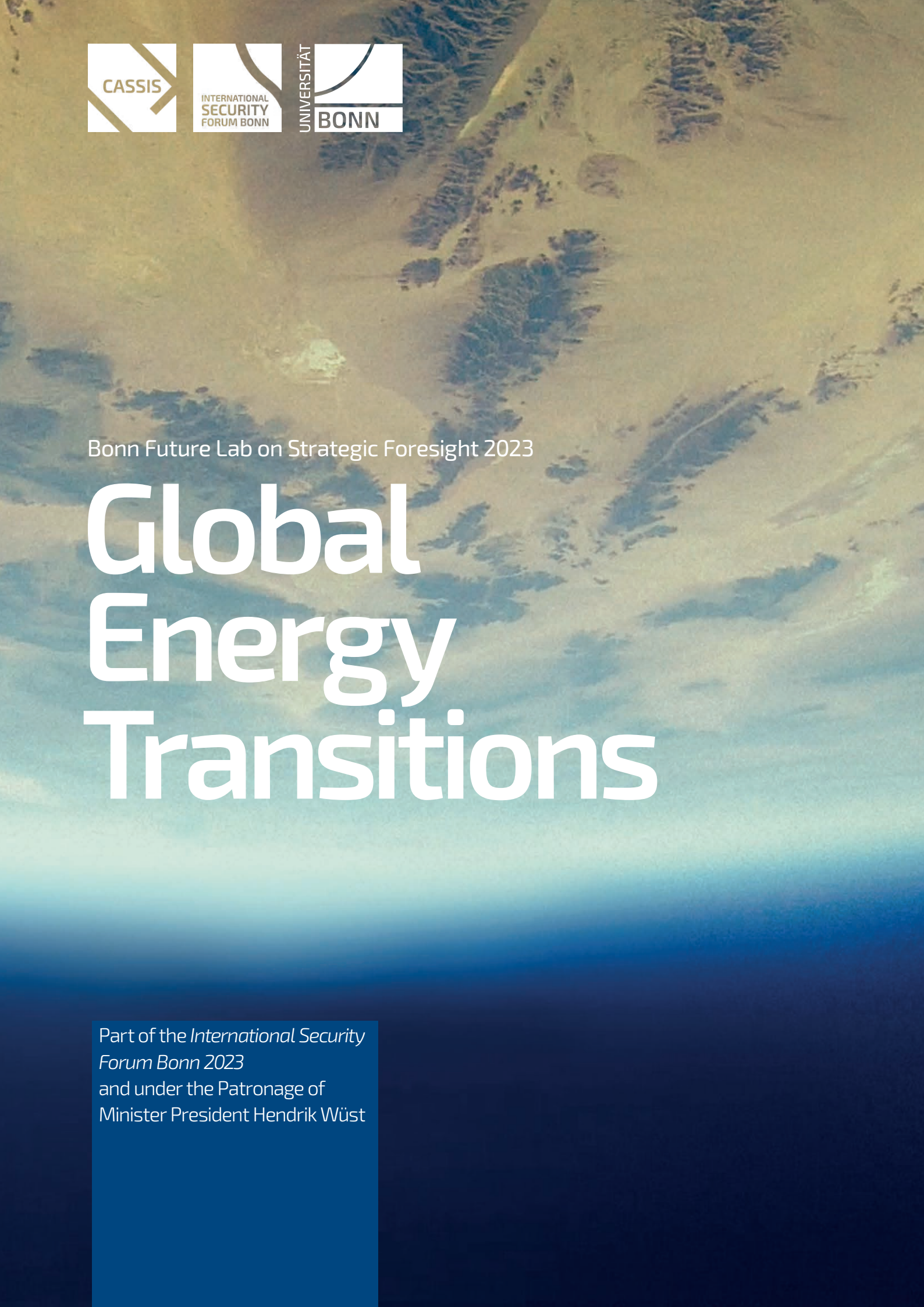


CASSIS

INTERNATIONAL SECURITY FORUM BONN

UNIVERSITÄT BONN

Bonn Future Lab on Strategic Foresight 2023

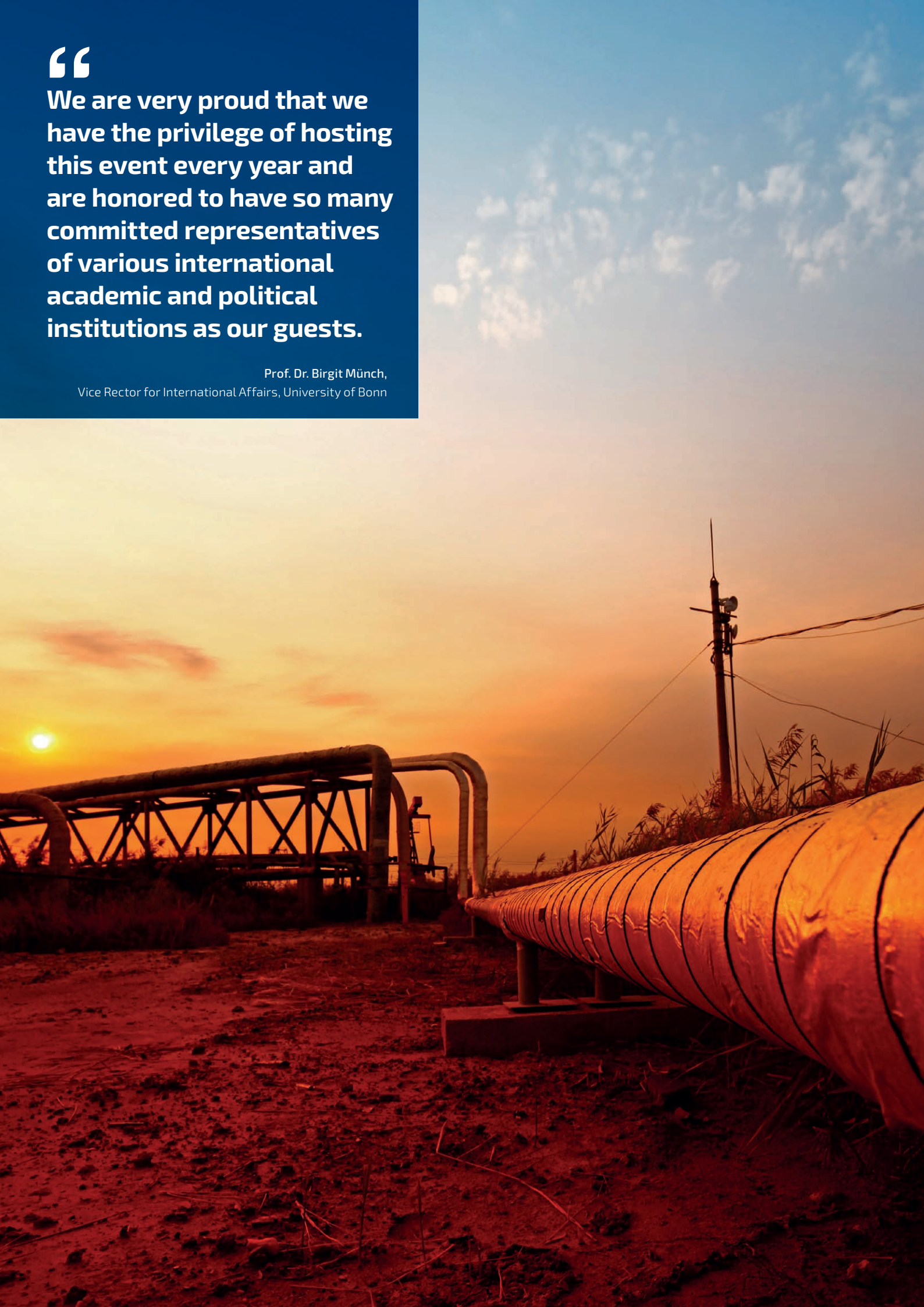
Global Energy Transitions

Part of the *International Security Forum Bonn 2023*
and under the Patronage of
Minister President Hendrik Wüst

Contents

“We are very proud that we have the privilege of hosting this event every year and are honored to have so many committed representatives of various international academic and political institutions as our guests.

