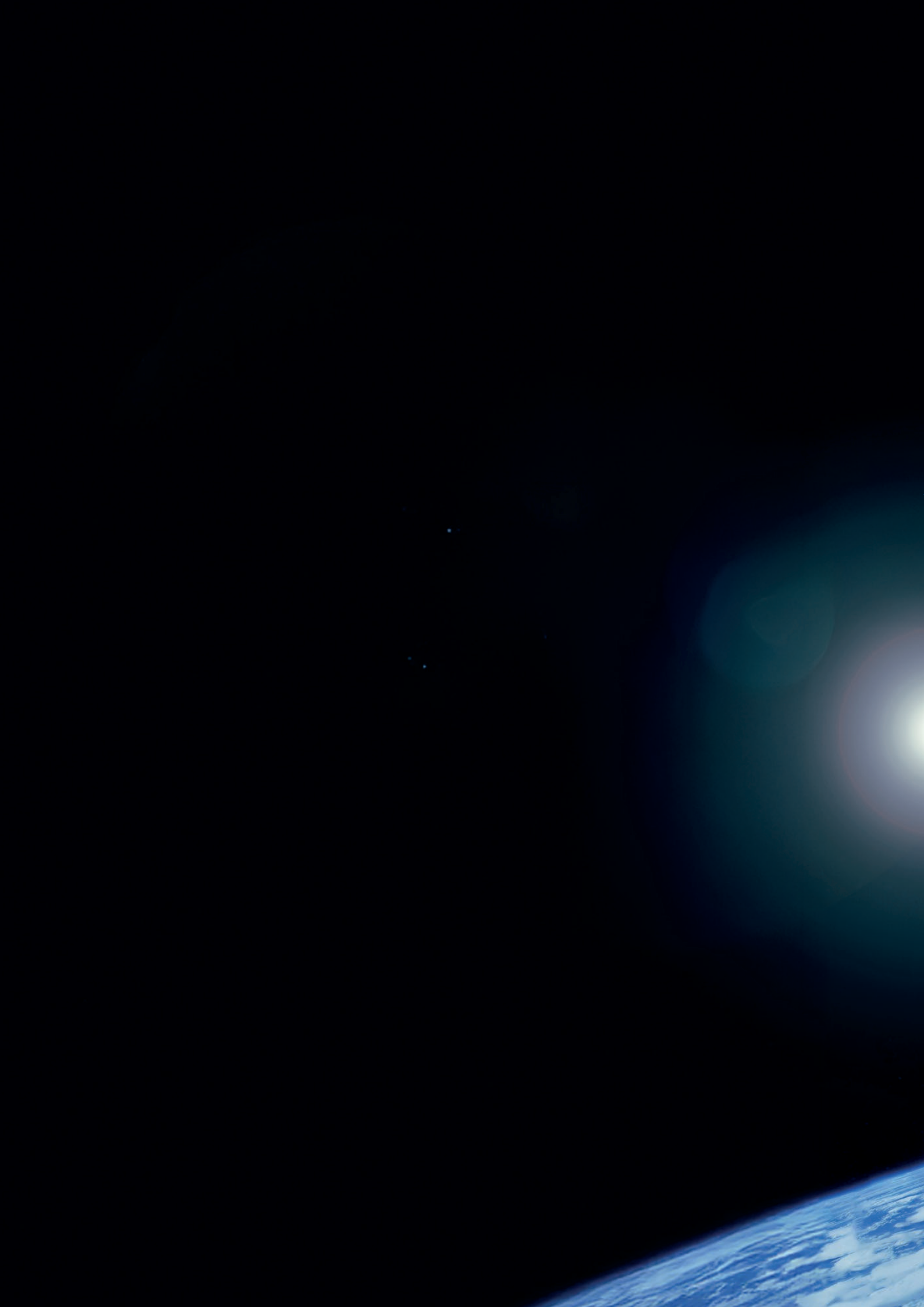
Bonn Future Lab on Strategic Foresight 2025

Securing a Sustainable Space

Under the Patronage of Federal Minister of
Research, Technology and Space Dorothee Bär



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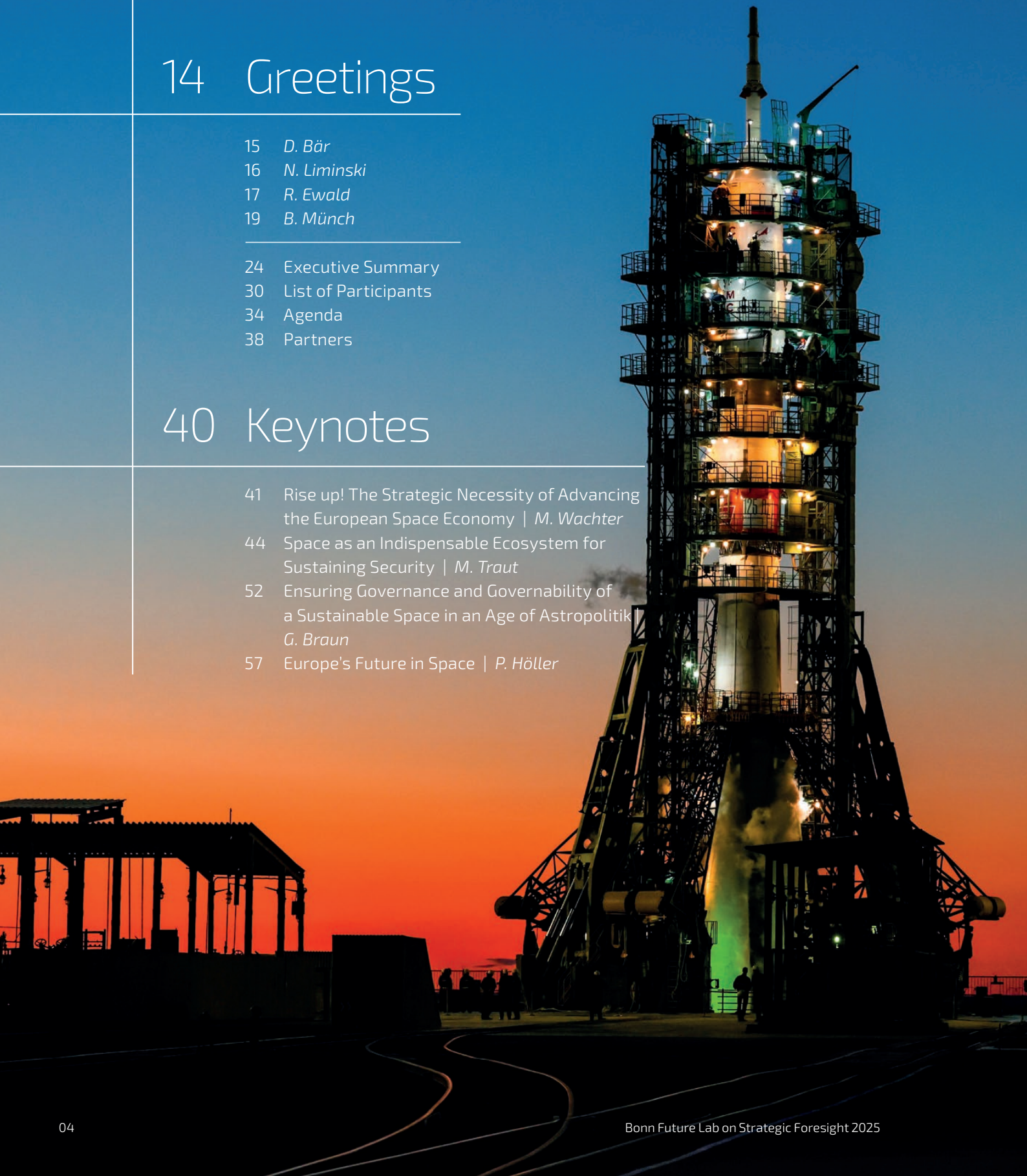
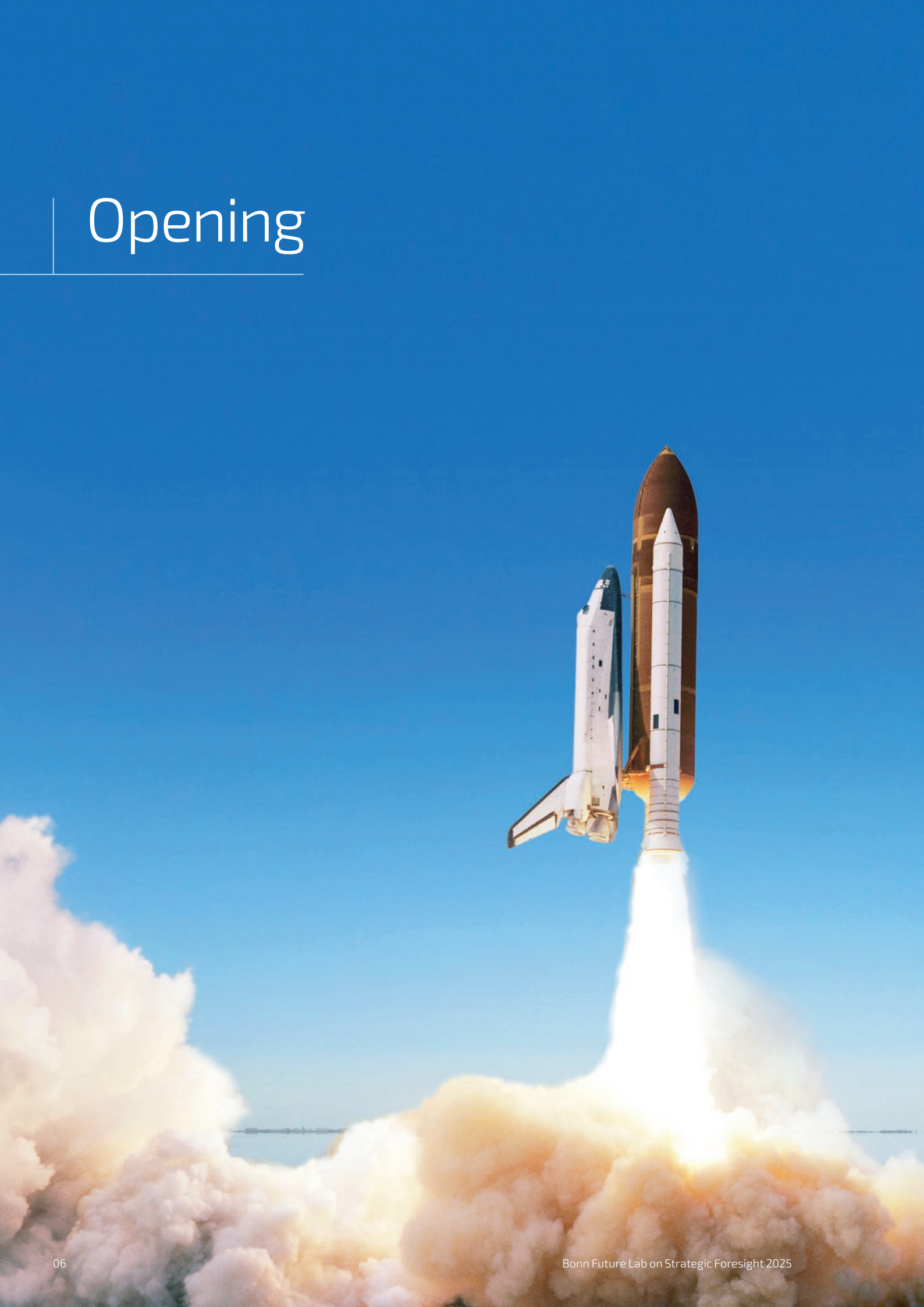


62 Reflections

100 Workshop

Opening



Dr. Enrico Fels
Managing Director CASSIS

Dear reader,

It is my great pleasure to welcome you to this report of the *Bonn Future Lab on Strategic Foresight 2025 "Securing a Sustainable Space"*. The Bonn Future Lab brought together more than thirty emerging leaders of tomorrow with almost 80 experts and practitioners, training these young multipliers in strategic foresight with a special focus on space security and Europe's role in the new space economy – a topic that is as visionary as it is timely.

The Bonn Future Lab was formed to be an important part of the traditional and well known International Security Forum Bonn (ISFB). Over the past decade, the ISFB has grown into North Rhine-Westfalia's most recognized venue for strategic dialogue. With the *Bonn Future Lab*, we developed a forward-looking complement – a format where research, policy and practice meet foresight; where we examine the forces that shape the decades to come. In essence, the Bonn Future Lab exists because we believe that understanding tomorrow is a responsibility today.

Let me begin with a thought that captures both the vulnerability and the promise of humanity's still quite new chapter in space. The space-policy scholar Kai-Uwe Schrogl observed a few years ago:

"The global future will depend on the secure use of outer space for all policy areas.
If space utilization as critical infrastructure is disrupted, our modern societies will break down. Space security is a key factor for survival. This is why space is also contested – and space assets are vulnerable."

Importantly, this is not science fiction, but has been our strategic reality for quite some time now – and it is precisely why we at CASSIS chose space politics as the main topic of the 2025 Bonn Future Lab. Despite its growing importance, space affairs and *Astropolitik* still receive far too little public, political, and scientific attention. We speak – for good reasons – so often of energy, climate, or digital transformation – but we tend to forget the infrastructure above our heads (and on the ground) that binds all these transformations together.

Before turning to the different segments of this report's discussions and our distinguished experts, allow me a few words to express my heartfelt gratitude: We at CASSIS are deeply honored that Federal Minister Dorothee Bär assumed the patronage of the *Bonn Future Lab of Strategic Foresight 2025.* Her strong commitment to research, technology and space policy embodies precisely the connection between innovation and strategic foresight that we seek to promote here in Bonn. It is a special privilege for all of us at CASSIS to have Germany's first Space Minister as our Lab's esteemed patron and we are immensely grateful for her support and encouragement!

In the same vein, we are extremely thankful for the continuous support provided by Minister Nathanael Liminski (MBEIM NRW) to the ISFB and for the trust the State Government of North Rhine-Westphalia has placed in our work. Without this partnership, CASSIS could not pursue its mission of connecting academic excellence with strategic relevance for policy and society.

Our sincere gratitude also goes to our partner organizations and sponsors – the *Foundation for International Dialogue of the Savings Bank* in Bonn, the *Academy of International Affairs NRW*, the *German Space Command*, the *Institute for International Cooperation, Technological Diplomacy and Communication (ICI),* the *Hanns Seidel Foundation,* the *German Society for Security Policy (GSP),* the *AmerikaHaus NRW* and the *Institut Français Germany.* Your collaboration and trust made the Bonn Future Lab a truly collective endeavor.

Our three keynote speakers have mirrored the logic of the *Bonn Future Lab* itself:
industry, security and governance – the three pillars of sustainable space resilience. The first keynote, *"Rise Up! The Strategic Necessity of Advancing the European Space Economy,"* was delivered by Matthias Wachter, Managing Director of the New Space Initiative at the *Federation of German Industries (BDI).* He has been a leading voice for Europe's private space sector – advocating for innovation, competitiveness and cross-industry cooperation as the backbone of Europe's strategic autonomy. He opened the conference's discussions by showing how a strong industrial ecosystem is crucial to Europe's sovereignty in space.

The Lab's second keynote, *"Space as an Indispensable Ecosystem for Sustaining Security,"* followed with Major General Michael Traut, Head of the Bundeswehr's *Space Command.* As one of Germany's most senior military authorities for space operations and situational awareness within NATO and the EU, General Traut exemplifies the growing integration of space into defense and deterrence. In his speech, he vividly explored how protecting our orbital infrastructure has become a central task of modern security policy.

Our third keynote, *"Ensuring Governance and Governability of a Sustainable Space in an Age of Astropolitik,"* was provided by Dr. Gerald Braun, Head of Division for Security and Special Assignments of the *German Space Agency* at DLR and the civilian Director of the *German Space Situational Awareness Centre.* Dr. Braun brought unique insights from the operational heart of Germany's space-security architecture, linking policy, technology and governance in the management of one of Europe's most critical infrastructures.

"Our societies depend on space infrastructure for communication, navigation, finance, logistics, development, environment and defense. Space is the invisible backbone of modern civilization and according to the UN also needed for achieving more than half of the Sustainable Development Goals (SDGs)."

Together, these three perspectives and the thematical matching panels with high-ranking experts reflected what our Bonn Future Lab was about: to connect economic strength, strategic security and responsible governance in shaping Europe's role in space. Because having such a role is important: The space economy is expected to surpass one trillion US dollars by 2035. Satellite constellations, launch systems and commercial innovation are transforming how we communicate, navigate and perceive our world. But with progress comes dependence – and with dependence, vulnerability. Space therefore has become a strategic domain, contested and crucial alike. Both the space strategies of the EU and Germany are clear: Europe must become more resilient, competitive and sovereign – or risk further strategic marginalization and economic decline.

This was also captured in the dinner speech by State Secretary Paul Höller (MWIKE NRW), entitled *"Europe's Future in Space,"* which offered a compelling strategic reflection on the choices shaping Europe's trajectory beyond Earth. He framed Europe's future in space as a question of choices made today, shaped by collaboration and guided by conviction. State Secretary Höller argued forcefully that Europe's space ambitions must be sustainable, sovereign and rooted in solidarity, if they are to command and endure global relevance. Highlighting North Rhine-Westphalia as an enabling space region, he underscored the responsibility – and opportunity – for regions to help Europe reach for the stars in a manner that serves both our planet and future generations.

"Engineering excellence is the conditio sine qua non of any successful space endeavor. Without it, there is no orbit, no launcher, no data... But technology alone is not enough. Lasting success in space for states and economies demands astropolitical, legal and economic reflection."

This strategic vision gains particular urgency when viewed against the backdrop of current conflicts, where space has become an increasingly contested and operationally decisive domain. Perhaps nowhere has the strategic centrality of space become clearer than in Russia's war against Ukraine. A recent report of the *Center for Strategic and International Studies* (CSIS) warns that: *"The temptation of blinding an opponent, or delivering unanswerable strikes from outer space, may be too much to resist in the next war."*[1] At the outset of the invasion, Moscow nearly succeeded in blinding Kiev. Only the rapid deployment of Starlink and the "unblinking eye" of Western commercial and military-governmental earth-observation networks preserved Ukraine's ability to communicate, coordinate and endure. Alas, this humiliating experience has already led some Russian strategists to call for enhanced counterspace operations designed to blind, disrupt and, if necessary, destroy enemy reconnaissance and communication satellites. It is worrying, that this reportedly also includes discussions about the potential usage of nuclear devices in orbit. All in all, this underlines how essential space has become to modern warfare and the functioning of modern states – and how vulnerable space assets now are.

I use the term "space blindness" *(Weltraumblindheit)* to describe the persistent tendency of both the public and the politicians to treat space as peripheral – the realm of engineers rather than strategists. This must change. Our societies depend on space infrastructure for communication, navigation, finance, logistics, development, environment and defense. Space is the invisible backbone of modern civilization and according to the UN also needed for achieving more than half of the Sustainable Development Goals (SDGs).

Yet, space surprisingly still receives too little attention – politically, publicly and also academically. Among almost sixteen thousand professorships in the fields of Law, Social Sciences and Economics in Germany, there is just one chair in Space Law – and none at all in Space Security, Space Economics or Space Governance. Considering the astonishing importance of this multi-billion euro critical infrastructure in holding our modern world together, this negligence is both indefensible and inadvisable. Moreover, it is openly dangerous: Whoever overlooks space, overlooks the foundation of our future.

Of course, I am talking about the humanities here, so let me be clear: Engineering excellence is the conditio sine qua non of any successful space endeavor. Without it, there is no orbit, no launcher, no data. (SpaceX's astounding successes with Falcon 9, Starship and Starlink exemplify this point quite clearly.) But technology alone is not enough. Lasting success in space for states and economies demands astropolitical, legal and economic reflection – areas where, frankly, the United States, China and to some extent perhaps even Russia are academically ahead of us. If Germany and Europe truly wish to shape their future in space, we must thus invest not only in developing great hardware (and software) for space, but also in strategic thinking about space.

A healthy and competitive space economy is more than an opportunity – it is a strategic resource for every state's economy, military and the wellbeing of its citizens. Countries like Japan, South Korea, India or the UAE clearly acknowledge this. Germany and Europe must therefore strengthen both their academic institutions and their private space sector. Without a vibrant industrial ecosystem, dependencies will only worsen – and dependence is the opposite of sovereignty. This is particularly true in politics. As the great scholar of International Relations Kenneth Waltz once observed: "Those who have what others want or badly need are in favored positions." That, in essence, is structural power. Initiatives like the European Launcher Challenge and the € 35 billion defense

1 https://www.csis.org/analysis/introduction-how-think-about-modern-warfare

investment package in space security announced by Minister Boris Pistorius a few months ago are thus important strategic steps toward building the capabilities Europe dearly needs.

The *German Space Agency,* the *Bundeswehr Space Command* and the *Federation of German Industries* (BDI) among others play pivotal roles in this space ecosystem. In order for Germany to remain among the world's leading space powers, they need, I believe, strong academic partners capable of providing foresight, strategy, business ideas and – in general – the human capital necessary to keep Europe among the leading space powers. We need to ask ourselves: How can Germany and Europe become strategic actors in space if we do not study it strategically? How can we build space resilience if we do not train minds to anticipate disruptions?

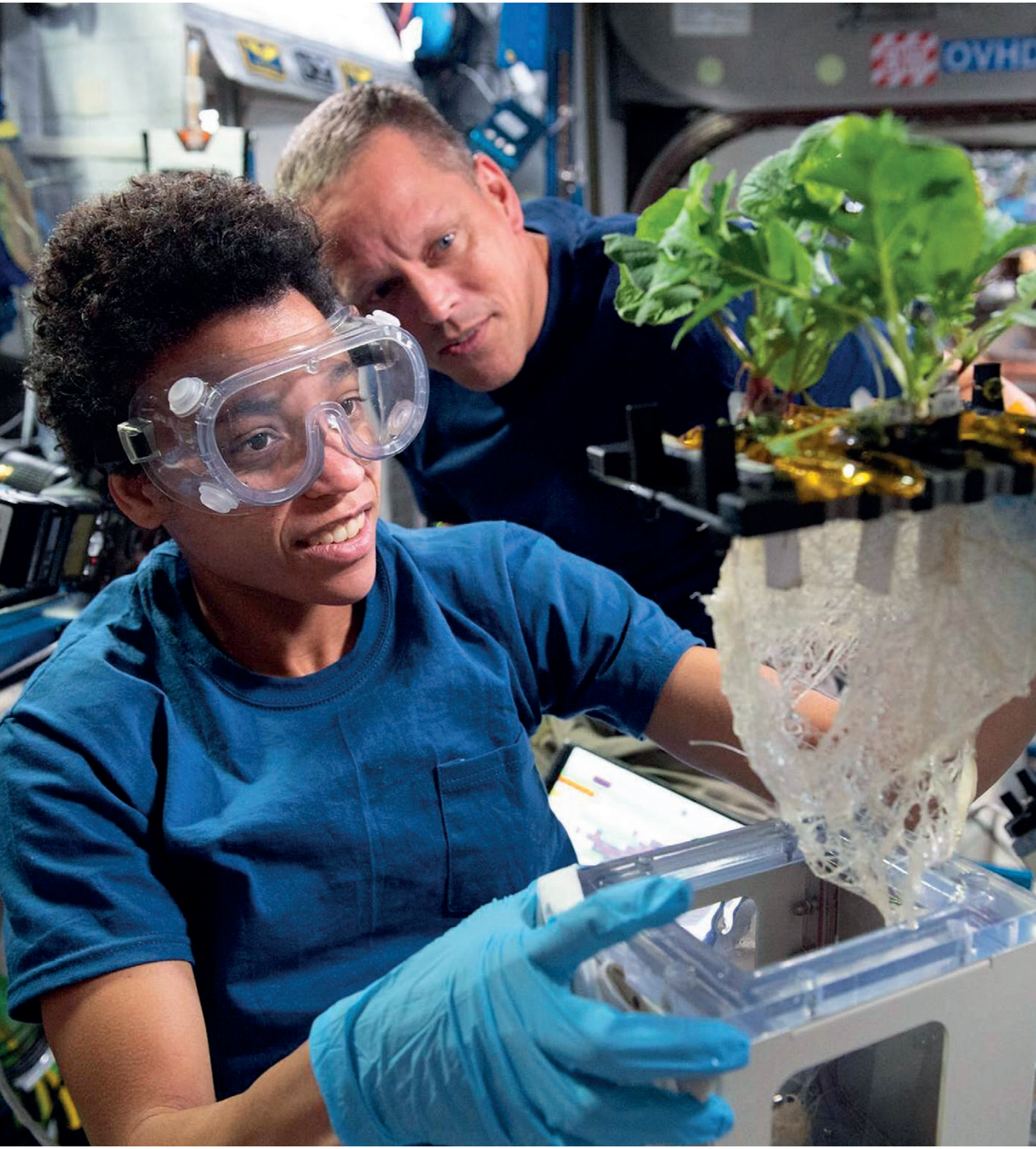
It is important to find sound answers to these questions while space governance is becoming ever more complex. Competing frameworks such as the *Artemis Accords* and the *International Lunar Research Station* (ILRS) reflect not only technological rivalry but diverging worldviews. To navigate these challenges responsibly, we must invest not only in rockets – but also in astropolitical reflection and foresight. Germany and Europe need dedicated chairs and research programs as well as interdisciplinary networks linking space technology, law, economics and strategy.

The future of space will not be determined by technology alone, but by the clarity of our thinking, the courage of our decisions and the foresight of our societies. Space is our fifth sphere of existence – alongside land, sea, air, and cyberspace – and in it, security and sustainability are inseparably connected. We must ensure that this domain remains sustainable, accessible and secure – for all humankind, today and tomorrow.

Alas, as the well-known political realist John Mearsheimer reminds us, in international affairs *"it is better to be Godzilla than Bambi."* I believe John's assessment is correct also when it comes to space affairs. However, power without purpose is as dangerous as purpose without power. And Europe's purpose, as history has shown, often emerges only when necessity forces it to act – when crisis transforms reflection into resolve. I hold that we are well advised to recognize that necessity now – before a big crisis involving space arrives. Complacency is not an option anymore. Let us therefore ensure that Germany and Europe get the capacity to act with both strategic realism and moral responsibility, so that outer space remains a realm of fruitful international cooperation and sustainable human progress.

To conclude, I invite you to explore this report as a resource for better understanding some of the strategic challenges ahead and to join us in shaping the evolving astropolitical landscape through collaborative governance and strategic foresight in space affairs.

"Yet, space surprisingly still receives too little attention – politically, publicly and also academically. Among almost sixteen thousand professorships in the fields of Law, Social Sciences and Economics in Germany, there is just one chair in Space Law – and none at all in Space Security, Space Economics or Space Governance. Considering the astonishing importance of this multi-billion euro critical infrastructure in holding our modern world together, this negligence is both indefensible and inadvisable. Moreover, it is openly dangerous: Whoever overlooks space, overlooks the foundation of our future."

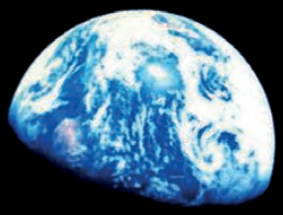


Greetings

Transcriptions of delivered speeches.
The spoken word prevails.

Dorothee Bär

Federal Minister of Research, Technology and Space;
Patron of the Bonn Future Lab 2025



Hello to everyone in Bonn.

I am so happy to be the patron of your Space Day, to show in no uncertain terms that this topic is a top priority. The future is decided in space and it is being decided now. There is so much to do, which is why formats such as the Bonn Future Lab „Securing a Sustainable Space“ are so valuable. Thank you to Dr. Enrico Fels and the entire organization team and to Professor Reinhold Ewald, who even went to space during his time as an astronaut!

Major General Traut, Mr. Wachter and Dr. Braun: Between you, you perfectly demonstrate how wide-ranging and significant this topic has become for our country.

Whether it’s the next moon mission, precious satellite data or hybrid threats, today Germany’s security also needs to be defended in space.

“Space is a bridge. A bridge to more knowledge, to new capabilities and a bridge for cooperation.” This was the compelling plea made by US space expert John Horack when he visited our Ministry recently to talk to our staff. Many challenges are much easier to solve – or indeed can only be solved – by working together. We need to consider establishing new collaborations and strengthening existing ones, not least our transatlantic networks, which unfortunately are really being put to the test at the moment.

But this is also an opportunity for Europe. We are closing ranks. Your event is evidence of this. With sessions on astropolitical needs for security or space debris management, this is a clear and positive sign. We are working together to find solutions. And this is where we need you as responsible and bold creators, who can think ahead and, most importantly, who understand how everything is connected.

Bridge builders between technological innovation and international governance, between the military and civilian spheres. Bridge builders who secure freedom, peace and prosperity. This is our joint mission.

Thank you for shaping and driving our future up there for our future down here.
I hope you all enjoy an inspiring and successful conference.

Nathanael Liminski

Minister for Federal, European and International Affairs and the Media
and Head of the State Chancellery of North Rhine-Westphalia

Dear Prof. Kronenberg, dear Prof. Münch, dear Dr. Fels, ladies and gentlemen,

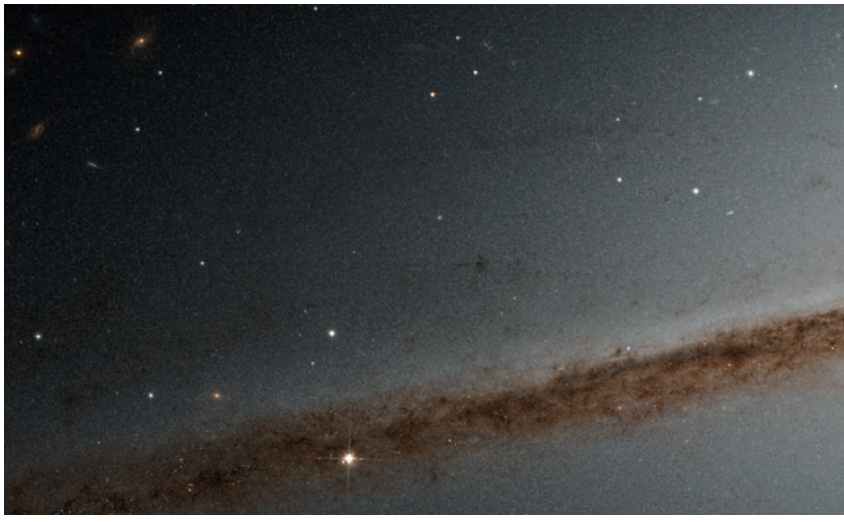
There are decades where nothing happens, and there are weeks where decades happen. This well-known saying captures, perhaps better than any other, the times we are living in. And in security policy, we are certainly living through such weeks.

When we look at international security today, change is unfolding at a breathtaking pace. Compared to the relative calm of the Cold War, we find ourselves in an era of profound transformation. Across all regions, the pace of change challenges institutions, alliances and assumptions alike.

In Europe, Russia's war of aggression against Ukraine has shattered our security architecture, confronts us with new technological challenges and hybrid threats, and demands a swift and united European response. In the Middle East, the events of October 7th and their horrific consequences have changed regional dynamics and left open how a new and stable order might emerge. Across the Atlantic, we are witnessing forms of politics unfamiliar to the architects of the post-war order, and with them a transformation of our transatlantic partnership. A partnership in which Europe must assume greater responsibility for its ownsecurity – and a world in which the value of free trade and multilateral cooperation is increasingly contested. In other words, expertise and research on international security are in unprecedented demand.

I am therefore delighted that this year's *International Security Forum* addresses all of these pressing issues, and many more. The overarching topic of the Bonn Future Lab is „Securing a Sustainable Space", a theme that could hardly be more relevant for North Rhine-Westphalia. As a state, we have made space policy a key priority. In April, we brought together leading industry stakeholders at our own SpaceTech Summit, and we are determined to establish North Rhine-Westphalia as a major European space hub. With the selection of Cologne as the EU's governmental satellite communications ground segment site, we are proud to contribute to Europe's space autonomy and technological sovereignty in this strategic domain.

Let me thank you for this year's excellent program and for organizing this important conference here in Bonn. It shows once again that Bonn is not only our Cold War capital, but also a place where ideas for a secure and sustainable future are being shaped.



Prof. Dr. Reinhold Ewald

Physicist, ESA astronaut and Space Ambassador of North Rhine-Westphalia

Good morning dear participants of the conference „Securing a Sustainable Space“!

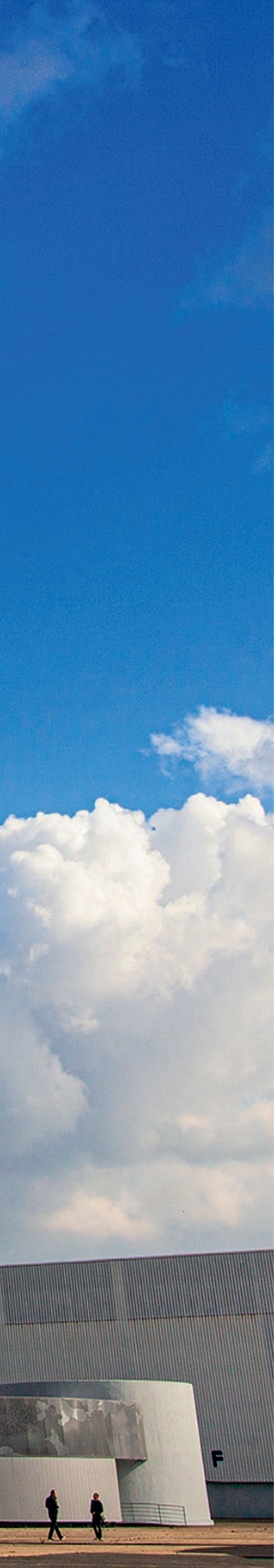
My name is Reinhold Ewald, I'm a European astronaut with a German passport, and I had the privilege to fly to the Mir space station in the late 90s. As you probably know, the space station history in Russia started with a military aspect, but in the long run, space stations were not used militarily at the time I was on board of the Mir space station.

The military use of space and the use of space as an important feature of a technological nation has emerged strongly in these last months, if not years. And so, securing a sustainable space, securing sustainable access to space, securing sustainable existence in space has become one of the most important features to secure a nation from any unforeseen catastrophes.

I'm wishing you a very successful conference here, as well as a successful workshop. I'm pretty sure that space will be on the agenda of the Western nations – those that are united in the European Space Agency, and others that have become interested in space. And so, I wish you good results and hopefully space will be on the agenda in the longer future to come.

"And so, securing a sustainable space, securing sustainable access to space, securing sustainable existence in space has become one of the most important features to secure a nation from any unforeseen catastrophes."

Welcome



Prof. Dr. Birgit Münch

Vice Rector for International Affairs at the University of Bonn
and Member of the CASSIS Advisory Board

Dear Ministers,
Excellencies,
Ambassadors,
Distinguished Guests,
Members of the Armed Forces,
Colleagues, Friends,
Members of the CASSIS family,
dear Prof. Kronenberg,

It is a distinct honor and a great pleasure to welcome all of you – on behalf of the Rectorate of the University of Bonn – to the ninth International Security Forum Bonn, held here at our University of Excellence in the United Nations and Federal City of Bonn.

