Security* 30 no. 1 (2021), https://doi.org/10.1080/09662839.2020.1795836.

[39] Kristi Raik and Martin Quencez, "Whose Zeitenwende? Germany Cannot Meet Everyone's Expectations," DGAP Policy Brief No. 17 (Berlin: German Council on Foreign Relations [DGAP]), June 2023, https://dgap.org/en/research/publications/whose-zeitenwende-germany-cannot-meet-everyones-expectations.

[40] Federal Government of Germany, *National Security Strategy*, 31.

[41] Robin Allers and Håkon Lunde Saxi, "Zeitenwende or Business as Usual? German Defence Policy Following Russia's Invasion of Ukraine," in *NATO and the Russian War in Ukraine: Strategic Integration and Military Interoperability*, ed. Janne Haaland Matlary and Rob Johnson (London: Hurst, 2024), 154.

[42] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023.

[43] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023.

[44] The German maritime industry was expecting additional orders of munitions including torpedoes. As of this writing, those contracts had not yet materialized. Research discussion with senior German defense industry official in Berlin, Germany, May 2, 2024.

[45] Research discussion with senior German defense industry official in Berlin, Germany, May 3, 2024.

[46] Research discussion with senior German defense industry official in Berlin, Germany, April 29, 2024.

[47] Federal Government of Germany, *National Security and Defence Industry Strategy*, 4.

[48] Research discussion with senior German industry official in Berlin, Germany, April 29, 2024.

[49] Research discussion with senior German government official in Berlin, Germany, September 25, 2023.

[50] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023.

[51] Research discussion with senior official of a regional NATO ally in Berlin, Germany, May 2, 2024.

[52] *18. Bericht des Bundesministeriums der Verteidigung zu Rüstungsangelegenheiten* [*18th Report of the Federal Ministry of Defense on Armament Matters*] (Berlin: Federal Ministry of Defence, January 2024), 12, linked from https://www.bmvg.de/de/aktuelles/18-ruestungsbericht-die-zeitenwende-wird-greifbar-5732228.

[53] "Bundestag beschleunigt Beschaffungswesen bei der Bundeswehr" ["Bundestag accelerates procurement system at the Bundeswehr"), German Bundestag, July 7, 2022, https://www.bundestag.de/dokumente/textarchiv/2022/kw27-de-bundeswehrbeschaffungsbeschleunigung-900544.

[54] Research discussion with senior German defense industry official in Berlin, Germany, May 1, 2024.

[55] Research discussion with senior German defense industry official in Berlin, Germany, May 1, 2024.

[56] Research discussion with senior German government official in Berlin, Germany, September 25, 2023.

[57] Giegerich and Terhalle, *The Responsibility to Defend, 65*.

[58] Research discussion with senior German government official in Berlin, Germany, September 25, 2023.

[59] German Federal Ministry of Defence, *Defense Policy Guidelines 2023,* 33.

[60] Research discussion with senior U.S. official in Berlin, Germany, April 30, 2024.

[61] Research discussion with senior German defense industry official in Berlin, Germany, April 29, 2024.

[62] Research discussion with senior German defense industry official in Berlin, Germany, April 29, 2024.

[63] Research discussion with senior German defense industry official in Berlin, Germany, April 29, 2024.

[64] Research discussion with senior German government officials in Berlin, Germany, September 25, 2023.

[65] Sebastian Sprenger, "Europeans are Building a War Economy. Can They Master It?," *Defense News,* February 23, 2024, https://www.defensenews.com/global/europe/2024/02/23/europeans-are-building-a-war-economy-can-they-master-it/.

[66] Research discussion with senior German government official in Washington, DC, September 14, 2023.

[67] Research discussion with senior German government official in Washington, DC, September 14, 2023; "Europe's Armsmakers Have Ramped Up Capacity," *The Economist*, March 20, 2025, https://www.economist.com/europe/2025/03/20/europes-armsmakers-have-ramped-up-capacity.

[68] "Europe's Armsmakers Have Ramped Up Capacity."