Prof. Dr. Birgit Münch,
Vice Rector for International Affairs, University of Bonn



Foreword

The Bonn Future Lab on Strategic Foresight is a multiday format established by *CASSIS*, the *German Institute of Development and Sustainability (IDOS)*, the *NRW Academy of International Affairs* and the *Bonn Alliance for Sustainability Research* as the second segment of our International Security Forum Bonn (ISFB), which takes place under the patronage of Minister-President Hendrik Wüst.

We are very happy that the list of our partners keeps growing and that we were able to organize the Bonn Future Lab on Strategic Foresight 2023 in close collaboration with two prestigious organizations: the *German Economic Institute (IW)* as well as the *Institute of Energy Economics (EWI)* at the University of Cologne.

We are fortunate to have received tremendous support from both new and long-term friends and partners for organizing the Bonn Future Lab on Strategic Foresight 2023: the *Foundation for International Dialogue of the Savings Bank in Bonn*, the *Friedrich Naumann Foundation for Freedom*, the *Hanns Seidel Foundation*, the *Society for Security Politics*, the *Institut francais and the French Embassy*, the *German Council on Foreign Relations and the Peter Klöckner Foundation!*

As the second segment of our annual ISFB, the Bonn Future Lab on Strategic Foresight was developed as an evidence-based discussion format in order to give greater attention to global megatrends and combine Bonn's academic strengths in security, strategic, developmental and sustainability research with the important insights we can gain from employing strategic foresight methods.

For this, the Bonn Future Lab on Strategic Foresight combines an international conference day with a two-day Strategic Foresight Workshop.

During this workshop, techniques and methods of strategic foresight are taught to 30 to 40 young experts and applied on our conference day's topic in order to allow for the consideration of various futures.

The Bonn Future Lab on Strategic Foresight 2023 deals with the topic of "Global Energy Transitions". It is clear that the challenges and opportunities posed by the evolving energy landscape are among the most critical issues of our time.

As these over 30 young people are among the "decision-makers of the day after tomorrow", we hope that the debates during the Bonn Future Lab on Strategic Foresight among renowned national and international experts provided them with further knowledge and insights for helping mankind tackling the chances and risks emanating from global energy transitions.

Let us first acknowledge the broader context: The global energy landscape is undergoing a seismic shift, driven by a convergence of strategically important factors: technological advancements, environmental imperatives, and geopolitical realities. The transition from fossil fuels to cleaner, healthier, more sustainable energy sources is not only an economic and strategic necessity, but a moral imperative for the well-being of our planet and future generations.

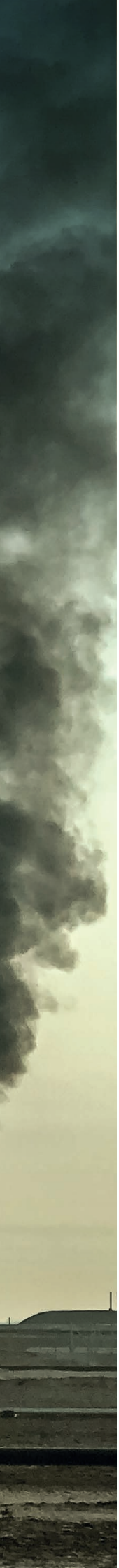
Next, we need to delve into the economic implications of this transition. The shift towards renewable energy sources, such as solar, wind, and hydroelectric power, presents vast economic opportunities. It stimulates innovation, drives job creation, and opens new markets. However, we must also be mindful of the challenges that may arise during these times of transitions, particularly in regions

and economic sectors heavily reliant on traditional energy sectors. In this regard, it is very clear that the costs of these transitions are considerably higher than that of a monthly scoop of ice cream per family as a German environmental minister once falsely promised them to be.

Moreover, social dimensions need to be acknowledged: Mining of rare earths and critical resources often plays out under horrendous work conditions and is locally destroying neighborhoods and livelihoods. Crafting inclusive policies that ensure a just transition for all is paramount. Let us also not lose sight of the environmental dimensions of this transition. The transition to renewable energy must be carried out in a manner that respects and preserves our natural ecosystems. Lithium mining, for instance, is an ecologically nasty endeavor with devastating effects on the environment. It is imperative that we balance economic progress with ecological stewardship.

Turning our attention to the realm of international relations, the global energy transition has profound geopolitical implications. It reshapes the dynamics of energy interdependence and influences the balance of power among nations. The rise of renewable energy technologies also reshuffles the deck in terms of resource availability and control, potentially altering the geopolitics of energy access and security.

China and the US, for instance, are heavily reliant on 11 so-called strategic minerals needed for developing alternative energy technologies. While this creates incentives to either increase own efforts to secure access to these materials or to ensure properly working global markets to satisfy the demand of all interested buyers, the insights we can gain from political realism provide a rather pessimistic prognosis regarding the most likely course taken by competing great powers. In the same vein, it remains to be seen whether the shutting-down of Germany's remaining nuclear reactors was a strategically and economically wise decision during these geopolitically troubled times.



Effective policy frameworks are the linchpin of any successful energy transition. Governments, international organizations, and the private sector must collaborate to set clear, ambitious but realistic targets for renewable energy adoption, invest in research and development, and establish regulatory mechanisms that incentivize sustainable practices. Additionally, international cooperation and agreements are essential to address cross-border challenges and ensure a coordinated, global approach to energy transitions.

A pivotal player in the discussion on global energy transitions is the element hydrogen. Often referred to as the "fuel of the future", hydrogen offers a promising avenue for decarbonizing sectors that are challenging to electrify directly, such as heavy industry and longhaul transportation. However, unlocking the full potential of hydrogen requires concerted efforts in research, development, infrastructure deployment and international cooperation.

From a European perspective, moreover, it is important to acknowledge today's much riskier geopolitical landscape while seeking to transform large parts of Europe's industry and energy sectors into hydrogen-based economies. An evidence-driven "H2 Reality Check" to strategically assess the long-term sustainability (geopolitically, economically, and ecologically) of European hydrogen plans is therefore dearly needed.

One of the most dynamic and promising aspects of global energy transitions lies in the cooperation among what we at CASSIS term "Tech Middle Powers". These nations, characterized by their advanced technological capabilities and a shared commitment to sustainability, are poised to play a leading role in shaping the future energy landscape. Collaborations between countries like Australia, South Korea, France, Germany, Israel, the Emirates, and others can provide a blueprint for how shared knowledge, resources, and investments can accelerate the transition to more renewable energy sources.

In conclusion, the matter of global energy transitions is not merely a technological or economic issue. It is a defining strategic challenge of our time which has entered a post-post-Cold War era that most certainly seems to be more volatile than the preceding decades. Under these circumstances, we require sober strategic assessments of the multifaceted facts of global energy transitions that informs visionary leadership in order to jointly work towards achieving sustainable and both ecologically and economically viable futures.

We are very pleased that many esteemed national and international colleagues from various fields joined us for the Bonn Future Lab on Strategic Foresight 2023 in order to discuss this pressing nexus and push the strategic sustainability debate forward. As these national and international experts engaged in the discussions and collaborations during the second segment of the ISFB, the urgency of this endeavor, the risks and chances as well as the shared responsibility we bear towards the generations yet to come were a constant theme of our intellectual engagement. We strongly appreciate that a large number of the participants contributed Op-Eds for this report in order to exemplify the conference day's intriguing discussions.

In closing, we at CASSIS feel honored for the support we have been able to receive and we are very grateful that so many individuals and institutions provided highly appreciated backing for making the Bonn Future Lab 2023 possible. Many thanks to all of them!

We hope you enjoy this report!