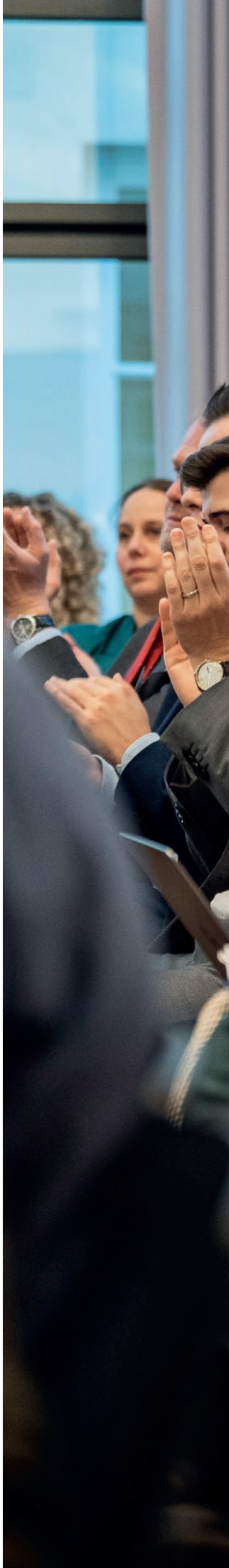
Even after nearly a decade, the *International Security Forum Bonn* continues to exemplify the vital role that academic institutions can play as trusted venues for strategic dialogue – convening scholars, policymakers and diplomats to engage in thoughtful discussion on the most pressing issues of our time.

As we turn to the program of this year's conference, one observation becomes immediately apparent: the *International Security Forum Bonn* has evolved into one of Germany's foremost academic platforms for the exchange of ideas on security policy.

The themes on this year's agenda – European security fractures, transatlantic uncertainties, digital dependencies, and the strategic dimensions of outer space – reflect not only the turbulence of our era, but also the broad intellectual horizon that defines our University's approach to global affairs.

As an institution deeply rooted in the humanities and social sciences, and as a University of Excellence with a strong international outlook, we see it as part of our mission to provide space – both literal and intellectual space – for open, evidence-based dialogue on questions of security, strategy, and responsibility. As Vice Rector for International Affairs at the *University of Bonn*, my responsibilities include engaging with critical voices on pressing issues and maintaining relationships with universities and institutions abroad, while at the same time focusing on domestic political conditions. Social and global crises have a direct impact on our work. Our goal is to take measures that advance us on the path to becoming an international university. A central component of this strategy is our principle of promoting successful international cooperation with partner universities around the world as far as possible, regardless of geopolitical developments, without neglecting the consequences that these developments have necessitated; to give but one example: supporting refugee researchers from Ukraine, Russia, and Belarus as part of our Cologne/Bonn Academy in Exile with the University of Cologne. This principle follows our conviction that successful international cooperation thrives on dialogue and exchange and that academic partnerships can serve as bridges.

"Universities, I believe, have a vital role to play in this endeavor: not as political actors, but as platforms of reflection, exchange, and foresight. They are places where we can test assumptions, challenge dogmas, and imagine new possibilities – without fear, but with curiosity and courage."



Allow me, first of all, to thank the organizers of this remarkable conference. *The Center for Advanced Security, Strategic and Integration Studies* – CASSIS – has once again shown what academic excellence coupled with strategic foresight can achieve.

Under the distinct leadership of its three directors Prof. Kronenberg, Prof. Hilz and Prof. Schlie, and especially through the exceptional work of its Management Office team around Dr. Enrico Fels, CASSIS has succeeded in turning a bold idea into a vibrant international brand. Your tireless dedication, professionalism, and intellectual energy have made this event possible – and have made the *University of Bonn* proud. Please allow me to express, on behalf of the Rectorate, our sincere gratitude to the entire CASSIS team.

We also extend our deep appreciation to the Patron of this year's *International Security Forum Bonn,* Minister Nathanael Liminski, and to Minister Dorothee Bär, who has taken on the patronage of the *Bonn Future Lab on Strategic Foresight.* Their engagement shows how closely academic innovation and public policy can and must cooperate in shaping the strategic capacity of our society.

Security and strategy are not only questions of military balance or geopolitical design. They are also questions of human responsibility, of understanding complexity, and of preparing for futures that are uncertain but not unforeseeable.

In that sense, the themes discussed here – from European strategic autonomy, digital sovereignty, to the Middle East and space resilience – speak directly to the inter- and transdisciplinary DNA of our University. At Bonn, we believe that sustainable security requires insights from political science, economics, law, technology, and – last but not least – ethics alike. And we are particularly proud that this Forum is complemented by a Future Lab that trains the "leaders of the day after tomorrow" – a model that perfectly reflects our commitment to internationalization and academic excellence with societal impact.

Let me also express the University's gratitude to all partners, sponsors, and supporting institutions, whose trust and collaboration make this annual Forum possible. Your engagement ensures that knowledge does not remain confined within lecture halls but informs real-world policy and decision-making.

And, of course, in this regard also a warm thank you to our distinguished keynote speakers for enriching this conference with their perspectives and experience. Your insights remind us that even in times of disruption, dialogue remains the strongest foundation of security.

Ladies and Gentlemen,

The world of 2025 challenges us to rethink what security means – and who is responsible for safeguarding it. Universities, I believe, have a vital role to play in this endeavor: not as political actors, but as platforms of reflection, exchange, and foresight. They are places where we can test assumptions, challenge dogmas, and imagine new possibilities – without fear, but with curiosity and courage.

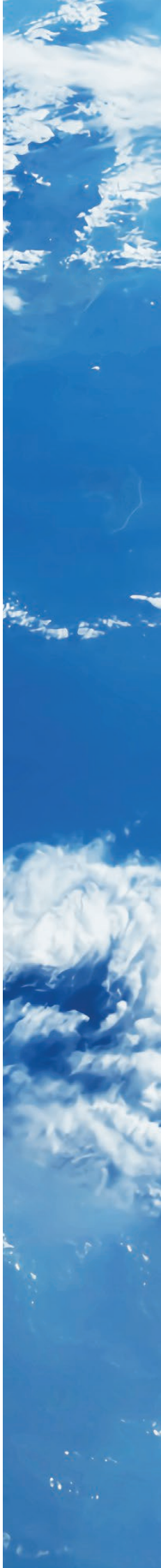
This is precisely what the *International Security Forum Bonn* and the *Bonn Future Lab* stand for. They symbolize what a university can offer to society: clarity in analysis, humility in judgment, and confidence in cooperation.

On September 30 and October 1, the review for the 2025 Excellence Initiative took place – our university was the first to be reviewed. The topic of transfer has become significantly more relevant in this round of excellence. For us, policy advising plays a major role in the area of transfer, and has done so for many decades. Alongside other university institutions such as BICC and IDOS, CASSIS naturally plays a fundamental role in this. I would even say that we are one of the most important players in this area of transfer at our university.

Let me therefore conclude with a simple message of pride and encouragement:

The *University of Bonn* is proud to host this outstanding Forum, proud of CASSIS and its team, and proud of the vibrant network of partners and participants gathered here today. Thank you all very much for accepting our invitation and actively participating in this conference with us – and welcome again to the *International Security Forum Bonn 2025!*

"At Bonn, we believe that sustainable security requires insights from political science, economics, law, technology, and – last but not least – ethics alike."



Executive Summary

Bonn Future Lab on Strategic Foresight 2025 „Securing a Sustainable Space“ – Conference and Workshop[1]

Focusing on the issue of “Securing a Sustainable Space”, the *Bonn Future Lab on Strategic Foresight* was conducted over three days (October 30th to November 1st) at the University of Bonn. The primary objective of this format was to cultivate networks between emerging talents from across Germany and recognized scientists, industry professionals and military representatives from leading national and international institutions. These included, among others, the *German Space Agency (DLR), Durham University,* the *Federal Academy for Security Policy (BAKS),* the *Digital Economic Security Lab (DIESL)* at *Aalto University*, the *International Space University (ISU)*, the *German Bundeswehr’s Space Command*, the *German Institute of Development and Sustainability (IDOS), Northeastern University Boston*, the *Institute for Air Law, Space Law and Cyber Law at the University of Cologne*, the *Fraunhofer Institute for Technological Trend Analysis (INT),* and the *NewSpace Initiative at the Federation of German Industries.*

At the core of the workshop was the aim to shed light on the strategically critical, yet insufficiently studied field of European space security, providing the participants with a profound understanding of key challenges, vulnerabilities, and strategic risks shaping Europe’s space security environment. The event also sought to develop attendee’s expertise in strategic foresight by introducing them to essential skills and methodologies such as scenario development or the identification of global megatrends. In addition, a significant objective was to create opportunities for building professional relationships with researchers and experts across diverse scientific disciplines.

1 We would like to thank Tim Bender and Fin Henri Brockfeld of the EPIS Thinktank for their support in compiling the results of the Bonn Future Lab 2025.

In 2025, the Bonn Future Lab on Strategic Foresight as part of the International Security Forum Bonn, hosted by the *Center for Advanced Security, Strategic and Integration Studies* (CASSIS) at the *University of Excellence Bonn,* focused on the critical issue of Securing a Sustainable Space. CASSIS had the privilege to run the Bonn Future Lab under the patronage of Federal Minister Dorothee Bär, Federal Minister of Research, Technology and Space. Minister Bär's support underscores the relevance of research and technological development as a cornerstone of a sustainable space security architecture for Germany and Europe. In total, the Bonn Future Lab on Strategic Foresight gathered more than 100 participants.

The Bonn Future Lab was preceded by the main day of the ISFB, which addressed the topic "Ruptures Waiting for Responses. Reconsidering European Security Relations." The event brought together distinguished policymakers, academic experts, and diplomatic representatives, including Ambassador retd. Daniel Benjamin, President of the *American Academy* in Berlin and Sara Nanni, MP, Spokesperson for Security Policy for the *BÜNDNIS 90/DIE GRÜNEN Parliamentary Group*. It also featured three panel discussions with renowned international scholars addressing pivotal issues such as "The Goals Are Known, but the Path Is Unclear – Reconsidering European Security Relations", "Responding to Technological Ruptures. Digital Dependencies During Geopolitical Rivalries", and "Between Normalization and Conflagration: Decoding the Middle East's Competing Futures".

The Bonn Future Lab on Strategic Foresight, organized with partners such as the *Foundation for International Dialogue of the Savings Bank* in Bonn, the *Hanns Seidel Foundation,* the *German Bundeswehr's Space Command,* the Institute for *International Cooperation, Technological Diplomacy and Communication (ICI), AmerikaHaus North Rhine-Westphalia,* the *German Society for Security Policy (GSP)*, the *Academy of International Affairs NRW (AIA)* the *Institut français Bonn,* and the *EPIS Thinktank,* consisted of an international conference day and a two-day Strategic Foresight Workshop. The former revolved around the matter of "Securing a Sustainable Space", featuring contributions from various national and international specialists. Building on the theoretical foundations from the conference day, the hands-on workshop then provided young professionals with valuable insights into current debates on scenario development. It familiarized them with key techniques and methods used in strategic foresight, before they collaboratively devised and discussed strategic solutions to key security challenges. They produced five exploratory scenarios, each illustrating a different potential future, informed by the knowledge acquired during the international conference day.

The international conference day commenced with the keynote speech "Rise Up! The Strategic Necessity of Advancing the European Space Economy" delivered by Matthias Wachter, Managing Director of the *NewSpace Initiative* at the *Federation of German Industries (BDI)*. He introduced participants to the strategic significance of the rapidly expanding global space economy and underscored its growing relevance for Europe's competitiveness. Wachter emphasized that space is becoming a central growth engine, with forecasts predicting that the global space market could rise to nearly €2 trillion in the coming decades. In doing so, he highlighted the crucial role of governments as strategic investors and reliable anchor customers, noting that public support through procurement, pilot projects, and partnerships is essential for scaling and strengthening Europe's space sector.

The keynote was followed by the panel "Strategic Conditions for a Sustainable European Space Industry," chaired by Prof. Géraud Gaillard *(International Space University).* The panelists, Ms. Sabine von der Recke *(OHB Systems AG),* Prof. Dr. Bruno Reynaud de Sousa *(University of Minho),* Dr. Susanne Heckrodt *(German Space Agency),* and Dr. Susann Lüdtke *(Lüdtke Intelligence & Analytics),* examined how sustainability can be achieved in a European industrial context. A key element of the discussion were references to the commercial space ecosystem in the United States, which, despite diverging dynamics within the individual states, is characterized by strong cooperation at the federal level. Efforts within the European Union, on the other hand, tend to be characterized less by coordination, but by competition and duplication. With much capital flowing to industry in the United States, Europe risks falling behind unless it cultivates a more coherent venture-capital culture that can mobilize investment at scale. Additional crucial factors for a robust European space economy were pointed out to be risk-tolerant and long-term capital, stable customers, and efficient, less bureaucratic processes in the ESA, the EU and national governments likewise. Recommendations for Europe were an increasing focus on public-private partnerships with states acting as anchor customers, as well as a quick (even if costly) implementation of pilot projects as industry projects. Sustainability was defined not only as environmental sustainability, but also as sustainable access to space, with all experts agreeing that an independent and reliable European launching capability is crucial for Europe's strategic autonomy and securing reliable access for future missions. The panel converged on the view that states unable to maintain competitiveness in orbit risk losing critical industries and value chains on Earth.

A second keynote speech, "Space as an Indispensable Ecosystems for Sustaining Security," was given by Major General Michael Traut, Head of the *German Bundeswehr's Space Command.* General Traut pointed out that space has evolved from a mere strategic enabler into a strategic nexus, as modern military and civilian systems rely heavily on space-based services. From a military perspective, he underlined that those who can process and act on space-derived information the fastest gain a clear operational advantage. He concluded by stressing that European nations should not strive for space dominance, but for space superiority, thus ensuring their own freedom of action while fostering scientific and economic cooperation with trusted international partners.

The succeeding panel, "Space Between Securitization and Astropolitical Needs for Security," discussed how space is positioned between security-focused narratives and broader astropolitical interests. With Dr. Gilles Rabin *(Hic et Nunc)* as chair, Dr. Béatrice Hainaut *(Institut de Recherche Stratégique de l'École Militaire/*

IRSEM), PD Dr. Antje Nötzold *(University of the Bundeswehr Munich),* Prof. Dr. Bleddyn Bowen *(Durham University),* and Mr. Tal Inbar *(Missile Defence Advocacy Alliance)* emphasized that critical space infrastructure has become increasingly contested and fragile, while simultaneously underpinning essential transformations on Earth. A central theme was astropolitical dynamics. Speakers noted that the third space age is driven largely by the United States, supported by alliances and powerful commercial actors that together operate most of the world's satellites. China was referenced as a central strategic actor, characterized by a tight fusion of civil and military structures, the deliberate use of technical standards as instruments of influence, and the rapid expansion of its BeiDou navigation system. Europe was advised to approach China with strategic caution, anticipate potential dependencies created through standards, and interpret Chinese space activities through the lenses of security, economic resilience, and long-term power projection. Russia, meanwhile, was described as having reached the limits of its space expansion and now lagging behind US and Chinese developments.

The last keynote of the conference day, "Ensuring Governance and Governability of a Sustainable Space in an Age of Astropolitik," was delivered by Dr. Gerald Braun, Permanent Deputy to the Director of Security and Special Assignments at the *German Space Agency* at DLR. He highlighted the rising collision risks in increasingly crowded orbits and emphasized the urgent need for effective space traffic management. While the Outer Space Treaty provides fundamental governance principles, Braun argued that more legal frameworks are needed to address modern issues such as liability, environmental protection, and safety. He suggested that future agreements could take inspiration from frameworks such as the United Nations Convention on the Law of the Sea (UNCLOS), treating space as a shared global commons requiring coordinated regulation and resilient, sustainable management.

The following panel, "Space Governance amidst the Decay of Multilateralism," with Prof. Dr. Mai'a Cross *(Northeastern University Boston),* Dr. Kunhan Li *(Digital Economic Security Lab/* DIESL, at *Alto University),* Ms. Juliana Süß *(German Insitute for International and Security Affairs/*SWP), and Prof. Dr. Dr. h.c. Dr. h.c. Stephan Hobe *(University of Cologne)* as well as Mr.

Jens Schroeter *(ArianeGroup)* as chair, thematized options of space governance in an era of intensifying great-power competition. The experts discussed the idea of space as a global commons and an international commodity that requires innovative forms of governance reacting to the latest technological and commercial developments. With regards to the current geopolitical landscape, however, they also highlighted a growing fragmentation of international space governance marked by the emergence of political "blocs" such as those forming around the Artemis Accords. As not all major powers have an interest to cooperate, the prospects for universal norms are increasingly constrained, and regulatory influence becomes tightly linked to the possession of credible capabilities. The simultaneous blurring of civil, commercial, and military activities further complicates governance prospects: While commercial constellations enhance global capabilities, their involvement in military operations raises difficult legal and ethical questions, including the status of commercial satellites under international law and the allocation of responsibility for their protection.

The discussions on October 30th highlighted three key points for Europe's space future. First, Space is now a crowded, commercial, and contested ecosystem serving as a strategic nexus. Second, Europe must choose between dependency and deliberate design: Without decisive action on access, industry, governance, and standards, it risks relying on external actors in a domain central to security and economic prosperity. Finally, sustainable space requires aligning security, economic, and governance agendas, as resilient access, competitive industry, environmental stewardship, and credible regulation are mutually reinforcing pillars that ultimately demand strategic foresight and informed public debate.

October 31st started with the panel discussion "Wake Up Call: On the Foreign and Security Policy Strategy Capabilities of the German Federal Government", aiming to discuss the strategic capabilities of the "Bundesregierung" against the backdrop of a rapidly evolving international security environment. The discussion brought together Prof. Dr. René Bantes *(Fraunhofer Institute for Technological Trend Analysis/*INT), Dr. Henning Riecke *(Federal Academy for Security Policy/* BAKS), and Dr. Olaf Theiler *(Bundeswehr Planning Office)* and was chaired by Sibel Öztürk-Baştanoğlu *(Hanns Seidel Foundation).* The panel was framed as a "wake up call", emphasizing that effective foreign and security policy requires more than the production of strategy documents. The panelists converged on the view that strategies must be translated into concrete actions, with a clear alignment between political objectives and the instruments and resources available for their implementation. Without this coherence between goals and means, strategic planning risks remaining largely declaratory. The panel further underlined that meaningful strategic capability depends on long-term planning horizons and the political courage to move beyond established routines, should they no longer correspond to current and emerging threat environments. Finally, the experts highlighted the need to operate on two interconnected levels of strategy and communication: a long-term strategic level grounded in empirical analysis and structural trends, and a political action level shaped by media dynamics and what was referred to as the "attention democracy". To bridge these levels, the panelists agreed that political communication must be audience-appropriate, enabling complex foresight and analytical insights to effectively inform concrete political decision-making.

The organizers would like to express their sincere thanks to all those who contributed to making the Bonn Future Lab such a valuable forum for exchange, as well as the Lab's cooperating partners, namely the *Foundation for International Dialogue of the Savings Bank in Bonn,* the *Hanns Seidel Foundation,* the *German Bundeswehr's Space Command,* the *Institute for International Cooperation, Technological Diplomacy and Communication* (ICI), *AmerikaHaus North Rhine-Westphalia,* the *German Society for Security Policy* (GSP), the *Academy of International Affairs NRW* (AIA) the *Institut français Germany,* and the *EPIS Thinktank.* The Bonn Future Lab enabled participants to gain new knowledge and perspectives on astropolitics, space security, ans strategic questions, while at the same time opening up new research questions and arenas for future inquiry. The discussions proved to be particularly fruitful for the workshop participants over the following two days, who were able to draw on the insights, experiences, and impulses generated during the conference. A format of this quality and depth would not have been possible without the generous support and commitment of the Bonn Future Lab's partners.

List of Participants

Maia Achtermann
Evangelisches Studienwerk Villigst

Amb. retd. Claude-France Arnould
Brussels Institute for Geopolitics

Prof. Dr. René Bantes
Fraunhofer Institute for Technological Trend Analysis (INT)

Dr. Summar Iqbal Babar
Academy of International Affairs NRW (AIA)

Roberta Bartkuté
Friedrich Naumann Foundation for Freedom (FNF)

Jakob Bartolomey
Bonn Student Group for Foreign and Security Politics (BHAS)

Brig. gen. retd. Dr. Michael Bartscher
Institute for Security Policy at Kiel University (ISPK)

Marc Becker
German Federal Ministry of Defence

Paul Behne
German Society for Security Policy (GSP); Strategy& (PwC)

Tim Bender
EPIS Think Tank

Adj. Prof. Dr. Julian Bergmann
German Institute of Development and Sustainability (IDOS)

Manuel La Rosa Betancourt
Neutron Star Systems

Amb. retd. Prof. James D. Bindenagel
Center for Advanced Security, Strategic and Integration Studies (CASSIS)

Prof. Dr. Bleddyn Bowen
Durham University

Dr. Gerald Braun
German Space Agency at DLR

Fin Henri Brockfeld
EPIS Think Tank

Prof. Dr. Mai'a Cross
Northeastern University Boston

Prof. Dr. Bruno Reynaud De Sousa
University of Minho

PStS retd. Ekin Deligöz
Bündnis90/Die Grünen

Fabian Etscheid
Bonn Student Group for Foreign and Security Politics (BHAS)

Dr. Ralf Ewald
German Space Agency at DLR

Dr. Enrico Fels
Center for Advanced Security, Strategic and Integration Studies (CASSIS)

1st Lt. Dominik Fischer
German Bundeswehr Space Command

Dr. Hendrik Fischer
Group Leader Industrial Policy, Department of Strategy and Communication, German Space Agency at DLR

Dr.-Ing. Andreas Flock
German Aerospace Center (DLR)

Frederic Forkel
German Society for Security Policy (GSP)

Lysan Forster
German Space Agency at DLR

Dr. Marieluna Frank
Institute for Qualifying Innovation Research and Consulting (IQIB)

Daniel Funke
Hanns Seidel Foundation (HSS)

Prof. Géraud Gaillard
International Space University (ISU)

Sascha Geissler
University of the Bundeswehr Munich

Dr. Dirk Göpffahrt
State Chancellery NRW

Sabine Groth
State Chancellery Hesse

Katja Grünfeld
Institute of Air Law, Space Law and Cyber Law at the University of Cologne

Sara Hadley
German Aerospace Center (DLR)

Dr. Béatrice Hainaut
Institut de Recherche Stratégique de l'Ecole Militaire (IRSEM)

Dr. Susanne Heckrodt
German Space Agency at DLR

Prof. Dr. Andreas Heinemann-Grüder
Center for Advanced Security, Strategic and Integration Studies (CASSIS)

Prof. Dr. Wolfram Hilz
Institute for Political Science at the University of Bonn

Prof. Dr. Dr. h.c. Dr. h.c. Stephan Hobe
Institute of Air Law, Space Law and Cyber Law at the University of Cologne

State Secretary Paul Höller
Ministry for Economic Affairs, Industry, Climate Action and Energy of the State of North Rhine-Westphalia

Col. retd. Andreas Hornik
German Association of Defense Technology (DWT)

Tal Inbar
Missile Defence Advocacy Alliance

Kristina Jasper
German Space Agency at DLR

Konstantin L. Kasakov
U.S. Consulate General Düsseldorf

Maria Kislat
Federation of German Industries (BDI)

Mathias Klohn
German Aerospace Center (DLR)

Deborah Klein
German Space Agency at DLR

Simon Knollmann
German Academic Scholarship Foundation

Dr. Franziska Knur
German Aerospace Center (DLR)

Prof. Dr. Joachim Krause
Institute for Security Policy at Kiel University (ISPK)

Amb. retd. Prof. Dr. Heinrich Kreft
Amb. ret., Program Director China International Diplomatic Academy German Foreign Ministry

Michael Krons
University of Bonn

Moritz Krug
Hanns Seidel Foundation (HSS)

Philipp Kürten
Department of Science and Technology Studies at the University of Vienna

Prof. Dr. Dr. Michael Lauster
Fraunhofer Institute for Technological Trend Analysis (INT)

List of Participants

Ulli Leibnitz
SPACE at CGI Germany

Dr. Julia Leininger
German Institute of Development and Sustainability (IDOS)

Robert Leonards
University of Bonn

Dr. Mariia Levchenko
Berghof Foundation

Dr. Kunhan Li
Digital Economic Security Lab (DIESL) at Aalto University

Dr. Susann Lüdtke
Lüdtke Intelligence & Analytics

Stuart MacDonald
Academy of International Affairs NRW (AIA)

Sophia Maier
Hanns Seidel Foundation (HSS)

Maryam Mallekzada
University of Bonn

Constantin Mitschelen
German Society for Security Policy (GSP)

Prof. Dr. Birgit Münch
Vice Rector for International Affairs at the University of Bonn and Member of the CASSIS Advisory Board

Dr. Florian Neisser
Federal Office of Civil Protection and Disaster Assistance (BBK)

Ralf Nestler
Table Media

PD Dr. Antje Nötzold
University of the Bundeswehr Munich & Center for Advanced Security, Strategic and Integration Studies (CASSIS)

Jean-Pascal Östreich
German Federal Ministry of Defence

Sibel Öztürk-Baştanoğlu
Hanns Seidel Foundation (HSS)

Prof. Nicolas Peter
European Space Agency (ESA)

Simon Peters
German Space Agency at DLR

Denise Potinius
msg systems ag

Prof. Dr. Key Pousttchi
wi-mobile Institute for Digital Transformation

Dr. Gilles Rabin
Hic et Nunc Conseil

Dr. Stephan Recher
AeroSpace.NRW

Dr. Henning Riecke
Federal Academy for Security Policy (BAKS)

Dr. Stephanie Rith
TechHub SVI at Bayern Innovativ GmbH

Dr. Steffen Schaepe
German Space Agency at DLR

Felix Schmidt
FibreCoat GmbH

Ramona Schmitt
Federation of German Industries (BDI)

Frederik Schmitz
Center for Advanced Security, Strategic and Integration Studies (CASSIS)

Maximilian Schranner
Center for Advanced Security, Strategic and Integration Studies (CASSIS)

Jens Schroeter
ArianeGroup

Laurin Schulze
German Space Agency at DLR

Fanny Sergel
Evangelisches Studienwerk Villigst

Verena Shifferman
German-Israeli Foundation for Scientific Research and Development (GIF)

Dr. Anna Shpakovskaya
Academy of International Affairs

Dr. Arne Sönnichsen
Institute for Qualifying Innovation Research and Consulting (IQIB)

Isabella Stuerzer
Institute for Peace Research and Security Policy

Dr. Robert Stüwe
German Energy Agency (dena)

Juliana Süß
German Institute for International and Security Affairs (SWP)

Dr. Olaf Theiler
Bundeswehr Planning Office

Col. retd. Ralph Thiele
EuroDefense Germany

Maj. Gen. Michael Traut
Commander of the Space Command of the German Federal Armed Forces

Lena Utecht
Center for Advanced Security, Strategic and Integration Studies (CASSIS)

Gen. retd. Jörg Vollmer
Fraunhofer Institute for Communication, Information Processing, and Ergonomics (FKIE)

Ruth Vollmer
Bonn International Centre for Conflict Studies (BICC)

Paul Niclas von Ambüren
BlueRock Security & Resilience Strategies GmbH

Sabine von der Recke
OHB System AG

Dr. Inez von Weitershausen
QualityMinds GmbH

Matthias Wachter
Federation of German Industries (BDI)

Dr. Joachim Weber
Center for Advanced Security, Strategic and Integration Studies (CASSIS)

Jana Weigert
Hanns Seidel Foundation (HSS)

Elijah K. Wething
German Society for Security Policy (GSP)

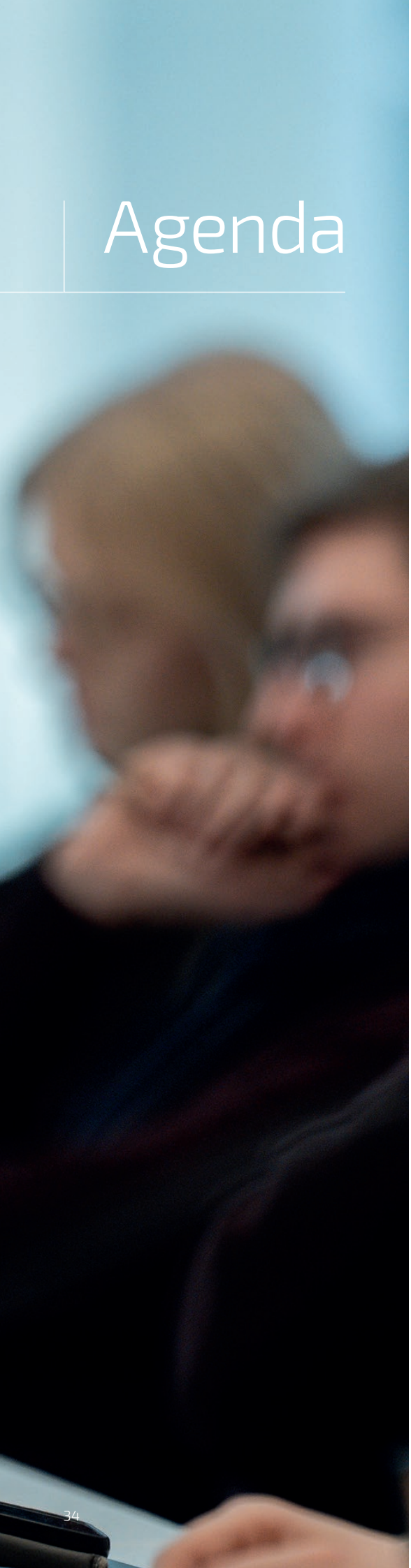
Alexander Weyershäuser
Center for Advanced Security, Strategic and Integration Studies (CASSIS)

Jan David Zabala Gepp
Federal Office of Civil Protection and Disaster Assistance (BBK)

Jan Zühlke
German Society for Security Policy (GSP)

Diana Zydek
Hanns Seidel Foundation (HSS)

As of October 27th, 2025



Agenda

Thursday, October 30th

9:00 a.m.	**Opening & Welcome** Dr. Enrico Fels, CASSIS Federal Minister Dorothee Bär, Federal Minister of Research, Technology and Space Prof. Dr. Reinhold Ewald, Space Ambassador of the State of North Rhine-Westphalia
10:00 a.m.	**Keynote 1 "Rise up! The Strategic Necessity of Advancing the European Space Economy"** Mr. Matthias Wachter, Managing Director at NewSpace Initiative, Federation of German Industries (BDI)
10:30 a.m.	**Panel 1 "Strategic Conditions for a Sustainable European Space Industry"** ■ Ms. Sabine von der Recke, OHB Systems AG ■ Dr. Susanne Heckrodt, German Space Agency at DLR ■ Prof. Dr. Bruno Reynaud De Sousa, University of Minho ■ Dr. Susann Lüdtke, Lüdtke Intelligence & Analytics Chair: Prof. Géraud Gaillard, International Space University (ISU)
12:00 a.m.	**Lunch**
1:00 p.m.	**Keynote 2 "Space as an Indispensable Ecosystem for Sustaining Security"** Maj. Gen. Michael Traut, Commander of the Space Command of the German Federal Armed Forces

1:30 p.m.	**Panel 2 “Space Between Securitization and the Astropolitical Needs for Security”** ■ Dr. Béatrice Hainaut, Institut de Recherche Stratégique de l’Ecole Militaire (IRSEM) ■ PD Dr. Antje Nötzold, University of the Bundeswehr Munich & CASSIS ■ Prof. Dr. Bleddyn Bowen, Durham University ■ Mr. Tal Inbar, Missile Defence Advocacy Alliance Chair: Dr. Gilles Rabin, Hic et Nunc
3:00 p.m.	**Coffee Break**
3:30 p.m.	**Keynote 3 “Ensuring Governance and Governability of a Sustainable Space in an Age of Astropolitik”** Dr. Gerald Braun, Permanent Deputy to the Director of Security and Special Assignments, German Space Agency at DLR
4:00 p.m.	**Panel 3 “Space Governance amidst the Decay of Multilateralism”** ■ Prof. Dr. Mai’a Cross, Northeastern University Boston ■ Dr. Kunhan Li, Digital Economic Security Lab (DIESL) at Aalto University ■ Ms. Juliana Süß, German Institute for International and Security Affairs (SWP) ■ Prof. Dr. Dr. h.c. Dr. h.c. Stephan Hobe, Institute for Air Law, Space Law and Cyber Law at the University of Cologne Chair: Mr. Jens Schroeter, ArianeGroup
5:30 p.m.	**Transfer to the Academy of International Affairs NRW (AIA)**
6:30 p.m.	**Welcome** Dr. Mayssoun Zein Al Din, Director of the Academy of International Affairs NRW (AIA) Reception incl. Dinner Speech on “Europe’s Future in Space” By State Secretary Paul F. Höller, Ministry for Economic Affairs, Industry, Climate Action and Energy of the State of North Rhine-Westphalia Chair: PD Dr. Antje Nötzold, University of the Bundeswehr Munich & CASSIS

Bonn Future Lab 2025: Strategic Foresight Workshop[1]

Friday, October 31st

09:00 a.m.	**Wake-Up Call** "On review. On the foreign and security policy strategy capabilities of the German federal government" **Greetings: Dr. Enrico Fels, CASSIS** ■ Prof. Dr. René Bantes, Fraunhofer Institut für Naturwissenschaftlich-Technische Trendanalysen (INT) ■ Dr. Henning Riecke, Federal Academy for Security Policy (BAKS)) ■ Dr. Olaf Theiler, Planning Division of the Federal Armed Forces Chair: Sibel Öztürk-Baştanoğlu, Hanns Seidel Foundation
10:30 a.m.	**Break**
10:50 a.m.	**Recap** (plenary) Uncertainty Analysis Elicitation of Key Factors
12:30 a.m.	**Lunch**
14:15 p.m.	**Scenario Development** (plenary and team sessions)
17:30 p.m.	Outlook

1 The two day workshop was conducted in German. Agenda in English translation.

Saturday, November 1st

9:00 a.m.	**Scenario Pitches**
10:45 a.m.	**Break**
11:00 a.m.	**Strategy Development** (team sessions)
12:30 a.m.	**Lunch**
1:30 p.m.	**Strategy Development** (team sessions)
4:00 p.m.	**„Sharktank of the Futures“** (plenary) Presentation and discussion of scenarios and strategies with practitioners and experts ■ Dr. Julia Leininger, German Institute of Development and Sustainability (IDOS) ■ Katja Grünfeld, Institute for Air Law, Space Law, and Cyber Law at the University of Cologne ■ Dr. Arne Sönnichsen, Institut für qualifizierende Innovationsforschung und -beratung (IQIB) ■ Prof. Dr. Andreas Heinemann-Grüder, CASSIS
5:30 p.m.	**Debriefing**

Partners

Foundation for International Dialogue
of the Savings Bank in Bonn

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Technological Diplomacy
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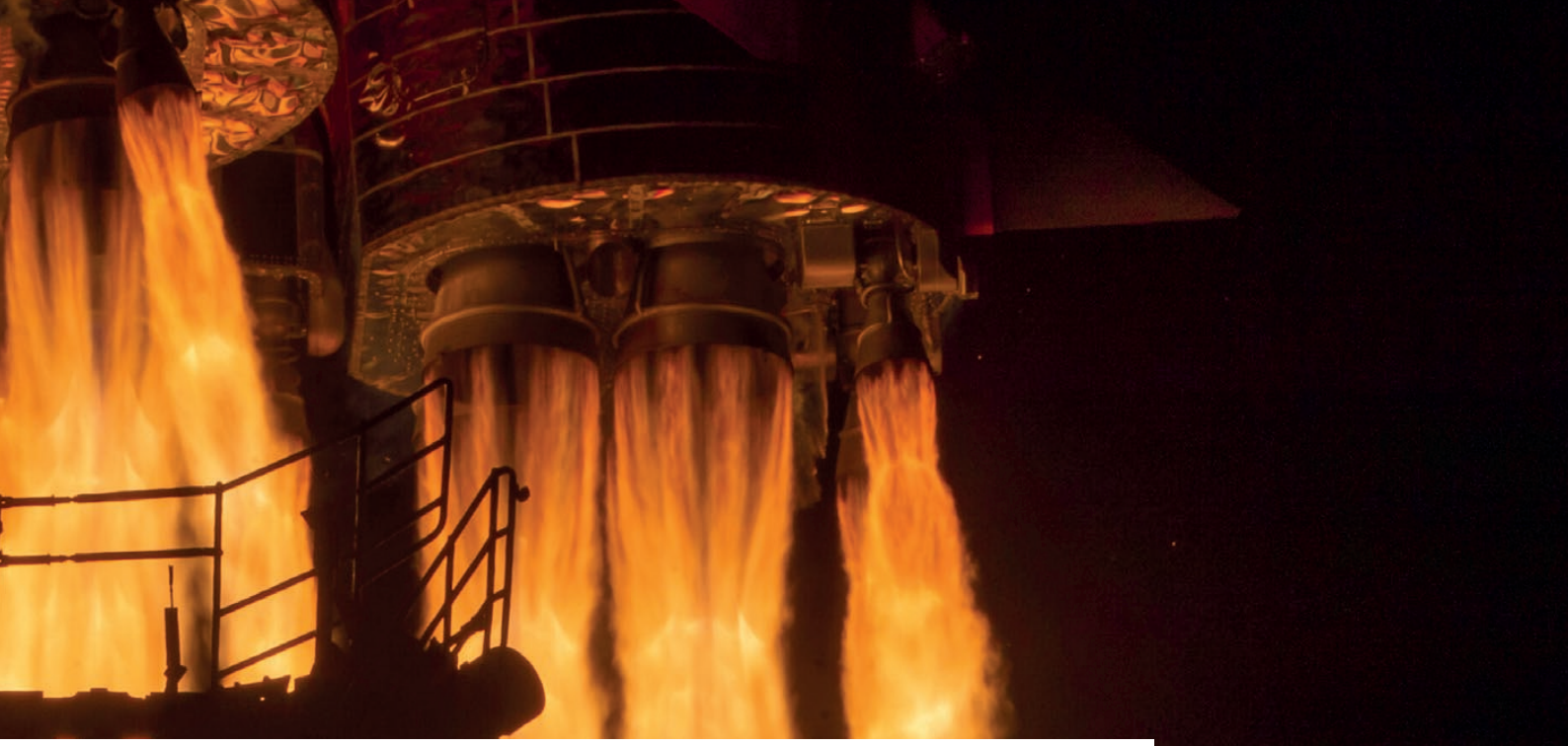


Hanns Seidel Stiftung

GSP Gesellschaft für Sicherheitspolitik e.V.