[69] Guntram B. Wolff et al., "Fit for War in Decades: Europe's and Germany's Slow Rearmament Vis-à-Vis Russia," Kiel Report No. 1 (Kiel, Germany: Kiel Institute for the World Economy, September 2024), 11, https://www.ifw-kiel.de/publications/fit-for-war-in-decades-europes-and-germanys-slow-rearmament-vis-a-vis-russia-33234/.

[70] Sprenger, "Europeans are Building a War Economy." As one German official also noted, "For Ukraine there is a rise in demand, but industry can't do much more." Research discussion with senior German government official in Berlin, Germany, May 2, 2024.

[71] Oleksandr V. Danylyuk and Jack Watling, "Winning the Industrial War: Comparing Russia, Europe, and Ukraine, 2022–2024," RUSI, April 2025, 33, https://www.rusi.org/explore-our-research/publications/occasional-papers/winning-industrial-war-comparing-russia-europe-and-ukraine-2022-24.

[72] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023. *Mittelstand* generally refers to small and medium-sized enterprises in Germany, often highly focused on a specialized product or technique and with a history of family ownership.

[73] Federal Government of Germany, *National Security and Defence Industry Strategy*, 4.

[74] Research discussion with senior U.S. official in Berlin, Germany, April 30, 2024.

[75] Research discussion with senior German defense industry official in Berlin, Germany, April 29, 2024.

[76] "Europe's Armsmakers Have Ramped Up Capacity.".

[77] Thomas X. Hammes and Mark Montgomery, "Joint Warfighting Concept 2034–2044," Defense Paper Series, Special Competitive Studies Project, December 24, 2024, linked from https://www.scsp.ai/resource/defense-paper-series/.

[78] Research discussion with senior German defense industry official, May 2, 2024.

[79] "Borussia Dortmund CEO Defends Club's Sponsorship Deal with Germany's Biggest Arms Manufacturer," AP News, November 24, 2024, https://apnews.com/article/dortmund-rheinmetall-arms-deal-sponsor-c60ffdfd034f052c0d87861808b8f82f.

[80] "Europe's Armsmakers Have Ramped Up Capacity."

[81] Statement of General Christopher G. Cavoli, United States Army, United States European Command, Testimony Before the United States Senate Armed Services Committee, April 3, 2025, https://

www.armed-services.senate.gov/hearings/to-receive-testimony-on-the-posture-of-united-states-european-command-and-united-states-africa-command-in-review-of-the-defense-authorization-request-for-fiscal-year-2026-and-the-future-years-defense-program.

[82] "Swiss Again Reject German Request to Re-Export Swiss Ammunition to Ukraine," Reuters, November 3, 2022, https://www.reuters.com/world/europe/swiss-government-rejects-german-request-re-export-swiss-ammunition-ukraine-2022-11-03/; research discussion with senior U.S. official in Berlin, Germany, April 30, 2024.

[83] The term *vendor lock* refers to a government being locked into using a specific vendor or a vendor's architecture, in software for example, which may impeded other investment priorities or create interoperability challenges.

[84] Research discussion with senior German government official in Berlin, Germany, May 2, 2024.

[85] Research discussion with senior German government official in Berlin, Germany, May 2, 2024.

[86] Linus Terhorst, "Lessons on Boosting Production from the German Defence-Industrial Strategy," RUSI, February 25, 2025, https://www.rusi.org/explore-our-research/publications/commentary/lessons-boosting-production-german-defence-industrial-strategy.

[87] Wolff et al., "Fit for War in Decades," 25.

[88] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023.

[89] Research discussion with senior U.S. official in Berlin, Germany, April 30, 2024.

[90] KNDS reportedly bought an 80-percent stake in the Friedrich Wilhelms-Hütte foundry in Mülheim, Germany, just outside of Duisburg. See Alistair MacDonald, "Facing a Battle for Armored Steel, This Tank Maker Bought the Factory," *Wall Street Journal*, July 11, 2023.

[91] Wolff et al., "Fit for War in Decades," 14.

[92] Research discussion with German academic in Berlin, Germany, February 15, 2024.