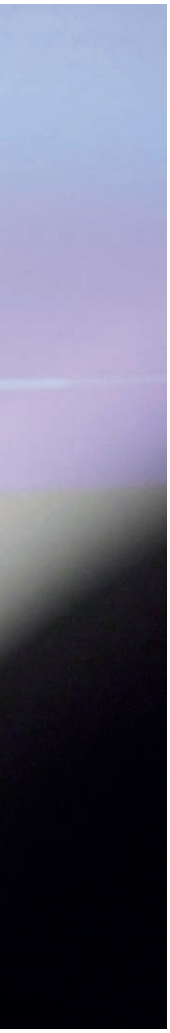
Dr. Enrico Fels
Managing Director

Maximilian Schranner
Project Coordinator

Welcome Adress by the Vice Rector for International Affairs Prof. Dr. Birgit Münch

Dear Directors of CASSIS, Prof. Dr. Wolfram Hilz and Prof. Dr. Volker Kronenberg, Dear Managing Director Dr. Enrico Fels,
Dear speakers and panelists, Professor Dr. Detlef Stolten from the Forschungszentrum Jülich, Dr. Dawud Ansari from the German Institute for International and Security Affairs, Professor Dr. Hubertus Bardt from the German Economic Institute and Professor Dr. Marc Oliver Bettzüge from the University of Cologne,
Dear honored guests Richard Rohde, Johannes Abresch, Professor Dr. Maria Julia Trombetta, Mohammed Baharoon, Professor Dr. Kathleen J. Hancock, Vice President Gilles Le Van, Professor Dr. Stefan Liebing, Professor Dr. Stefanie Meilinger, Professor Dr. Jochen Prantl, and all guests who are here today,
Dear colleagues and partners,

It is a great pleasure for me to welcome you to the occasion of the Bonn Future Lab on Strategic Foresight within the annual International Security Forum at the University of Bonn, hosted and organized by our esteemed colleagues at CASSIS. We are very proud that we have the privilege of hosting this event every year and are honored to have you, so many committed representatives of various international academic and political institutions, as our guests. The topics that have surely been addressed within the forum yesterday and will be addressed today in this Lab on “Global Energy Transitions” – including, for example, sustainability, diplomatic shifts, the war in Ukraine and of course the attacks in Israel and their resulting repercussions for the region – are pressing topics in international relations, which are of course of great importance to me as Vice Rector for International Affairs.



Therefore, as part of the Vice Rectorate's firm belief in science diplomacy and the ability of science, research and international collaboration and cooperation to provide solutions to the current challenges we face, we are continually working to implement the University of Bonn's Internationalization Strategy 2025, in which we strive to attract outstanding international researchers and students and offer them optimal conditions for researching, studying and teaching at our University. Dealing with the demands of the current global challenges affects everyone, from students to administrative staff to professors, and only through interaction between all of these groups can these challenges be met.

One focus of our internationalization strategy is reliable, long-term partnerships with universities abroad. Strategic university partnerships are our most intensive form of international cooperation. They ensure established communication and aim to create stable infrastructures at both the administrative and academic levels. Some of our partners have been part of our international network for many years and therefore have very close ties to Bonn. Our five strategic partner universities are the University of Melbourne, the University of Ghana in Accra, Waseda University in Tokyo, the University of St Andrews in Scotland, Emory University in Atlanta and the Hebrew University of Jerusalem. The latter four are also part of a recently formed global network, which aims to build on existing bilateral links and extend them to a multilateral level, with all partners free to participate with projects of their choice to benefit from the experience gained bilaterally in the past.

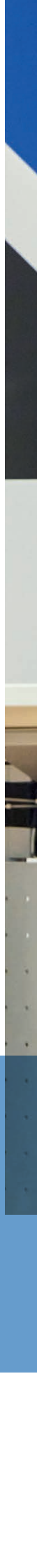
Other elements involved in the implementation of our Internationalization Strategy – and of course I will only mention a few here – are the improvement of our onboarding of international researchers, a relaunch of research mapping, the introduction of multilateral projects such as Joint Professorships in our Global Network, already realized with our partner St Andrews, and work on the Distinguished Professors Emeriti program. Our European University NeurotechEU as well as projects with researchers and institutions in Eastern Europe and the Global South should also be mentioned, the latter being driven by Visiting Professorship programs for young scientists. A lighthouse initiative of the Vice Rectorate for International Affairs in this regard is building a hub for global collaboration at the University of Bonn, which aims at creating more visibility for our diverse range of research projects related particularly to Africa and South America, facilitating networking activities among researchers from Bonn and those from academic institutions there.

Therefore, within the Vice Rectorate's annual International Days that began yesterday – and which in fact include today's keynotes from Prof. Dr. Stolten und Dr. Ansari and continues this afternoon – we decided to host a Global Fair focusing on Ghana and Brazil, highlighting our joint projects as well as opportunities for exchange and research collaboration with partners in these countries, but also these regions more broadly. Although we know that your first obligation is to your contributions to this Lab, my team and I would be more than happy to welcome you to our Fair in the University's Main Building in your free time. And I hope you will excuse that I

must leave directly after speaking with you, as we are also hosting a panel discussion as part of the International Days with your CASSIS colleague Prof. Dr. Maximilian Mayer on the topic “African-European Perspectives on Migration: Advancing the Field through Transdisciplinarity”.

To come back to another program that is very important for the internationalization of our University, I would like to mention the Bonn University Ambassadors Program. As scientists from all over the world conduct research and teach at the University of Bonn – a fact that we are very proud of and which is an outstanding enrichment for the excellence of Bonn's science and for university life – we have appointed former visiting researchers of the University to represent us within their respective higher education institutions and countries. Based on their experiences in Bonn, these Ambassadors – from Jordan, Israel, the Netherlands and India, to name a few – serve as a point of contact for scientists interested in doctoral studies, research, teaching, mobile exchange or other types of collaboration at and with the University of Bonn. With the Bonn University Ambassadors, we seek to strengthen our international networks and we were able to achieve this during our annual workshop with them just yesterday, also as part of the International Days. Our cooperation with them is immensely important to us and being part of one Universitas also means being there for each other. I think now especially of our Ambassadors in Israel and elsewhere, but also of all those affiliated with our University who find themselves impacted by the many devastating crises around the world.

Which now brings me to my final thoughts before you begin today: Despite all of the exciting endeavors I have just outlined, our academic culture of open collaboration with partners abroad is being confronted with new shocking realities. Since February 2022, and particularly since the Vice Rectorate established with the University of Cologne, the Cologne/Bonn Academy in Exile for Ukrainian, Belarussian and Russian researchers at risk, I have felt moved to continuously address the saddening repercussions of Russia’s full-scale invasion and war against Ukraine. With this war at our doorstep and the devastation it has brought to Ukraine and its people, it was already easy to be deeply shaken in the belief that all differences can be overcome through dialogue and compromise, but now the brutal terror attacks on Israeli civilians by Hamas that began on 7 October and the resulting conflict afflicting both Israeli and Palestinian civilians, evoke again this same feeling. However, the Rectorate expressed quickly in a public statement after the initial attacks, which I would like to reiterate now, the University’s condemnation of the terror attacks in Israel, its support of victims and those affected and its continued strong connection to our Israeli partners. We have been in touch with these partners – which as I mentioned before are an integral part of our University through projects and programs such as Strategic Partnerships, the Global Network, Distinguished Professors Emeriti and Bonn University Ambassadors, to name only a few – offering our support as events unfold. This was possible in part due to a hotline for affected University members and partners established by the International Office, which can currently be found on the homepage of the University website.



While nothing compared to the suffering of the people experiencing these crises firsthand, their impact on German society and academia is indeed profound. All stakeholders must reevaluate their response to the challenges of working with difficult partners under tense circumstances in the name of science diplomacy. The maintenance of strategic and effective science diplomacy is crucial to continued successful international cooperation, not just at this University or within the field of higher education, but more broadly and why I am so very pleased that during this event you will be considering important questions for the future, together, in open dialogues with each other. This is what is needed most. To conclude, I would like to thank Dr. Enrico Fels and the entire team at CASSIS and all colleagues and partners who made this conference possible, and you, dear guests, for taking the time to share your expertise with us and with each other. Only through such exchanges, bringing together partners in international relations, can we enable successful international cooperation in Germany and beyond. I wish you a very informative and fruitful event and an enjoyable time at the University and in the city of Bonn.

Thank you very much!