EPIS Thinktank

Keynotes

Transcriptions of delivered speeches.
The spoken word prevails.

Matthias Wachter

Managing Director at NewSpace Initiative, Federation of German Industries (BDI)

Rise up! The Strategic Necessity of Advancing the European Space Economy

Dear Dr. Fels, Enrico, thank you very much for the kind introduction and the warm words. I'm feeling very honored being here. Ladies and Gentlemen, when we talk about security, competitiveness and strategic capability, we must also talk about space. Space is no longer a niche topic. It is a central element of our industrial strength, our security, our sovereignty and our future.

I would like to thank the Center for Advanced Security, Strategic and Integration Studies for hosting this event and for having me. It's a pleasure to speak here at CASSIS – one of the very few civilian university institutions in Germany conducting social science and security policy research on space. We need more institutions like CASSIS. Universities are key in shaping our thinking in space.

Why is this so relevant? Because the strategic dimension of space has shifted fundamentally over the past two decades. During the Cold War, space was primarily a state-dominated domain, symbolic of technological and military power. Today, we are witnessing a paradigm shift: space has become a competitive, contested and commercialized domain. Because most space technologies can serve both civilian and military purposes, this development has far-reaching implications for international security and strategic stability.

"NewSpace", as we call it sometimes, stands for moving beyond familiar structures. It means acting fast, trying new approaches and having the courage to take risks. Europe needs exactly this mindset if we want to play a real role in global space activities and not just watch from the sidelines. The big questions of the future – security, digitalization, raw materials, energy, climate – will not be decided on Earth alone. They will also be decided in orbit. And this is not a futuristic scenario, it's happening right now. Space is already one of the key strategic technologies and fields. It strengthens our industries across all sectors here on earth. It secures technological sovereignty, opens new business models and creates economic resilience in an increasingly unstable geopolitical environment.

This is not a promise – it is economic fact. According to the study "Aufholjagd im All" by Roland Berger and the Federation of German Industries (BDI), the global market for space-based infrastructure and services is expected to quadruple by 2040 – from around 500 billion to 2 trillion euros. The study highlights the enormous cross-sector potential of Space as well as the challenges we must address.

Many people ask: do we not have other, more pressing problems on Earth? Why should we invest so much money in space? The answer is: yes, we must invest in space. The Apollo Program shows why. In the 1960s, it was government demand for cutting-edge technology: smaller, faster and more reliable computers, that unleashed an unprecedented wave of innovation in the United States. This state-driven push created enormous economic wealth and laid the foundation for today's digital world.

As the Roland Berger study points out, the American innovation ecosystem, the close network of public funding, research, venture capital and commercialization, can be traced directly back to Apollo and the creation of DARPA, the Defense Advanced Research Projects Agency. DARPA was founded to fund high-risk, high-reward research and became the birthplace of key technologies like the internet and modern microelectronics. Without these two pillars, there would be no Silicon Valley, no global technological leadership of the U.S. economy. Apollo proved that bold goals inspire nations, accelerate technological progress and generate prosperity far beyond the space sector itself.

And back to Europe: while the opportunities are growing, so is the gap between Europe and the United States and China. We have to be honest about that. This gap has consequences that go far beyond space. Those who are not competitive in orbit will lose sovereignty in key areas on Earth. This is why space is not just an industrial policy issue. It is a security policy issue. It is a sovereignty issue. Europe has a strong industrial base. We must secure this strength and expand it strategically.

One example can be seen in Germany. At the BDI Space Congress 2025 a couple of weeks ago, Defense Minister Boris Pistorius announced that the federal government will invest 35 billion euros in space capabilities by 2030. This is a real game changer: 7 billion euros per year – the same as the annual space budget of the European Space Agency. This decision is a substantial strategic commitment and sends a clear message: space is not “nice to have” – it is strategically essential.

This strategic reorientation is not happening in isolation. Around the world, governments are massively increasing their defense-related space budgets. In the United States and in Israel, space has long been a core element of defense. NATO has officially declared space the fifth operational domain, alongside land, air, sea and cyber. In November this year, the ESA Ministerial Council in Bremen will decide on the future of Europe in space. Europe must step up and commit the necessary level of funding for the next three years. If we act decisively now, we can increase our market share and strengthen Europe’s role in the global space economy.

"Why is this so relevant? Because the strategic dimension of space has shifted fundamentally over the past two decades. During the Cold War, space was primarily a state-dominated domain, symbolic of technological and military power. Today, we are witnessing a paradigm shift: space has become a competitive, contested and commercialized domain. Because most space technologies can serve both civilian and military purposes, this development has far-reaching implications for international security and strategic stability."

But – and history shows this clearly – money alone will not get us there. Capital is necessary, but without the right framework it will not have real impact. Europe's Space ecosystem has grown in recent years because there was room to act – especially here in Germany, where we have a very dynamic New Space industry. Too much regulation would slow this down. New regulations bring more costs, more bureaucracy, more uncertainty, so we need to be very wise in undertaking that. Bureaucracy hits start-ups and small and medium-sized enterprises the hardest, the very actors driving innovation.

The planned EU legislation, the so-called EU Space Act, raises concerns. The EU has no clear legal competence. A one-size-fits-all approach ignores national strengths and needs. And it risks repeating the mistakes of the AI Act. Too much regulation at the wrong time. We need an environment that supports innovation, not blocks it. Public institutions should not try to do everything themselves. They should act as anchor customers. Contracts are the most efficient way to promote innovation. They create markets, secure demand and attract additional private investment. That is very important. This is not a theory.

Other countries are showing us how it works in practice. The United States uses dual sourcing – competition, not dependency. Israel uses government contracts to drive defense innovation. Ukraine created Brave1 – an agile innovation platform connecting industry, research and security institutions. We also see promising initiatives in Europe: the European Launcher Challenge, the Flight Ticket Initiative, the Space Innovation Hub in Germany. These initiatives show what is possible when policy, industry and research work together. But we must be brave enough to turn pilot projects into real industrial policy.

And we should not forget: space is critical infrastructure. The cyberattack on Viasat on 24 February 2022 one hour before the Russian attack on Ukraine was a warning. Without satellites there is no secure communication, no intelligence, no navigation. Without space there is no operational capability on earth. Space capabilities are, again, no longer "nice to have", they are essential elements of national and allied defense.

This is why investment decisions are not only about technological progress, but about security, resilience and strategic deterrence. The loss of European access to space after the end of Ariane 5 was a strategic shock. One year without launch capacity and the reliance on the Russian Soyuz rockets. This must never happen again. Let me be clear: If Europe wants to be taken seriously as a security actor, it must be able to guarantee its own access to orbit. I am therefore very happy that Europe is back with a new Ariane 6 rocket. Responsive Space – the ability to launch quickly and flexibly – must become a central European goal.

History teaches us a clear lesson: large budgets alone do not guarantee good outcomes. Especially in times of rapid expansion, poor investment decisions can have long-term negative consequences. To fully leverage this innovation potential, the state must act as a strategic investor. Public funds should be used to build agile ecosystems between industry, established companies, start-ups, SMEs and research institutions. This is how private investment can be mobilized. Competitive procurement processes, targeted dual-use promotion and early demonstration missions can accelerate technology transfer between defense and civilian sectors. Every euro invested in this way strengthens both security and Europe's technological sovereignty. In short: investing in space means investing in security, innovation and prosperity.

This is also why the upcoming ESA Ministerial Council is more than a technical meeting. It is a strategic moment for Europe. The decisions made there will shape the competitive landscape for years to come. If Europe wants to remain relevant, it must make bold decisions – on funding, on industrial policy and on regulatory frameworks that enable growth. Franco-German cooperation will be critical in this regard.

When we talk about "NewSpace", we are talking about enabling, not restricting. About creating rooms to act, not closing it down. Europe must not regulate away its own competitiveness. We must target public funding where it creates innovation. We must modernize procurement – faster, more open and more competitive. We must align defense and industrial strategy to create sustainable technological leadership.

Ladies and Gentlemen, Europe must rise up to this strategic challenge. We must create freedom, not limit it. We must create incentives, not obstacles. And we must rise up together as Europe – and seize this strategic opportunity. Because those who master space will shape the future.

Thank you very much.

Major General Michael Traut
Commander of the Space Command of the German Federal Armed Forces

Space as an Indispensable Ecosystem for Sustaining Security

I was asked to deliver a keynote on that scientific and academic topic, space as an indispensable ecosystem for sustaining security. But since there are so many well-known faces in this room and so many people working on the space domain in different ways, I'm pretty sure that this won't be the end of the discussion. Well, thank you, Dr. Fels and CASSIS, of course, for having invited me again after having heard other speeches from me. So you're still inviting me. That's something I really like.

And your forum reminds us that in our century, security is no longer defined solely by the classic military domains land, sea, air and the virtual one, cyber, but stability of the space above us. What does that actually mean? So our Minister of Defense has delivered a speech a little more than one month ago. Some people of you were present in this room. I was as well, and I felt actually to allow me those personal remarks, I felt like a young boy experiencing Christmas, Easter and birthday at one time. And the young boy who got the things he was wishing for for many years got those things at least promised to be realized in the near future.

However, the minister told us as well that Russia and China are our immediate neighbors. The minister told us that threats are present. And he told us that Germany, let's say, finally realized how important the space domain is for our security, our stability, our prosperity and not only for our scientific and academic development.

I would say that Germany has a long time underestimated that importance of space for our security. And we perceived, we used to perceive, I have, I now can say, we used to perceive space as a more, as a scientific and academic hobby rather than a necessity for our national security. So space is not distant. Space is decisive. Everything that sustains our society, energy, navigation, communication, you know all about that, relies on orbital infrastructure. So space has become the invisible backbone. Well, if you look up there in the sky, you see many satellites flying, so it's not quite invisible anymore. So there are many visible traces of our space activities. But space has become the backbone of our global stability.

Space was once primarily a scientific frontier. Now it's the nervous system of our economies and the command layer for our defense. In short, we all rely on space. Our modern societies rest on orbital infrastructure. For decades, this was kind of exclusive, state-driven, and linear because of the global competition between two superpowers. Today, space has evolved into a complex ecosystem, [and now I hit my first buzzword here, ecosystem] of states, industries, research institutions and international organizations. Each element depends on the others. Decisions made in space shape security, economy and diplomacy on Earth. When we speak about sustaining security, we are speaking about sustaining the ecosystem that makes security possible. So, we need to consider space as a shared responsibility.

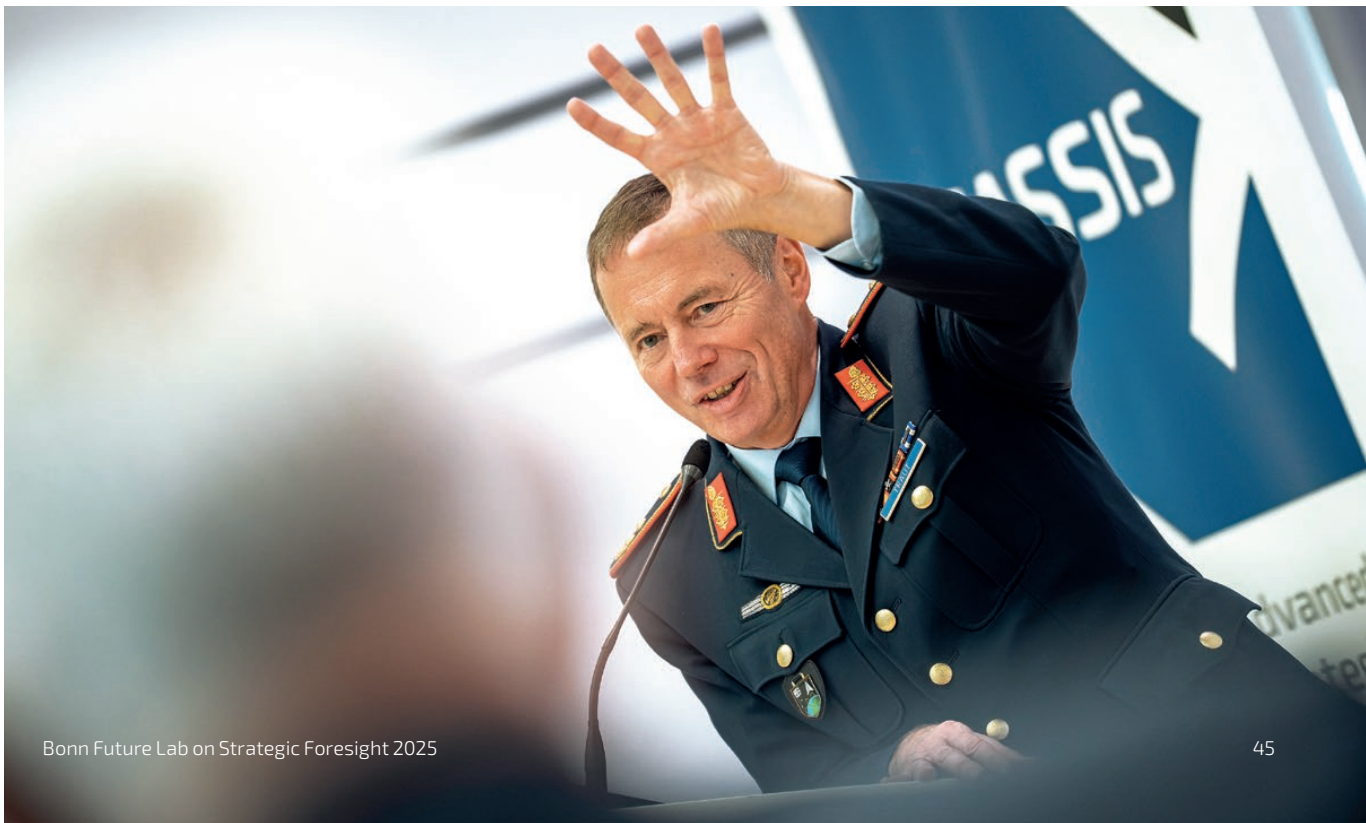
Let me go a little bit into space. Welcome to space. So many objects in space. And the headline, sometimes we miss out the headline, but it's in every of my presentations. Space is a unique strategic arena. It has always been, at least since Sputnik 1. You all know about that history. Sputnik 1 wasn't only the demonstration of the superiority of Soviet technology. Sputnik 1 was a clear message to the United States saying: "Well, we are not only able to shoot something into the orbit, we are able to reach Los Angeles in 20 minutes with something which is potentially very weird."

Space is an ecosystem, and it's complex. That's a new reality. So, I would like to share some thoughts on complexity. It's not complicated, it's complex. The way we think about space has fundamentally changed. It's no longer a distant domain where few nations pursue prestige. It has become a living ecosystem where every orbit, every signal and every actor are connected. They can't evade. Space is global. No boundaries. And the only laws which apply are the laws of Isaac Newton and Johannes Kepler and you can't betray them. That's impossible.

In the early decades of spaceflight, access to orbit was limited to a handful of state programs. It was about exploration, demonstration and, of course, deterrence right from the outset. Those days are gone, but not completely. So, we still have the deterrence issue in space. However, the environment has changed dramatically. Today, space is crowded. Space is commercial. Space is contested, shaped by hundreds of actors and tens of thousands of satellites and hundreds or even millions of pieces of space debris, which is human-made. Humanity took only about 60 years to pollute space like it is today. The success of human innovation has created a web of interdependence. What happens in one orbit can have cascading effects across other orbits, across economic sectors, across state borders and that doesn't only apply for the good old Kessler effect you all know about, but for the functionality of orbital systems, of orbital constellations.

One single example. Russia has declared this July – Moscow times on the 17th of July – that Russia perceives everything which is done by a space-based service in support of Ukraine is considered to be a legitimate target for Russian electromagnetic warfare measures. So that's something which could affect civilian and commercial actors who, as we know, deliver some services as well to Ukraine in the core of their business. You may say that's only an economical thing, but you already feel that this has an impact on defense and security questions.

So, since space is so interlinked and space is a network and a web of complex interaction, we should try not to manage that complexity – I don't think that it's possible – but to embrace that complexity. So how to manage complexity? I think that's an own sector of scientific research which has nothing to do with space



from the outset. However, I think the conclusion might be we should embrace that complexity rather than trying to reduce it or even to manage it. I don't think that this is impossible.

Well, a few words about complexity to make it even more complex. Civil, commercial and defense lines do not longer apply by themselves as stovepipes. Rather, they blur into each other. A cyber attack on a commercial satellite – and we know all the examples – can have national security implications. A single piece of debris, which we might even not have detected before, can trigger international tension because of accusations that somebody would have destroyed a satellite. A disruption in orbit can paralyze financial markets or humanitarian response.

Space has so moved from being a strategic enabler to being a strategic nexus. Managing just such an ecosystem requires a system mindset and the understanding of linkages, interdependencies and dependencies, of course. And that's the question for all of us in our different realms of research, of development, of action. Try to embrace that complexity. And, of course, it's on the run. It's not stable. Space is developing so, let's say, dynamically, that we need to even keep up with the development.

Security. Well, some of you are of German mother tongue. You know that we have a deficiency in our German language, that we somehow mix up two terms in one word, which means the German word, the German term of Sicherheit. So, I will expand on both sides, on security and safety. Security is the strategic backbone of sovereignty.

Let me begin with the first and most fundamental dimension. That is security. Because without security, every other aspiration remains fragile. Space underpins everything sovereignty depends on: communication, navigation, reconnaissance, Earth observation, command and control, early warning, all those military functions serving security depend on space-based services. The ability to act securely in space is inseparable from the ability to act securely on Earth. Space is no longer only in support. It's a strategic backbone of sovereignty.

Yet, security must not be mistaken for dominance. Some people talk about space superiority. Nobody's talking about space dominance, hopefully, because dominance actually means that there is only one actor left. And I think the complexity issue already orders or determines us to allow a hopefully peaceful, let's say, interaction between powerful actors.

Space is about resilience, awareness and assured access. The goal is actually not to weaponize orbits but to stabilize them. Our goal is to ensure that no actor can threaten the data, the services and products on which our societies rely. And if you look at other societies of potential adversaries, more or less, well, there are societies who perhaps may be less reliant on space-based services, but advanced societies are for sure and the Chinese society is as well. So there might be some commonality of interest as well.

So, defending space means defending the enablers of peace. Germany approaches the space security through cooperation, not through confrontation. And I just can echo, I did an interview with a young British journalist this morning, and I just echoed the quotes we all heard this year, lastly at the Space Symposium in Colorado Springs, where General Saltzman and General Whiting, the chief of the Space Force, the U.S. Space Force and the commander of the U.S. Space Command, both said “space is a team sport.” Nobody can tackle, no actor, regardless of the size, can tackle space alone. So, it's a strong interest for all of us to be in the strongest team. I would say the Bayern Munich of space.

"Our common goal has to be to keep the orbital environment predictable, transparent and safe. When safety keeps us secure today, it's sustainability that keeps us secure tomorrow. Sustainability in space, right? That sounds like an environmental science seminar right now, not a military person speaking to you."

That's something, well, I have to say, I don't really like hegemony in the German football league. However, in space and in terms of securing our security in space, I would like to belong to the Bayern Munich team in space. And the strongest team in space, actually, and I underline the word team, actually. So, if a team plays a single player, the team will always win because of its diversity, because of team play, because of the synergies you get out of a team. And therefore, I only can underline the quotes of General Saltzman and Whiting. Space is a team sport.

So, within the Combined Space Operations Initiative and the Operation Olympic Defender, which Germany joined about a year ago and, of course, within our defense alliance, NATO and, of course, within the European Union, we contribute to shared resilience. We, Germany, we contribute to building situational awareness, coordinating responses and fostering transparency. We work hand-in-hand with allies, civil agencies, industry and science. And security in space is not about preparing for conflict. It's about preventing it from ever reaching the orbit.

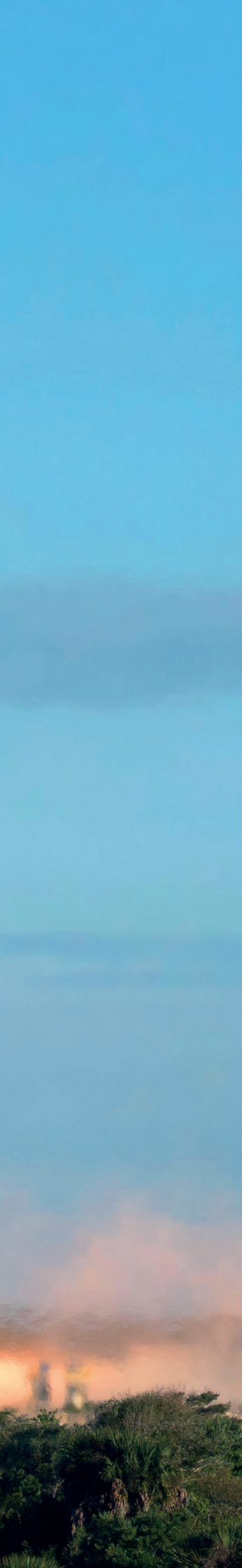
Let's talk a little bit about safety. Safety is about operational integrity and responsible conduct. If security is the backbone of sovereignty, then safety is the discipline that keeps this backbone upright. It is about how we operate, how we behave and how we build trust in one of the most congested environment humanity has ever managed to create in only a couple of decades. Space is not empty, as you know, and the debris problem and the, let's say, traffic management problem is increasing by enormous rates. Every orbit is a shared resource. Every maneuver carries a risk. Every actor shares, therefore, a responsibility for his actions.

Safety is not only a technical checklist – it must be and it should be a behavioral norm. It begins with transparency, sharing orbital data, notifying others about maneuvers. It depends on coordination among civil, commercial and military operators. It succeeds through trust. Trust and confidence. Knowing that actions in orbit are visible and explainable and everybody who represents a space-faring actor should be conscious of that obligation.

Responsible behavior in orbit is the first line of safety in space. Operational safety is also a policy matter, and I think that we have, as a humanity, we have some steps to do in bringing forward responsible behavior in space. If I look back at the open-ended working group of the United Nations on responsible behavior in space and about the results, I think we can agree that we do have some steps to do in advance.

Collisions or interference can escalate tensions as quickly as any terrestrial incident, and I would argue even quicker. This could happen in a couple of hours. And again, Russia and China are our immediate neighbors. Russian and China's satellites are overflying us, and we are overflying Russia and China with our satellites, and those satellites meet on a regular basis up there in orbit. And if something happens, there's a big, big necessity of transparency. Our common goal has to be to keep the orbital environment predictable, transparent and safe.

When safety keeps us secure today, it's sustainability that keeps us secure tomorrow. Sustainability in space, right? That sounds like an environmental science seminar right now, not a military person speaking to you. But believe me, I'm a strong fan of keeping up sustainability in space. I don't want Kessler's effect ever to happen. Sustainability is foresight, ensuring that our decisions today expand, not limit tomorrow's option. Sustainability is a long-term security function rooted in knowledge, governance and ethics.



Sustainable space depends on sustained knowledge. It's built in laboratories and universities like CASSIS in Bonn, and discoveries made there enable safer operations and smarter architectures. With that science, it's not separated from security, of course. It's all interlinked: sustainability, safety and security. It is utmost important that we try to make space sustainable as well, and that knowledge is the currency of sustainability.

Building on that, it is innovation which turns then those aspirations into action. On-orbit servicing, active debris removal, in-space manufacturing are all parts for architectures of a responsible space actor and a responsible space power. Europe and Germany in particular have the talent and the moral imperative to lead that. Sustainability is not a cost to be managed – it's an investment in our future. Of course, sustainability, as always – like we successfully managed for the open seas and our atmosphere – true sustainability needs rules and institutions. Governance is not a constraint, it's a precondition for sustainability. In that case, for sustainability, for the sake of sustainability, we must sanction our frameworks.

Last, a couple of words on economy before you made it, actually. The fourth dimension of the whole space complex ecosystem is economy, to my mind. Bill Clinton used to say, "It's the economy, stupid." That applies to space as well. The bridge between innovation and sovereignty; more than 75% of all space infrastructure is by today commercial. You all know about the studies on the development of this commercial space market by the next couple of years or the next decades.

The health of the space economy determines our ability to act, deter and recover. My personal vision, actually, is I added something to my wish list because some wishes are already fulfilled. I added something to my wish list. It's a self-sustaining space economy in Europe where we get away from medieval manufacturing of satellites into serious production, into a stable space economy where innovation takes place by the economy, by commercial actors and innovators because that's always quicker than state-driven innovation. Secondly, we do have those spinoffs for safety, security and defense because this lies in the interest of the economical, of the commercial actors as well. Sustaining a health space economy requires predictable rules, reliable investments and protections against hostile acquisition.

"I don't want Kessler's effect ever to happen. Sustainability is foresight, ensuring that our decisions today expand, not limit tomorrow's option. Sustainability is a long-term security function rooted in knowledge, governance and ethics."

At the same time, those boundaries between public and private, civil and defense are more and more porous and blurring. Public-private cooperation or even defense-commercial cooperation is no longer optional. I think I've been talking about that for quite a while as well.

We need to work together with space industry and commercial actors when we want to make space safe, secure and sustainable in a completely different way than we did that in the other domains. The common goal must be not to dominate markets; it's to lead through excellence, partnership and trust, because, first of all, the market is big enough to serve a number of actors. Secondly, monopolies never survive, so there's always room for more than one actor or more than one commercial provider.

Let me come to my conclusion. Germany's future in space – from a military perspective, of course – I would underline that from dependency to design. These four dimensions – complexity, security, safety and sustainability – form the ecosystems that our society, our industry and our statehood should underline, but it doesn't organize itself. It needs some direction. It needs some design. It needs, of course, some discipline. Germany has both the responsibility and the capability to lead, not by dominance, but by coherence, credibility and partnership.

We want to shape rules. We want to help to shape standards, to create standards and, of course, we want to make space safe, sustainable and secure. For too long, Europe, perhaps, and including Germany, we have relied on third parties and external providers. It's time to move from that dependency to design, to play a significant role in the future design, how we want to work, how we want to operate in space and for space.

And that strategic sovereignty begins, of course, not only with strategic design, but with reasonable investment – and, well, you all have noted our Minister's speech. And it's not only the Minister of Defense. We do have a Ministry of Research, Technology and Space in Germany right now, as you perfectly know, and, of course, there will be some investments on our research and technology branch as well.

Our investments are coming back to the military side of the house, for example, in space situational awareness, satellite communication, earth observation, reconnaissance, dual use technologies and, of course – and that's my last wish, actually. Nobody goes to the arena with a shield if you were a Roman gladiator, you know all that. – So, active space capabilities, not necessarily to use them, but to show them, to be able, to have them, will make us a credible and a serious partner for our team.

Well, at the end, if you look at the whole future in space, I think we can be optimistic. Of course, investments are expensive, and you have been discussing about the budgetary situation of Germany in the coming future, and perhaps there is no way out. Space is a, let's say for us, an emerging market, and we need to pick the chance to work as ourselves into that emerging market and, let's say, create some prosperity and wealth by that emerging market.

"We want to shape rules. We want to help to shape standards, to create standards and, of course, we want to make space safe, sustainable and secure."

Germany has been quite good at high tech in the last couple of decades. And why is that, that I met two German engineers at the launch site 39A in Cape Canaveral a couple of years ago. These were two car production engineers of the German automotive industries, hired by SpaceX. Imagine why. Because they know how to do production, serious production. They knew how to do high quality products. They knew how to work in a complex, in a competitive environment. And that's something we are pretty good at in Germany. We have been pretty good at, and we should transport that into a sustainable space industry.

Ladies and gentlemen, I've spoken of space not as a theater of competition, but as an ecosystem of interdependence. Well, it's of course complex, and it will stay complex, but it's indispensable that we face that complexity, and we try to embrace, not to manage.

Our ambition is simple. As Germans, to be a nation whose presence in space adds stability to Earth. Space is the mirror of our collective maturity. How we behave in orbit reflects who we are as nations. We choose competition and distrust or foresight and cooperation. I would rather take the latter.

The path we choose will decide whether space remains a source of stability or becomes a symptom of instability, and that's something we cannot want. If we treat space as shared ecosystem, it will sustain security. If we treat it just as a battlefield, we will all lose altitude. Our task, therefore, is clear, to move from dependency to design, from fragmentation to foresight and from competition to shared and co-responsibility. Thank you very much. I hope I kept you awake.

Dr. Gerald Braun

Head of Department at the German Space Agency at the German Aerospace Center and civilian head of the interdepartmental Space Situation Center

Ensuring Governance and Governability of a Sustainable Space in an Age of Astropolitik

Dear ladies and gentlemen, dear Mr. Fels, I have the pleasure to give you a keynote to the next panel, "Ensuring Governance and Governability of a Sustainable Space in an Age of Astropolitik." First, I want to thank you for the kind invitation and the opportunity to deliver this keynote address on an important topic.

"Ensuring Governance and Governability of a Sustainable Space in the Age of Astropolitik" is for me a completely new issue because I'm an operational manager. But nevertheless, I will try to move up to this political level and give you some of my insights on the issue.

As already mentioned, we are now at a decisive point in human history, a point at which space is no longer just a domain of science and research, as we heard, but is also increasingly becoming a theater of political, economic and strategic interests. In this area, which has been appropriately described as astropolitics, we have to ask ourselves how can we ensure the sustainable use of space? And how do we ensure that the necessity or the necessary rules are not only established, but also respected?

Before we discuss the possibility of a sustainable governance system in space, we should first define the term sustainability in this context and explain the fundamental characteristics of human space utilization. In this context, sustainability means preserving the utilization of space for current and future generations. This is particularly noteworthy because the infrastructure in space is exposed to both natural physical influences and human impacts. There are currently around 15,000 satellites in orbit, of which approximately 12,500 are active. These 15,000 satellites in orbit are exposed to both natural physics and the human influences.

One of the most important of these natural physics in space is space weather. Strong radiation bursts and coronal mass injections from the sun can affect, disrupt, or damage ground, air and space infrastructure. Communication connections to satellites and GNSS signals are especially vulnerable. For example, space weather can disrupt Galileo signals to such an extent that precise positioning becomes impossible, leading to limitations for most applications.

In addition, satellite orbits themselves can be directly disrupted. A very prominent example of the influence of space weather on satellite infrastructure occurred in January 2022.

A large coronal mass ejection resulted in the loss of 38 SpaceX satellites. In addition to the natural influences already mentioned, humans also influence their own space infrastructure through behavior. Of particular concern in this regard is space debris, fragments of satellites, launch systems that continue to orbit the Earth long after their mission has ended.

In addition to the approximately 15,000 satellites in orbit, around 40,000 objects known as space debris are regularly tracked in space. According to ESA models, there are around 1.2 million objects measuring 1 centimeter to 10 centimeters and around 140 million objects measuring 1 millimeter to 1 centimeter in space. Imagine an object of a centimeter size which impacts a satellite as the same result as you would put a hand grenade into the satellite.

Given this enormous amount of space debris, it will come as no surprise to you that proximity warnings are part of everyday business for satellite operators. Just to give you a figure, automatically produced proximity warnings for a satellite in a 520 to 40 kilometer orbit, which is not so much congested, are around 20,000 a year. These proximities will be operated then automatically, mostly reduced to zero from point of view of a collision risk, but nevertheless that shows how demanding also space situational awareness at the end is.

In the best case scenario, it will not be necessary to avoid space debris if further analysis and observation reduce the risk of collision below a critical threshold. In addition to the larger pieces of space debris that are regularly tracked, small undetected pieces can pose a major threat to satellites. For example, on August 23rd, 2016, a solar panel of the European Earth Observation Satellite Center 1A was likely struck by a small piece of space debris causing a partial damage in the solar array.

It was immediately after launch that that happened. Due to the increasing importance of space for both civilian and military actors, it can be assumed that the amount of space debris will increase in the coming years. Space is therefore becoming crowded.

I don't need to explain to this expert audience what an increased amount of space debris means for human use of space in the context of a threatening Kessler Syndrome like General mentioned before. It is obvious that space infrastructure is a vulnerable infrastructure, both from natural and human-made influences. It is therefore important to mention that a sustainable governance system in space can only exist in the long term if the space infrastructure is resilient.

"We are also clearly committed to international law with regard to the use of space resources such as those on the moon. Furthermore, we should ensure that the extraction of space resources will be conducted in accordance with international law."

In this context, resilience means that space infrastructure is designed to withstand natural and human impacts, not to interchange resilience and redundancy. As just pointed out, it is already very challenging to build any kind of infrastructure in space. Creating an organizational framework full of rules that can prove itself in the long term is even more challenging.

This is because space is no longer an untouched vacuum. It is an increasingly congested area in which nations, companies and actors of all kinds pursue their interests. Without space, no modern nation in the world can survive in a global competition, whether civil or military, because a space-based infrastructure forms a backbone of military imaging capabilities, navigation systems and communication infrastructure.

As you all know, the race for space resources has already begun. Even in space, there are strategic heights that are limited in number but desired by many and therefore hold a great deal of potential for conflict. Just consider, for example, satellite frequencies or strategic slots in geostationary orbit.

The days when space was an exclusively peaceful place are surely coming to an end. Just to give you a very brief insight, when we started with SSA in Germany, it was all clear that the 700 kilometer sun-synchronous orbits were the most congested orbits. At that time already, existed international not rules but agreements to try to de-orbit satellites from the 700 kilometer orbits down to the 500 kilometer orbits.

Nowadays, we see that the most military imaging capabilities are there on the 500 kilometer orbits, and what goes up must come down after years and decades, and it will all pass these orbits, which are extremely interesting and important for our defense activities. A few years ago, some might have dismissed this as military theoretic, but today, most of us understand that it reflects the reality we are facing. We must ask ourselves, how can we ensure that international space law continues to be respected and what capabilities are needed to safeguard the peaceful use of space for economic and scientific purposes in an increasingly adverse geopolitical context? That is the pressing question of our time.