[93] Research discussion with senior German industry official in Berlin, Germany, April 29, 2024.

[94] Danylyuk and Watling, "Winning the Industrial War," 52.

[95] Research discussion with senior German defense industry official in Berlin, Germany, April 29, 2024.

[96] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023.

[97] Sophia Besch, "A *Zeitenwende* for Germany's Defense Industry," in *Assessing the Zeitenwende: Implications for Germany, the United States, and Transatlantic Security*, ed. John Deni and Jeff Rathke (Carlisle Barracks, PA: U.S. Army War College Press, 2025), 44, https://ssi.armywarcollege.edu/SSI-Media/Recent-Publications/Article/4080077/assessing-the-zeitenwende/.

[98] Around 400 AI companies are members of the German AI Association, which also adheres to the civil clause restricting cooperation with the MoD and the Bundeswehr. See Heiko Borchert et al., *Master and Servant: Defense AI in Germany* (Hamburg: Defense AI Observatory, December 2023), 33, https://defenseai.eu/wp-content/uploads/2023/03/daio_study2312_master_and_servant_borchert_schuetz_verbovszky.pdf.

[99] The German civil clause (*Zivilklausel*) is a voluntary self-declaration that prevents universities from engaging in defense research and cooperating with defense industry. The clause originated at the University of Bremen in 1986 and spread to other universities across Germany after the end of the Cold War. See Borchert et al., "'Unchain My Heart.'" In addition, the Bundeswehr will not benefit from the 6 centers of competence on AI the German government will set up along with funding for more than 100 professorships on AI at German universities. See Borchert et al., *Master and Servant*, 31.

[100] Borchert et al., "'Unchain My Heart,'" 437–38; Federal Government of Germany, *National Security and Defence Industry Strategy*, 8.

[101] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023

[102] Research discussion with senior German industry official in Berlin, Germany, April 29, 2024.

[103] Giegerich and Terhalle, *The Responsibility to Defend*, 76.

[104] Borchert et al., *Master and Servant*, 31.

[105] Giegerich and Terhalle, *The Responsibility to Defend*, 76.

[106] German defense industry officials expressed hope that the MoD would update its approach to R&D funding. Currently R&D is typically built into major acquisitions. Industry is hopeful that the MoD will increasingly provide direct funding for demonstrators or prototypes as experiments into what might be possible, and then full production if warranted. Research discussion with senior German defense industry official in Berlin, Germany, May 1, 2024.

[107] Federal Government of Germany, *National Security Strategy*, 57; Federal Government of Germany, *National Security and Defence Industry Strategy*, 7.

[108] Research discussion with senior German industry official in Berlin, Germany, May 2, 2024. The state-owned development bank, KfW, has been buying on behalf of the German federal government. "Germany to Buy 25% Stake in Defence Supplier Hensoldt—Sources," Reuters, December 12, 2020, https://www.reuters.com/business/aerospace-defense/germany-buy-25-stake-defence-supplier-hensoldt-sources-2020-12-12/.

[109] Douglas Barrie and Ben Schreer, "Industrial Defence of the Realms," Military Balance Blog, International Institute for Strategic Studies, December 16, 2024, https://www.iiss.org/online-analysis/military-balance/2024/12/industrial-defence-of-the-realms/.

[110] The German Navy has stood up several groups like the U.S. Navy's Task Force 59 (for unmanned systems) to spur innovation, and the Navy Concept 2035 outlines a plan to incorporate increased automation in the fleet. Research discussion with senior German industry official in Berlin, Germany, May 2, 2024; Borchert et al., *Master and Servant*, 19–20. See also Élie Tenenbaum and Léo Péria-Peigné, "*Zeitenwende*: The Bundeswehr's Paradigm Shift," *Focus stratégique* no. 116, Institut français des relations internationales [French Institute of International Relations] (Ifri), September 2023, 84, https://www.ifri.org/en/studies/zeitenwende-bundeswehrs-paradigm-shift.

[111] Research discussion with senior German industry official in Berlin, Germany, April 29, 2024.