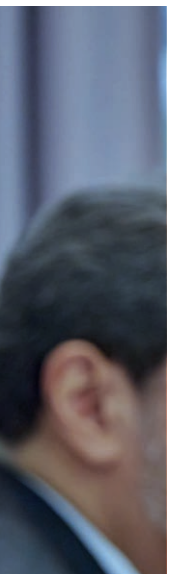
Executive Summary

The *Bonn Future Lab on Strategic Foresight*, themed *"Global Energy Transitions"*, was conducted over three days, running from October 20th to October 22nd 2023 at the University of Bonn. The primary objective of this event was to foster connections between young professionals and students from various regions in Germany and internationally renowned scientists and policy experts affiliated with prominent national and international institutions. These included the *United Nations University*, the *Heritage Foundation*, the *Federal Academy for Security Policy (BAKS)*, the *Institute of Energy Economics at the University of Cologne*, the *Colorado School of Mines*, the *Australian National University*, the *Dubai Public Policy Research Center (b'huth)*, the *German Institute for International and Security Affairs (SWP)*, the *International Centre for Sustainable Development (IZNE)* and the *German Institute for Development and Sustainability (IDOS)*.

The central focus of this workshop was to provide participants with an indepth understanding of the current state of research in the field of Global Energy Transitions. Additionally, it aimed to equip attendees with skills and methodologies in the realm of strategic foresight, including scenario development and the identification of global megatrends. Another key aspect of the event was to facilitate networking opportunities with researchers and experts from diverse scientific backgrounds.

The *Bonn Future Lab on Strategic Foresight,* which was part of the eighth *International Security Forum Bonn (ISFB)* and hosted by the Center for Advanced Security, Strategic, and Integration Studies (CASSIS) at the University of Excellence Bonn, under the patronage of Minister-President Hendrik Wüst, placed a significant focus on the critical theme of the Global Energy Transitions. In total, the *Bonn Future Lab on Strategic Foresight* successfully gathered more than 100 participants.

The preceding main day of the ISFB, which took place at the University Forum Bonn, was dedicated to the topic *"A World out of Joint – Global Power Shifts and Religious Extremism".* This event featured several prominent policymakers, academic experts, and diplomatic figures, including Pauline Kao, Consul General for the United States in North Rhine-Westphalia, Prof. Dr. Assaf Moghadam, a professor at the Lauder School of Government, Diplomacy, and Strategy at the Reichman University Herzliya, Sir Richard Shirreff, a retired General and former Deputy Supreme Commander of NATO Europe, London and Prof. Dr. Jochen Prantl, a scholar specializing in Strategic and Defense Studies at the Australian National University. Additionally, three panel discussions were held during the event. Each featuring esteemed international scholars who spoke on globally significant topics such as *"Global Power Shifts and the Future Strategic Landscape", "Political Islam as a Hybrid Actor in Europe – Activities, Means, and Strategies", and "Afghanistan and Pakistan on a Knife's Edge – Transatlantic Perspectives".*



The *Bonn Future Lab on Strategic Foresight*, in collaboration with its implementing partners such as the *German Institute of Development and Sustainability (IDOS)*, the *Institute Français,* the *German Economic Institute*, the *Institute of Energy Economics* at the University of Cologne, the *Friedrich Naumann Foundation for Freedom,* the *Peter Klöckner-Foundation,* the *German Society for Security Policy,* the *Hanns-Seidel Foundation*, the *Bonn Alliance for Sustainability Research*, and the *Foundation for International Dialogue of the Savings Bank in Bonn* organized an international conference day and a two-day Strategic Foresight Workshop. The international conference day concentrated on the subject of Global Energy Transitions, featuring insights from distinguished experts, both nationally and internationally recognized. Furthermore, the Strategic Foresight Workshop provided young, interdisciplinary multipliers from across Germany with an understanding of ongoing discussions related to scenario development. It equipped them with knowledge about techniques and methods for strategic foresight, with a partnership involving the *Institute for Qualifying Innovation Research and Consulting GmbH (IQIB).* Building upon these insights, the workshop participants engaged in the development and discussion of comprehensive strategic solutions for pressing security challenges. They did this by creating four distinct exploratory scenarios, each highlighting different visions of the future, incorporating the newly acquired knowledge gained during the presentations and discussions of the international conference day.

The international conference day was opened by a keynote speech *"Strategic Pathways for Sustainable Hydrogen Evolution"* by Prof. Dr. Detlef Stolten *(Forschungszentrum Jülich).* He gave the participants an overview of current hydrogen research and particularly emphasized the importance of hydrogen as a future energy technology. Thus, he stressed that hydrogen is primarily a technology for the transportation sector (ships, trucks, ferries and possibly someday cars and airplanes).

A second keynote speech "*Geopolitics of Hydrogen: Anticipating the Future Energy-Security Nexus*" was held by Dr. Dawud Ansuri *(German Institute for International Security Affairs, SWP)*. He emphasized the importance of foresight in the energy sector. In this regard, he presented useful methodologies for forecasting dynamics in the hydrogen energy markets to the audience of experts. He also highlighted the importance of diversification of hydrogen importers. Germany's energy demand will increase in the coming years, so the security of hydrogen supply will play a fundamental role. Therefore, security considerations must also be taken into account in energy policy.

The first input session under the topic "*Geopolitics of Energy Transitions*" was chaired by PD Dr. Antje Nötzold, *University of Technology Chemnitz.* The panelists Dr. Gilles Lepesant *(Centre national de la recherche scientifique, CNRS)*, Michael Rühle (Climate and Energy Security, *NATO*, ret.), Prof. Dr. Maria Julia Trombetta *(University of Nottingham Ningbo)* and Dr. Frank Umbach *(European Cluster for Climate, Energy and Resource Security (EUCERS) at CASSIS)* debated about the Geopolitics of Energy Transitions and upcoming security issues from their specific points of view. During the discussion, the experts focused on the importance of protecting critical infrastructures, especially pipelines and cybersecurity. Furthermore, the importance of long-term reliable energy strategies and partnerships between the relevant countries was emphasized. A unilateral dependence on a single energy supplier, however, must be avoided at all costs, because geopolitical conflicts are likely to increase in the future. The possibility of using synthetic fuels for NATO militaries was also discussed. In this regard, it was noted that it is important that the synthetic fuels are as efficient as classic kerosene. Another problem is that NATO needs large quantities of fuel and synthetic fuels are currently still far too expensive to buy in large quantities. The conclusion of this input session ended with a plea: During the transformation of our economies, it is important to ensure that key industries remain in Germany and do not migrate, even if this means higher costs. Stable democracies need to possess sufficient industrial capabilities in certain key industries to remain strong and resilient to external and internal pressures.

After that, the second input session *"Geoeconomics and Energy Transitions"* took place. It was hosted by Prof. Dr. Hubertus Bardt *(German Economic Institute, IW).* The panelists were Prof. Dr. Marc Oliver Bettzüge (*Institute of Energy Economics at the University of Cologne, EWI),* Dr. Kevin Dayaratna *(Heritage Foundation)* and Prof. Dr. Stefan Liebing *(Conjuncta).* During the discussion, the main point made was that a quick and, above all, realistic schedule for energy transitions is needed. It was moreover emphasized that not tackling climate change properly means losing billions of dollars. In addition, the importance of green hydrogen as an energy source was pointed out, as the switch to green electricity alone will not be enough to transform our economies.

Furthermore, Europe's enormous dependence on resources was warned of. The continent does not have significant deposits of a number of important resources. Hence, there is a great danger of strategic dependence on other countries. However, this problem can be solved with the help of diversification of energy suppliers. At the end of the discussion, the possibility of a "war for resources" was mentioned. Especially against the background that strategic and rare minerals are becoming more and more important for green technologies (hydrogen, batteries, etc.). Hence, there with a steadily growing world population (currently about 8 billion people), a scarcity of resources and the resulting tension is most likely unavoidable. Germany and Europe need to be better prepared for this according the experts.