As you all know, the most important legal agreement governing the use of outer space is the United Nations Outer Space Treaty of 1967. According to this treaty, there are no national territories in outer space. Instead, the principle of free use of outer space is applied.

Outer space is therefore not a legal vacuum as it is sometimes portrayed. There is a binding legal framework based on this treaty and its supplementary agreements supported by United Nations resolutions and guidelines and embedded in existing international law. This is above all the UN Charter which enshrines general prohibition of the use of force as a foundation of our modern international order.

"Space traffic coordination is the first step towards preventing accidents in space."

When new activities arise for which no clear rules exist yet, this legal framework must, of course, be further developed. However, the existing foundation should by no means be called into question. It still serves us very well.

We are also clearly committed to international law with regard to the use of space resources such as those on the moon. Furthermore, we should ensure that the extraction of space resources will be conducted in accordance with international law. We do not want the moon and other celestial bodies to be subject to the first come, first served principle.

We want the exploitation of the moon to be based on international law. Space should be open to all states as an international common. This also includes free access to all regions and celestial bodies.

Ladies and gentlemen, how can we further develop our legal framework in these times of geopolitical tension? It is important to mention at this point that compared to the 1967 Outer Space Treaty, any further development of our legal framework today must take into account our complex multipolar order. In 1967 geopolitics, especially in space, was almost exclusively determined by the two superpowers, the US and the Soviet Union. In comparison today we are talking about a multipolar world order.

In addition to the US and Russia, China, India and several European countries have joined the field of space exploration as ambitious space-faring nations. Furthermore, space is no longer exclusively a state domain. Private companies such as SpaceX, Blue Origin and Amazon are now relevant players.

So how can we ensure that space is used peacefully, fairly, and sustainably in these geopolitical challenging times? To answer this question, it is worth taking a look at the past and at the proven international legal systems, in particular the United Nations Convention on the Law of the Sea, or UNCLOS for short. Over decades, UNCLOS has created a comprehensive and binding legal system for the world's oceans. It defines the sovereign rights of coastal states, regulates freedom of the seas for other states and establishes a clear framework for the use of maritime resources.

Above all, UNCLOS is based on the principle that the oceans are not the property of individual states, but a common heritage of humanity that must be used responsibly and preserved for future generations. These principles and structures provide a blueprint for how we could better regulate space as a global resource. After all, space, like the deep sea, is not the territory of any single state, but a shared, boundless environment.

"So how can we ensure that space is used peacefully, fairly, and sustainably in these geopolitical challenging times?"

The basic framework of space law under international law embodied in the 1967 Outer Space Treaty has already established fundamental principles. The prohibition of national appropriation, the obligation to use space for peaceful purposes and the promotion of international cooperation. While the 1967 Treaty established the fundamental principles of international space law, including the prohibition of national appropriation, the peaceful use of outer space and international cooperation, it did not create a detailed and comprehensive regime to govern today's complex issues such as liability, environmental protection and safety.

A particularly urgent and growing issue in space law is the regulation of space traffic. With the rapid increase in satellites, spacecraft and space debris, the risk of collision and interference is rising significantly. Unlike in the maritime sector, where shipping rules and traffic monitoring have long been established, there are currently no globally binding standards or coordination mechanisms for controlling space traffic.

In this regard, there is sometimes a discussion about space traffic coordination and sometimes about space traffic management. However, these two space traffic concepts do not necessarily stand in conflict with each other. Space traffic coordination is the first step towards preventing accidents in space.

A management or administrative approach looks at the bigger picture, perhaps the second step and assumes that preserving space requires more than just avoiding collisions through coordination. Space traffic management also addresses the issue of how all states and interested parties can be given equal access to space without overburdening the space environment and, in the medium term, making it usable only at high costs for a small military or economic elite. Germany is therefore promoting a comprehensive approach, both in Europe and at the international level that includes initial steps towards space traffic coordination, but could also pave the way for long-term management.

A fundamental prerequisite for sustainable regulation of space traffic is the availability of technical capacities to independently observe and analyze space traffic. That is why we are expanding the Space Situational Awareness Center and investing in national space situational awareness capabilities. After all, only those who have independent information can make sovereign decisions.

In addition to the technical dimension of space traffic, the operational dimension is no less important. There are many issues to be clarified with our numerous international partners. That is why we need a global dialogue on questions such as the following.

What data formats do we use? Which communication channels? What criteria do we use to assess close approaches? On the basis of which data do we decide whether an avoidance maneuver is necessary? The UN Committee on the Peaceful Use of Outer Space recently set up a new expert group on this issue. Germany will actively contribute to this discussion, particularly with the operational experience gained from the German Space Situational Awareness Center. Given the importance of space transportation, I would be delighted if the panel following my keynote could discuss one or two of the mentioned questions.

Dear audience, allow me to conclude with a small personal note. We are all gathered here today with very different backgrounds and professions. What unites us is our enthusiasm for space.

I would therefore be delighted if you would all work together within the scope of our capabilities to ensure that space remains sustainably accessible for future generations, for our children and grandchildren. Thank you.

"We are all gathered here today with very different backgrounds and professions. What unites us is our enthusiasm for space. I would therefore be delighted if you would all work together within the scope of our capabilities to ensure that space remains sustainably accessible for future generations, for our children and grandchildren."

Paul Höller

State Secretary at the Ministry of Economic Affairs, Industry, Climate Action and Energy of the State of North Rhine-Westphalia

Europe's Future in Space

Dear Dr. Zein Al Din,
Dear Dr. Fels,
Dear Dr. Nötzold,

Distinguished guests, ladies and gentlemen, Minister Neubaur very much wanted to be with you today, because the topic of your conference is really close to her heart.

Unfortunately, due to prior commitments, she is unable to attend in person. She has therefore asked me to represent her here and to extend to you her warmest greetings. She would also like me to assure you that her commitment to this field remains as strong as ever - and she looks forward to discuss with you on other occassion.

1. Introduction – Europe at a Crossroads

The global space sector is currently undergoing a profound transformation. New actors are entering the field, commercial models are emerging, and geopolitical tensions are reshaping the way nations engage with space.

Today, space is no longer just about exploration. It is about infrastructure, security, and data sovereignty. The United States, China, and India are rapidly expanding their space capabilities, combining public investment with strong private entrepreneurship.

Europe, by contrast, possesses outstanding research and technology but sometimes lacks the speed, the focus, and the unity of purpose that others demonstrate. Unfortunately, this is not the only case in which the EU struggles.

This decade will determine whether Europe continues as a reliable partner - or takes the decisive step to become a true strategic leader in space. Europe is at a crossroads.

It can no longer rely on traditional partnerships and must find its own way.

The aim of my remarks today is to outline how Europe's role can evolve, and how North Rhine-Westphalia, as one of Europe's most dynamic regions, as Europe´s heartbeat, can make a significant contribution as both a driver and a model for innovation. Because this own way of Europe in this new uncertain world should be used as a chance.

2. Europe's Strategic Role in a Changing Space Landscape

Space has become a vital domain for economic strength and political sovereignty. It underpins navigation, communication, Earth observation, climate monitoring, and disaster management.

Yet Europe still depends heavily on non-European systems such as GPS or Starlink - and that dependency carries strategic risks and risks for our national and european security. To safeguard our autonomy, we must secure our own access to space, in both launch capability and data infrastructure.

Our space assets face growing challenges: geopolitical rivalries, technological dependencies, and increasing congestion in orbit. To meet these challenges, Europe needs a united vision that combines autonomy, sustainability, and cooperation.
Programs like IRIS^2 and GovSatCom are important steps in this direction.

They aim to build secure, European-owned communication constellations that strengthen our sovereignty. But to be effective, the ESA, the EU, and national agencies must work hand in hand. Fragmentation weakens us; coordination empowers us.

The challenge is not one of technology – Europe already excels there – but of strategic determination. Space policy is not just science policy. It is industrial, digital, and security policy all at once.

That is why we need an ongoing dialogue between governments, industry, research, and society. Together we must address ethical and environmental concerns, while keeping space open, safe, and sustainable. Europe's ambition should not be driven solely by competition, but by the desire to make its voice heard – guided by responsibility, openness, and cooperation.

3. Germany and NRW in the European Context

Germany plays a leading role in European space programs – as an investor, a technology provider, and a policy driver. And within Germany, North Rhine-Westphalia occupies a truly unique position.

Cologne hosts the European Astronaut Centre of ESA, where human spaceflight and astronaut training are coordinated. Across Cologne, Aachen, and Bonn, several DLR institutes conduct world-class research and technology development. In Uedem, the Bundeswehr Space Command oversees military space operations and situational awareness - an increasingly important field. At the same time, universities such as RWTH Aachen, the University of Bonn, TH Köln, and the Fraunhofer institutes form a strong academic foundation.

The GovSatCom Hub currently being established in Cologne-Porz, in collaboration with DLR, ESA, the federal government, and the state of NRW, will serve as a key part of the European IRIS^2 program for secure satellite and quantum communication.

NRW's industrial base is equally impressive: over 80 companies in the region contribute to space projects, providing technologies in digitalization, sensors, materials, and advanced engineering. Many of them are "hidden champions" – small in size but essential to Europe's success in space.

Through initiatives such as the ESA Business Incubators in Aachen and Herten, and the HighTech.NRW startup accelerator, the state actively supports start-ups and hightech innovation. AeroSpace.NRW, acting on behalf of our ministry, connects research, industry, and strategic partners.

And since April 2025, our NRW Space Ambassador, Professor Dr. Reinhold Ewald, has been further strengthening visibility and cooperation across the aerospace community.

Few regions in Europe bring together civil, defense, and commercial dimensions of space activity as effectively as NRW. This makes it an ideal ecosystem for dual-use innovation and European collaboration.

4. NRW's Core Strengths and Capabilities

NRW's strengths lie in its technological excellence and its ability to connect disciplines. In materials science, lightweight structures, robotics, propulsion systems, automation, and digital twins, the region sets high standards. Around Bonn, cutting-edge communication technologies and cybersecurity expertise further enhance this ecosystem.

A dense network of small and medium-sized enterprises – from the automotive, mechanical engineering, and electronics sectors – stands ready to apply their expertise to space applications.

With ESA, DLR, and the Bundeswehr all present in the region, NRW forms a "strategic triangle" that brings together research, testing, and application.

The innovation scene is equally vibrant: start-ups are working on satellite data, AI-based Earth observation, and green propulsion technologies. Add to this the excellent logistics, infrastructure, airports, and international connectivity – and it becomes clear why NRW is one of Europe's best-prepared regions for the new era of space industrialization.

5. Opening Space to Non-Space Industries

The next wave of growth in the space sector will come from cross-sectoral integration. Many companies in NRW already have the know-how needed for space applications – even if they don't yet see themselves as part of the space economy.

Automotive suppliers, for example, bring precision engineering and lightweight materials. Machinery and robotics companies can enable automated satellite production. IT and cybersecurity firms can ensure secure data transfer and network management.

Our goal must be to lower entry barriers and open clear pathways into the space supply chain. We can achieve this through dedicated "Space Transfer Hubs" for matchmaking and knowledge exchange, through test and certification programs to prove the "space readiness" of products and through targeted support for dual-use innovation across civil and defense sectors.

In short: we want to help companies evolve – from earth to orbit.

6. Policy Outlook and Recommendations

To make this vision a reality, Europe needs strategic coordination. ESA, the EU, national, and regional authorities must align their goals and define shared priorities for space sovereignty. Civil and defense programs should be better coordinated to avoid duplication and strengthen Europe's capacity for action.

At the same time, we must foster innovation. Small and medium-sized enterprises deserve strong support to enter the space value chain. Access to funding for dual-use and crossover technologies must become simpler and more predictable.

And private investment will only grow if programs are stable, transparent, and long-term in nature.

7. Europe's Ethical and Strategic Responsibility

Europe's ambitions in space must reflect its core values: responsibility, cooperation, and sustainability. We must act as stewards of a shared ressource - ensuring that space remains a domain of peace and collaboration. Transparency and trust should guide all our actions.

We should actively promote international norms on space debris, dual-use technologies, and ressource exploitation - but in a way that avoids excessive regulation and supports competitiveness. And we must use space capabilities to advance the UN Sustainable Development Goals, particularly in climate protection and humanitarian response.

Ultimately, space is not only about technology or security. It is about responsibility, solidarity, and foresight.

"NRW's strengths lie in its technological excellence and its ability to connect disciplines. In materials science, lightweight structures, robotics, propulsion systems, automation, and digital twins, the region sets high standards. Around Bonn, cutting-edge communication technologies and cybersecurity expertise further enhance this ecosystem. ... With ESA, DLR, and the Bundeswehr all present in the region, NRW forms a "strategic triangle" that brings together research, testing, and application."

8. A Call for European Unity and Vision

The coming decade will decide whether Europe is a rulemaker or a rule-taker in space. To shape our own destiny, we must act with courage – the courage to invest in launch capabilities and infrastructure, the courage to collaborate across borders and disciplines, and the courage to lead by example – technologically, ethically, and politically.

North Rhine-Westphalia stands ready to contribute as an innovation hub, as a bridge between industry and science, and as a trusted partner in building Europe's future in space.

9. Conclusion – Shaping Europe's Future in Space

Europe's future in space will be defined by the choices we make today – by our collaborations, and by our convictions. We must ensure that this future is sustainable, sovereign, and guided by solidarity.

Regions like North Rhine-Westphalia enable Europe to reach for the stars responsibly, and for the benefit of our planet and future generations.

Thank you very much for your attention. I now look forward to your questions and to our discussion.

Reflections

Prof. Dr. Dr. h.c. Dr. h.c. Stephan Hobe
Director of the Institute for Air Law, Space Law and Cyber Law
at the University of Cologne

The Safety, Security and Sustainability of Space

We are only gradually becoming aware of the relevance of space for humanity. First, there is the tremendous scientific achievement, particularly on the part of engineers, that made it possible to send humans to the moon for the first time in 1969. Fifty years later, priorities have shifted. On the one hand, a large number of private individuals have joined the conquest of space over the past 10 years or so. This has gone so far that there is talk of transporting people and materials through space, mining resources on celestial bodies, experiencing weightlessness through non-orbital flights, and finally experiencing the solar system from a moon base or living on other planets in our solar system. That is one side of the coin, and it alone sets almost no limits to the imagination.

On the other hand, it is important to consider the military aspect of space utilization. Here, too, there are interesting new developments. Since the Second Gulf War in 1991, there has been no armed conflict that has not involved the use of space. The US Global Positioning System (GPS) was initially a purely military application. Today, space plays an essential role for the major space powers, the US, Russia, and China, but also for India, Brazil, and Israel. The legally fundamental Outer Space Treaty of 1967 stipulates in Article IV, paragraph 1, that neither weapons of mass destruction nor nuclear weapons may be used in space. Demilitarization goes even further on celestial bodies themselves, where, according to Article IV, paragraph 2 of the Outer Space Treaty, no weapons may be stored. The fact that the US, under President Trump, has established its own new branch of the armed forces for space, the "Space Force," is a clear sign of the increased military significance of space. While the idea of defending the country was already a goal under US President Reagan with his Strategic Defense Initiative, but was ultimately not implemented for various reasons, considerations are once again gaining the upper hand today that, in any case, give space a prominent role in national defense. Likewise, Germany recently adopted its Space Safety and Security Strategy that aims to "work with allies and partners and, based on international law, identify natural and man-made dangers and threats early on and protect and defend shared space infrastructure accordingly."

This is also a facet of achieving sustainability in space. It is becoming increasingly clear that care must be taken not only to use space in a variety of ways in the present, but also to be able to do so in the long term. However, it is now clear that more than 60 years of space travel have left debris behind, especially in the most heavily used orbits. In this respect, it is important to make a strong commitment to the sustainable use of space. It is known that around 130 million tiny pieces of debris are scattered across the most heavily used orbits, in addition to 36,500 objects larger than 10 cm and 1 million objects between 1 and 10 cm in size – objects large enough to render space objects such as satellites inoperable. It is important to make the currently non-legally binding "Space Debris Mitigation Guidelines" effective by complying with them and to strive to develop guidelines for the removal of space debris from the most important orbits that the space community can accept as a basis. Only then can the future of human use of space be sustainably secured.

In conclusion, it can be said that significantly greater use of space by civilian actors is to be expected in the future, that space will also gain increasingly significant military potential, and that humanity must make greater efforts to ensure the sustainability of its use, whereby existing contamination from space debris must be minimized as much as possible.

Dr. des. Marieluna Frank Dr. Arne Sönnichsen
Scientific Advisors for Space Policy, Institut für qualifizierende Innovationsforschung und -beratung (IQIB)

Accompanying Change in the Orbits: Rethinking Narratives, Sustainable Security and Shared Responsibility

Few policy fields are undergoing transformation as rapidly and as fundamentally as the orbital ecosystem. The expansion of satellite constellations, the increasing diversity of stakeholders, the geopolitical reconfiguration of spacefaring alliances, and irreversible dependencies on orbital infrastructures are reshaping how states, industries, and societies interact with orbital space. This accelerating change raises a central question: What do we need in order to guide and govern this transformation responsibly? The discussions at the BFL offered core insights that illuminate not only what kinds of capacities and capabilities are required for a secure, safe, and sustainable orbital future but also what "complementary capabilities" are useful to effectively accompany change in the orbits.

1. A Different Way of Talking about Orbital and Outer Space

First, there is the need to fundamentally rethink the way how we speak about orbital and outer space. Currently, established discourses are rather technical and insular, being largely confined to the "space bubble". However, considering its fundamental significance for modern societies, orbital space cannot remain the domain of engineers, defence planners or commercial actors alone but requires participation from the broader society. Social capital – meaningful civilian participation, room for controversy and contestation, collective awareness, trust and shared norms – matters just as much as financial investment. More general formats that open the door for public engagement as well as long-term investment in research, teaching and strategic communication are needed. Ultimately, this would contribute to a sustainable competence building to encounter the current skills shortage.

2. Recognizing the connection between ecological sustainability and security

The connection between ecological sustainability in the earth orbits and long-term security is more central than security debates usually acknowledge. Orbital infrastructures are often conceived solely as projection surfaces of geopolitical rivalries: as potential targets that must be protected, defended, and made resilient. Yet this focus is too narrow.

A credible long-term perspective on the orbital future must acknowledge that orbital infrastructures operate within an environment with a limited carrying capacity – an environment that can be degraded, congested, or destabilised. Every new constellation, every launch, and every fragment adds to the strain on an already crowded ecosystem. Misuse or unregulated activity does not merely increase technical risks; it can also heighten geopolitical tensions. Protecting infrastructure presupposes protecting its underlying scaffold - the orbits themselves.

These orbits consist of a limited spatial resource whose functionality can only be preserved if it is managed sustainably from the outset. If this ecological dimension is ignored, we risk sooner or later facing an orbital "repair maintenance backlog": a growing

need for remediation and clean-up that ultimately threatens the technical, economic, and security-related usability of the earth orbits. Long-term security in orbit is therefore inseparable from their ecological condition. Sustainability is not a parallel goal to security – it is one of its preconditions.

This perspective reframes security not as dominance, but as coherence, coordination and partnership. Effective orbital and space security, in this view, is less about building superior capabilities and more about safeguarding the long-term functionality of the orbital environment itself. Such a mindset is crucial for the preservation of both sovereignty and resilience in the decades ahead, and deeply connected to the purpose of strategic foresight: imagining and narrating all possible futures, anticipating future pressures, recognizing risks, and acting early enough to shape the trajectory of systemic change.

3. Security Through Cooperation and Foresight

Seen in this light, sustainability and responsible behavior in the earth orbits are not optional add-ons but long-term investments in security and stability. Orbital sustainability is therefore not a parallel concern to foresight; it is one of its core foundations and a prerequisite for any meaningful anticipation of the futures of space governance, security, and cooperation.

With large-scale investment expected in the orbital economy, we need more than technological momentum and security-policy ambition – we need a clearly articulated, long-term perspective for the maintenance and protection of orbital infrastructures. Earth orbits are not an infinitely available expanse but a limited resource whose long-term usability depends on responsible management, regulation and sustainable governance. If Europe and Germany aspire to build secure, high-performing and integrated orbital and space infrastructures for the long run, their planning horizons must recognize that orbital infrastructure management requires not only financial investment but continuous maintenance, monitoring, regulatory mechanisms and sustainable technical standards – ensuring that systems are not only launched but operated responsibly, replaced in an orderly manner and ultimately removed at the end of their lifetime.

It is therefore desirable – and ultimately essential from a security perspective – to avoid repeating in earth orbits the mistakes that are proven so costly on the ground. A realistic, future-oriented approach must consider the entire lifecycle of orbital systems, including deorbiting, traffic management and sustainable resource use. Only if we understand orbital infrastructure as a long-term project can today's promised billions truly translate into a robust, secure and strategically meaningful future in earth orbits.

4. Space Governance as a Complex System of Shared Responsibility

Finally, the space community has to be aware of its responsibility as space diplomats and multiplicators of two dominant narratives in international space politics: "Space as a battlefield" versus "Space as a realm of human cooperation and exploration." Preventing the prevalence of the battlefield-narrative, we need more space diplomacy, bridge-building between competing narratives and discourses, deeper transatlantic cooperation and innovative forms of engagement that foster exchange and collaboration between stakeholders.

Public perception plays a decisive role here. The majority of the population still views orbital and outer space as a shared space of peaceful cooperation. Preserving this perception requires inclusive governance and mindful communication and language that cultivate transparency, trust, participation and shared purpose.

The future of orbital and space governance must be conceptualized as a framework of shared responsibility. Sustainability, diplomacy and cooperation are essential strategic foundations for securing the orbital environment – and with it, Europe's future in orbital and outer space.

Prof. Dr. Mai'a K. Davis Cross

Dean's Professor of Political Science, International Affairs, and Diplomacy
and Director of the Center for International Affairs & World Cultures
at Northeastern University Boston

Europe's Space Paradox: Why Autonomy May Strengthen Transatlantic Ties

Europe stands at a defining moment in its space trajectory. In June 2025, the EU launched its Vision for the European Space Economy – the first comprehensive strategy to make Europe a global space leader by 2050.[1] This vision represents a paradigm shift, treating space as a complete economic ecosystem encompassing orbital infrastructure, in-space resource utilization, and even space mining. Alongside this, the proposed EU Space Act aims to replace thirteen fragmented national regulations with harmonized legislation, creating, in effect, a single market for space activities.[2]

At the same time, rhetoric about space militarization has reached a fever pitch. US President Trump has declared, "space is a war-fighting domain," and US Space Force promotes the slogan, "Always the predator, never the prey."[3] Russia may be developing nuclear weapons in orbit and China is getting closer to achieving dual-use space technology that could threaten space as a peaceful domain.

As the EU rapidly develops its space strategies for the future, will its strategic autonomy weaken the transatlantic relationship, or strengthen it? And are we really heading toward so-called Space Race 2.0, or is this actually an opportune moment?

I argue that Europe's evolving space architecture enables both independence and partnership simultaneously. And that the persistence of cooperation despite militaristic rhetoric reveals a deeper truth that policymakers ignore at their peril: space remains predominantly cooperative and treating it as inevitably conflictual risks making this a self-fulfilling prophecy.

Europe's Institutional Architecture

Europe's dual institutional structure – ESA for science and development alongside EUSPA for operations and security – has been criticized as inefficient. But this architecture actually enables the simultaneous pursuit of scientific cooperation and strategic independence, both crucial in a time of geopolitical turbulence.

ESA, founded in 1975 with an explicit commitment to "exclusively peaceful purposes," continues deep partnerships with NASA on the James Webb Space Telescope, the Artemis Lunar Gateway, and Mars exploration. The Gateway's HALO module, built jointly by ESA contractors and Northrop Grumman, completed primary construction in 2024. ESA is providing the Ariane 6 launch vehicle (successfully tested July 2024), the Orion service module, and Gateway habitation modules. With twenty-three member states, ESA develops Europe's space systems – from the Ariane 6 launcher to scientific missions exploring Mars, Mercury, and beyond – while maintaining deep partnerships on the ISS and Artemis program. Over 231,000 Europeans now work in the space sector.[4]

1 https://defence-industry-space.ec.europa.eu/vision-european-space-economy_en
2 https://defence-industry-space.ec.europa.eu/eu-space-act_en
3 Mai'a K. Davis Cross, "Why we don't understand what a space race means," OUP Blog, 17 December 2019.
4 Robert Schuman Foundation / European Parliament, "EU Space policy: an underestimated success," Policy Paper 611, 19 October 2021.

Meanwhile, EUSPA, officially launched in May 2021 with an unprecedented budget of nearly €15 billion for 2021-2027, develops independent European operational capabilities. It oversees Galileo navigation services, Copernicus earth observation applications, and GOVSATCOM secure communications. Most significantly, in December 2024, the Commission signed a landmark €10.6 billion contract for IRIS² (Infrastructure for Resilience, Interconnectivity and Security by Satellite). This multi-orbital constellation of 290 satellites represents Europe's third flagship space program and will provide secure governmental communications beginning in 2030. As EU Commissioner Andrius Kubilius stated at the signing: "We are under threat. Our communications are under threat. We cannot afford to be too dependent on countries or companies from outside the European Union."[5] Yet, IRIS² is explicitly designed to offer access and maintain interoperability globally, not to isolate Europe.

This dual structure combined with increased space capability makes the EU a more valuable partner to the US. Indeed, a capable, independent European space sector that emphasizes cooperation is powerful worldwide, setting the tone for the future of human presence in space.

The Cooperative Reality of Transatlantic Space Relations

Despite militaristic rhetoric, in actual practice, this is a deeply cooperative story. NASA has engaged in over 4,000 cooperative programs since the 1960s. The International Space Station (ISS) represents fifteen nations operating together for over two decades. NASA Administrator Jim Bridenstine captured this operational reality: "We can't do what we do without the support of our international partners. We want to do more than we've ever done before, and collaboration and cooperation is the way to get it done."[6]

This is not just talk. The Artemis program depends fundamentally on European contributions. The Lunar Gateway, set to replace the ISS as the largest civilian international cooperation project in history, represents deep technological interdependence that can-

not be easily unwound. Even the establishment of the US Space Force, which sparked concerns about militarization, has proceeded alongside continued deepening of transatlantic space cooperation.

Why does cooperation persist despite geopolitical tensions? Space operates at the extremes of human capability and aspiration. Precisely because establishing human presence beyond Earth is so difficult, cooperation becomes essential. As Stephen Hawking observed, "Space exploration has already been a great unifier. We seem able to cooperate between nations in space in a way we can only envy on Earth."[7]

The historical record supports this. Even during the 1960s Space Race, President Kennedy invited the Russians to work on a joint moon landing; Khrushchev accepted in principle.[8] That agreement paved the way for Spacelab, Apollo-Soyuz, Shuttle-Mir, and ultimately the ISS. Despite Russia's war on Ukraine, Roscosmos continues ISS participation until decommissioning in 2030. This persistence of cooperation even across lines of conflict demonstrates space diplomacy's remarkable resilience.

For Europe, this creates strategic opportunity. The continent's regulatory sophistication, commitment to sustainability, and emphasis on peaceful purposes position it as an essential bridge in international space cooperation. The EU Space Act's harmonized safety and sustainability standards could become the regulatory foundation other actors adopt to access

5 Jeff Foust, "Europe signs contracts for IRIS² constellation," Space News, 16 December 2024.
6 Jim Bridenstine, remarks at the International Astronautical Congress, 2018.
7 Mark Wall, "Stephen Hawking Wants to Ride Virgin Galactic's New Passenger Spaceship," Space.com, February 20, 2016.
8 Mai'a K. Davis Cross, "The Social Construction of the Space Race: Then and Now," International Affairs, 2019.

European markets and partnerships, projecting European values and norms globally through soft power in space.

Europe's Strategic Position

Europe's evolving space architecture positions it uniquely for the challenges ahead. The global space economy is projected to reach $1.8 trillion by 2035.[9] In 2020, eighty percent of the world's space economy consisted of commercial entities. This rapidly expanding commercial sector offers Europe opportunities that transcend traditional bilateral government relationships.

The June 2025 Vision recognizes this reality by establishing over forty concrete actions treating space as a complete economic ecosystem. It proposes a "Space Team Europe," a high-level forum bringing together member states, the Commission, EUSPA, ESA, space industry, SMEs, and research organizations. This inclusive approach leverages the EU's strength across governmental, commercial, and scientific domains simultaneously.

Moreover, Europe's emphasis on space sustainability serves both security and cooperation. Space debris, orbital congestion, and infrastructure vulnerability threaten the domain's long-term viability for all actors. European leadership on debris mitigation, responsible satellite design, and sustainable operations addresses collective challenges while enhancing European credibility and influence. Systems that enhance sustainability simultaneously reduce conflict risks and enable continued shared use of the orbital environment.

This is where Europe's institutional architecture proves its value, with ESA driving scientific cooperation and peaceful exploration while EUSPA develops operational capabilities, enabling autonomy while becoming indispensable to international partnerships and human aspirations in space.

"European leadership on debris mitigation, responsible satellite design, and sustainable operations addresses collective challenges while enhancing European credibility and influence. Systems that enhance sustainability simultaneously reduce conflict risks and enable continued shared use of the orbital environment."

The emergence of new space powers, particularly China, gives the EU an opportunity to bridge global divides. While US-China space relations remain constrained by the 2011 Wolf Amendment (effectively prohibiting NASA-China cooperation), Europe can help to maintain channels with both powers. ESA collaborates with China on scientific missions including the joint Einstein Probe and SMILE observatory while maintaining its deep NASA partnerships. This flexibility enhances rather than undermines transatlantic cooperation by providing alternative channels for engagement. And this can ultimately build resilience and reduce misperceptions in areas of space security.

Choices That Shape Trajectories

Looking ahead, Europe faces choices that will determine whether space becomes another arena of great power competition or demonstrates that cooperation remains possible amid strategic rivalry. First, rhetoric matters profoundly. European leaders should consistently frame space in terms of collective challenges and opportunities – sustainability, debris mitigation, climate monitoring, scientific discovery – rather than battlefield competition. This strategic communication keeps cooperative pathways open while positioning Europe as a responsible space power.

Second, to continue to lead the EU's space sector requires sustained investment, both financially and diplomatically. Through space diplomacy, the EU should maintain support for multilateral frameworks like the Artemis Accords, which now have around 60 signatories, providing platforms for inclusive cooperation beyond traditional spacefaring nations.

9 World Economic Forum and McKinsey & Company, "Space: The $1.8 Trillion Opportunity for Global Economic Growth," April 2024.

Finally, Europe can leverage its regulatory power strategically. The EU Space Act's harmonized framework could become the global standard for commercial space activities, much as EU data protection regulations have influenced global practice.

Conclusion

Europe's space strategy represents more than industrial policy or technological ambition, but an opportunity to demonstrate that strategic autonomy and deep partnership can be complimentary, especially when the aim is to prevent space as the next battlefield. The persistence of widescale international cooperation in space, despite militaristic rhetoric, shows that the draw of space as a fundamentally peaceful and cooperative domain remains strong. Space remains what the 1967 Outer Space Treaty declared as, "the province of all mankind." But that status requires active diplomacy, leadership, and strategic choices. As humanity's presence in space expands, the choices we make now will shape whether we usher in a new space age or succumb to a militarized space race. Given that we all depend on space for our daily lives and it is a domain indispensable to addressing climate change, the EU can pursue strategic autonomy, alongside transatlantic space cooperation, while leading the world in preserving space for all.

"Europe's space strategy represents more than industrial policy or technological ambition, but an opportunity to demonstrate that strategic autonomy and deep partnership can be complimentary, especially when the aim is to prevent space as the next battlefield."

Dr. Béatrice Hainaut

Researcher "Outer Space Activities", Institute for Strategic Research (IRSEM)
at the Ministry for Armed Forces, France

Europe's Shift toward Space Security and Defense: What is at Stake?

It has become increasingly clear to many Europeans today that Europe's defence and security are, above all, matters for Europeans themselves. This is reflected not only in rising defence budgets but also, for some, in the promotion of a European strategic autonomy vis-à-vis the major powers. Russia's invasion of Ukraine has acted as a catalyst after decades of underinvestment built on the so called dividends of peace. The return of war to European soil, and the threat of its expansion in one form or another, is reshaping both national and European priorities.

At the same time, our historic ally, the United States (US), is formalising its intention to influence Europeans' choices in response to what it depicts as our supposed *"civilizational erasure"*[1]. The newly issued US National Security Strategy explicitly identifies the activities of the European Union (EU) as an "issue". The American strategy therefore seeks to interfere in its internal affairs.

What lessons can be drawn from these geopolitical upheavals for Europe's space sector?

First of all, the war in Ukraine is rich in lessons. It started with a Russian cyber attack on the user terminals of the commercial satellite network KA Viasat, which was used in particular by Ukrainian military personnel and civilians. In twenty first century warfare, it is therefore not only a matter of destroying ground communication networks first (which indeed followed shortly afterwards) but also those in orbit.

At the request of the Ukrainian Minister for Digital Transformation, Elon Musk's company SpaceX rapidly made available to Ukraine the antennas required to use the Starlink connectivity constellation. Did this alter the course of the war? Did it strengthen Ukrainian resistance? It is difficult to say, but it is clear that this connection has become the backbone of Ukrainian military operations. Very quickly, the purchase of space based services multiplied: optical and radar imaging satellites (Maxar, Planet, ICEYE…), communication satellites (SpaceX, Eutelsat…), as well as satellites for the detection, geolocation, and characterisation of radio frequency signals (Hawkeye 360, Spire Global…). Of course, war is not solely a matter of space services. Nevertheless, this battlefield highlights the paradox of contemporary warfare: a mixture of older technologies with cutting edge capabilities. Ukraine needs ammunition, but also space services to use it effectively. Upstream, satellite derived data allow Ukrainian forces to plan their operations as effectively as possible. During operations, they enable the adjustment of artillery fire. Moreover, some drones – particularly those used over long distances – could no longer operate without satellites providing positioning, navigation, and timing (PNT). Ukraine's significant dependence on foreign commercial space services is far from satisfactory. This became strikingly clear during the episode in which Elon Musk had switched off Starlink to thwart a drone attack on Russian ships in 2022.

1 National Security Strategy of the United States of America, December 2025, 2025-National-Security-Strategy.pdf

Europe has drawn lessons from this. But what are we referring to when we talk about space in Europe? Are we referring to European countries? To the member States of the EU? Or to the member States of the European Space Agency (ESA)? Probably to each of them.

European countries may include States that are geographically part of the European continent but do not belong to the political and economic organisation of the EU. There are 50 countries in Europe, of which 27 are members of the EU. ESA meanwhile, has 23 member states, three of which do not belong to the EU (Norway, Switzerland, and the United Kingdom). Several governance frameworks coexist when it comes to how Europe does space: national, intergovernmental (ESA), and integration-based (EU). National logics can generate competition between States, as each is keen to defend its economic and industrial interests.

"The European shift toward space security and defense must contribute to counter the existential threat posed by Russia while, at the same time, to reduce the United States' ability to interfere in our strategic choices."

The EU, for its part, has made space a genuine European policy area, with competence shared with the member States (Article 189 of the Treaty on the Functioning of the EU – TFEU). In 2024, the EU appointed a Commissioner for Defence and Space. Although this portfolio is theoretically limited to defence industrial policy, the Commission's ambitions also appear to extend into the field of defence policy itself, which normally falls under the remit of the Common Security and Defence Policy (CSDP). Today, the Commission, through the Directorate General for Defence Industry and Space (DG DEFIS), leads numerous dual-use space programmes and projects such as the IRIS²[2] connectivity constellation.