[112] Research discussion with German academic in Berlin, Germany, May 2024.

[113] Borchert et al., *Master and Servant*, 7.

[114] The Bundeswehr, like the German economy, will increasingly feel the demographic pressures of an aging population. German Defense Minister Boris Pistorius said in May 2024 that Germany needs

"some kind of military conscription," and that Germany had made a mistake when it ended compulsory military service in 2011. See Tim Martin, "German Defense Minister: Restart Conscription, Pursue 3 Percent GDP on Defense," *Breaking Defense*, May 10, 2024, https://breakingdefense.com/2024/05/german-defense-minister-restart-conscription-pursue-3-percent-gdp-on-defense/; Richard Connor, "German Defense Minister Calls for War Readiness by 2029," *DW*, June 5, 2024, https://www.dw.com/en/german-defense-minister-calls-for-war-readiness-by-2029/a-69276059.

[115] Research discussion with senior German government official in Berlin, Germany, May 2, 2024.

[116] Bundesministerium für Wirtschaft und Klimaschutz [German Federal Ministry for Economic Affairs and Climate Action], "Strategy Paper of the Federal Government on Strengthening the Security and Defence Industry," February 14, 2020, https://www.bmwk.de/Redaktion/DE/Downloads/S-T/strategiepapier-staerkung-sicherits-und-verteidigungsindustrie-en.pdf?__blob=publicationFile&v=4.

[117] Cakirozer, "2023—General Report—Ensuring an Allied Defence Industrial Base for NATO's New Deterrence and Defence Baseline," 1.

[118] Federal Government of Germany, *National Security Strategy*, 33, 59; Federal Government of Germany, *National Security and Defence Industry Strategy*, 11.

[119] Research discussion with senior allied official in Berlin, Germany, September 26, 2023; research discussion with allied official in Washington, D.C., November 8, 2023.

[120] Research discussion with allied official in Washington, D.C., November 8, 2023.

[121] See paragraph 14, *Wales Summit Declaration*.

[122] Research discussion with senior allied official in Berlin, Germany, September 25, 2023; research discussion with senior NATO ally official in Berlin, Germany, May 2, 2024.

[123] NATO, "Defence Expenditure of NATO Countries (2014–2024)," June 17, 2024, https://www.nato.int/cps/en/natohq/news_226465.htm. The German National Security Strategy notes in the foreword by Chancellor Olaf Scholz, "We will allocate 2 percent of our GPD, as an average over a multiyear period, to reaching NATO capability goals, initially in part via the newly created special fund for the Bundeswehr." Federal Government of Germany, *National Security Strategy*, 13. In May 2024, German Minister of Defense Boris Pistorius called on both Berlin and Washington to hit 3 percent of GDP on defense. Martin, "German Defense Minister: Restart Conscription, Pursue 3 Percent GDP on Defense."

[124] Research discussion with German academic in Berlin, Germany, March 27, 2024.

[125] "Policy Statement by Olaf Scholz, Chancellor of the Federal Republic of Germany and Member of the Bundestag, 27 February 2022 in Berlin."

[126] Research discussion with German academic in Berlin, Germany, March 27, 2024.

[127] Research discussion with U.S. military official in Stuttgart, Germany, September 18, 2023.

[128] Research discussion with German academic in Berlin, Germany, March 27, 2024.

[129] Research discussion with senior German industry official in Berlin, Germany, May 2, 2024; research discussion with senior German government official in Berlin, Germany, May 2, 2024.

[130] The European coalition includes Germany, the Netherlands, Spain, and Romania. The contract awarded by the NSPA to COMLOG, a joint venture between MBDA Germany and Raytheon (now RTX), is worth $5.5 billion. "NATO to Buy 1,000 Patriot Missiles to Enhance Allies' Air Defences," NATO, January 3, 2024, https://www.nato.int/cps/en/natohq/news_221626.htm. Production capacity will

expand specifically for the tactical Patriot Guidance Enhanced Missiles (GEM-T), which is a variant of the Patriot offered to international customers. Elisabeth Gosselin-Malo, "European Nations Team Up to Buy Patriot Missiles in $5.5 Billion Deal," *Defense News*, January 3, 2024, https://www.defensenews.com/global/europe/2024/01/03/european-nations-team-up-to-buy-patriot-missiles-in-55-billion-deal.