During the third input session, the topic of *"Innovation and Technology: Shortcuts to Sustainable Futures?"* was addressed. The distinguished panel included Prof. Dr. Kathleen J. Hancock *(Colorado School of Mines),* Prof. Dr. Stefanie Meilinger *(International Centre for Sustainable Development at the University of Applied Sciences Bonn-Rhein-Sieg, IZNE)* and Gilles Le Van *(Large Industries and Energy Transition Central Europe at Air Liquide).* The discussion was moderated by Dr. Bert Droste-Franke *(Institute for Qualifying Innovation Research and Consulting GmbH, IQIB).* In the ensuing discussion, the participants pointed out that the United States, as the largest economy, has a special pioneering role to play in climate protection. However, the USA were considered to be politically very divided with regard to measures and energy policies to climate protection. Finding a compromise between Democrats and Republicans was seen as very difficult. In addition, ordinary US voters were not believed to be particularly interested in climate protection legislation. The typical voter pays more attention to how much money a project will cost. It was also emphasized that in the future more energy will have to be stored for energy-intensive processes. Here, hydrogen comes into play again, because it can be stored much more easily than electricity. However, hydrogen was not seen as being solution (silver bullet) for a sustainable future, but it was considered to be of great importance for energy-intensive processes. The financing problem of new technologies was repeatedly addressed. Above all, more venture capital was deemed necessary to achieve successful and effective transformations in the energy sector.

The conference day concluded with a fourth and final input session. Mohammed Baharoon *(Dubai Public Policy Research Center, b'huth),* Prof. Dr. Jochen Prantl *(Australian National University),* Dr. Rita Strohmaier *(German Institute of Development and Sustainability, IDOS)* and Dr. Erick Tambo *(Pan African Cooperation and Educational Technologies at the United Nations University, PACET)* engaged in a spirited debate on the topic *"Beyond Dependence: Energy Cooperation Among Tech Middle Powers"* from their unique perspectives. The session was moderated by Prof. Dr. Maximilian Mayer *(CASSIS).* During the session, it quickly became clear that all participants agreed that global energy demand will increase many times over by 2040. Therefore, energy security will become even more important than it already is. With regard to the issue of security of supply, so called middle power countries will likely play a special role. Above all, middle powers were estimated to becoming more important as hydrogen producers and suppliers in the coming

years. Finally, the topic of (energy) interdependencies was taken up again. Today, due to globalization and supply chains, basically all countries were estimated to be too closely interconnected to achieve (energy-) independence. However, it is important to recognize future trends particularly when it comes to likely scarcities in the field of strategic minerals needed for renewable energy technologies and to develop one's suppliers accordingly.

The two Strategic Workshop Days were each opened by hybrid organized wake-up calls. The first Wake-Up Call dealt with the topic *"Wehrhaft. Resilient. Nachhaltig. Über die außen- und sicherheitspolitische Strategiefähigkeit der Bundesregierung"*. Prof. Dr. René Bantes *(Fraunhofer Institute for Technological Trend Analysis, INT)*, Dr. Henning Riecke *(Federal Academy for Security Policy, BAKS)*, Dr. Olaf Theiler *(Bundeswehr)* participated as experts. The Wake-Up Call was moderated by Jessica Nies *(German Society for Security Policy, GSP)*. The experts agreed that the federal government's ability to formulate and pursue strategies could be improved. This necessarily includes foresight processes. After all, in times of multiple interconnected crises, strategic foresight has become even more important for successfully achieving political goals. In addition, it was also discussed that the naming and elaboration of one's own interests is a precondition for a country's strategic capability. According to the experts, the German government is still struggling with this, despite all progress made during the last years.

The second Wake-Up Call was dedicated to the topic *"Energiekrise oder chance? Der Blick aus den Regionen"* with Dr. Clemens van Doderer *(Hanns-Seidel Foundation Namibia)* and Birgit Lamm *(Friedrich-Naumann-Foundation Pakistan)*. The following discussion focused on the possibility of an energy partnership between Germany and Namibia. The country in South-West Africa aims to meet up to 3% of the world's demand for green hydrogen in the coming decades. However, the speakers emphasized that for this to happen large scale investments are needed for building new hydrogen generation and export infrastructures. Especially Germany and major international banks are therefore needed as investors. In contrast to Namibia, Pakistan needs many times more electricity due to its nearly 250 million inhabitants. Large amounts of electricity already have to be imported by the South Asian country. Due to the Russian war of aggression against Ukraine, Pakistan is now forced to pay higher prices for these electricity imports on the world market, which is exacerbating Pakistan's already poor economic situation and prevents sustainable investments its overloaded in energy infrastructure.

With this newly gained input, the strategic foresight workshop participants enriched the uncertainty analysis they already had begun in two digital preparational sessions. The preparational sessions were held via Zoom by experts from *Institute for Qualifying Innovation Research and Consulting GmbH (IQIB)* and offered the participants a first overview of the methods of scenario development.

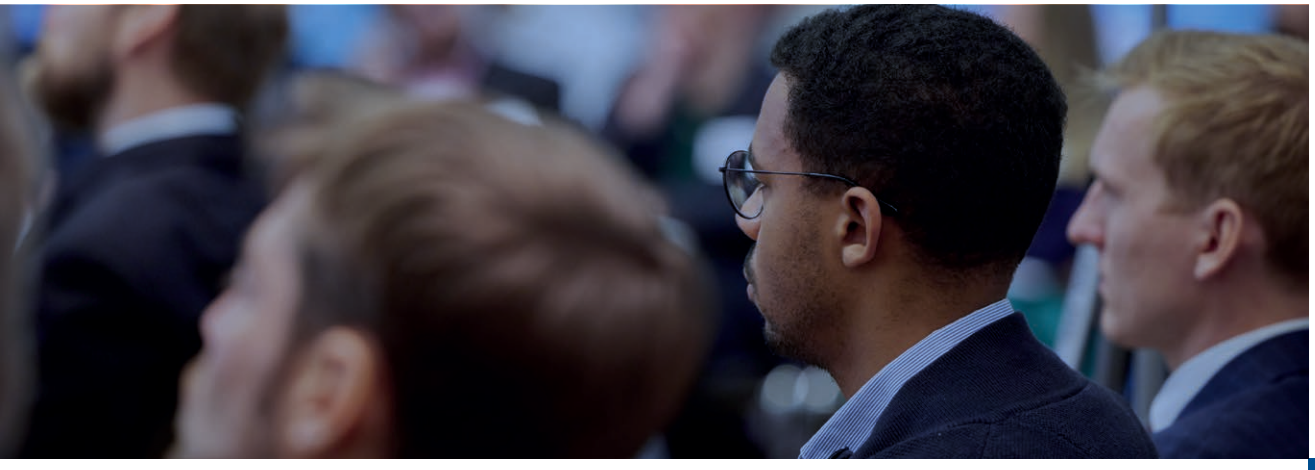
In the next step, the workshop was split up into working groups, tasked with a Pestel Analysis (1) Legal, (2) Social, (3) Technology and (4) Ecology. The day was concluded by a get-together in the plenum to discuss the work status of the different groups and the impressions of the participants.

On the two workshop days the participants operated in group sessions on different scenarios. Finally, with the help of the acquired knowledge, the topic "European Energy Security 2040" was presented from the perspective of four players (Germany, EU, the United States and the Russian Federation) during a group work segment. It was exciting to see what the individual groups focused on and what kind of different scenarios they had developed.

The *Bonn Future Lab* achieved a significant success on a number of levels. It facilitated extensive professional exchange and networking among a diverse group of participants. This included young attendees, over twenty esteemed international experts, as well as up to forty local and regional researchers and guests. This rich diversity of participants created networking opportunities for everyone involved. The University of Bonn served as an exceptional venue for the *Bonn Future Lab* and the *ISFB*. It attracted not only local and regional scholars but also renowned international scientists. This convergence of expertise provided the young participants with a unique opportunity to gain a wide range of knowledge and insights throughout the conference duration.