On the ESA side, change is equally palpable. In November 2025, member States made strong financial commitments (€22.3 billion) for the 2026–2028 budget. A new initiative has also been introduced, *European Resilience from Space*, which will receive a budget of €1.2 billion. For ESA, *"The clear mandate for use of space applications for non-aggressive defence purposes signifies an historic change for ESA"*[2]. Indeed, until now, in addition to the reluctance of the member States, the ESA Convention – which encourages cooperation among member States for exclusively peaceful purposes – had excluded the development of technologies related to defence and security.

2 ESA Member States commit to largest contributions at Ministerial, ESA website : ESA - ESA Member States commit to largest contributions at Ministerial, November 2025.

Despite the sometimes complex relationship between the EU and ESA, the European Commissioner Andrius Kubilius, and ESA Director General Josef Aschbacher have demonstrated their unity in advocating for greater European space autonomy.

It is precisely this European "unity" that the current US administration views unfavourably as a threat to the US interests . Should the US withdraw from Europe's military defence, it nonetheless intends to "help Europe correct its current trajectory" . One can therefore expect increased American interference on our continent. European space programmes may equally face consequences if deemed detrimental to American interests.

The rise in national budgets in many European countries devoted to military space capabilities is a significant step forward. But it may also lead to greater procurement from American companies – whether for equipment or services – at the expense of the development of Europe's own industry. This will carry costs that are not merely financial. The technological choices made today will shape the Europe of tomorrow. And because technology is never neutral, it is increasingly used today for geopolitical purposes. In parallel, we can observe today a convergence between space technologies and digital technologies (Microsoft Azure and SpaceX's Starlink/Amazon Web Services and the Amazon LEO constellation). Yet, our daily lives, our economy, and our security rely to a large extent on these non-European systems. A recent example, albeit outside the strictly European sphere, should nonetheless alert us to potential threats to our strategic autonomy. Nine judges of the International Criminal Court were severely sanctioned after taking actions that displeased Washington. In addition to being barred from entering the US, they have been blocked from accessing some of their Microsoft digital services. The bottom line is that the European space autonomy should go hand in hand with the European digital sovereignty.

The European shift toward space security and defense must contribute to counter the existential threat posed by Russia while, at the same time, to reduce the United States' ability to interfere in our strategic choices.

"Should the US withdraw from Europe's military defence, it nonetheless intends to "help Europe correct its current trajectory" . One can therefore expect increased American interference on our continent. European space programmes may equally face consequences if deemed detrimental to American interests."

Tal Inbar

Strategic Aerospace and Missiles Research, Senior Research Fellow,
Missile Defense Advocacy Alliance

Securing Europe's Cosmic Commons: A Strategy for Autonomy in the New Astropolitical Age

Securing a sustainable and autonomous European space environment is an imperative that transcends mere policy, demanding a strategic response to a complex synthesis of astropolitical, technological, and conceptual challenges. The contemporary space domain is defined by escalating geopolitical competition, aggressive militarization, and the disruptive velocity of commercialization, necessitating an immediate and cohesive European strategy. The required outline of European action could be divided into these domains:

I. The Strategic and Geopolitical Imperative: Defining Autonomy

The core challenge for Europe is to solidify its space autonomy while strategically navigating the existing web of international security relationships.

- Sovereign Geopolitical Positioning: Europe must establish true sovereign capacity in space security policy. This involves carefully balancing strategic interdependence with key allies (e.g., the U.S. and NATO) against the absolute necessity of maintaining autonomous decision-making. This dual imperative is crucial given the major power rivalries (U.S.-China-Russia) and the ascendancy of influential non-state actors (e.g., SpaceX).
- Independent Space Domain Awareness (SDA): Strengthening the European Space Surveillance and Tracking (EUSST) framework is paramount. Achieving a robust, independent SDA capability eliminates critical strategic reliance on non-EU actors for essential situational intelligence, fortifying European sovereignty.
- Legal Harmonization and Technological Sovereignty: National fragmentation in space regulations must be resolved through the harmonization of EU Space Law, thereby creating a unified, predictable regulatory ecosystem.
- EU-NATO Coordination: The relationship with NATO requires delicate calibration. Deepening cooperation on space defense must be managed to ensure the EU retains its distinct autonomous decision-making capacity and the ultimate freedom to act independently.

II. The Conceptual Shift: Securitization of the European Space Enterprise

The transition from a purely civilian space policy to one that fully incorporates defense and security requirements is a fundamental conceptual and structural change for the Union.

- **Prerequisites for Independent Security:** Developing a fully independent European Space Situational Awareness (SSA/SST) capability is the foundational prerequisite for security. This capacity is vital for the **protection and resilience of critical space infrastructure** against evolving hybrid and kinetic threats.
- **Cyber Resilience and Redundancy:** Defending European space assets against sophisticated cyber threats is a core security function. This demands investments in high levels of resilience and operational redundancy to safeguard essential services, including Global Navigation Satellite Systems (GNSS), communications, and Earth Observation (EO) systems.

- **Integration of Dual-Use Systems:** This paradigm shift entails the integration of existing heritage systems (e.g., Sentinel and Copernicus) into Common Security and Defense Policy (CSDP) missions.

III. Counterspace Vulnerabilities and Risk Mitigation

Europe must proactively address the full spectrum of direct and indirect threats challenging its operational capabilities in orbit and beyond.

- **ASAT Threat Mitigation and Industrial Reinforcement:** Addressing the immediate threat posed by foreign Anti-Satellite (ASAT) capabilities (kinetic, cyber, directed energy) mandates a dual approach: **strengthening the European industrial base** and drastically reducing external supply chain dependencies for mission-critical components.
- **The Innovation-Security Nexus:** A critical challenge is the reconciliation of the open, dynamic nature of the European **NewSpace** ecosystem with the necessity of imposing strategic controls to protect vital national and European security interests.
- **Commercial Securitization and Risk Management:** The growing involvement of private operators in providing security services signals a trend toward **commercial securitization.** This requires the EU to develop robust frameworks for governance, liability, and risk management when delegating sovereign functions.

IV. The Economic and Industrial Base: Sustainability and Expansion

The long-term sustainability of European space operations hinges upon a competitive, resilient, and future-proof industrial base, capable of operating across all spatial regimes.

- **Integration and Industrial Champions:** The successful integration of European "New Space" companies is essential. This integration must specifically emphasize their role in **Access to Space** (launch services) and Earth Observation (EO) across all orbital regimes (LEO, MEO, GEO).
- **Ground Segment Resilience:** Securing the geographically dispersed European ground infrastructure against cyberattacks, jamming, and physical sabotage is vital for maintaining command and control and continuous data downlink capabilities.

- **Secure Connectivity and Autonomy:** The utilization of the EU's secure connectivity initiatives is critical to ensure the provision of resilient, encrypted communications for governmental and security users, further cementing **operational autonomy.**
- **Defining the Cislunar Domain**: Given the increasing strategic importance of the space between Earth and the Moon, the EU must preemptively **define the spatial perimeter of its security interests** within the cislunar domain and allocate the necessary resources for future protection and governance.

The pursuit of a sustainable and secure European space environment demands nothing less than **full Technological Sovereignty** and substantial, targeted investment in **resilient industrial capacity.** Future security efforts must strategically extend Europe's strategic presence into new domains such as the cislunar realm, while simultaneously reinforcing Europe's foundational role as a principled actor promoting responsible international norms for the peaceful use of the cosmos.

This article was written **before** the publication of the space strategy documents in Germany and France - and after they were published, a key part of the opinions presented at the Bonn meeting in October – received an official seal of approval. This is the case with France's space strategy – which emphasizes the area of Resilience and Defense, and with the German strategy - which emphasizes the need for close cooperation between Germany and NATO but emphasizes the strategic importance of developing independent German capabilities - including access to space.

Prof. Dr. Bruno Reynaud de Sousa
Assistant Professor at the School of Law of the University of Minho

Strategic Conditions for a Sustainable European Space Industry

For years, Europe has embraced the NewSpace paradigm. But as calls for strategic autonomy grow amid escalating security threats, this approach falls short. Europe must urgently rethink its space strategy to build a resilient, competitive industry - one that bridges the gap vis-à-vis U.S.-based commercial companies, while capitalising on its own strengths.

The transatlantic divide in space is stark. Over the past decade, the synergy of venture capital and government support has catapulted U.S.-based companies into leadership positions in several domains, namely launch and telecommunications. In contrast, Europe's industry, while advanced in specific niches, operates on a smaller scale, faces technological disadvantages, and suffers from funding challenges.

The United States boasts a dynamic commercial sector, fuelled by massive private investment and government contracts, enabling agile innovation and rapid expansion. Companies like SpaceX exemplify this, revolutionising reusability with the Falcon 9's first successful landing in 2015 – a milestone that has propelled the U.S. to lead global launches. In 2025 alone – the record year for launches – American operators conducted 173 orbital launches out of 301 reaching orbit, over twice China's 84 and dwarfing Russia's 15. SpaceX accounted for more than 160 of those. Europe, by contrast, managed just six launches, all from France, reflecting a more cautious, fragmented ecosystem dominated by aerospace and defence primes and public sector-backed providers. U.S. superiority extends to orbit, particularly Low Earth Orbit (LEO), where more than 14,000 active satellites reside[1]. The vast majority are U.S.-owned or operated, with more than 9,200 being active Starlink satellites – an order of magnitude ahead of Russia's 1,500 or China's 900.

Funding disparities exacerbate the imbalance. A 2022 McKinsey report highlighted that European space startups attracted €500 million in 2020 – nine times less than the $4.4 billion invested in U.S. counterparts. Even Europe's record €1.5 billion in venture capital for space in 2024, bucking a broader VC slowdown, remains a fraction of American levels. The Draghi and Letta reports underscore the problem[2]: the EU's 27 fragmented capital markets hinder investment. Furthermore, Europe's public space spending as a share of GDP stood at 0.06% in 2023, far below the U.S.'s 0.262% or even Luxembourg's leading 0.135% within Europe[3]. To close this gap, Europe needs a truly functioning capital market, as public budgets alone won't deliver the full range of resources required to meet the current level of ambition.

Transatlantic relations, once caricatured by Robert Kagan as "Americans from Mars and Europeans from Venus", have strained further amid trade disputes and the Ukraine crisis, risking a divide akin to separate

1 All satellite and launch data retrieved on 15 December 2025 from McDowell, J. (2025). Space Statistics (Jonathan's Space Pages). Retrieved 31 August 2025 from https://planet4589.org/space/stats/index.html.

2 Draghi, M. (2024). The Future of European Competitiveness: A Competitiveness Strategy for Europe, including "In-Depth Analysis and Recommendations" (Part B). European Commission. Retrieved 31 August 2025 from https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en Letta, E. (2024). Much more than a market: Speed, Security, Solidarity - Report on the Future of the Single Market. European Commission / Council of the European Union. https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf

3 European Space Agency. (2025). Report on the Space Economy 2025. ESA. https://space-economy.esa.int/documents/tJMabTj61KkdG-VOtF6SKw6wGSxicen6ajUWamCG3.pdf

solar systems[4]. However, both sides must be prepared for "DeepSeek moments" in space – disruptive shifts in which China's ability to develop space capabilities at speed and scale enables new milestones in launch and human spaceflight – as we have yet to see full innovation in space-based services (namely, telecommunications with satellite-based direct-to-device connectivity).

The question remains whether Europe will be able to muster the full range of resources to match the revised levels of ambition at the EU and national levels. To sustain a veritable European space industry and secure a meaningful level of strategic autonomy, an alignment between the public and private sectors is key. The EU is required to decisively embrace its role in market regulation and deliver certainty to all stakeholders by cutting red tape, unlocking private capital, and fostering innovation.

Whereas in the U.S., startup companies seem to be on a path to take over national defence from the primes, in Europe, a similar trend is not visible. As Europe navigates the challenges of integrating dual-use capabilities to achieve coordination and, subsequently, arrive at interoperability, one topic for debate over the next five years is how a European defence technological base for space could be configured. For the time being, there is one certainty: Europe's window to deliver speed and scale is narrowing, as the next five years will likely see the consolidation of U.S.-based supremacy in space.

"The transatlantic divide in space is stark. Over the past decade, the synergy of venture capital and government support has catapulted U.S.-based companies into leadership positions in several domains, namely launch and telecommunications."

4 Sousa, B. R. (30 September 2025). The Brussels Effect in orbit: can the EU Space Act reshape global space governance in an American-led era? Official Blog of UNIO. https://officialblogofunio.com/2025/09/30/the-brussels-effect-in-orbit-can-the-eu-space-act-reshape-global-space-governance-in-an-american-led-era/

Dr. Hendrik Fischer

Group Leader Industrial Policy, Department of Strategy and Communication,
German Space Agency at DLR

Space as a Strategic Opportunity for Europe

Space is no longer just an isolated place of scientific curiosity. It has become a critical part of our modern infrastructure. Navigation systems, financial transactions telecommunications, weather and Earth observation data: all of these things depend on our satellites these days. Our digital, networked world depends on the availability of space infrastructure. Therefore, space has long been a strategic ecosystem without which neither economic stability nor national security can be guaranteed. It is not surprising that space has already become an arena of geopolitical rivalry. Because of the strategic importance of space, China and the USA use their space capabilities as instruments of power.

In this context, Germany has also decided to pay greater attention to the importance of space: Russia's full-scale invasion of Ukraine has reminded us once again that space is not just about innovation and exploration, but is also essential for our security in Europe.

When we talk about space, we cannot forget to mention the Ministry of Defence's plan to invest 35 billion euros in space infrastructure over the next five years. As German Space Agency we are convinced, that the dual-use nature of many space technologies naturally makes coordination essential. Space policy therefore requires a holistic approach. In this context, the €35 billion decision by the Federal Ministry of Defence is particularly noteworthy, as it marks a turning point in space security policy: money is no longer the limited resource, instead it is time.

Germany is also taking on more responsibility within the European Space Agency (ESA). Over the next three years, Germany will contribute more than €5 billion to ESA programmes. This amount means that Germany remains the largest contributor to the ESA, accounting for around 23 per cent of its funding. This approach is in line with the German Federal Government's stated ambition for Germany to be the leading space nation in Europe.

As pointed out, Germany fully recognises the strategic importance of space. Based on the impressions I gained during the Bonn Future Lab on Strategic Foresight, I would like to draw particular attention to the following three strategic aspects of future space utilisation:

1. We need a resilient space infrastructure that not only detects attacks but also survives them. This includes expanding the capabilities of the Space Situational Awareness Centre, introducing rapid launch missions to quickly transport satellites into space and protecting terrestrial infrastructure for long-range reconnaissance and jamming by satellites.

2. We need a strong European space industry that does not rely on US launchers, Asian supply chains or foreign mega-constellations. For example, the European Launcher Challenge (ELC) and the Space Innovation Hub are important steps towards strengthening the European space industry. The European Launcher Challenge (ELC) promotes the transformation of the launcher sector towards more competition. The aim here is to increase the speed of innovation in the launcher sector and thus achieve greater competitiveness in the long term. In this regard, it is particularly pleasing that two German micro-launcher companies, ISAR Aerospace and Rocket Factory Augsburg, are participating in the European Launcher Challenge.

The Space Innovation Hub was established by the German government and the German Space Agency in order to better exploit the innovation potential of the German space industry. This platform brings together civil and military actors, start-ups, established companies, academia and public authorities with the aim of implementing innovative projects quickly and in a practical manner. The Space Innovation Hub supports innovative projects from the initial idea to market readiness, thus ensuring targeted funding.

3. We need a space governance model that is better suited to tackle the challenges of the 21st century. Because space must be better protected as an international common. In particular, space debris and increasingly crowded orbits pose a threat to the long-term and safe use of space. In this regard, the German Space Agency is committed to further developing the Outer Space Treaty to ensure that it supports a sustainable space traffic management system for collision avoidance, as well as the systematic reduction of space debris.

4. We need faster and better cooperation within Europe. Because Europe faces competition from other spacefaring nations, such as Russia, China and the USA. In order to be successful in this competition, Europe must speak with one voice more often and take European interests into account more than national interests. Germany, as the largest financier of space infrastructure in Europe, must boldly take the lead here.

Finally, I would like to mention a thought that occurred to me during my reflections on the Bonn Future Lab on Strategic Foresight 2025: Europe has everything it needs to be successful in the space sector in the future. We have not only intelligent but also motivated people in politics, industry, science and many other fields. We have the technical understanding and we now also have the budgets. There is no reason to assume that Europe will not be able to meet the future challenges in the space sector. In the end, it is important that we carry out the necessary reforms, work together better and do not allow ourselves to be distracted by particular interests. Now is the time to use this strategic opportunity together.

Prof. Dr. Heinrich Kreft

Amb. ret., Program Director China International Diplomatic Academy
German Foreign Ministry

The Race to Space. Europe in the Global Space Race with the US, China, Russia, and India

Until the 1970s, space travel focused on the moon and the competition for national prestige between the two superpowers, the US and the Soviet Union. After early successes by the USSR ("Sputnik"), the US finally won this competition with the manned moon landing. With the policy of détente and finally the end of the Cold War, a phase of cooperation also followed in space – symbolized by Soviet-American docking maneuvers in space and the joint operation of the International Space Station (ISS).

But 55 years after Apollo 11, competition in space has picked up speed again. Space is no longer purely a scientific domain, but a strategic arena in the global power struggle. In addition to the traditional space players, the US and Russia, China has developed into a leading space power, and India has also made significant progress in space travel in recent years. Europe, with its diverse space agencies and companies, faces the challenge of maintaining and expanding its position in this international competition.

How does Europe compare to the aforementioned players, and what opportunities and challenges does this present?

Space travel and its importance for national security and defense, but also for the economy as a whole, is at the heart of the national strategies of the US, the PRC, and India. A quote from US President Donald Trump exemplifies the new rivalry between the major powers in space: "You can't be number one on earth if you're number two in space."

With Copernicus and Galileo, Europe is one of the leading space nations in the fields of Earth observation, meteorology, and navigation – but it has significant deficits in the field of manned spaceflight and, above all, in the areas of security and defense as well as the commercial use of space. The role played by satellite communications in particular in the Russian-Ukrainian war and NATO's dependence on US capabilities in this area, coupled with growing doubts about the reliability of the US, are a wake-up call for European (space) policy.

But it is also about Europe's positioning in a key field for the future, as Mario Draghi also emphasizes in his report on European competitiveness. The global space industry exceeded the $600 billion mark for the first time in 2024, according to the latest Space Report from the US Space Foundation, a non-profit organization that regularly publishes analyses and data on the development of the space industry.

The growth of the space economy accelerated further last year, reaching 7.8 percent. The Space Foundation expects continued dynamic growth and forecasts a market volume of one trillion US dollars for 2032.

In 2024, commercial providers accounted for 78 percent of the global volume, with the remainder coming from government programs. Government spending on space travel rose by 6.7 percent to a total of $132 billion. The US alone invested $77 billion of this in national security and civil space programs.

SpaceX stands out among private space companies. Elon Musk's company alone carried out 81 of the world's 149 so-called orbital launches in the first half of 2025, i.e., rocket launches in which payloads are successfully placed into orbit.

This means that one launch took place every 28 hours last year. Europe, once a leader in this field, has only recorded two successful orbital launches from the Centre Spatial Guyanais (CSG) in Kourou, French Guiana, in 2026. At least Europe now has its own access to space again, which it had lost due to the delayed commissioning of Ariane 6 and the decommissioning of its predecessor model in 2023.

The battle for space is characterized by technological innovation, strategic importance, and economic potential. In the US, it is primarily private companies that have driven innovation in recent years. In addition to SpaceX, these include Jeff Bezos' Blue Origin and a large number of lesser-known start-ups, but Boeing, the former market leader, also continues to do good business with NASA. The secret to the US's success is a mixture of government leadership and private-sector innovation, which dates back to the opening up of space to private actors during the presidencies of Ronald Reagan and Barack Obama.

Not only economically and increasingly in terms of power politics, but also in space, it is China that has risen at record speed to become the US's biggest rival. Since the 2000s, China has made enormous progress with its own space programs, manned missions, lunar and Mars expeditions, and its own space station (Tiangong). Beijing achieved a pioneering coup in 2019 with the first landing on the far side of the moon.

Russia, a pioneer in space travel, also remains a major player, especially in the field of manned spaceflight and satellite technology. The US and Russia are still cooperating on the operation of the joint ISS space station. While the US wants to cease operations by 2031 at the latest, Russia plans to detach its own modules and use them as the nucleus of its own space station.

"Space is no longer purely a scientific domain, but a strategic arena in the global power struggle. In addition to the traditional space players, the US and Russia, China has developed into a leading space power, and India has also made significant progress in space travel in recent years."

With little attention from the global public, India has built up an efficient and cost-effective space industry, which is best known for satellite launches and scientific missions. In 2023, India became the fourth nation to successfully land an unmanned spacecraft on the moon.

With the European Space Agency (ESA), the EU's space program, and numerous national space agencies and private partners, Europe is a significant but, compared to the other players, rather medium-sized player with some strengths and considerable weaknesses. On the one hand, Europe has a strong industrial base, particularly in areas such as satellite technology, space technology, and scientific research. Internationally, the ESA works closely with international partners, primarily NASA and Elon Musk's SpaceX, and, until Russia's attack on Ukraine, Roscosmos. The focus has so far been on science and sustainability with satellite constellations (e.g., Galileo navigation system), Earth observation (Copernicus), and space research.

A major weakness is the large number of national space agencies within Europe alongside the ESA and the EU, which too often leads to coordination problems and inefficient resource allocation.

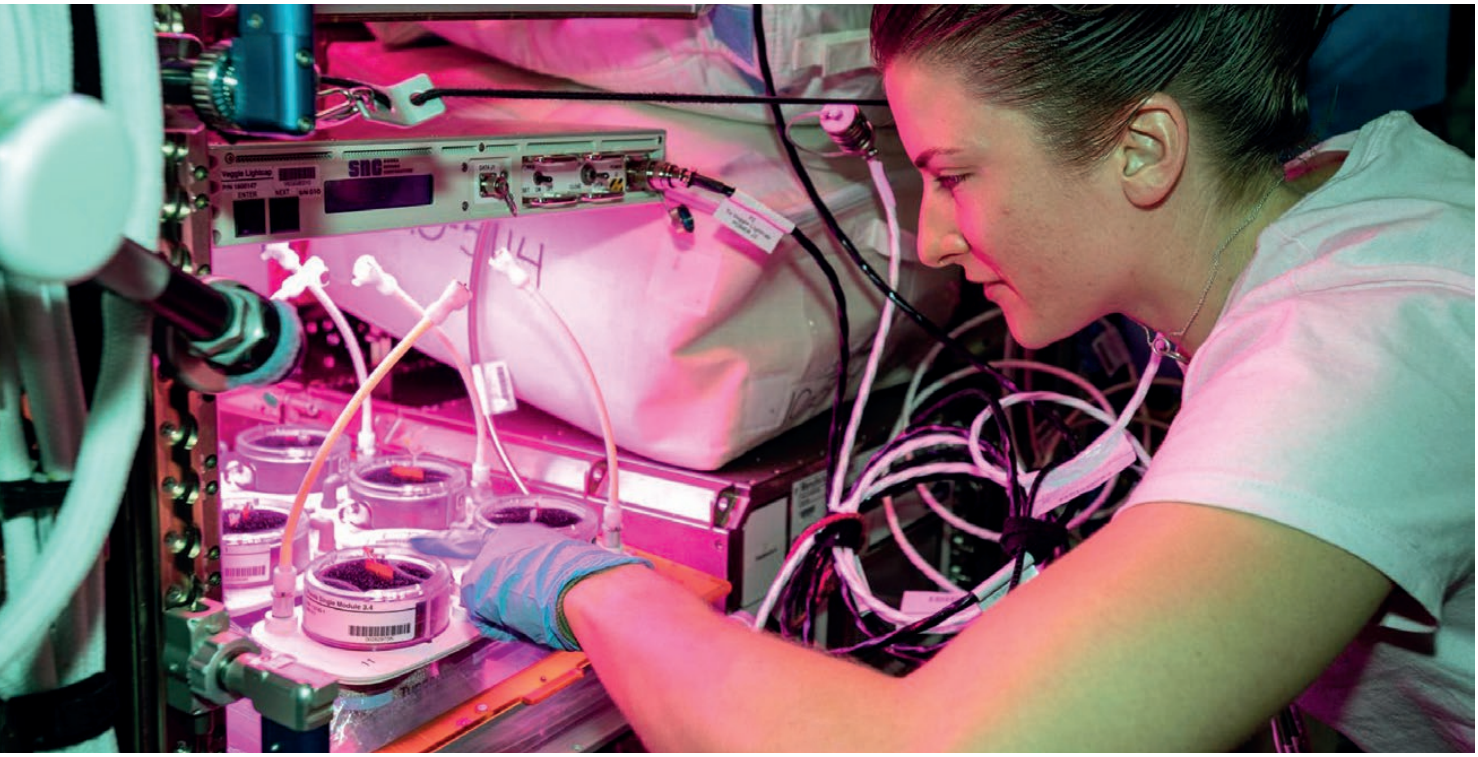
Another weakness, especially compared to American and Chinese competitors, is funding, which still comes from public coffers for 85 percent of the world's space programs. SpaceX also receives the majority of its contracts from NASA and the Pentagon. While Europe currently spends just 0.07 percent of its GDP, or around €14 billion per year, on its space activities, the US invests around five times as much through NASA and the Pentagon. Any increase in investment would have to come primarily from Germany, as Europe's largest economy currently invests only half as much in space activities as France.

Space travel is key to the future of Germany and Europe – it strengthens our industry across all sectors, secures technological sovereignty, and opens up new business models. In addition to the market leaders Airbus and ArianeGroup, which also includes the Bremen-based satellite manufacturer OHB, there are now German startups such as Isar Aerospace and Rocket Factory Augsburg, which are now involved in the dynamic market for space activities with their own technological developments.

The new federal government has recognized the strategic importance of space travel and has established a dedicated ministry for the first time, where Minister Bär also has her sights firmly set on space as part of her "High-Tech Agenda Germany." At the BDI Space Congress on October 25, Defense Minister Pistorius announced an investment of €35 billion in space projects by 2030.

It was moreover fitting that the last ESA Ministerial Council meeting took place in Bremen in November. Germany significantly increased its contribution to €5.4 billion. In addition, the EU Commission presented a draft "EU Space Act" in June, which sets the right priorities with a focus on competitiveness, resilience, and innovation.

"The battle for space is characterized by technological innovation, strategic importance, and economic potential. In the US, it is primarily private companies that have driven innovation in recent years."



PD Dr. Antje Nötzold
Senior Researcher, "Support for Arms Control in Space",
University of the Federal Armed Forces Munich

Dr. Enrico Fels
Managing Director of CASSIS

From Observer to Shaper: Germany Redefines Its Role in Space

Space as a Strategic Domain

Space today is far more than a site of scientific exploration. It has become a central arena of strategic competition among rivaling great powers – comparable to land, sea, air, and cyberspace. Its economic significance is expanding rapidly: the global space economy is growing at around nine percent annually and is projected to triple by 2035. At the same time, space holds immense security relevance. Modern states depend on secure satellite communications, precise positioning and navigation signals, and reliable Earth observation – both in everyday life as well as in crises and conflicts.

A failure of this critical infrastructure would have severe consequences: navigation services and air traffic would come to a halt, communication networks would become unstable, emergency and rescue services would be only partially functional, and stock trading could be suspended. Government agencies, armed forces, and intelligence services would likewise experience massive constraints on their ability to act. The conclusion is clear: space security is now an essential component of national and international security – and ultimately a prerequisite for the functioning of modern societies.

Space is also inseparably linked with global future challenges. Neither the 17 UN Sustainable Development Goals nor major global challenges such as climate change, food security, or early-warning systems can be addressed effectively without space capabilities. UN Deputy Secretary-General Amina Mohammed has aptly described space as the "foundation of our present and future."

Space as Critical Infrastructure and Political Domain

With the growing importance of space activities, the risks of strategic dependencies increase as well. Those who possess – and control – space-based communication and observation systems wield considerable influence. For Europe, and Germany in particular, maintaining technological and security-policy autonomy is therefore essential. Technological excellence is the foundation for this. Without top-level engineering capabilities, neither economic competitiveness nor security interests can be safeguarded. Yet technology alone is not enough. Strategic foresight, institutional learning, and close cooperation between academia, government, and industry are equally indispensable. This is precisely where the German government's new Space Safety and Security Strategy (S4) comes in.

Germany Repositions Itself – the S4 Closes a Strategic Gap

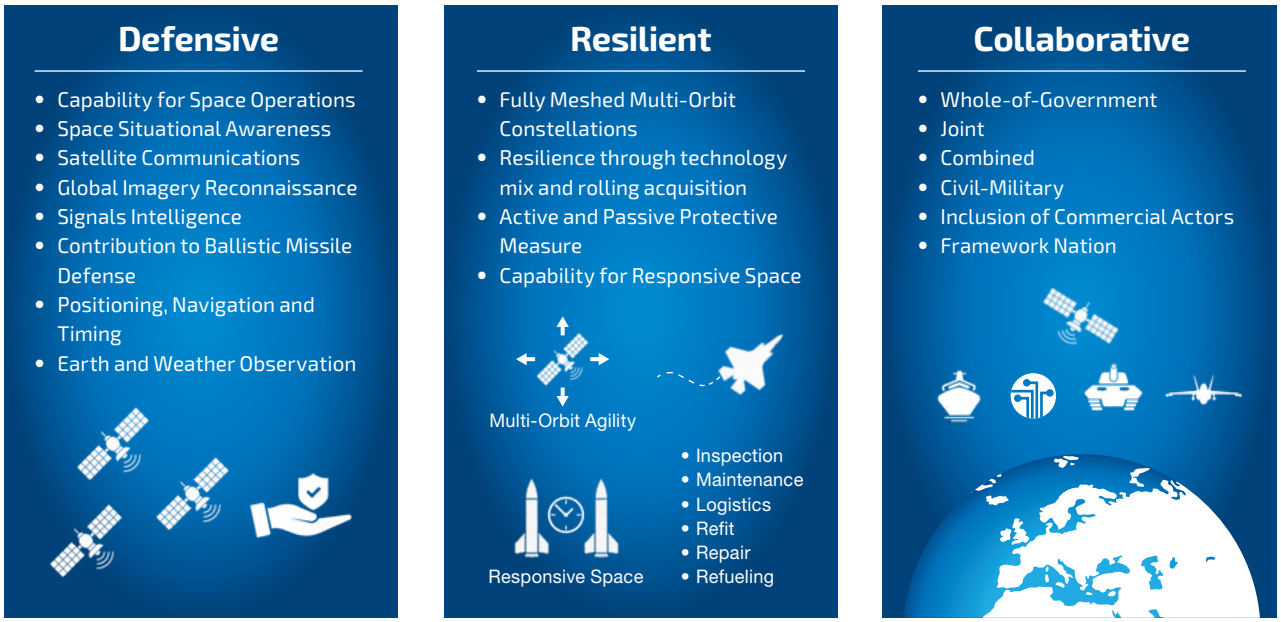
With this comprehensive strategy for space security, Berlin addresses a long-standing strategic deficit. While countries such as the United States, France, and the United Kingdom adopted dedicated space security and defence strategies years ago, Germany lacked a comparable framework. The S4 now provides, for the first time, a political-strategic foundation for a whole-of-government space security architecture – with a clear focus on protection, resilience, and defence capability.

At its core, the S4 emphasises the protection of German satellites and ground segments, the expansion of space situational awareness, secure communications, and the development of new in-orbit defence and protection capabilities. Germany does not intend to act alone but seeks to assume a leadership role within Europe – serving as what is described as an "framework country." The strategy aims to strengthen a German pillar within NATO and the EU and to intensify cooperation with partners. This includes the planned establishment of a European Space Component Command (ESCC) at the Bundeswehr Space Command in Uedem, which will conduct joint space operations with European partners.

Operational Priorities for German Space Security

The S4 realistically identifies the main security challenges: a global competition for technology, resources, and influence in space. An increasing number of states are developing their own constellations, and some possess so-called counterspace capabilities – such as jamming, laser dazzling, or even the kinetic destruction of satellites. Such actions would not only disrupt space operations but also endanger other actors by generating debris. Natural risks such as space weather, which can seriously damage satellites, add further complexity. The S4 addresses all of these hazards and sets out concrete measures to strengthen resilience. Germany places particular emphasis on international cooperation and close coordination within the United Nations, especially regarding the negotiations about international binding norms of responsible behaviour in space.

Figure 1 – Planned Space Safety and Security Architecture of the S4



Up to €45 Billion by 2030 – A Strategic Investment Programme

The S4 is not merely a conceptual document; it is backed by substantial financial commitments. By 2030, up to €45 billion is to be invested in space-related capabilities – around €35 billion in the defence sector and approximately €10 billion through other ministries. The Federal Ministry of Defence has presented a clear and coordinated implementation roadmap.

Key elements include:

- comprehensive single-picture space situational awareness,
- the ability to plan and conduct independent space operations,
- active protection and defence measures, such as ground-based lasers, jamming systems, inspection and watchdog satellites,
- and a responsive space approach enabling rapid replacement of failed (or destroyed) systems.

All new capabilities are to be designed to ensure interoperability and to avoid creating additional debris – a central contribution to the sustainable use of outer space.

Tailwinds for German and European Industry

The planned investments will also strengthen the German and European space industry. New satellite systems, monitoring technologies, and launch services will predominantly be developed by German and European companies. This generates value creation, know-how, and industrial resilience in a rapidly expanding global market. Given the dynamic growth of the space economy, failing to seize these opportunities would be strategically negligent. While companies outside Europe will continue to provide important systems, Berlin clearly aims to think and act in a European context in order to reinforce transatlantic ties. Public users are to gain faster access to innovative space technologies and services, with breakthrough innovations supported through instruments such as the Space Innovation Hub.

Ambitious, Balanced, and Long Overdue

In international comparison, the German S4 ranks among the most ambitious and comprehensive strategy documents in the field of space security. The federal government has clearly studied the strategies of other states in depth and crafted an independent, balanced and realistic approach. The financial scope surpasses European benchmarks and sends a clear signal: Germany intends not only to use space, but to taking the European lead to help shaping it.

The S4 also closes a troubling security-policy gap that has existed since the end of the Cold War. It is grounded in realistic threat assessments, clear policy guidelines, and long-term objectives. Crucially, Germany is now prepared to approach space as a strategic domain – one of technological innovation, economic value creation, and astropolitical responsibility. This is both prudent and necessary: only if Europe adopts such a strategic perspective can it safeguard its interests and values in space in a sustainable and autonomous manner. The S4 makes clear that Germany is determined to move forward.

Figure 2 – Strategic Priority Areas for German Space Security Policy

Dr. Susanne Heckrodt

Head of Department, Launch Systems,
German Space Agency at DLR

Jan Schnabel

Project Manager, Launch Systems,
German Space Agency at DLR

The European Launcher Challenge (ELC) Shaping Europe's Spacefaring Future

Space is important. Communication systems, material technologies and biological research have all been improved by the ability to reach space. Reaching space, or rather an orbit, has become less of a challenge over the decades: 2025 marked the first year in human history with over 300 orbital launches achieved – compared to a mere 86 launches in 2015, only ten years ago.

In 2025, two different European rockets achieved orbital launches: Ariane 6 and Vega-C both currently secure Europe's independent access to space. In addition, Spectrum attempted an orbital launch. Statistically, new rockets from a new launch provider almost never reach orbit on the first launch attempt – this was also the case with Spectrum. Overall, the first test flight was a success. The rocket lifted off successfully from the pad, a lot of important data was collected during the flight, Improvement steps for the future were identified and the launch site remained undamaged. Spectrum, developed by German newspace company Isar Aerospace is one of the current most promising privately developed European rockets to achieve the milestone of an attempted orbital launch.

"Rockets are the flagships of spacefaring nations, visible and awe-inspiring, with engine tests that ignite excitement and launches that inspire future generations. However, they are merely the means to an end – transporting payload such as satellites, space station modules, scientific experiments and spacecraft into Earth's orbit and beyond."