[131] Research discussion with German academic in Berlin, Germany, March 27, 2024.

[132] Federal Government of Germany, *National Security Strategy*, 31.

[133] Helferich, "The (False) Promise of Germany's *Zeitenwende*," 87.

[134] Besch, "A *Zeitenwende* for Germany's Defense Industry," 43.

[135] "Germany Doubles Arms Exports to Ukraine, Halves Them to Israel in 2024," Reuters, December 18, 2024, https://www.reuters.com/world/europe/germany-doubles-arms-exports-ukraine-halves-them-israel-2024-2024-12-18/.

[136] In 2022, Rheinmetall was ranked #28, KNDS ranked #44, ThyssenKrupp ranked #62, Hensoldt ranked #69, and Diehl was ranked #93. "The SIPRI Top 100 Arms-Producing and Military Services Companies in the World, 2022," Stockholm International Peace Research Institute, https://web.archive.org/web/20240215192622/https://www.sipri.org/visualizations/2023/sipri-top-100-arms-producing-and-military-services-companies-world-2022.

[137] Research discussion with senior German defense industry official in Berlin, Germany, April 29, 2024.

[138] Research discussion with senior German industry official in Berlin, Germany, May 2, 2024.

[139] Giegerich and Terhalle, *The Responsibility to Defend*, 8. The German National Security Strategy says the government will adhere to its "restrictive baseline policy," but it will take into account alliance security interests, the geostrategic situation, and the needs of enhanced European arms cooperation. Federal Government of Germany, *National Security Strategy*, 15. See also Giegerich and Terhalle, *The Responsibility to Defend*, 82–83.

[140] Helferich, "The (False) Promise of Germany's *Zeitenwende*," 87.

[141] Research discussion with senior German government official in Berlin, Germany, May 2, 2024.

[142] Research discussion with senior German government official in Berlin, Germany, September 25, 2023.

[143] Giegerich and Terhalle, *The Responsibility to Defend*, 83.

[144] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023.

[145] The German National Security Strategy notes, however, that the German federal government "is endeavouring to improve the parameters for the security and defence industry and will enable government-to-government sales." Federal Government of Germany, *National Security Strategy*, 33.

[146] Discussion with senior U.S. military official in Berlin, Germany, April 30, 2024.

[147] Federal Government of Germany, *National Security Strategy*, 33; Federal Government of Germany, *National Security and Defence Industry Strategy*, 9.

[148] For heavy weapons such as tanks, infantry fighting vehicles, howitzers, multiple rocket launch systems, and air defense systems, see *Ukraine Support Tracker: A Database of Military, Financial,*

and Humanitarian Aid to Ukraine, Kiel Institute for the World Economy, accessed January 14, 2025, https://www.ifw-kiel.de/topics/war-against-ukraine/ukraine-support-tracker/.

[149] SPD/Green/FDP Coalition Agreement (*Mehr Fortschritt Wagen, Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit, Koalitionsvertrag 2021–2025 Zwischen der SPD [Sozialdemokratische Partei Deutschlands], Bündnis 90/Die Grünen und FDP [Freie Demokratische Partei]*), 115, https://www.spd.de/koalitionsvertrag2021/. See also *Ukraine Support Tracker*. The German National Security Strategy also includes careful language: "As regards the control of arms exports, the Federal Government will continue to adhere to its restrictive baseline policy and set benchmarks in an arms-export control law. . . . At the same time, a responsible arms-export policy takes into account our alliance and security interests, geostrategic challenges, support for partners facing direct threats, and the requirements of enhanced European arms cooperation." Federal Government of Germany, *National Security Strategy*, 45.