Moreover, in form of an intense strategic foresight workshop in cooperation with the experts from the *IQIB*, the more than thirty young workshop participants from different German organizations and institutions such as the *United Nations University*, the *German Institute for International Security Affairs (SWP)*, the *Studienstiftung des deutschen Volkes*, the *Hanns-Seidel-Foundation*, the *Evangelisches Studienwerk*, the *Friedrich Naumann Foundation for Freedom*, the *Institute of Energy Economics at the University of Cologne*, the *Fraunhofer Institute for Technological Trend Analysis*, the *German Society for Security Policy* and *the Young DGAP* gained relevant skills in the field of strategic foresight and scenario developing.

We are highly thankful that we were able to implement the Bonn Future Lab into the broader frame of the *International Security Forum Bonn.* The discussions during the breaks made clear that the format was highly appreciated by all participants. We would like to take this opportunity to thank our partners and supporters again: the German Institute of Development and Sustainability, the *German Council on Foreign Relations*, the *Institute Francais*, the *German Economic Institute*, the *Institute of Energy Economics at* the *University of Cologne*, the *Friedrich Naumann Foundation for Freedom*, the *Peter Klöckner-Foundation*, the *German Society for Security Policy*, the *Hanns-Seidel Foundation*, the *Bonn Alliance for Sustainability Research* and the *Foundation for International Dialogue of the Savings Bank in Bonn.*



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as of October 15th, 2023

Agenda

Friday, October 20th

09:00 a.m.	**Opening & Welcome** Dr. Enrico Fels, CASSIS Prof. Dr. Birgit Münch, Vice Rector for International Affairs, University of Bonn
09:30 a.m.	**Keynote "Strategic Pathways for Sustainable Hydrogen Evolution"** (public) Prof. Dr. Detlef Stolten, Forschungszentrum Jülich
10:15 a.m.	**Input Session 1** **"Geopolitics of Energy Transitions"** ■ Dr. Gilles Lepesant, Centre national de la recherche scientifique (CNRS) ■ Michael Rühle, Climate and Energy Security Section, NATO, ret. ■ Prof. Dr. Maria Julia Trombetta, University of Nottingham Ningbo ■ Dr. Frank Umbach, European Cluster for Climate Energy and Resource Security (EUCERS) at CASSIS Chair: PD Dr. Antje Nötzold, University of Technology Chemnitz
11:45 a.m.	**Coffee Break**
12:00 a.m.	**Input Session 2** **"Geoeconomics and Energy Transitions"** ■ Prof. Dr. Marc Oliver Bettzüge, Institute of Energy Economics at the University of Cologne (EWI) ■ Dr. Kevin Dayaratna, Heritage Foundation ■ Prof. Dr. Stefan Liebing, Conjuncta Chair: Prof. Dr. Hubertus Bardt, German Economic Institute
1:30 p.m.	**Lunch**

2:30 p.m.	**Keynote 2** **"Geopolitcs of Hydrogen: Anticipating the Future Energy-Security Nexus"** (public) ▪ Dr. Dawud Ansari, German Institute for International and Security Affaires (SWP)
3:15 p.m.	**Input Session 3** **"Innovation and Technology: Shortcuts to Sustainable Futures?"** ▪ Prof. Dr. Kathleen J. Hancock, Colorado School of Mines ▪ Prof. Dr. Stefanie Meilinger, International Centre for Sustainable Development (IZNE), University of Applied Sciences Bonn-Rhein-Sieg ▪ Gilles Le Van, Large Industries and Energy Transition Central Europe Air Liquide Chair: Dr. Bert Droste-Franke, Institut für qualifizierende Innovations-forschung und -beratung GmbH (IQIB)
4:45 p.m.	**Coffee Break**
5.15 p.m.	**Input Session 4** **"Beyond Dependence: Energy Cooperation Among Tech Middle Powers"** ▪ Mohammed Baharoon, Dubai Public Policy Research Center (b'huth) ▪ Prof. Dr. Jochen Prantl, Australian National University ▪ Dr. Rita Strohmaier, German Institute of Development and Sustainability (IDOS) ▪ Dr. Erick Tambo, Pan African Cooperation and Educational Technologies (PACET), United Nation University Chair: Prof. Dr. Maximilian Mayer, CASSIS
6.45 p.m.	**Dinner and Reception**

Strategic Foresight Workshop

(in German, by invitation only)

Saturday, October 21th

09:00 Uhr	**Wake-Up Call** Wehrhaft. Resilient. Nachhaltig. Über die außen- und sicherheitspolitische Strategiefähigkeit der Bundesregierung **Welcome: Dr. Enrico Fels, CASSIS** ■ Prof. Dr. René Bantes, Fraunhofer INT ■ Dr. Henning Riecke, Bundesakademie für Sicherheitspolitik (BAKS) ■ Dr. Olaf Theiler, Bundeswehr Chair: Jessica Nies, Gesellschaft für Sicherheitspolitik e.V. (GSP)
11:00 Uhr	**Recap** (Plenum) Überblick über den Workshopverlauf Methodische Einführung
11:30 Uhr	**Einflussfaktoren und Wirkungsanalyse** Ergebnisse der Trendanalyse, Ausarbeiten der Einflussfaktoren, Wirkungsanalyse (Plenum und Kleingruppen)
13:30 Uhr	**Mittagspause**
14:30 Uhr	**Fallbeispiel** „Resilienz-Monitoring für die Digitalisierung der Energiewende (ReMoDigital)" Davy Van Doren, Institut für qualifizierende Innovationsforschung und -beratung GmbH (IQIB)
15:15 Uhr	**Szenarienentwicklung** (Plenum und Kleingruppen)

Sunday, October 22nd

09:00 Uhr	**Wake-Up Call (hybrid)** **„Energiekrise oder -chance? Der Blick aus den Regionen“** ▪ Dr. Clemens von Doderer, Hanns-Seidel-Stiftung e.V. Namibia ▪ Birgit Lamm, Friedrich-Naumann-Stiftung für die Freiheit Pakistan Moderation: Maximilian Schranner, CASSIS
10:00 Uhr	**Recap (Plenum)** **Methodische Einführung Strategieentwicklung I**
10:30 Uhr	Erarbeiten von Auswirkungen auf das Thema, Chancen, Risiken (in Kleingruppen)
13:00 Uhr	**Mittagspause**
14:00 Uhr	**Methodische Einführung Strategieentwicklung II** **Erarbeiten von strategischen Zielen und einer Roadmap** (in Kleingruppen)
15:30 Uhr	**Vorstellung und Diskussion der Strategien** (im Plenum)
17:30 Uhr	**Debriefing**