Short History on the European Launcher segment

Until the late 2010s, operational European rockets were only institutionally developed and funded: The European Space Agency (ESA) and its member states decided on the technical aspects of the rocket, including payload capacity, fuel and oxidizer mixture, engine characteristics and external boosters. Funding was assigned to European companies bound by the GEO-Return principle, which then developed and manufactured systems and subsystems of the launcher. These were subsequently integrated and tested with ESA conducting constant reviews through the process.

This work is challenging and time consuming on technical, political and legal levels. Different routes must be taken through development, compromises between states must be reached and funding must be adjusted. However, the European idea of cooperation is the cornerstone of these projects. Sovereignty in space transportation is expensive and only through cooperation can European countries achieve commercial and scientific success.

In the past, this concept worked well for Europe, with Ariane 4 having no major competitors and resulting in a huge commercial success due to increased demand. However, with the introduction of Ariane 5 in the mid-1990s, the world had changed. Competitors from the US and Russia had emerged and the satellite market did not develop as estimated. In 2014, the development of Ariane 6 was initiated by ESA and its member states. By the time the first Ariane 62 flew in the 2024, the world had changed drastically again. Six of SpaceX's Falcon 9 launched in 2014 compared to 46 launches in 2024, with significant upgrades resulting in a drastically increased payload capacity and the possibility of reusing the first stage multiple times. For Europe to be able to compete and cooperate with other spacefaring nations in the launcher segment and in the entire space sector, something had to change.

The Rockets' role

Rockets are the flagships of spacefaring nations, visible and awe-inspiring, with engine tests that ignite excitement and launches that inspire future generations. However, they are merely the means to an end – transporting payload such as satellites, space station modules, scientific experiments and spacecraft into Earth's orbit and beyond. This is the primary task of a rocket, providing reliable and cost-effective performance with sufficient availability to meet payload requirements.

This is where the European Launcher Challenge (ELC) comes in, symbolizing a paradigm shift in the ideology of rocket development and operation in Europe. The programme supports privately funded European companies, planning to launch small rockets into orbit. Instead of directly financing and developing rockets, ESA will purchase launch services as an anchor customer with preset requirements, such as payload mass and orbit. Additionally, ESA will co-fund capacity upgrades for the privately developed launch vehicles in a hands-off approach, with companies required to secure substantial private co-funding for those developments and bear the development risk. The goals of the ELC from a European institutional perspective are the three essential points mentioned above:

- **Reliability:** In the near future, there should be at least two launch vehicle suppliers for the small and medium payload class. This is a response to the European launcher crisis between 2023 and 2024, which was caused by Ariane 5's decommissioning, an unforeseen problem with Vega-C and the delay in development for the Ariane 6. As a result, European payloads were either grounded or had to pay a premium to be launched by spacefaring partners from outside Europe.

- **Cost Effectiveness:** The programme aims to shift the commercial and technological risk from the member states and therefore the taxpayers to the companies. This will incentivize companies to reduce development time and costs, find innovative solutions to compete in a constantly changing market and produce enough launch vehicles to meet demand. Companies will also be motivated to evaluate the market and decide whether a new launch vehicle for an increased number of payloads or larger payloads is necessary.

- **Availability:** With the increasing demand for launch options and capacity for satellite constellations, the ramp-up of launch vehicles after its inaugural flight must be steep and the production must be fast and effective. Companies participating in the ELC have already taken this into account when developing their launch vehicles, promising to meet this vital requirement.

The ELC is a milestone-based programme, with challengers required to prove to ESA until the end of 2027 that they can reach orbit. In the summer of 2025, five European companies were preselected by ESA based on their track record and success: Isar Aerospace (DE), MaiaSpace (FR), Orbex (UK), PLD Space (ES) and Rocket Factory Augsburg (DE). In November 2025, the ESA ministerial council took place in Bremen/Germany. The European support for the paradigm shift in launcher development was significant. Over 900 Mio. € (e.c. 2025) have been allocated to the ELC programme. In the context of roughly 4 billion € being allocated to ESA launcher programmes this is a significant commitment and trust to Europe's future in the launcher segment and space.

"The ELC is the correct answer to the challenges Europe faces in the launcher segment. Nonetheless providing continued support to the legacy companies and their employees involved in the development and operation of Ariane 6 and Vega is equally important."

The Future of Launchers in Europe

The ELC is the correct answer to the challenges Europe faces in the launcher segment. Nonetheless providing continued support to the legacy companies and their employees involved in the development and operation of Ariane 6 and Vega is equally important. These companies possess significant know-how, accumulated over decades and are currently the backbone of the European launcher market and Europe's spacefaring capabilities. Both approaches are crucial for now and the future to launch both small and large European payloads from Europe. It will be necessary to continue pursuing both paradigms of launch vehicle development for a time. Moreover, a challenge is always an opportunity. Legacy companies have the advantage of not having to make mistakes that the new challengers will inevitably face. Nonetheless, they will need to find ways to adapt to the new system and remain competitive on the new market. In the end, the goal is clear: autonomous, reliable and cost-effective access to space as a fundamental prerequisite for institutional and commercial space ambitions.

Sibel Öztürk-Baştanoğlu

Head of Division Western Europe, North America, European Policy Issues,
Institute for European and Transatlantic Dialogue, Hanns Seidel Foundation, Munich

Bavaria as a Test Case: Space Resilience in an Era of Geopolitical Competition

Since 24 February 2022, space has moved from a largely future-focused topic to an immediate security concern. Russia's war against Ukraine has shown how essential satellites are for communication, navigation and intelligence – and how quickly modern societies become vulnerable when these services are disrupted or attacked. GNSS interference that affects aviation and shipping, critical infrastructure and military operations is no longer an isolated problem; it has become a regular feature of today's conflicts.

Against this backdrop, Bavaria is more than just another space hub. It is a practical test case for a wider European challenge: can Europe build space capabilities that hold up in a crisis, while still competing with the United States and China? Bavaria acted early. In 2018, the Bavarian government announced that it would invest more than 700 million euros in space activities under the "Bavaria One" initiative. What started mainly as innovation and industrial policy is now increasingly linked to resilience and sovereignty. Germany's space security strategy and the EU's focus on secure connectivity provide the broader frame.

This changes how Bavaria should be assessed. The key question is not only what exists today, but what can be expanded quickly, connected to wider systems, and kept running under pressure. In other words: can ideas about "space resilience" be turned into functioning capabilities?

Oberpfaffenhofen: Operational Backbone

A core asset is mission operations in Oberpfaffenhofen. The German Aerospace Center (DLR) hosts the German Space Operations Center (GSOC), which has been operating and monitoring spacecraft since the late 1960s. At the same site, the Columbus Control Center runs Europe's ISS laboratory for ESA. What matters here is not the label, but the capability: a mature operations ecosystem with routines, redundancies and experienced teams that can keep missions running, diagnose anomalies quickly, and coordinate responses across partners.

This is also why ESA, DLR and the Free State of Bavaria are expanding the Columbus Control Center into a lunar mission control capability linked to the Lunar Gateway. Exploration is the immediate driver, but the strategic value goes further: Europe strengthens its operational autonomy in complex programmes, builds up know-how for future lunar infrastructure, and anchors key parts of mission control in a location that sits at the intersection of technology, industry and security policy.

Navigation and PNT: Managing Disruption

Since 2022, threats to satellite navigation have gained much more attention – not only for armed forces, but also for civilian infrastructure. Spoofing and jamming can affect aviation and maritime transport, logistics and timing services. Bavaria is responding by expanding its Galileo-related activities: DLR set up the Galileo Competence Center in Oberpfaffenhofen in 2019, and in 2025 construction began on a larger facility to expand capacity over the long term.

This makes the resilience debate more concrete. It allows research and testing to focus on practical needs: detecting interference, improving operational procedures, strengthening receiver technology, and ensuring that civilian users and security requirements are better aligned. The main question is whether these capabilities will become part of national and European routines – for example in aviation safety, critical infrastructure protection and military command systems – rather than staying limited to pilot projects.

"In today's geopolitical environment, Bavaria is not simply another space success story. It is a reality check for Europe: can Europe build capabilities that still function under pressure – in war, in hybrid disruption, and in long-term competition?"

European Sovereignty and Industrial Delivery

European "space sovereignty" is increasingly judged by whether Europe can deliver services – secure communications, intelligence and satellite constellations. IRIS^2 (Infrastructure for Resilience, Interconnectivity and Security by Satellite), the EU's flagship initiative for secure connectivity, aims to build a resilient communications system for governmental and commercial use. For Bavaria, the key issue is less on programme design and more on whether Europe can deliver at scale: ground infrastructure, terminals, certification and industrial capacity will determine whether IRIS^2 becomes a reliable service.

Bavaria is closely integrated into key stages of this value chain. Airbus Defence and Space points to Ottobrunn/Taufkirchen as an important site, including solar array production and clean-room integration facilities. MT Aerospace in Augsburg contributes to key supply chains for launch systems such as Ariane 6. These contributions are central to Europe's system capability and sovereignty: they help decide whether Europe can actually get launch and connectivity systems built and running fast enough – at the required scale, within tight timelines, and with the necessary security safeguards.

At the same time, familiar bottlenecks remain: ramping up production, ensuring enough testing capacity, finding skilled workers, and creating predictable demand through procurement and long-term programmes. Compared with the US, Europe has a smaller commercial market and the state plays a less decisive role as early customer. Compared with China, industrial capacity and state steering are less tightly linked. Bavaria cannot change these structural conditions on its own, but it shows where Europe is strong (for example, in high technology and quality) – and where implementation still falls short.

Dual-Use as the New Normal

Space and security are increasingly intertwined. This is especially true for communications, navigation and Earth observation. Bavaria has also responded institutionally. The TechHUB SVI (Security and Defence Industry) connects companies, start-ups and research. Since 2025, it has hosted a "military space" technology platform that aims to bring development, security requirements, certification and procurement considerations together earlier.

Whether this approach works depends on issues that matter across Europe: access to growth capital, regulation that protects security without slowing everything down, clear procurement pathways, and standards that enable interoperability. Bavaria brings useful pieces to the table – operational know-how, navigation and control infrastructure, industrial capacity and new coordination formats. The key test is whether these pieces actually translate into services that work reliably in everyday use and remain robust in a crisis.

Conclusion: Bavaria as a Reality Check

In today's geopolitical environment, Bavaria is not simply another space success story. It is a reality check for Europe: can Europe build capabilities that still function under pressure – in war, in hybrid disruption, and in long-term competition? Bavaria's strengths are clear: mission operations, Galileo-related expertise, industrial contributions and new dual-use interfaces.

Whether this leads to lasting resilience and sovereignty will depend on execution: scaling what works, fixing bottlenecks, and embedding Bavarian assets in national and European structures. This will determine whether Bavaria remains a regional success – or becomes a cornerstone of Europe's ability to act in space under real-world conditions.

Bonn Future Lab on Strategic Foresight 2025

Dr. Stephan Recher
Deputy Network Manager Space, AeroSpace.NRW

North Rhine-Westphalia: On Its Way to Becoming Europe's Next Space Hub

North Rhine–Westphalia (NRW) is in the midst of a remarkable transformation: a shift from industrial heartland to one of Europe's most dynamic emerging centers of space innovation. Long associated with steel, energy, and heavy machinery, the region is now positioning itself as a driver of technological sovereignty, security, and innovation for the 21st century. Backed by political resolve, a robust industrial backbone, and world-class research institutions, NRW is pursuing a bold mission: ensuring that Europe's path to space quite literally runs through Germany's most populous state.

Since 2021, the state government has formally designated space technologies as a strategic priority. With initiatives such as the AeroSpace.NRW cluster and the SpaceTech.NRW launched in April 2025, policymakers, industry leaders, and researchers are working more closely than ever before. As Minister-President Hendrik Wüst put it, "The path to space leads through North Rhine-Westphalia." That statement reflects more than rhetoric: it signals a long term strategy to strengthen Europe's autonomy in orbit while bringing future technologies – new materials, artificial intelligence, quantum technologies – into space-related production and applications.

"Investments in AI, satellite communications, advanced materials, and sustainable technologies can secure long term competitive advantages – if political leaders recognize what is at stake."

The infrastructure to support this ambition is already in place. Cologne hosts major research institutes of the German Aerospace Center (DLR), working on critical aerospace technologies, as well as the European Astronaut Centre (EAC), where ESA astronauts receive their training. LUNA, the lunar simulation facility is preparing Europe for future missions to the Moon and beyond. Adding to this ecosystem is the GovSatCom Hub under construction in Cologne-Porz – a €50 million investment by NRW that will anchor Europe's IRIS² secure satellite communications program. Meanwhile, the Space Situational Awareness Center in Uedem, jointly operated by the Bundeswehr's Space Command and the DLR, monitors near Earth space and protects critical civilian and military satellite infrastructure.

Industry, too, is accelerating. Many of NRW's long-standing small and medium-sized enterprises have quietly supplied German and European space primes for decades. Their products – mechanical and electronic components, production systems, advanced materials, high frequency technology, and cybersecurity solutions – are woven into Europe's space capabilities. A recent headline underscored the region's momentum: Rheinmetall and Finnish company ICEYE are establishing a radar satellite production line in Neuss, with the first satellites expected to support reconnaissance and security missions from 2027 onward. To help these players collaborate and scale, the AeroSpace.NRW network offers a platform for partnerships, research alliances, and new business models.

NRW's scientific excellence provides yet another pillar of this emerging space ecosystem. Aachen alone hosts two essential institutions: RWTH Aachen University – an internationally recognized excellence uni-

versity offering advanced aerospace programs and cutting edge research in aviation, space systems, and sustainable technologies – and Aachen University of Applied Sciences, whose practice-oriented aerospace programs feed directly into industry pipelines. Beyond Aachen, universities in Cologne, Bonn, Bochum, Dortmund, Duisburg-Essen, and Rhein-Sieg contribute engineering talent, research collaborations, and expertise in security technologies developed with partners such as the DLR. And at the tri-border region with Belgium and the Netherlands, the proposed Einstein Telescope – designed to study gravitational waves – could become one of Europe's most ambitious scientific projects. In short, NRW has evolved into an academic and research powerhouse – and an increasingly indispensable partner for the aerospace sector.

Cologne: Europe's New Heart of Secure Satellite Communications

If Europe intends to send its most sensitive data through space securely, it will soon pass through Cologne. The new GOVSATCOM Hub will operate as a control and service center for government agencies, security institutions, and critical infrastructure operators. As part of the EU's IRIS² mega constellation, the hub anchors Europe's push for digital sovereignty. Hundreds of interconnected satellites will ensure secure, resilient communications – and NRW will sit at the center of this strategic capability.

The decision to locate the hub in Cologne is a vote of confidence in NRW. Its proximity to the DLR and Cologne/Bonn Airport supports logistics and security requirements, while seamlessly extending an already vibrant aerospace ecosystem. But the project is more than a technical investment. A new innovation campus is planned around the hub – bringing together researchers, start ups, and industry. The result: new jobs, international partnerships, and an injection of momentum into the region's technology landscape. Digital security and quantum communication will be major pillars of the work ahead.

The Next Ten Years Will Be Decisive

NRW is poised not only to remain a production and research hub but to assume a central role in Europe's broader security architecture. Investments in AI, satellite communications, advanced materials, and sustainable technologies can secure long term competitive advantages – if political leaders recognize what is at stake. Space is no longer a peripheral topic. It is a strategic field on which Europe's economic resilience, technological sovereignty, and geopolitical strength increasingly depend.

Sabine S. Groth

Senior Ministerial Councilor and Head of the Office of the Hessian Space Coordinator

Hessen in Space – Turning a German Federal State into a Relevant Space Location

Introduction

Hessen, right at the heart of Germany and Europe, is known for its blend of tradition and modernity: the federal state offers a rich cultural heritage with numerous palaces, gardens, state theaters, museums, and libraries as well as a wide array of cultural experiences, from historical sites to modern art. And Hessen is a vital economic region, attracting business and innovation. The state benefits from its central location in the middle of Germany and Europe. Its efficient mobility sector, with the Frankfurt Airport, major railways, highways, and waterways, forms the basis for the state's strong economy. Especially the financial sector plays a key role for the hessian economy, and the bank towers in Frankfurt shape the city's modern face. As the most important site for modern data centers in continental Europe, with the powerful De-CIX Internet node and its outstanding competence in the field of cyber security, the state also sets the tone in the field of digitalization.

In addition to the state-financed institutions of higher education and private education centres, Hessen has a rich tradition of many highly competitive non-university research institutes. The wide range of expertise offered by the research institutes extends from natural sciences and medical research to engineering and the arts. These institutes are a major source of innovation and progress that reaches far beyond Hessen's borders.

"In Hessen, important space related research activities are carried out in numerous public research establishments."

Space and space related activities in Hessen

When it comes to space, Hessen has a lot to offer. Over the past years the German Land has become a relevant and a strong space location, with a great variety of stakeholders in the private as well as in the public sector.

With ESOC and with EUMETSAT, Hessen is also the home of two impressive and leading International, intergovernmental Organizations in the field of space: Already in 1967, the European Space Operations Centre ESOC as ESA's control centre, was established in Darmstadt. ESOC, "Europe's gateway to space" since its early days has been responsible for the operation of all ESA satellites and for the necessary worldwide network of ground stations. ESOC has so far provided operational support for more than 60 ESA satellites, among them Huygens, Mars Express, Rosetta, Envisat, GOCE and Herschel/Planck. The centre has also supported numerous missions of other national and International Organisations and plays a leading role for the mission control of the European Copernicus sentinels.

In 1986 EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites, was founded. EUMETSAT operates the geostationary satellites Meteosat -10, and -11 over Europe and Africa, and Meteosat-9 over the Indian Ocean. It also operates two Metop polar-orbiting satellites, is a partner in the cooperative sea level monitoring Jason missions (Jason-3 and Jason-CS/Sentinel-6) and exploits the four Sentinel missions of the Copernicus space component dedicated to the monitoring of atmosphere, ocean and climate, furthermore the Sentinel-3 marine, all on behalf of the European Union. In close

cooperation with ESA, these important earth observation projects are carried out.

Numerous universities, public authorities and companies in Hessen are involved in the most diverse aspects of space activities, in the application of space-related services and in the use of data stemming from space. From atmospheric research to space simulation facilities, robotic applications to novel propulsion systems - more than 50 different university institutes all over Hessen show an impressive portfolio in space research and technology, as well as in academic education.

In Hessen, important space related research activities are carried out in numerous public research establishments. The bandwidth of the research and development activities extends from the principals of physics to the application-orientated research in space infrastructures.

Numerous small, medium and large companies, in part well-known and interconnected globally, in part "hidden champions", in part active in regional and pan-regional markets, contribute with their space related products, services and processes to economic growth and to the creation of high-tech jobs in the state. Up to now, more than 100 private companies are part of the network "Hessen in Space".

These private companies – SMEs as well as industrial enterprises - offer the greatest variety of products used in space, for the use of space-based services and for services based upon space data. This broad range extends from research, development, manufacture and distribution of various industrial products like propulsion for spacecrafts and space probes, optical technologies, sensors, materials for harsh surroundings, via diverse enterprise-related services to technical advice, quality assurance and the certification of firms in the space industry.

In supporting innovative start-ups from or related to the space sector, the Centre for Satellite Navigation Hessen cesah GmbH and the ESA Business Incubation Centre in Darmstadt (ESA BIC) are important players. Cesah's focus lies on networking activities as well as the financial and technical support for start-up companies.

Hence, Hessen has a lot to offer in the space sector – and it is heading towards strengthening and further expanding its activities and networking for a strong, visible and powerful scientific and economic location for space.

Of course, Hessen is in competition with other German states and European regions and has to stand its ground. Our central concern is to actively shape the future of space in Hessen with the involvement of the stakeholders and to jointly advance the state in the space sector.

"Almost every single ministry of the Hessian state government is either actively involved in supporting space related activities in Hessen or in using space data or services based hereupon."

Hessen in Space – Space Coordinator and Hessian Space Strategy [1]

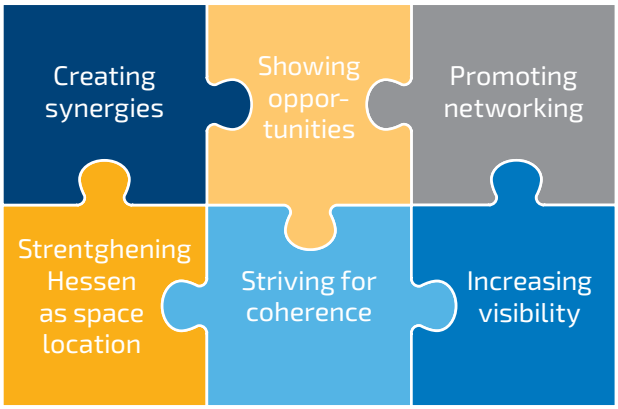
A milestone for the further development of its capabilities and its visibility as "Raumfahrtstandort" was the nomination of the space coordinator of the Hessian state government. With effect as of 01. August 2021, Professor Dr. Johann-Dietrich Wörner was appointed as Hessian space coordinator - unnecessary to explain why the Hessian state government chose Wörner – former president of the Technical University of Darmstadt, former chairman of the board of directors of the German Aerospace Center DLR and former Director-General of ESA. With Wörner, an excellent and well-connected person was entrusted, knowledgeable in the field of European space activities like no other, and in addition familiar with Hessen as a space location.

Among his first activities as space coordinator, Wörner invited all Hessian Ministries including relevant public authorities and agencies of the State of Hessen to exchange information on relevant space activities in their respective fields of competence. The outcome of this meeting was as surprising as it was encouraging: Almost every single ministry of the Hessian state government is either actively involved in supporting space related activities in Hessen or in using space data or services based hereupon.

The second step was the systematic search for stakeholders in Hessen in the field of space. This was followed by an evaluation of the stakeholder's activities and competences in the field of space. Based on a questionnaire, universities, research establishments, companies, public authorities located in Hesse were invited to describe their professional competences, products and activities on the one hand, and to formulate their expectations of the State Government of Hessen on the other.

Based on this evaluation, the Space Coordinator and his Office in the Hessian State Chancellery were able to get a very detailed picture of the space scene in Hessen, which in turn was an important prerequisite for the development of the Hessian space strategy.

1 More information can be obtained on the space coordinators website www.raumfahrtkoordinator.hessen.de (website currently only available in German language). The space strategy in English language can be downloaded here as well.



The process of strategy development was completed in a very short time. In just a few weeks, Jan Wörner and the author, as Head of the Space Coordinator's office in the Hessian State Chancellery, drew up the first space strategy in the history of Hessen. It was adopted by the Hessian Cabinet on 29 April 2022 and is oriented towards five core objectives, dedicated to the overall goal of strengthening Hesse as a space location:

The Hessian space strategy strives to strengthen the core competencies both in the country and of the state, and to use potential synergies in the interests of positioning the State of Hessen as a space location nationally, throughout Europe and internationally. Through targeted promotion and further development of skills and through the networking of the relevant stakeholders Hessen, aims at developing further its position in the space sector and make it more visible in technological and scientific areas. Though a meanwhile well-known and highly appreciated annual conference "Hessen in Space" as well as an annual experts symposium in the field of space law a strong network of stakeholders has been developed, supported by the participation in strategically important space and science fairs, such as the SpaceTechExpo and the W3+Fair.

The space strategy certainly forms an integral part of the Hessian innovation policies and cluster activities. Hence, the space strategy is embedded in the goals of the state government of Hessen regarding the promotion of education, science, research, technology and economy. It fits in with existing strategies such as aviation, mobility, digitalization, cybersecurity, environmental protection, climate change, agricultural policies, state planning and regional policies. And it is linked to hessian education policies, including promoting the STEM[2]-subjects, which again shows that space is an interdisciplinary topic.

Furthermore, the Hessian space strategy ties the Hessian space activities to the current and future space activities of the other German states, of Germany, the European Union and the European Space Agency ESA. The exchange with other European regions through NEREUS, the Network of European Regions using Space Technologies, of which Hessen was among the networks founding members, is very much oriented to an intensive national and international, above all European cooperation.

2 STEM: Science, Technology, Engineering and Mathematics

Dr. Stephanie Rith
Project Manager at TechHUB SVI - Bayern Innovativ GmbH

Bavaria's Strategic Efforts in Space and Defence: A Personal Perspective

Building a Strong Space Ecosystem in Bavaria

With the adoption of the Bavarian Space Strategy "Bavaria One" in 2018, the Free State of Bavaria has taken bold and deliberate steps to position itself as a European leader in the space ecosystem. This positioning has been driven by a combination of political will, strategic investment, and a collaborative innovation culture that bridges academia, industry, and government. At the heart of this strategic approach lies the deep understanding that space is not only a technological frontier but also a critical enabler of economic growth, security, and sovereignty. Bavaria's leadership understood early on that to remain competitive and resilient in a rapidly changing geopolitical and technological landscape, the state needed to invest in future-defining capabilities such as space technologies and subsequently defence technologies.

The 2018 "Bavaria One" strategy marked an important commitment by the Free State of Bavaria to space technologies. With funding of over €700 million, the strategy set out ten areas of action, including research, education, infrastructure, and startup support. One of its visible outcomes was the establishment of the Department of Aerospace and Geodesy at the Technical University of Munich (TUM) with the aim to develop it to be the Europe's largest aerospace faculty, with over 50 professorships and 2,000 study places. Its proximity to key industry players such as Airbus and the German Aerospace Center (DLR) has fostered a vibrant environment for applied research and talent development. Another important pillar is also the expansion of the DLR site in Oberpfaffenhofen, envisioned as a world leading hub for Earth observation activities, supported by significant public investment since 2018. Bavaria aimed to establish itself as a powerhouse in satellite navigation through the establishment of the DLR Galileo Competence Center in Oberpfaffenhofen. The decision to locate the European Moon Control Centre in Oberpfaffenhofen further reinforces this strategic trajectory to strengthen the Bavarian space ecosystem. Together with the European Space Agency (ESA) and the Free State of Bavaria, the DLR will evolve the existing Columbus Control Centre into a dedicated operations hub for future lunar missions.

The strategy from 2018 also identified emerging technology fields, such as quantum and information technologies for space applications, space robotics, and technologies for in orbit operations including servicing and satellite refuelling. It stated also the ambition to position Bavaria as a leading location for the development and production of launch vehicle technologies across multiple payload classes. This is a success that Bavaria has already achieved through its two leading micro-launcher start-ups, Isar Aerospace and Rocket Factory Augsburg, and the strong supplies companies such as HPS or the Augsburg based MT Aerospace for the European Ariane rocket program.

"Bavaria's leadership understood early on that to remain competitive and resilient in a rapidly changing geopolitical and technological landscape, the state needed to invest in future-defining capabilities such as space technologies and subsequently defence technologies."

From Research Excellence to NewSpace Entrepreneurship

In parallel with strengthening the universities and research institutes, Bavaria has cultivated a thriving NewSpace start-up scene. This began years ago with the ESA Business Incubation Centre (BIC) Bavaria, which was founded in 2004. Since 2009, it has received financial support from the Bavarian Ministry of Economic Affairs, Regional Development and Energy. Strong universities in this field, such as TUM and the University of the Federal Armed Forces in Munich, also play a major role with their own start-up support programmes. The support of space start-ups in Bavaria is underpinned by a robust support infrastructure for start-ups in Bavaria with public institutions such as Bayern Kapital and LfA Förderbank. Bayern Kapital provides venture capital through co-investment models with private investors, and is one of Germany's leading venture capital companies specialising in deep tech. Initiatives like BayStartUp and Gründerland Bayern offer business plan competitions, coaching, and networking opportunities, ensuring that innovative ideas can mature into viable enterprises. The Bavarian cluster initiative is also part of the Free State's efforts to strengthen the ecosystem. The Bavaria's Aerospace Cluster, managed by bavAIRia e.V., acts as a central platform that connects industry, research institutions, SMEs, and policymakers. At the same time, Munich Aerospace complements this ecosystem on the research side, bringing together TUM, the University of the Bundeswehr Munich, DLR, and Bauhaus Luftfahrt in a dedicated alliance that pools scientific expertise, advances joint research programmes, and reinforces the Munich region's position as a leading hub for aerospace innovation.

"In parallel with strengthening the universities and research institutes, Bavaria has cultivated a thriving NewSpace start-up scene. This began years ago with the ESA Business Incubation Centre (BIC) Bavaria, which was founded in 2004."

Expanding into Security and Defence: A Strategic Shift

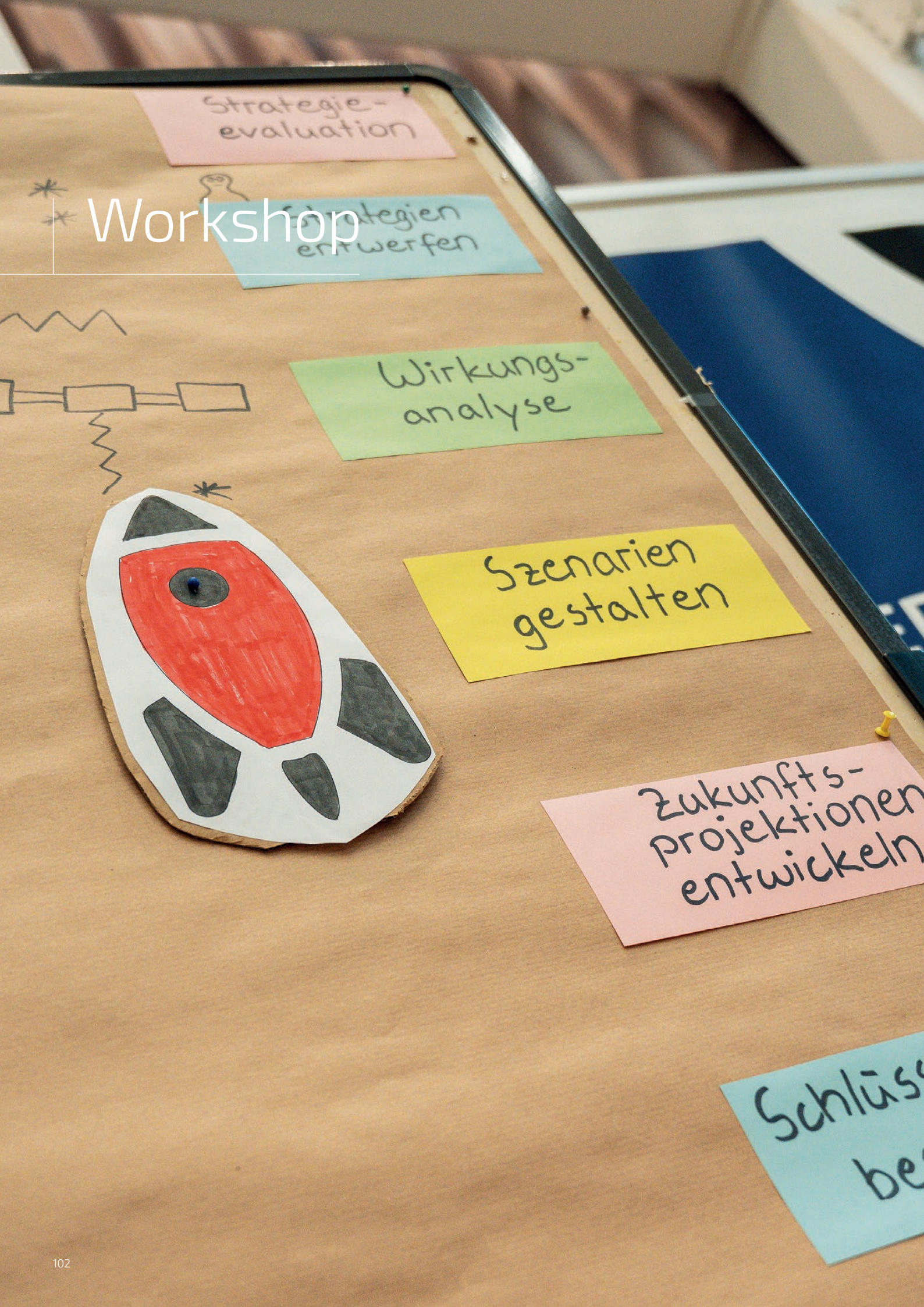
Over the last three years, the Bavarian strategic focus has expanded to include the security and defence industries more strongly and visibly. The establishment of the TechHUB SVI (SVI stands for 'Security and Defence Industry') at Bayern Innovativ GmbH in 2022 demonstrates Bavaria's dedication to aligning its technological capabilities with national and European defence objectives. This TechHUB SVI connects over 200 partners, including defence companies, startups, research institutions, and the Bundeswehr, fostering innovation in areas such as autonomous systems and military space. The establishment of the 'Military Space' technology platform within the TechHUB SVI at Bayern Innovativ in September 2025 highlights the recognition of the increasing significance of space technologies in defence and the increased strategic importance of space in military operations. The platform aims to support and connect the key players in military space technologies with focus on tangible applications. It specifically integrates Bavaria's strong expertise in the field of space and defence technologies from agile start-ups to established companies. Relevant experts are deliberately approached across all sectors. By promoting systematic exchange and joint projects, the aim of the TechHUB SVI with its technology platforms is to accelerate the development of highly innovative technologies and make a decisive contribution from Bavarian companies strengthening European sovereignty and competitiveness in military space technologies.

"Bavaria's early investments and ecosystem readiness have positioned it as a key player in the space and defence sector with exemplarily the Bavarian sites of Airbus Defence and Space, OHB, ArianeGroup."

The adoption of the German federal government's first space security strategy in November 2025 highlights the importance of maintaining and expanding operational capabilities in space, particularly within the military. Notably, the strategy identifies key areas of action that can now be addressed by various stakeholders within ecosystems. Bavaria's early investments and ecosystem readiness have positioned it as a key player in the space and defence sector with exemplarily the Bavarian sites of Airbus Defence and Space, OHB, ArianeGroup. This is further exemplified by start-ups in the launch sector, such as Isar Aerospace and Rocket Factory Augsburg and the highlighted role in the German space security strategy of the SPACE research centre at the University of the Federal Armed Forces in Munich. Germany's space security strategy can significantly strengthen the ecosystem, provided that the opportunities that arise are seized.

The Bavarian strategic course setting since 2018 offers a model for strengthening a resilient, innovative, and strategically aligned space and defence ecosystem. Looking ahead, Bavaria faces both challenges and opportunities. The global space and defence landscape continues to become more competitive and complex. For Bavaria it is important to remain agile, support the scaling of its startups, recognize and strengthen further the role of small and medium-sized supplier companies, and foster deeper collaboration across industries. Integrating expertise from automotive, IT, and AI sectors might be crucial for future space and defence innovations as well as the public engagement, political will and foresight.

Workshop


Strategie-
evaluation
Wirkungs-
analyse
Szenarien
gestalten
Zukunfts-
projektionen
entwickeln

Maximilian Schranner

Project Manager of the Bonn Future Lab and PhD candidate
at CASSIS, NATO Defense College Next Generation Fellow

Exploring Space Future(s) – The BFL2025

Strategic Foresight Workshop

The Idea
The aim CASSIS pursues with the Bonn Future Lab on Strategic Foresight is threefold:

1. Connecting international experts and practitioners on emerging security challenges and foster deep and open discussion among them;
2. Introducing German junior academics and young professionals – decision makers of tomorrow – to these unfolding themes in International Security and exposing them to the current world-leading debates around these issues;
3. And teaching these next-generation German leaders ways to think strategically about the inherent insecurities of the future.

The Bonn Future Lab thus plays the long game.
Instead of putting forth alarmism or producing hasty policy recommendations that will never see the light of day, CASSIS' flagship format influences the perception and decision-making capabilities of young, bright minds. One day, having scope to shape policy or confronted with challenging situations, they hopefully know how to think critically and in alternative scenarios, and can incorporate the existential security lens into their calculations.