[150] *Ukraine Support Tracker.*

[151] "Ukraine to Produce One Million Drones Next Year, Zelenskiy Says," Reuters, December 19, 2023, https://www.reuters.com/world/europe/ukraine-produce-one-million-drones-next-year-zelenskiy-says-2023-12-19/; Ministry of Defence of Ukraine, "The Ministry of Defence Has Delivered Over 1.2 Million Drones to the Defence Forces. By the End of December, an Additional 100,000 Will Be Provided," December 11, 2024, https://mod.gov.ua/en/news/the-ministry-of-defence-has-delivered-over-1-2-million-drones-to-the-defence-forces-by-the-end-of-december-an-additional-100-000-will-be-provided. Coalition allies have also promised 1 million drones within a year. Natalia Drozdiak et al., "Ukraine is Promised 1 Million Drones Within a Year by Allies," Bloomberg, February 15, 2024. The Ukrainian defense industry has also reportedly scaled up to produce eight self-propelled Bohdana (NATO standard, domestically developed) artillery systems per month, and increased R&D spending from $162 million to $1.3 billion in 2024. Lara Jakes, "Ukraine's Arms Industry is Growing, but Is It Growing Fast Enough?", *New York Times*, April 2, 2024.

[152] Alexandra McLees and Eugene Rumer, "Saving Ukraine's Defense Industry," Carnegie Endowment for International Peace, July 30, 2014, https://carnegieendowment.org/research/2014/07/saving-ukraines-defense-industry.

[153] Nataliya Katser-Buchkovska, "The Future of Critical Raw Materials: How Ukraine Plays a Strategic Role in Global Supply Chains," World Economic Forum, July 9, 2024, https://www.weforum.org/agenda/2024/07/the-future-of-critical-raw-materials-how-ukraine-plays-a-strategic-role-in-global-supply-chains/; Stephen Blank, "Ukraine's Titanium Can Armor the West," Center for European Policy Analysis, September 14, 2022, https://cepa.org/article/ukraines-titanium-can-armor-the-west/.

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GmbH, accessed June 24, 2024, https://www.rheinmetall.com/en/company/subsidiaries/rheinmetall-ukrainian-defense-industry.

[157] "Joint Venture with Ukrainian Partner: Rheinmetall to Produce Artillery Ammunition in Ukraine," press release, Rheinmetall AG, February 18, 2024, https://www.rheinmetall.com/en/media/news-watch/news/2024/02/2024-02-19-joint-venture-in-the-ukraine. The Turkish drone maker, Baykar, is also in the process of building a manufacturing facility in Ukraine. In March 2024, it was announced three French companies were near similar agreements. Finally, the joint French-German conglomerate KNDS announced a joint venture to build parts for tanks and howitzers in Ukraine, and eventually entire weapon systems. See Jakes, "Ukraine's Arms Industry is Growing, but Is It Growing Fast Enough?". Ukraine is also taking steps to combat corruption in its defense-industrial base; see Kateryna Stepanenko et al., "Ukraine's Long-Term Path to Success: Jumpstarting a Self-Sufficient Defense Industrial Base with U.S. and EU Support," Institute for the Study of War, January 14, 2024, https://www.understandingwar.org/backgrounder/ukraine's-long-term-path-success-jumpstarting-self-sufficient-defense-industrial-base.

[158] Donovan and Posaner, "Robert Habeck Wants Germany to Rebuild Ukraine."

[159] Research discussion with senior German defense industry official in Berlin, Germany, September 25, 2023. Ukrainian weapons manufacturers are prohibited from exporting weapons until the war is over; see Jakes, "Ukraine's Arms Industry is Growing, but Is It Growing Fast Enough?".

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[166] NATO, "NATO Industrial Capacity Expansion Pledge," July 10, 2024, https://www.nato.int/cps/en/natohq/official_texts_227504.htm.

[167] Pettyjohn and Dennis, *"Production is Deterrence,"* 4.

[168] Originally proposed in Andriy Zagorodnyuk and Eliot A. Cohen, "A Theory of Victory for Ukraine: With the Right Support and Approach, Kyiv Can Still Win," *Foreign Affairs*, May 21, 2024.

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About the Author

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