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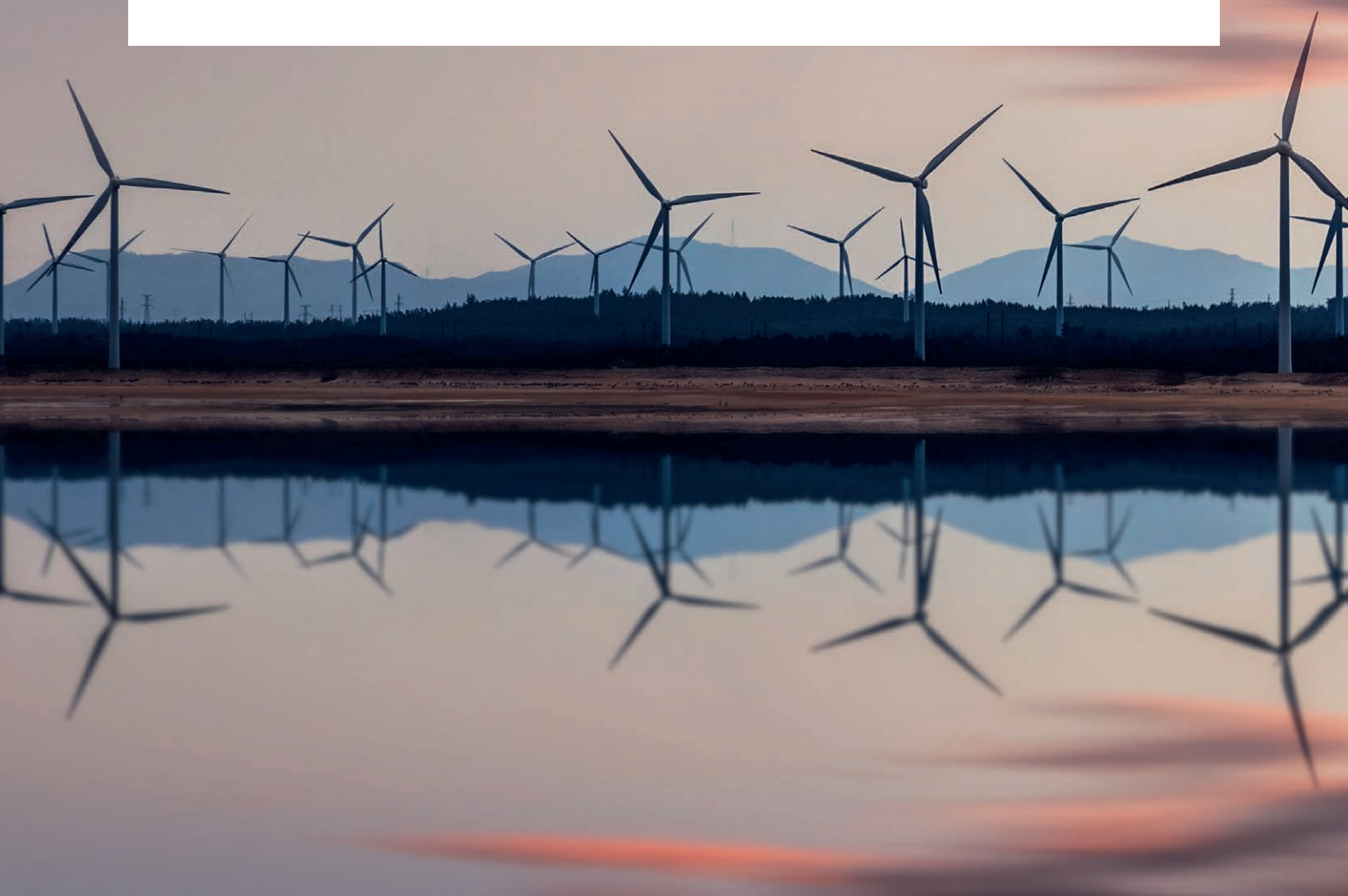


Reflections

Dr. Gilles Lepesant, Senior researcher at the Centre national de la recherche scientifique (CNRS), Paris and Associate fellow at the Asian Energy Studies Centre (AESC), Hong Kong.

Geopolitics of the EU Energy Transition

Before discussing the geopolitics of the energy transition, it is worth remembering that transformations of the energy systems in the world have in the past always been a matter of addition rather than substitution. In some countries, some sources of energy have been replaced by others but at the global level consumption of biomass and coal has never been as important as it is today, despite the surge of other sources of energy. As a matter of fact, 80% of the world energy mix is still based on fossil fuels. However, the share of renewable sources of energy is growing fast and solar could replace coal as the main source of power by 2027 (according to the International Energy Agency, IEA).

In the EU, 22.5% of energy consumed in 2022 was generated from renewable sources (compared to 10% in 2005). The target set for 2030 is ambitious (42,5%) and electrification is supposed to increase sharply, especially in the mobility sector. Such a transformation of the European energy system will trigger new interdependencies within the EU and between the EU and its trade partners. Considering that borders between geopolitics and geoeconomics are more blurred than ever, four challenges faced by the EU can be highlighted.

First, the EU has to increase its strategic autonomy in the area of clean energy technologies in the context of a fragmenting world economy. Talking about deglobalization is – at least for the time being – exaggerated but fragmentation is gaining ground as a result of national industrial policies and trade disputes. Clean energy technologies are not the only ones affected but together with the chips industry, they are at the core of current tensions between US, China and Europe. Chinese investments in Europe have reached a ten-year low in 2022, a drop that took it back to its 2013 level. Similarly, EU investments in China have been declining from 2018 to 2021.

The US is implementing a foreign policy "for the middle class" (J. Biden).[1] Since 2000, the country has lost 5 million manufacturing jobs. The country is deeply divided but Democrats and Republicans agree at least on one observation: international economic integration did not bring China closer to western political values and it did not stop it from expanding its military ambitions. Hence the focus put on concepts such as "friend-shoring" or "reshoring". The priority is to build factories at home to rebuild the middle class. China has a different narrative but the concept of "dual circulation" means among other things diversifying trade and decreasing Chinese vulnerability to political pressures from the West.

Whether these strategies will bear fruit remains to be seen as they imply a whole transformation of economies. We are entering a different era. Borders are no longer seen as a constraint that should be minimized and trade liberalization is no longer a priority. The current European Commission has portrayed itself as a "Geopolitical Commission" and has rightfully called for a more "sovereign" EU. The EU is however much more dependent on foreign suppliers for its energy demand than it is the case for the US or China and its trade to GDP ratio is 92% against 37% and 25% for China and the US, respectively. In a world of growing trade tensions, the EU will have to avoid being mere collateral damage of the US-China dispute. Following the Inflation Reduction Act (IRA), it has adopted the Green Deal Industrial Plan (GDIP) based among other things on the Critical Raw Materials Act (CRMA) and Net-Zero Industry Act (NZIA). The challenge will be to reverse the process of deindustrialization that has been at work over the last decades while complying with WTO rules and keeping access to the Chinese and the US market.

1 J. Traub (2021), Biden´s ´Foreign Policy for the Middle Class´ is a revolution, (Foreign Policy) Link: https://foreignpolicy.com/2021/03/17/bidens-foreign-policy-middle-class-revolution/.

The second challenge is to ensure that the focus put on manufacturing in the context of the Green Deal does not undermine the single market. The phasing down of the stateaid regime through the Temporary Crisis and Transition Framework (TCTF) is very much supported by some member states but it might entail a fragmentation of the single market. A truly European industrial policy with an easy access to funding is more important than ever and the GDIP was a first step in that direction. Providing for an appropriate level of protection of the EU market could prove necessary, too, but would most likely be controversial. For example, green hydrogen domestic production (10 million tonnes expected for 2030) will have to be complemented by imports (10 million tonnes) but the EU's competitive place vis-à-vis the US could become a cause for concern. The head of the Trade Committee at the European Parliament has already called for anti-dumping measures in case US green hydrogen imports supported by IRA would overflow onto the EU market.[2]

In China, the overcapacity of the battery industry is set to surge to nearly four times what the country needs by 2027 and twice the volume of what China's entire car fleet would need to go completely electric by 2030.[3] China's annual vehicle exports surpassed those of South Korea in 2021 and Germany in 2022. For the Chinese industry, targeting markets overseas is all the more important, now that China has enough capacities to supply the world market with batteries (and with solar panels) but keeps building new capacities. Since the IRA may put the US market out of reach of some Chinese companies, the European market could become more attractive, meaning that the EU will have to make a choice between cost competitive imported goods and more expensive ones built in Europe. In this context, progressive industrial policy is set to become an even more sensitive topic since a backlash movement against proclimate policies is gathering pace.

A third challenge would be to implement the Green Deal despite the increasing political polarization in some Member States. In 2020, a Deutsche Bank paper about the Green Deal asked: "Are we ready for an honest discussion?"[4]. The question is more relevant than ever. The EU has adopted a strong regulatory framework and there is no lack of funding, even in comparison with the IRA. The target – achieving climate neutrality by 2050 – shows that despite its decision-making process relying on 27 Member States and on a fragmented European Parliament, the EU can implement ambitious strategies. Since most of the Green Deal Directives related to energy have been adopted, implementation is now key. It should not be taken for granted as the narrative of "the end of the month" might well prevail over the "end of the world" one. Against the backdrop of social discontent, Germany and France have agreed to postpone the deployment of heat pumps. The end of the sale of combustion engine cars by 2035 has triggered concerns that could become more acute in case well-established European car manufacturers are displaced by Chinese competitors. At city level, 2023 elections in Europe have seen a rightward tide linked to a rejection of ambitious climate and sustainable mobility policies.[5] In several Member States, far-right parties have risen in the polls while lambasting green energy policies promoted by mainstream parties.