Our approach at CASSIS is to tackle this broad vision by undertaking a strategic foresight process every year with a group of these young leaders on a relevant security issue of our times. This time, we focused on "Building a Sustainable Space" – thus, the myriad of challenges and opportunities posed by space.

Building on the input and exchanges with world-leading scholars and practitioners during an international conference day, the participants conducted a short, exemplary strategic foresight process. The main focus of this exercise is to introduce the young audience to the ontology of foresight and to structural thinking about alternative futures, rather than teaching the full catalogue of methods or producing appealing, fully finalized outcomes.

This summary of the Bonn Future Lab on Strategic Foresight 2025 Workshop will introduce our angle on strategic foresight, outline the workshop's procedure, and, finally, present the scenarios and strategic lines of action the group developed.

CASSIS' approach to Strategic Foresight

"Strategic foresight is a structured and systematic approach of exploring plausible futures to anticipate and better prepare for change. Strategic foresight is not about predicting a single future. It is about the analysis of plausible futures, which can support better policy making." (OECD). At CASSIS, we learned that rather than elaborating on ever more specific methods for different use cases and frequently exogenously producing scenarios for issues that seem relevant to us, the real game-changer in impact is the ontology to start with.

- There are no facts about the future. All the data we dispose of, and we might be able to analyse and extrapolate, is always dependent on the past and omits the uncertainty that comes before us.
- There is not one predictable future. From the vantage point of the present, there are multiple, if not infinite possible futures possible futures. They are unfolding in various, interlinking, and inherently complex directions. Some more probable, some less. Some things are very unlikely, but highly impactful.
- The goal of the game is not to uncover the entire range of futures in order to predict the future. The goal of Strategic Foresight is to think systematically about the possibilities that might unfold to be resilient and prepared for surprises, to detect challenges early, and to be ready to seize opportunities: To effectively handle the flux inherent in the occurrence of the future.

Understanding these uncertainties and the existential contingency the future poses for us does not lead to withdrawal into helplessness or simple reaction. If the future is not determined one way or the other, or it does not unfold in the way some want to convince us of – there is room to act and to shape events. And the one who understands the future(s) the best can shape it most effectively.

The Workshop

The entire workshop of the Bonn Future Lab 2025 effectively served the goal of conveying this understanding to a group of highly promising junior professionals and academics. The group consisted of nearly 30 participants from diverse backgrounds across Germany. The group included graduate students and young professionals from policy, administration, the military, and the private sector. Prior knowledge of space security varied; some worked on the topic actively on their own, while others shared a general interest in or an occupation related to security and were eager to dive more deeply into the mega issue of space.

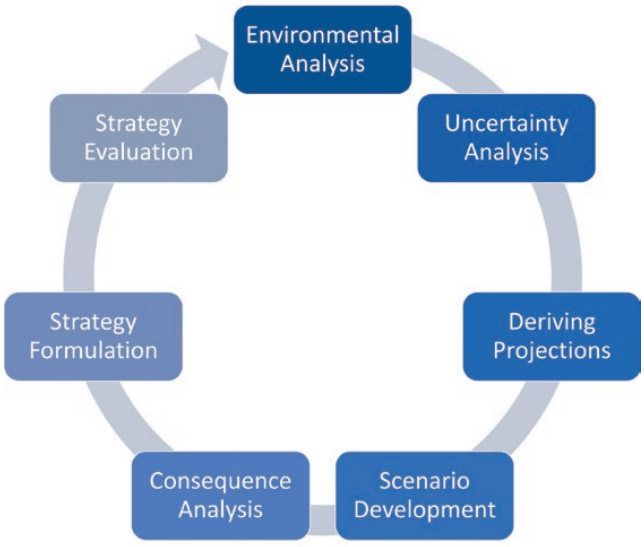
To lay the groundwork and prepare the group's receptors to meaningfully engage with and absorb the debates of the international conference day, the workshop began with a digital kick-off meeting. The participants first got to know each other, and the workshop team introduced the ontology of foresight and the basic guardrails of space security. In a lively conversation, CASSIS Senior Fellow and Germany's leading space security policy expert, Dr. habil. Antje Nötzold, took the group along for a critical tour de force of all things space.

During the digital kick-off, participants learned about the workshop's proceedings. The exploratory foresight should lead to alternative, insecure, and relevant scenarios, upon which strategic options for various political actors could be elucidated. The foresight exercise's aim was thus to explore possible futures of one specific topic. CASSIS pre-defined this topic as **"European Space Security 2040".**

In the days ahead, the participants would work through the following steps to arrive at coherent, relevant scenarios. The basis is the **environmental analysis.** In this, the relevant factors influencing the issue over the next 15 years are gathered. These factors undergo an **uncertainty analysis,** which identifies the most

pertinent and uncertain aspects. For the carved-out key factors, **projections** are drawn up – this is the first step in looking into the future. The projections form the frame of the scenarios, which were then designed and further explored in a **consequence analysis.** Based on that, the group could **draft strategies.** For the didactic goal of BFL2025, the workshop was designed mainly in a clear, qualitative way, allowing participants to easily follow each step's progress.

Starting with the digital kick-off and continuing as homework until the face-to-face workshop, the participants set out individually to identify impact factors. They were tasked with brainstorming and researching external factors influencing the topic. Which are the relevant factors that could still develop in the future



and at the same time affect the future under consideration? These factors of influence are the definable variables that constitute the workshop's view of the future. They are not projections or manifestations of how the future might unfold on their own, but rather the categories and elements that the group considers essential to the progression of the issue.

These factors were gathered digitally, and the input from the international conference day was included. The organizational team consolidated the set of factors by smoothing out duplications and clarifying single entries. Having gotten to know each other in Bonn, the first real workshop day began with an exercise to familiarize the group with all the individually gathered factors of influence. For this, the group was divided and all the factors assigned to one of the PESTLE (Political, Economic, Social, Technological, Legal, Ecological) categories. This was not aimed at weighing the factors or including one of each category in the scenario development, but to show the participants the variety and breadth of possible paths of influence on our topic and to get to know each factor.

From this gathering and sorting, the group had to choose key factors of influence, as the limited amount of time did not allow for all factors to be considered during the scenario development. In fact, such approach might not might not even desirable as many factors could prove to be only mediately relevant or are simply more or less certain in the future – **and why work on an irrelevant and anyway well-known scenario?** Hence, the uncertainty analysis looked for highly relevant and highly uncertain factors of influence.

Key Questions of the Uncertainty Analysis:

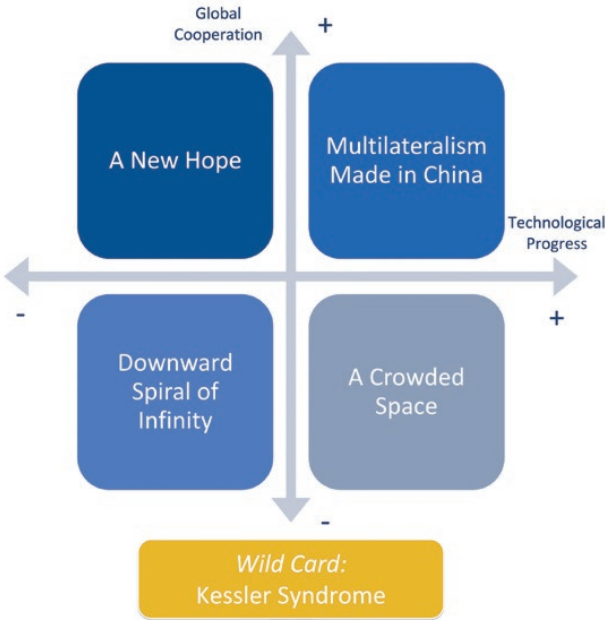
- Which of the elicited factors have a strong influence on European space security in the next 15 years?
- Is the factor's development predictable, or is the factor uncertain and could develop in different directions that need to be considered by the scenario team for further scenario development?

By simple voting, the workshop group identified seven key factors, all of which were uncertain and relevant. The group was once again split, then collaboratively came up with a maximum of three projections for each factor of influence. Here, the look into the future began. The groups were instructed to find alternative, creative, yet plausible ways in which the variable, as a factor of influence, could play out until 2040. Attention had to be paid to not only thinking from the present, but also to thinking big – a lot can happen in 15 years.

Key Factors found by the Workshop Participants

- Global Geopolitical Situation
- Militarization of Space
- Progression of AI
- Societal Resilience
- Availability of Critical Raw Materials
- Progression of US Domestic Politics
- Climate Change

How, then, can we proceed from this bunch of projections to meaningfully build scenarios? As the aim of the workshop was both to provide traceability for the participants and, ideally, to illuminate the edges of possible futures, the scenarios to be drawn were arranged along the lines of an alternative-scenario matrix. The groups were tasked with creating four scenarios along the axes of degree of global cooperation and technological progress. To convey that Strategic Foresight is not only about exploring future uncertainties and unknowns, but also to highlight vastly influential developments that get ignored, one fifth group built a wild card scenario on the "Grey Rhino" Kessler Syndrome.[1]



1 Bollien, Sebastian: Foresight-Phänomene. Im Tierpark der Strategischen Vorausschau, Bundesakademie für Sicherheitspolitik, in: https://www.baks.bund.de/sites/baks010/files/20230207_foresight-artikel_bollien.pdf, Februar 2023; Wall, Mike: Kessler Syndrome and the Space Debris Problem, in: https://www.space.com/kessler-syndrome-space-debris, 14.07.2022.

The participants were free to include projections of key factors of influence in their scenarios to draw up relevant and plausible stories of the future unfolding. By a short introduction into storytelling and usable templates, the participants learned that convincing storytelling is vital to deliver scenarios to decision makers. Harking back to the start: When there are no facts about the future, there is no data and external validity for scenarios.

After creating and presenting five exciting scenarios, the next step was the strategic part of strategic foresight. While each assigned one political actor, the groups searched for goals in these scenarios and were tasked with aligning them with the means available. To stimulate discussion and encourage thinking outside the box, Russia and China were two of the five actors the groups were to build strategies for. Strategy development happened along the following six steps:

- What is the **target vision** of the actor in the proposed future(s)? Which opportunities can you identify, and which risks may arise? Which state does the actor want to reach in 2040?
- Which are the most relevant and realistic **fields of actio**n to work on? Where does the actor have to prioritize to achieve the vision, given finite resources?
- Which concrete **measures** does the actor have to take in your strategies? Which steps are ahead in the fields of action?
- Who could be a **partner** for your actor on the global stage to reach the target vision?
- Which **risks** arise from the prioritization in your strategies? Do you ignore certain risks? Do new ones come up from the measures you take?
- Which could be **indicators** of success or early warning of failure in five-year steps, ever to update the strategy?

Conclusion and Outlook

The Bonn Future Lab 2025 workshop demonstrated that space is a highly relevant, if not the critical, arena of international security in the coming decades. The participants started their work from the vantage point of an ever-rising importance of and attention to the issues surrounding our planet. While the future importance is nearly certain, the workshop's outcomes highlight that the trajectories of how this importance might play out vary widely. European Space Security 2040 could play out as a success story or a tragedy – and both ends could comprise possibilities that decision makers and the public do not anticipate.

What becomes apparent is that both space is highly influential on the occurrences on earth, but the most influential factors on the development of space access, usage, and conflict found by the workshop are, too, not endogenous to the spheres over 100km in height. Society, the economy, ecology, and politics on the ground determine how humanity can use space effectively or end up in conflict. Furthermore, as the wild card highlights, the ecology of space use is as complex and unstable as the Kessler syndrome, which is both existential and not too improbable.

These two points highlight the importance of systematically engaging with the future(s). Things can go wrong quickly, but there is still opportunity for proactive decision-making. Different actors can influence the paths that lead to space futures – for better or worse. If European space security is to be sustainable, policymakers need to address the challenge of shaping the future. And this is only achievable if they have given it careful thought.

Scenarios

Multilateralism Made in China

In 2040, humanity's access to and use of space are governed by a global multilateral regime established under a benevolent hegemon. Conflicts in the different orbits are a thing of the past, as the once-chaotic environment of competing actors has been replaced by a tightly regulated framework that manages radio spectrum allocation, orbital debris mitigation, and equitable access to space resources. This new world order was made possible by China's technological and economic global leadership, as well as its growing credibility as a reliable partner.

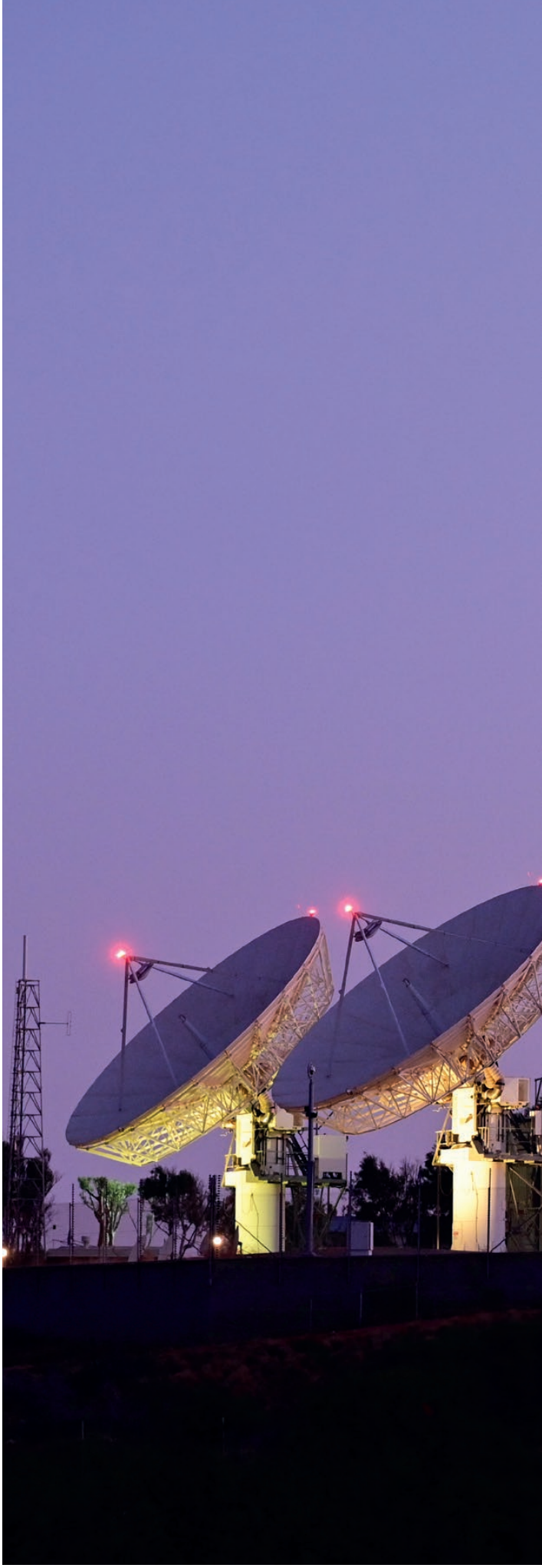
By the late 2020s, as many observers had expected, China's space economy had caught up technologically with leading private U.S. space companies. With significant developments in reusable micro launch-systems as well as on-orbit servicing, Beijing continued to strengthen its position as a leader in space through strategic investments in quantum-encrypted communication satellites and autonomous on-orbit servicing platforms.

Meanwhile, the traditional forerunner in space toppled in the early 2030s. In 2028, President Trump sought a third term, sparking severe unrest reminiscent of a civil war that dramatically shifted the US's focus to domestic issues. By force, Trump's quasi coup prevailed over the internal turmoil. Nevertheless, markedly weakened, the regime has to put a lot of effort into stabilizing its rule. Though large parts of the US business community initially endorsed the president's stay in power in the hope of hyper-liberalization, his erratic, in part contradictory policies aimed at regime survival were placing an increasing strain on the American economy. Its subsequent forced withdrawal from global power projection ultimately led to the collapse of the known international order. With NASA chronically underfunded and the Space Force reduced to an almost symbolic entity, the once vibrant New Space sector collapsed under financial and regulatory stress. Ventures such as SpaceX and Blue Origin either disintegrated or were nationalized in long-overdue bailout attempts.

"Finally stripped of its value base, the transatlantic alliance, once a fundamental pillar of US-European cooperation in spaceflight, collapsed."

Finally stripped of its value base, the transatlantic alliance, once a fundamental pillar of US-European cooperation in spaceflight, collapsed. Deprived of essential assets by its formerly most crucial ally, the European remainder of NATO could not prevent Russia's sobering complete occupation of Ukraine by 2029. However, the ramped-up European military spending at least sufficiently deterred Moscow from engaging in direct confrontation. In its defense industrial efforts, Europe had built up some strategic assets for space use, but it was still noticeably lagging behind great space powers. Russia, in spite of victory exhausted by a 15-year war effort, concentrated on economic recovery and was further burdened with the occupation of Ukraine. This resulted in a fragile Eurasian balance of power.

By 2030, The People's Republic of China had become the undisputed global leader in economics and technology. The dependence of the European states and the Russian Federation on Beijing intensified. After Xi Jinping died in 2032, moderate CPC cadres emerged, and China once again underwent strategic liberalization. This increased international confidence in Beijing. Space policy was a main pillar of this shift: Taking advantage of its technological leadership, China developed a new multilateral regime for regulating space open to third parties. The following European participation in said regime was driven not only by economic pragmatism but also by the clear integration of climate-oriented goals within space policy. China's active commitment to orbital solar reflectors for climate control, synthetic fuel production on the moon, and space-based carbon monitoring resonated strongly within the European Union desperate for ecological solutions. Through its leadership in this comprehensive framework in the following years, Beijing convinced its partners to extend the "Multilateralism Made in China" to more policy areas.



A New Hope

In 2040, a multilateral, but Washington-led International Space Agency regulates activities in and access to space. This is the result of a paradigm shift in the space sector, which once again put national governments at the forefront of all activities from ground-based infrastructure to LEO and to deep space exploration. Throughout the 2020s, private US firms, led by SpaceX leveraging its fully reusable Starship Ultra system, dominated the space industry. By 2030, essentially a monopoly had formed; almost no launches, missions, or communications in orbit were possible without the US space giant. Musk and his allies influenced U.S. politics by a tight grip on the Republican Party, seeking to shape strategic and industrial policy according to their oligarchic ambitions. Elon Musk tried to sway critics of his growing influence by emphasizing his desire to use his wealth and capabilities to promote international cooperation in space for humanity's greater and long-term good, occasionally even claiming the Nobel Peace Prize.

The turning point emerged in early 2031, when a domestically blocked US administration markedly escalated tensions with China and steered towards military confrontation through aggressive maneuvers and the relocation of significant assets. Influenced by admiration for strong autocratic leaders, economic reasons and fear of War III, Musk deprived the US government of its privileged access to SpaceX infrastructure, making large-scale military operations impossible. The US government viewed this as an attack on national sovereignty and reacted with the high-profile arrest of Musk and the seizure of SpaceX. This drastic step – combined with a freeze on government funding for private space companies – led to a rea-

"The turning point emerged in early 2031, when a domestically blocked US administration markedly escalated tensions with China and steered towards military confrontation through aggressive maneuvers and the relocation of significant assets."

lignment of space and technology policy, shifting the focus from vibrant private innovation and entrepreneurship to strict government regulation and even state ownership. Despite its clear economic and scientific drawbacks, the new strong-state strategy also created opportunities for diplomatic efforts, as the fragmentation of space actors were resolved and the government could now more directly leverage the U.S. space capabilities.

From 2034 onward, using its economic and technological dominance and building on the five space treaties conceptualized in the early phases of space exploration, the U.S. started drafting multilateral treaties to increase its influence over the space programs of allied countries. In exchange for cooperative security measures, intelligence exchange, and improved interoperability, these treaties promised technological cooperation and resilient access to space. For Western industrialized nations, especially the EU, participating in this regime was indispensable to achieving more stable conditions for their space-dependent economies. For them, the treaty system enabled long-awaited progress: in 2036, the ArianeNext reusable rocket entered service, finally allowing autonomous manned flight capability without the reliance on U.S. systems. Meanwhile, some developing and emerging countries also hoped to benefit from the growing space market through the treaties. In 2037, the International Space Agency was established as a Washington-led Western alliance with the potential to expand. It promised “A New Hope” for global space cooperation.

A Crowded Space

By 2040, the markings on the wall that were visible 15 years ago have become reality. Having once been a space of cooperation and the scientific aim for humanity's greater good, space has evolved into an arena of sheer power politics and arms races. Earth's technological and military superpowers are locked in confrontation.

The nail in the coffin for practical and benevolent cooperation in space were the US elections in 2028, which consolidated MAGA's leading role in D.C. In line with its isolationist ideology, the U.S. administration subsequently withdrew increasingly from international space projects and put ever more effort into increasing its own technological capabilities and military might. Massive investments went into autonomous defense satellites, laser-based orbital intercept systems, and next-generation reusable launch vehicles – in order to sustain America's technological edge towards the emerging civil and military space power on the other side of the Pacific.

Their rivalry was now widely described as the New Cold War. Space played a paramount role in the power struggle as both powers developed advanced space-based reconnaissance capabilities as well as early-warning space networks to gain a new perspective on the geopolitical chessboard. The logical geostrategic watershed followed in 2029, when these space intelligence assets made previously concealed military assets – such as submerged nuclear submarines – effectively visible. Ground warfare now more than ever relied on dominance in space. The consequences for the strategic component remain elusive and, fortunately, have not yet been tested…

Meanwhile, Europe could not solve its core challenges and still suffered from political division and internal rivalry: ambitious space programs stagnated as member states argued over financing and competen-

"Meanwhile, Europe could not solve its core challenges and still suffered from political division and internal rivalry: ambitious space programs stagnated as member states argued over financing and competencies. After effectively losing secure access to space when U.S. partnerships collapsed, the continent faced a strategic gap."

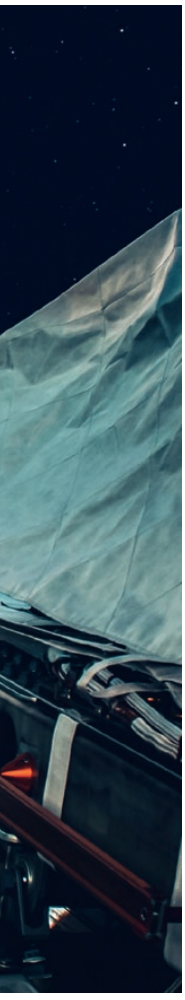
cies. After effectively losing secure access to space when U.S. partnerships collapsed, the continent faced a strategic gap. At least Germany and France successfully facilitated a bilateral heavy-lift rocket program by 2031, which secured a limited foundation of European sovereignty. This example showcases, that competition also intensified on the level below the two giants. For example, India and Japan launched ambitious independent mega-constellations for navigation and data relays in 2033 to consolidate their technological independence. The rising number of launches was increasingly overcrowding orbits, further intensifying competition. In 2031, the ISS, the last symbol of a more cooperative past, was abandoned and deliberately deorbited in a controlled manner, with no successor in sight despite early plans for commercial orbital platforms.

Finding themselves in a security dilemma, Washington and Beijing were committed to following each of their adversaries' steps in space, using any means necessary. Growing confrontation in the fields of intelligence and hybrid play led them on a path towards escalation. Following a surge in quantum-enabled cyberattacks on U.S. communications networks, several Chinese relay and surveillance satellites mysteriously failed in 2036. Thus, both parties began deploying offensive satellites capable of autonomous orbital maneuvering, electronic jamming, and anti-satellite intercepts, which were regarded as tools to deter further hybrid attacks. By 2040, the new military space race meant that technology had reached unprecedented levels of sophistication. Yet this progress came at a price: the technology landscape is heavily fragmented and dominated by military priorities, with only limited dual-use spillovers benefiting civilian or scientific applications. Space is no longer a realm of cooperation, but has become an arena for future “Star Wars”.

Downward Spiral of Infinity

2040 proved space capabilities to be Europe's Achilles' heel. As major powers shifted their focus away from the continent, Russia waged a war of aggression against the EU and even detonated a tactical nuclear warhead in Europe's Low Earth Orbit (LEO), generating a massive debris field that crippled navigation, reconnaissance, and communications across the continent. Although the long-term consequences remain unclear, Moscow appears to believe it can now decide the conflict through conventional superiority, having removed Europe's space-based technological edge.

The world entered this vicious spiral in 2026, when – foreseeably – the AI bubble burst. Western economies were severely shaken, triggering social upheavals in many countries. Despite the blatant failures of their promises, a group of techno-libertarian billionaires leveraged their remaining power to secure their ongoing influence and took hold of the U.S. Government. After the severe resistance was crushed, the United States re-emerged as an oligarchic state weakened by civil war, only superficially governed by a central authority. The control of critical orbital infrastructure and communication networks remained in the hands of oligarchic elites.



Amid the global economic upheaval, space innovation stagnated. Investments in reusable launch systems, lunar mining ventures, and on-orbit manufacturing projects evaporated. The collapse of once-promising AI-driven orbital traffic management systems led to a patchwork of manual oversight and outdated protocols for collision avoidance. Space actors thus focused on maintaining and repairing legacy satellite constellations to keep basic navigation and Earth-observation capabilities operational.

Simultaneously geopolitical tensions also ignited in the 2030s. While most European states kept democratic governments, the transformed U.S. buried the transatlantic alliance and also abandoned the multilateral frameworks that had previously governed orbital conduct. This regulatory vacuum was soon filled with distrust. Washington, Beijing, and Moscow, still unable to enhance their respective space capabilities because of severe budget constraints, instead increasingly engaged in destructive covert operations and hybrid attacks, not only, but especially in space. The total absence of effective governing bodies scared off private investors and cemented the stagnation of space innovation. Amidst this confrontational climate, Europe managed to sustain its legacy space assets – mainly weather, reconnaissance, and communication satellites.

With Europe being increasingly isolated, Russia seized the opportunity to launch a long-feared full-scale conventional attack in 2035 and quickly occupied the Baltic states. After those catastrophic losses, European militaries eventually managed to halt the Russian advance in Central Europe and Scandinavia. The remaining NATO command structures and Europe's more advanced military capabilities proved to be effective. Both sides entrenched themselves in a grueling five-year war of attrition. In 2040, with the war stalemated and his regime aging, President Putin thus authorized a self-destructive tactical nuclear strike in Europe's LEO to regain initiative by eliminating Europe's space-based technological advantage and plunged the continent into a downward spiral with no foreseeable end.

"The world entered this vicious spiral in 2026, when – foreseeably – the AI bubble burst. Western economies were severely shaken, triggering social upheavals in many countries."

Kessler Syndrome

For decades, many have warned of this cataclysmic scenario, but in 2040, many everyday processes and services taken for granted for decades – such as GPS navigation, global internet broadband, and real-time weather forecasting – have effectively become unfunctional. Chaos and uncertainty spread through the remaining media; the global financial architecture is inoperable; power grids have collapsed; and worldwide passenger and freight traffic are severely disrupted. Besides those drastic consequences for daily live, security and military actors were also severely affected by those disruptions. And all that came to pass due to noting more than orbital congestion: the tipping point of the Kessler Syndrome was reached.

How could this happen? By the end of the 2020s the fierce competition for technological and economic dominance between the U.S. and China increasingly reached the realms of space. In 2029, China and Russia initiated the deployment of their own extensive mega-constellations of satellites for secure communications, Earth observation, and navigation services in response to the already inflationary U.S. Starlink initiative. The Western response relied on ever expanding private firms, which addressed growing concerns about sustainability by highlighting their reusable launchers and on-orbit refueling. As the global space economy moved towards monopolies, space entered a new gold rush. The orbits got ever more packed.

"The debris caused a cascade effect that nearly dismantled all space infrastructure, ending the era of global satellite networks for the time being."

The 2030s began with a disaster that would be seen as a warning signal in hindsight. An unprecedented solar storm hit Earth, crippling parts of the global satellite infrastructure and setting back the development of space exploration by years. Several aftereffects in the form of collisions occurred, resulting in space debris blocking parts of the orbits and forcing operators to implement emergency deorbit maneuvers. Instead of cooperation for the common good, the shock fueled global competition, as the major powers saw the weakening of their rivals as an opportunity. The first to regain a foothold in space would be able to expand their relative power significantly. Both China and the U.S. therefore put novel, not yet fully developed AI-driven traffic-management systems for collision avoidance and orbital path planning into wide use. These systems temporarily enabled a rebound of space infrastructure.

However, the more responsibility that was given to these systems, the more complex the interactions in near-Earth orbit became. In 2040, a series of fatal software errors occurred when militarized autonomous AI satellite networks misinterpreted an accidental collision as an attack, initiating each other's destruction through directed maneuvers and proximity operations. This was the tipping point. The debris caused a cascade effect that nearly dismantled all space infrastructure, ending the era of global satellite networks for the time being. What had been narrowly avoided after the solar storm 10 years before had now come to pass: the "Kessler Syndrome".

"What had been narrowly avoided after the solar storm 10 years before had now come to pass: the "Kessler Syndrome"."

Strategies

Positioning China as a the leading Space Power

China should pursue a strategy aimed at consolidating its position as a leading global space power – technologically, economically, and symbolically – over the coming decades. This ambition is grounded in the assumption that sustained space capabilities will remain a central component of national power and international prestige. At the same time, long-term success will depend on China's ability to overcome technological constraints, geopolitical competition, and growing pressures for sustainability in the orbital environment. Strengthening domestic space capabilities therefore requires not only ambition, but also institutional resilience and strategic prioritization.

To operationalize this objective, the strategy should focus on three interlinked areas: space infrastructure, economic and industrial development, and security and stability. In the domain of space infrastructure, China should continue to expand national launch capacity through the modernization of spaceports, diversification of launch systems, and selective engagement with commercial actors. While such engagement can foster innovation and cost efficiency, maintaining strategic oversight remains essential to avoid dependency risks and preserve alignment with long-term national objectives. Flagship initiatives such as dense satellite constellations or a permanent lunar research presence should be pursued as long-term capability-building efforts rather than short-term prestige projects.

In the economic and industrial domain, long-term agreements on energy supply and access to critical raw materials with politically aligned partners could reduce exposure to external shocks and supply chain disruptions. Technological cooperation may function as a lever in these arrangements, although its effectiveness will depend on partners' willingness to accept asymmetric interdependence. Domestically,

"In the domain of space infrastructure, China should continue to expand national launch capacity through the modernization of spaceports, diversification of launch systems, and selective engagement with commercial actors."

further consolidation of space enterprises into larger and more competitive entities could strengthen market positioning, provided that efficiency gains are balanced against risks to flexibility and innovation.

In the area of security and stability, bilateral partnerships granting access to civilian infrastructure, logistics nodes, or tracking facilities in strategically relevant regions should be framed as mutually beneficial and transparency-enhancing, while denying any dual-use potential. This framing, however, will potentially face skepticism from competing space powers. Managing public perceptions should therefore be understood as an ongoing strategic task.

Enhanced international cooperation should focus on a limited set of reliable politically aligned partners. Russia, despite its constraints, remains a key collaborator due to its aerospace expertise and experience in long-term space programs. Belarus can contribute industrial capabilities and political alignment, while Pakistan offers opportunities for cooperative satellite programs and training exchanges. Together, these partnerships could serve China as a hedge against increasing geopolitical and technological fragmentation.

Finally, the strategy should incorporate mechanisms to monitor risks that could undermine long-term objectives, including technological decoupling, reputational challenges, budgetary pressures, and talent outflows. Relevant early-warning indicators include trends in satellite deployment and launch rates, the international diffusion of Chinese space technologies relative to U.S. alternatives, shifts in foreign investment, and the mobility of highly skilled personnel. Continuous monitoring would allow for incremental adjustment and reduce the need for abrupt strategic correction.

Germany as a Stabilizing Actor in a Volatile Space Domain

Germany should aim to position itself at the forefront of Europe's space activities by heading a alliance for multidimensional space capabilities. The main objective of this strategy is to actively shape international regulations governing space debris, liability regimes, orbital slot allocation, resource extraction, and space situational awareness, thereby safeguarding and advancing German and European interests. At the domestic level, Germany aims to strengthen its space economy, foster innovation, and support industrial leadership across critical sectors such as satellite systems, launch services, and propulsion technologies. High-visibility engagement, including the participation of a German astronaut in a future lunar mission under ESA's Artemis program, is intended to ensure popular support, enhance national prestige and demonstrate technological excellence. Together, coordinated European leadership, robust regulation, and domestic innovation are expected to achieve Germany's long-term strategic influence in space.

To operationalize this ambition, the strategy focuses on three areas of action: economy, foreign policy, and technology. From an economic perspective, Germany should expand the domestic and European space market through competitive bidding processes for large-scale projects. This includes flagship initiatives such as the IRIS^2 megaconstellation, with contracts awarded primarily to European companies to strengthen industrial capacity and reduce external dependencies. Public subsidies are seen as necessary to support industrial growth, maintain competitiveness, and enable companies to scale in an consolidating global space market.

In the field of foreign policy, Germany should seek to strengthen European sovereignty and stability by expanding and enhancing the resilience of its critical ground-based infrastructure, including telescopes,

"To operationalize this ambition, the strategy focuses on three areas of action: economy, foreign policy, and technology. From an economic perspective, Germany should expand the domestic and European space market through competitive bidding processes for large-scale projects."

ground stations, and launch sites. Acting as the largest contributor to the ESA budget is intended not only to secure influence within European space governance, but also to reinforce Germany's credibility as a leading stakeholder. The investment is both intended as a political signal and a practical instrument to shape strategic priorities at the European level.

Technological capability constitutes the third pillar of the strategy. Germany should prioritize the development of domestic launch capabilities in order to foster innovation and ensure independent access to space. Securing such access is considered essential for strategic autonomy, particularly in light of increasing geopolitical competition and the growing importance of space-based services for security, communication, and economic activity.

International partnerships are essential to achieving these objectives. Within Europe, close cooperation with the EU and ESA remains central to building a coordinated and technologically advanced European space presence. The U.S. continues to be an indispensable partner, even under challenging political conditions, offering access to joint missions, operational experience, and technology exchange. Partnerships with middle powers such as Japan, South Korea, and India provide opportunities for scientific and industrial cooperation as well as market expansion. Where security risks are manageable, selective civilian research cooperation with China and Russia may contribute to scientific progress and limited technological exchange.

The strategy faces several risks. Dependence on the United States may contribute to brain drain and technological reliance, while geopolitical competition with China could result in sanctions affecting access to critical raw materials. Rivalry with France may undermine Germany's capacity to contribute effectively to European sovereignty through the EU and ESA. Excessive regulation or insufficient market demand could weaken the domestic space sector, potentially indicated by declining interest from middle-power partners. Finally, limited public support for costly space initiatives could slow decision-making and provoke political criticism. Monitoring these risks and indicators is essential to enable timely adjustments and to safeguard Germany's long-term ambition to exercise sustainable leadership in a volatile space.

The EU's Strategy for a Regulated and Peaceful Space Environment

The proposed strategy for the European Union aims to establish the EU as a strategically autonomous actor within a peaceful and regulated space environment. This ambition is grounded in the assumption that long-term political relevance, economic resilience, and security will increasingly depend on reliable access to space-based infrastructure and the ability to shape the rules governing its use. The strategy therefore combines technological ambition with a strong normative commitment to sustainability and international cooperation.

To implement this vision, the strategy focuses on three interconnected policy areas: economy, research, and foreign and security policy. From an economic perspective, the EU should strengthen its space industry through targeted funding programs that

"Cooperation between research institutions, industry, and EU-level programs is necessary to ensure that innovation translates into operational capability and sustained competitiveness."

encourage joint ventures and cross-border cooperation among European actors. Initiatives such as "Buy European" are intended to secure supply chains, reduce dependencies on external providers, and enhance resilience in areas such as cybersecurity. At the same time, maintaining competitiveness and avoiding excessive market fragmentation will be essential to ensure long-term viability.

Concerning research, the EU should foster coordinated projects among member states and promote standardization its space sector. Common technical standards and interoperable systems could reduce duplication, improve efficiency, and support technological excellence. Cooperation between research institutions, industry, and EU-level programs is necessary to ensure that innovation translates into operational capability and sustained competitiveness.

Foreign and security policy constitutes the strategy's third pillar. Close cooperation with the U.S. and NATO remains central, particularly in the shared use of security-relevant satellite systems and the development of space situational awareness. These partnerships can enhance collective resilience and crisis response. At the same time, the EU should pursue dialogue with China and Russia in order to promote stability in space and prevent escalation. Engagement within the framework of a potential United Nations Space Treaty represents a key instrument for reinforcing the peaceful use of outer space, even if progress is likely to be politically contested.

A number of partners play an important role in supporting this strategy. The U.S. and NATO provide operational experience and strategic alignment in defense and space security. Japan, South Korea, and Israel contribute technological capabilities and strong research ecosystems that complement European strengths. The EU's space industry itself remains a central partner, forming the backbone for innovation, standardization, and resilient infrastructure.

The strategy faces several risks that could undermine implementation. Political disunity among member states may slow decision-making and weaken coordinated action. Over-regulation or insufficient competitiveness could hinder market development, while continued brain drain to the United States threatens Europe's human capital base. Persistent dependence on Chinese raw materials represents an additional structural vulnerability. Most critically, failure to achieve meaningful dialogue with the United States, China, or Russia on space governance could accelerate the transformation of space into a conflict-prone domain.

Early warning indicators for these risks include increasing competition and populism among member states, stagnation within the European space sector, declining engagement from international partners, and signs of an escalating space race between the United States and China. By monitoring these indicators and responding adaptive action, the EU can pursue its ambitious objectives while maintaining credibility and flexibility. If successful, this strategy would support a strategically autonomous, resilient, and cooperative European presence in space.

Russia's Power Projection and Hybrid Competition in Space

This strategy envisions Russia positioning itself as the dominant actor in Europe through maintaining a leading role in space. The overarching objective is to enhance Russia's ability to project power, constrain Western freedom of action, and reshape international norms. Space is understood as a critical enabler of this ambition, providing military, technological, and symbolic leverage in an environment of confrontation.

To achieve this, the strategy combines development advanced military space capabilities with political and economic instruments aimed at weakening cohesion within the EU, the U.S., and NATO. A central assumption is that Russia's relative strength lies not in economic scale, but in its willingness to employ coercive, asymmetric, and hybrid tools alongside selective technological leadership. Strategic cooperation with China is therefore a fundamental prerequisite for this approach, compensating for Russia's structural economic constraints while amplifying its global reach.

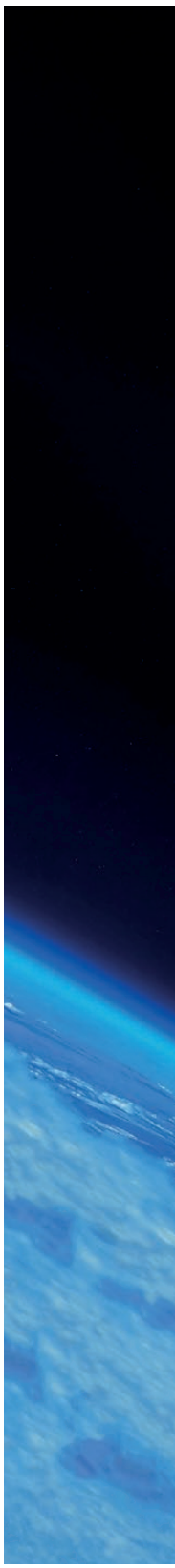
The strategy rests on three main pillars. First, Russia should expand its military space capabilities, with focus on research and development in advanced propulsion, surveillance, cyber, and dual-use technologies. This intends to increase coercive leverage over European states by enhancing Russia's ability to disrupt, threaten, or deny space-based services that underpin Western military and civilian infrastructure. State control over the space sector remains essential to align industrial output with national priorities to concentrate resources on strategic relevant technologies.

Second, Russia should leverage its strategic partnership with China and its position as a major energy and raw-material exporter in the field of industrial and research cooperation. This includes the development of alternative regulatory frameworks for space activities under a BRICS umbrella, which could challenge Western-dominated governance and reduce Russia's exposure to sanctions and regulatory constraints.

Third, in the realm of foreign policy, Russia should deepen alignment with China and other BRICS partners while simultaneously employing hybrid instruments like disinformation, influence operations, and cyber activities against the EU and the U.S. Especially by supporting pro-Russian and anti-democratic actors within Western societies as well as amplifying narratives critical of multilateral institutions, Moscow could weaken Western strategic cohesion.

Taken together, these actions aim to position Russia as a power capable of shaping international norms in a more competitive and fragmented space order. The strategy faces significant risks. Insufficient or inefficient funding of military space research could slow technological progress, with early warning signs including repeated launch failures, system vulnerabilities. Sustained Western balancing – reflected in high European defense spending, NATO-coordinated space investments, and continued support for Ukraine – poses a structural constraint on Russian ambitions. Especially prolonged conflict in Ukraine may limit Russia's economic and political flexibility, and also increase its dependence on China. Monitoring these indicators is essential to anticipate setbacks and adjust the strategy accordingly.

"Taken together, these actions aim to position Russia as a power capable of shaping international norms in a more competitive and fragmented space order."



Institutionalizing U.S. Space Leadership through Alliance-Building

Under a new administration, the United States should pursue a renewed, interest-based multilateralism to preserve its leadership in space. The objective of this strategy is to prevent China from achieving space dominance and drawing traditional U.S. allies into its orbit. To this end, the creation of an International Space Agency (ISA) is proposed as the core instrument to secure autonomous access to space for the U.S. and its closest allies, while simultaneously signaling renewed American reliability within the alliance. The ISA would serve both strategic and political functions. Strategically, it would consolidate space capabilities under Washington.-led coordination, reinforcing its technological and military edge vis-à-vis Beijing. Politically, it would function as a confidence-rebuilding mechanism after recent uncertainty. While ambitious, this approach assumes that the U.S could retain sufficient economic, technological, and political leverage to shape the future institutional architecture of global space cooperation.

Implementation should focus on three interconnected policy areas: economic and technological policy, resource policy, and public diplomacy. In the economic and technological domain, the U.S. should seek national control over critical space capabilities. This could include the use of security legislation, to align private-sector actors with strategic priorities.

This reflects the assumption that direct state influence may be necessary to ensure long-term prioritization of national security objectives. Substantial ISA funding would aim to support joint research, industrial development, and shared infrastructure across the alliance, including coordinated investments in equatorial launch facilities to reduce costs and distribute economic benefits among partners. In the area of resource policy, the strategy emphasizes joint agreements on critical raw materials and supply con-

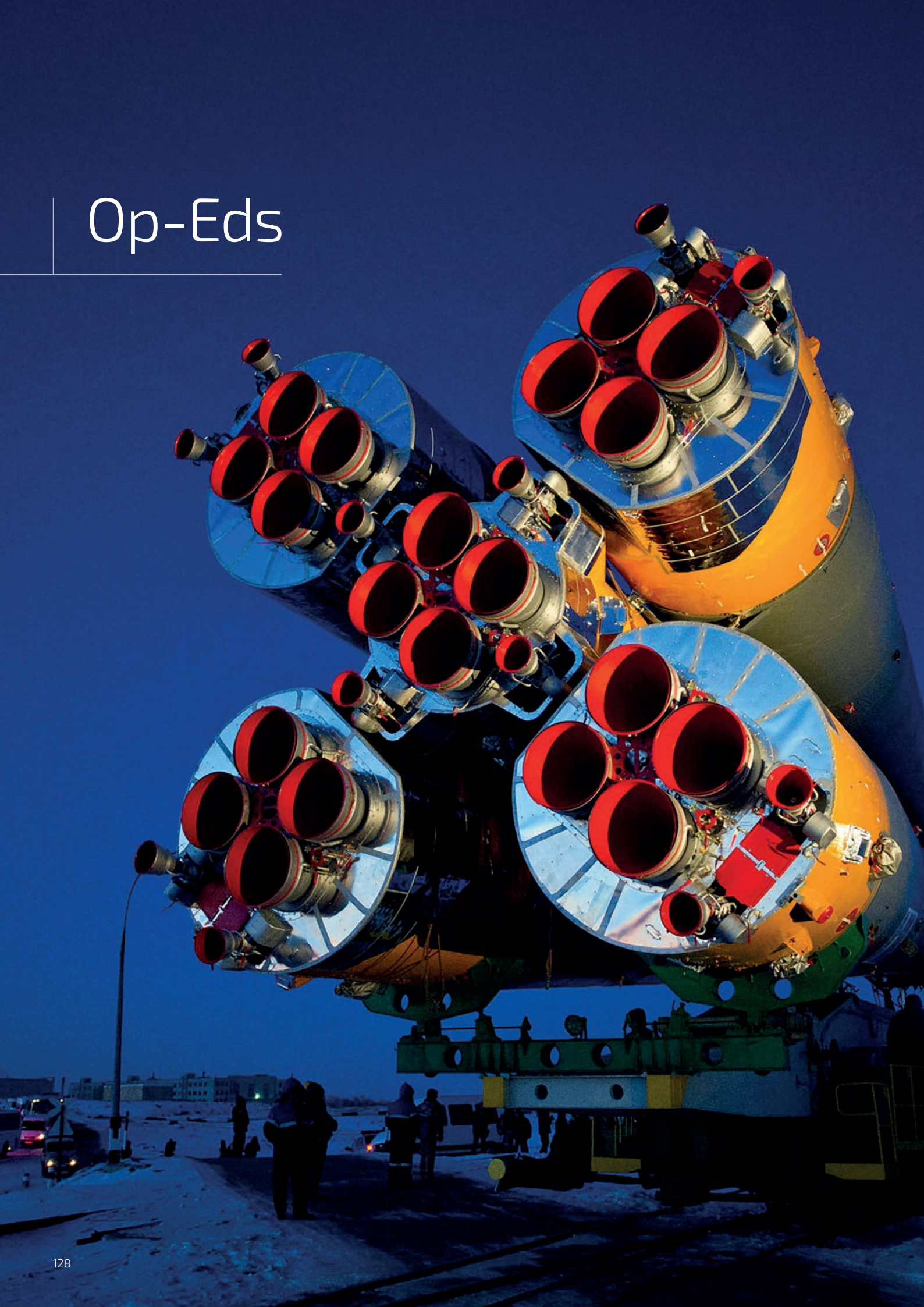
"Under a new administration, the United States should pursue a renewed, interest-based multilateralism to preserve its leadership in space."

tracts among ISA members. Such arrangements are intended to reduce strategic vulnerabilities and limit China's leverage over space-related supply chains. In public diplomacy, the ISA's success should reaffirm Western cohesion and reinforce the narrative of the United States as the central architect of a robust space order.

A phased partnership architecture anchored in U.S. leadership is central to achieving strategic impact. In Europe, priority partners include the United Kingdom, France, Germany and Ukraine, ensuring transatlantic technological and political alignment. In the Americas, Canada, Mexico, and Argentina are expected participants, while Brazil represents a particularly strategic partner due to access to the Alcântara Launch Facility and its importance in limiting Chinese regional influence. In the Indo-Pacific, Japan, South Korea, Australia, and Taiwan are indispensable due to their advanced capabilities and shared strategic interests. Once a Western-led foundation is established, carefully managed expansion to selected non-aligned emerging economies like India could allow the ISA to set global standards before China further consolidates its influence.

The strategy faces several risks. China – and to a lesser extent Russia – could respond aggressively, escalating a costly space race, with early warning signs including Chinese export restricitons on critical space resources. Non-aligned states may prefer Chinese investment, pursuing a "Silk Road to Space" rather than ISA membership, indicated by exclusive bilateral agreements with Beijing. In Europe, persistent anti-American protectionism could limit cooperation. Domestically opposition from the MAGA movement may constrain political support for new multilateral initiatives. Environmental and social resistance to resource extraction in partner countries could further complicate implementation. Despite these challenges, the strategy assumes that the ISA provides a viable path to secure U.S. leadership in space through interest based multilateral alliance building and thus counter China's rise.

Op-Eds



Dr. Olaf Theiler

Head of Future Analysis at the German Armed Forces Planning Office

"And yet it moves…"

One of the core aspects of any form of policy advice, regardless of the methods used, is the endeavor to practically combine analysis and government work so that, in the end, joint, implementable decisions are reached – with clear responsibilities and timeframes. Like many other forms of advice, strategic foresight achieves this goal more as an exception than the rule. The reasons for this are numerous and complex, relating as much to the advisors as to the individuals and bodies being advised.

Despite all the justified criticism of the frequently observed inability to implement reforms in Germany and their alarmingly slow pace if they occur, one should consider when the need for change really was felt. On a political level, real change did not begin in 2015 with the occupation of Crimea, when the first experts started to call for it, nor in February 2022 with the Russian invasion of Ukraine, when the need for change was addressed increasingly by the media, but rather in February 2025, when, practically simultaneously, Volodymyr Zelenskyy was humiliated in the White House, while Vice President Vance, at the Munich Security Conference, described the fight against the radical right in Europe as the most dangerous attack on freedom in Europe, without even mentioning Russia, its war in Ukraine, or its hybrid activities in Germany and Europe. In other words, political change, or rather the political willingness to change, is actually not even a year old. Even though much of the initial shock has since been pushed aside by the daily power struggles in Europe, in Germany and within the government as well as within the individual parties and ministries, the necessity of change has now arrived in daily media reports, in the general public, in the corridors of administrations and even in the minds of many politicians.

"In other words, political change, or rather the political willingness to change, is actually not even a year old."

On the other hand, the level of necessary changes in Germany is incredibly vast, no matter where you look: from defense and space exploration to digitalization at all levels, in civil protection and disaster relief, infrastructure, the economy, health and pension policy, or even the judiciary and in politics themselves. Everywhere you look, a backlog of reforms has accumulated over the last 30 years, the sheer scale of which is paralyzing, but which, given the complexity of the tasks, where everything is so often interconnected, seems practically insurmountable.

Of course, the oft-quoted statement that we in Germany (and the EU as well) don't have an analysis problem, but an implementation problem, is more than true. But what is the reason for this? Is it solely due to inadequate "politics" or politicians? I don´t think it is that easy; the problem is far more complex.

Yes, politicians live in their own world, a world of power, competition, opinion polls, majorities and political rivalry, also by the personalization of policy decisions and public sentiment that can be translated back into power. All of this makes it difficult to accept advice or even implement decisions against resistance. Such resistance is always present, whether from the political opponent, who would love to completely misunderstand any spoken word and then use this as an accusation. It is also present in media and society, where everything is all too readily talked to death.

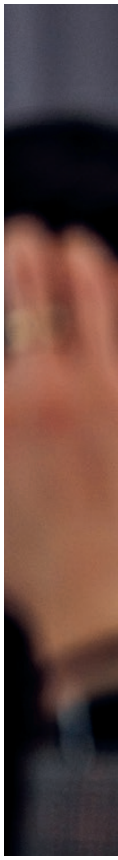
The administrative apparatus doesn't really help either, because it's based on the fundamental idea of stability, reliability, and transparency – in short, on rules. These rules become increasingly complex, comprehensive, and incomprehensible over time – even for the administrators themselves. Bureaucracy, by definition and very nature, is built against change.

So even if politicians want change, every minister quickly discovers that the system they have to work with resists these changes in a multitude of ways.

Consultants should therefore consider whether their advice is truly sound:

- How closely aligned are they with the needs of policymakers, and how closely aligned with the needs of public administration?
- Do they take into account resistance, whether political or emotional, and do they consider financial or legal issues?
- What about the interrelationships with other topics and reform needs? We "consultants" often focus solely on our own area of expertise, but it is always competing with other areas for attention and resources for implementation – whether media coverage, manpower, funding, or political capital.
- Can these recommendations be practically implemented in policy or even administrative regulations? Or are they formulated in such academic terms that they require a translation process? This process inevitably becomes a power struggle within politics and administration, thus altering the outcome of the consultation in a way that serves existing power structures more than it promotes change.

"And yet, things are happening in Germany, even if it always seems to be too little and too slow, as experts never stop to criticize. As in physics, triggering a reaction is usually the most difficult step; with each subsequent step, it (hopefully) becomes easier."



In order to achieve more reciprocal understanding, we would actually need entirely new structures that allow for the exchange of personnel between different levels, from politics to administration or academia and back again. Only in this way could we understand the different frameworks and become familiar with the different needs. Unfortunately, we are currently very far from this. Germany is organized in isolated spheres; politics, administration, and academia essentially remain among themselves. Genuine dialogue is rare, and mutual learning practically nonexistent. This means we lack one of the most important tools for good advice – understanding the other side.

And yet, things are happening in Germany, even if it always seems to be too little and too slow, as experts never stop to criticize. As in physics, triggering a reaction is usually the most difficult step; with each subsequent step, it (hopefully) becomes easier. We simply mustn't let up – and ensuring that this doesn't happen is, among other things, our task as admonishers, critics, and analysts.

Here is just one positive example: The long-awaited joint situational awareness picture of the Federal Government is finally taking shape with the establishment of the National Security Council. For the political security architecture of the Federal Republic of Germany, this is another important step following the first national security strategy of 2023. Consequently, the responsibility for revising the next security strategy will likely also lie with the National Security Council, which will lead to an improvement in the nationwide orientation of this strategy, partly because there will be no automatic resistance from other departments simply because a single ministry is taking the lead.

One shouldn't immediately burden this positive new development with overly high expectations; this is not creating a "super-ministry," nor a decision-making body to solve Germany's implementation problems. It is merely – but nonetheless, a truly fundamentally important – step toward nationwide security policy action.

Dr. Henning Riecke

Head of Strategic Foresight Competence Center at the Federal Academy for Security Policy (BAKS)

Now more than ever – Strategic Foresight as an Indispensable Tool for Government

American forces have captured the President of Venezuela for a trial in the USA, recklessly pushing aside the provisions of international law. President Donald J. Trump claims that Greenland needs to be part of the USA, confronting an ally, Denmark, and endangering the strongest alliance on Earth with indifference. Russia's brutal war against Ukraine and with hybrid means against the rest of Europe goes on, and whether the Europeans participate in negotiations about its end partly depends on the mood of leaders outside the continent. In line with Chinese policies of economic dependence and political influence or the escalation in the Middle East, these turbulent events are a sign of a shifting international order in which Germany and Europe are more and more side-lined.

These disruptions and their underlying slow-motion power shifts remind us of the calving of an iceberg, announced by loud bangs of the breaking ice, predictable, but hard to believe in its massive spectacle, while giving a frightening sight of the encompassing effects of a warming atmosphere. These events announce that our future will be different from the present and that we should move our boat away from the oncoming wave of icy water.

German governmental foresight has to consider these changes. Strategic foresight is a crucial tool for any capable government, for analysing trends and conditions, for imagining disruptive changes or shifting trends in a complex and fast-paced environment – that understanding is finally growing in most Western governments. One could even proclaim more drastically: The ability to imagine a different future is a precondition for the survival of the liberal-democratic order that most Western states and societies enjoy to secure freedom.

Economic strength, political stability, environmental sustainability and military and societal resilience are elements of this order and would ensure a more influential role in the coming alterations, yet all are in jeopardy for the members of the European Union, including Germany. That the blissful period of peace and prosperity in Europe will continue for much longer is not the most likely outlook. To be strategically capable would mean to think those scenarios to the end, to imagine even brutal changes and sacrifices and create the means to avoid them. That could include a narrative how the EU and NATO would have to cope with US-infringements on Greenland's autonomy, with political or even military means – and prospective negotiation packages to avoid such an outcome. One should imagine an even deeper operational cooperation between China and Russia, and its effects on battlefields in Europe. It is useful, looking at the Bonn Future Lab 2025 overall topic, to develop scenarios for a militarized and privatized near-earth space, along with recommendations for the European Union to be a better partner for governance in this crucial domain.

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Those dystopic scenarios are not the end of strategic foresight, however. It might be useful to paint bleak pictures to stir up political determination for resilience. The main purpose of looking into possible, parallel, plausible futures, however, is to develop ideas how to work for desirable outcomes, and to secure survival and betterment of the living conditions not only in your own country. That might be difficult, when the current conditions look hopeless and the trusted fundaments of our order break apart, but this is, where imagination must go.

Futures thinking opens a room for that kind of creativity. Imagine the helpful role of technology, especially AI or quantum computing. While they create a dynamism that is hard to predict and to withstand, they offer also many opportunities for strengthening economy, society and security alike. Think of new partners in governance, when transnational problems give incentives for cooperation. You can think, in a confrontative relationship, about the changes that might make cooperation more natural again. It is even fair to put foresight in charge of more radical thinking, looking at a not so far future where humans connect more deeply with integrated technologies, changing the nature of what is human in the first place, or where climate change affects even the moderate weather zone of central EU. Can we envision new global communities to cope with such challenges? Where does power come from in such a future?

To be sure, strategic foresight will not lead to certainty about the future. No scenario is likely to come true, nor should it. Even data-based prognosis is credible for only a short period ahead. Thinking in several futures, however, enables the mind to adapt quickly to changes. The outlook towards a conceivable crisis scenario helps us to prepare policy in advance, even when the political attention is not yet rife for appropriate measures ("Default Future Thinking"/"Denken auf Vorrat").

Germany is a test case how foresight might help the government to allow for more attentive and adaptable strategic thinking. It has a decade-long evolution and integration of strategic foresight in the work of government ministries and agencies. The year 2025 saw a restructuring of the institutional layout of strategic foresight as a government tool, aiming at the diligent use and better coordination of existing foresight. The conservative/social-democratic coalition agreed to create a National Security Council in the Federal Chancellery, not as governing institution like in the USA, but as a coordinating cabinet committee. One of its units is responsible to carry strategic foresight into the security-related deliberations of the Chancellery and the cabinet. The German NSC will be equipped with personnel from several ministries, and will most likely operate in the custody of the Foreign and Security Department in the Chancellery. This new instrument will most likely inspire future decisions on security policy with foresight. The coordination of strategic foresight activities of the 16 independent ministries has moved away from the chancellery and is now on the task list of the newly formed Federal Ministry of Digitalization and State Modernization. Both units now have to walk in lockstep and cooperate to use the foresight available in the government.

The enthusiasm, with which this endeavour has already begun, gives reason for hope: Strategic Foresight will be present in crisis reaction and strategy formulation alike, in the Federal Chancellery and the Federal Ministries and Agencies, where planners are more aware what others have done already in this regard. Should foresight become even more a part of German strategic culture, Berlin will be better equipped to face and lead the difficult redefinition of Europe's place on the more competitive world.

Paul Behne

Leading Researcher at the Defense & Security Institute, Strategy& (PwC)
and PhD Researcher in Conflict Strategy Analysis

Telling Fortunes: The Need for Academic Leadership for future-oriented Research

Envisioning futures is part of human nature. The ability to imagine different scenarios, plan appropriate actions and recalibrate assumptions once they have been made is essentially what we understand as strategic capability. This very elementary form of strategic foresight is part of the human's concept of success.

In a super-complex world, imagining equally complex future scenarios is an integral part of strategic action. Research institutes, think tanks and universities are therefore increasingly developing an independent field of strategic foresight with their own theories, methods and practices. In Europe, this field continues to be characterised by a lack of coherence and inconsistencies that inhibit the exploitation of the potential of strategic foresight. This would require thought leadership, bold pioneering and a clear agenda for linking interdisciplinary research and practice – a joint effort to improve strategic capability.

Strategy is the planning of a course of action, considering a broad range of factors, to achieve a desired future goal. Strategic thinking is therefore characterised by uncertainties, because every strategy depends on assumption about a future that cannot be known. Effective strategies are therefore usually those that can adapt flexibly to changing circumstances and do not rigidly adhere to a single possible future scenario. Structured engagement with these very scenarios is therefore decisive for the quality of strategy formation.

Strategic foresight now addresses these future scenarios. The discipline systematically examines futures and translates them into strategic decisions. Foresight does not predict the future; it seeks instead to explore multiple futures to develop robust strategies. In this way, the discipline can help to identify and assess risks, find potential and develop ways to exploit it, and design strategies for many eventualities, thereby making them resilient.

To this end, strategic foresight uses various methods, ranging from the systematic search for trends and discontinuities through horizon scanning and the comparison of contrasting future scenarios, to the survey-based development of future expectations using the Delphi method, to back casting and road mapping, in which paths to a desired future goal are thought out backwards.

Even though strategic foresight is increasingly establishing itself as a research discipline, there is criticism of the scientific nature of its methods. At the centre of the criticism is the low probability of the imagined futures actually occurring, the lack auf falsifiability and the normative and methodological biases. Strategic foresight would therefore appear to be more a political or consulting method – fields in which strategic foresight has long been established. In doing so, those voices neglect the academic rigor that lies in the precise utilization of the foresight methods.

The European Union uses strategic foresight in various institutions, the OECD and UN each have dedicated units for future analysis, and NATO plays a pioneering role in the discipline, which has a long tradition particularly in the field of security and defence. National administrations are also increasingly relying on strategic foresight, although investment in this capability varies greatly from country to country. While Finland, for instance, has already been able to establish constructive structures through its Committees for the Future and the UK has a long-standing tradition of integrated strategic foresight mechanisms, Germany is still lagging behind in its development. After initial projects in German federal ministries had little effect, the new National Security Council has yet to prove its future-sensitive strategic capabilities. In addition to politics, strategic foresight is also an established field in the industry. Larger companies and, in particular, consulting firms use methods from the toolbox to make market decisions or offer strategic consulting services based on future analysis. All of these actors could benefit from a sound science of strategic foresight that refines the methods that have often been used very flexibly and intuitively up to now and a research field that generates comprehensive insights into the effectiveness of individual methods and variations. Some stakeholders have already started to integrate academic strategic foresight into company structures highlighting the lack of input from classic academia.

The existing academic centres have not yet been able to tap into the established trends in politics and industry and therefore have little public visibility. Positive exceptions include the NATO Defense College, which enjoys a high level of impact and visibility thanks to its embeddedness into the defence alliance, and the Finland Futures Research Centre at the University of Turku, which demonstrates pioneering academic capabilities in future studies. The fundamental growth of the discipline can be seen in the increasing number of publications and focal topics at various renowned institutes. However, this development still appears uncoordinated and patchwork-like – there is a lack of strategy for the coherent positioning of the discipline.

Such a strategy could consist of creating more key functions between science and practice, which, for example, could be docked onto ministries and companies to facilitate the transfer of practical applications and academic knowledge. Such positions would not only secure long-term funding for research on strategic foresight but also allow the discipline to adapt to the requirements of practice, thus creating a symbiotic momentum. Setting the framework for strategic foresight would also define the field more clearly and have a coordinating effect on the academic sphere, making research results inter-institutionally compatible. Unlike other disciplines, practical relevance is an inherent part of strategic foresight, and thus the paradigm of feasibility and impact is also part of its science economy. Nevertheless, independent and critical research must be ensured by not blindly following the need of the market but by strategically translating critical research into actionable recommendations.

"What Europe lacks is not interest in strategic foresight, but leadership. Thought leadership to open up the hitherto little-researched areas of the discipline and leverage its potential; political and industrial leadership to link existing foresight hubs in a coherent network and integrate them into concrete practices."

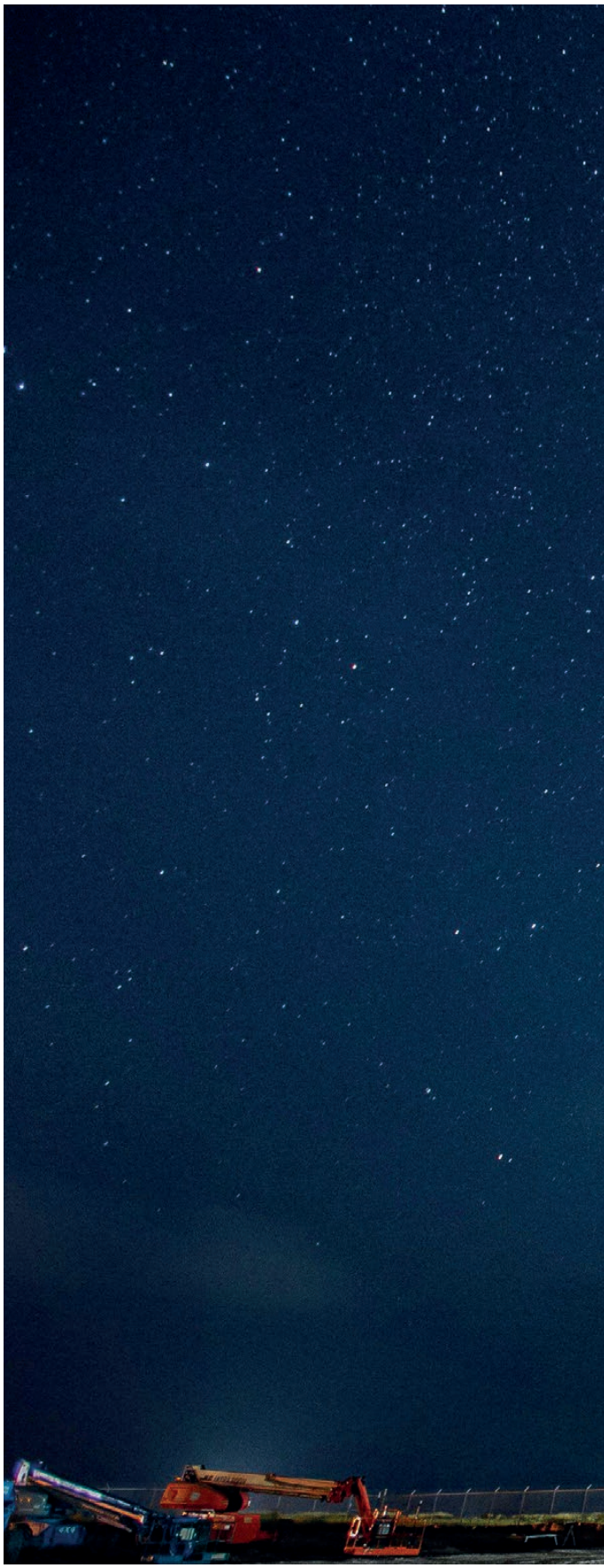
At the same time, however, the limitations of strategic foresight must not be ignored. It is certainly not a panacea on the path to strategic capability, but rather one of many factors, such as a change in political culture or coherent approaches to joint strategy development across departmental, regional and sectoral boundaries.

However, the advantages of enhanced academic field of strategic foresight are obvious:

1. It increases the methodological and epistemic quality of strategy formation.
2. It strengthens the resilience of strategies.
3. It critically evaluates existing practices, thereby advancing the discipline for academia and practice.

What Europe lacks is not interest in strategic foresight, but leadership. Thought leadership to open up the hitherto little-researched areas of the discipline and leverage its potential; political and industrial leadership to link existing foresight hubs in a coherent network and integrate them into concrete practices; and individual leadership from people who, as advocates of the academic discipline, draw attention to the results of strategic foresight and ensure their impact.

"Unlike other disciplines, practical relevance is an inherent part of strategic foresight, and thus the paradigm of feasibility and impact is also part of its science economy. Nevertheless, independent and critical research must be ensured by not blindly following the need of the market but by strategically translating critical research into actionable recommendations."



Contact
Center for Advanced Security, Strategic
and Integration Studies (CASSIS)
University of Bonn
Römerstraße 164
53117 Bonn, Germany

Bonn Future Lab Project Leads
Dr. Enrico Fels, Managing Director CASSIS
Maximilian Schranner, Project Coordinator

Phone: +49 (0) 228/73 62995
cassis@uni-bonn.de

https://www.cassis.uni-bonn.de
https://twitter.com/CASSIS_Bonn
https://www.linkedin.com/company/cassis-unibonn/

Production Support
Lena Utecht
Michael Müllers
Alexander Weyershäuser

Design
Ines Wegge-Schatz
www.designlevel2.de

Printing
Druckerei Eberwein OHG

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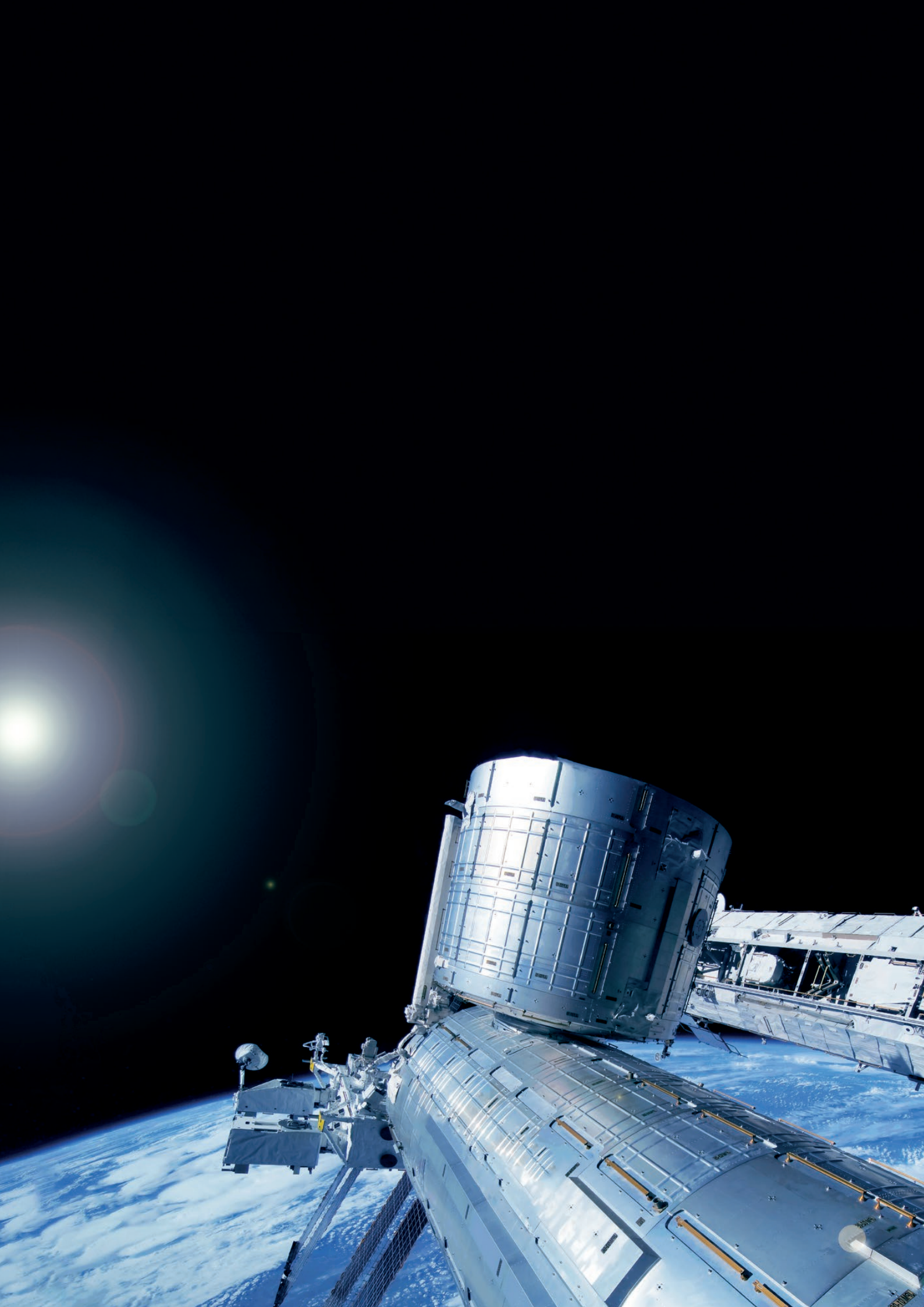

Center for Advanced Security, Strategic
and Integration Studies (CASSIS)
University of Bonn

cassis.uni-bonn.de