In such an environment, an inclusive approach and a just transition policy will be much required as protests against the energy transition are mainly echoed by populist and anti-European political forces. When talking about the geopolitical risks of the energy transition, one should not overlook the scenario of a fragmentation of the EU in case the process towards climate neutrality is not properly managed.

2 J. Packroff (2023), EU parliament trade chief calls for tariffs on US hydrogen, (Euractiv).

3 H. Dempsey and E. White (2023), China's battery plant rush raises fears of global squeeze, (Financial Times).

4 E. Heymann (2020), Climate neutrality: Are we ready for an honest discussion?, (Deutsche Bank Research).

5 C. Heeckt and F. Ripa (2023), Is Europe's green wave turning blue? Making sense of the rightward shift in European cities, (LSE blog), Link: https://blogs.lse.ac.uk/europpblog/2023/11/08/is-europes-green-wave-turning-blue-making-sense-of-the-rightward-shift-in-european-cities/.

Dr. Gilles Lepesant

Making the external EU energy policy consistent with the values promoted at home could be the next challenge. Environmental issues such as biodiversity and water-scarcity have right-fully become a key issue in EU policies and more generally Environment, Social and Governance (ESG)[6] principles have gained importance as shown by the European Commission proposal in 2022 of a Directive on corporate sustainability due diligence.[7]

As the volume of metal required is higher for renewable energies than for currently prevailing sources of energy (for the same output), the EU will have to import more and more minerals, the extraction of which is already causing widespread abuse of land, water and indigenous peoples' rights.[8] Among the countries that could become hydrogen suppliers, some (especially on the African continent) are affected by water scarcity, a lack of access to electricity or by a very slow roll-out of renewables despite the solar and wind potential they enjoy.

A new partnership between the EU and these countries may well trigger a win-win scenario but requesting from these countries (former European colonies in many cases) that they provide European countries with metals and green hydrogen, while they are lacking water and electricity to meet their basic needs might prove controversial.

Allegations of "green colonialism" or of "green imperialism" may be unfounded. However, they highlight the risks of a Eurocentric approach that would apply "double standards": striving for a cleaner environment at home while overlooking the environmental impacts of European policies abroad. Addressing such risks is difficult for two main reasons.

First, China has much lower requirements regarding the sustainability of energy transitions and several US states are restricting the consideration of ESG factors. In case EU investors and companies prefer to withdraw from markets where they face a reputational risk, non-European stakeholders would

6 Environment, Social and Governance.

7 European Commission (2022), Proposal for a Directive on corporate sustainability due diligence and annex, Link: https://commission.europa.eu/publications/proposal-directive-corporate-sustainability-due-diligence-and-annex_en.

8 F. Ratings (2020), Water Scarcity Is Greatest Risk to Metals and Mining.

Dr. Gilles Lepesant

probably fill the gap. The EU will have to find a way to enforce its standards on most of its partners. The second reason why addressing sustainability concerns abroad might prove difficult is, that it may trigger accusations that external EU green requirements are hiding a new kind of protectionism as shown by protests in South-East Asia and in Latin America, stirred by EU calls against deforestation. More generally speaking, the ongoing implementation of the Carbon border adjustment mechanism (Cbam) is already facing critique from countries pointing to a growing "green protectionism" on the side of the EU (India plans to file a complaint to the WTO over the EU's instrument).

Despite these issues, the fact remains that most of the EU trade partners in Africa, Latin America and Asia will be heavily affected by a lack of water in the years to come, which could hit the mining industry as well as other sectors linked to the energy transition. Green hydrogen production and platinum-group metals extraction (key components of electrolysers) require significant amounts of water. This issue could be addressed by investments in desalination plants powered by solar energy, but local communities may expect newly installed renewable energy capacities to meet first and foremost local needs. These concerns come on the top of numerous studies highlighting the consequences of metal extraction for local populations in low-income countries, even for metals that are not commonly labelled "critical metals" (human rights allegations recorded over the period 2010–21 have been mainly related to copper[9]). The approval of national authorities for mining operations does not provide in itself the guarantee that foreign investors abide by ESG principles.

To conclude, even when geopolitical challenges of the energy transition are seen through the lens of politics only, concerns related to environmental sustainability and to human rights deserve attention. A growing divide between an imagined "Global South" and a Europe alleged to apply double standards might erode the EU's legitimacy and influence. The EU can neither negate down its ambitions nor ignore its historical responsibility for the volume of carbon stuck in the atmosphere, or forget its colonial past. As 80% of emissions will come from emerging economies in the next 30 years, the EU will have to imagine a new partnership with them that addresses both EU climate ambitions and sustainability issues abroad. It will be especially important to form such a partnership with countries exporting metals and green hydrogen (particularly in Africa). While assessing the geopolitical risks associated with the external dimension of the Green Deal, local communities' expectations, water scarcity and biodiversity concerns should not be overlooked. The way geography is shaping geopolitics matters.

9 Business & Human Rights Resource Center (2023), Transition Minerals Tracker: 2022 Analysis.

Geoeconomics and Energy Transitions

Prof. Dr. Marc Oliver Bettzüge, Professor of Economics, Energy and Sustainability at the University of Cologne & Director EWI

Energy is power, or more precisely: Energy is power over time. Thus, applying power always requires a throughput of energy. As ecologists such as Alfred Lotka or Eugene Odum have pointed out, biological evolution selects for energy capture.[10] Similarly, mankind's cultural evolution has evolved around finding ways to harness new energy flows giving people increased power over nature (and other people).[11] Important examples include the control of fire, the control of solar flows through agricultural practices, the control of water flows and wind in mills, the control of fossil resources, or the control of nuclear decay for human use.[12]

From early on, innovations in energy capture, i.e. increasing the amount of primary energy drawn under human control, and innovations in energy converters, i.e. machines that turn the energy flow into useful human activity, went hand in hand. Expanding the range of controllable primary energy flows thus allowed humans to expand the range of equipment in use, too. The combination of more energy and more (and more sophisticated) equipment then allowed human societies to "get more things done".[13] Societies that "got more things done" then typically outcompeted those with smaller energy footprints: agriculturalists generally won over hunters-and-gatherers, and over the past 300 years industrial societies based on the combustion of fossil fuels came to dominate over agricultural societies that still only relied on annual solar energy flows.[14]

10 A.J. Lotka (1922), Contribution to the Energetics of Evolution. In PNAS 8 (6), 147-151; E.P. Odum (1969), The Strategy of Ecosystem Development, In: Science 164 (3877), pp.262-270.

11 R. Heinberg (2021), Power – Limits and Prospects for Human Survival.

12 Cf. V. Smil (2017), Energy and Civilization – A History.

13 Cf. I. Morris (2010), Why the West rules – for now, p. 144.

14 Fischer-Kowalski, M., F. Krausmann and I. Pallua (2014), A socio-metabolic reading of the Anthropocene: Modes of subsistence, population size and human impact on Earth. In: The Anthropocene Review 1 (1), pp. 8-33.


Prof. Dr. Marc Oliver Bettzüge

From the perspective of primary energy sources, energy transitions in the history of humankind therefore actually were energy additions:[15] As a new energy carrier was added to the list, earlier energy carriers with few exceptions would not fall out of use. Instead, the expansion of the energy available would allow the society to expand in scale and scope. For example, when cheap oil was adopted as an energy carrier, it did in fact replace coal in certain applications (e.g., shipping, household heat), but mostly it opened completely new energy services (e.g., automobiles, trucks, tractors, airplanes). And at the same time global use of coal continued to increase, with a focus on those energy conversions where it still was (and is) competitive (e.g., electricity generation, iron and steel production).

Thus, while there are many examples for energy transitions in specific use cases (e.g. for heat: fuelwood to coal, coal to oil, oil to gas, gas to electricity), the long-term trajectory of total human energy use is one of constant increase. In 1800, roughly 1 billion humans used around 6,000 Terawatthours (TWh) of non-food energy, with less than 2 percent coming from coal.[16] In 1900, 1.7 billion humans already employed roughly 12,000 TWh of non-food energy: the centennial increase stemming almost completely from an enormous expansion of the use of coal, especially in the UK, Germany, and the USA. And today (data from 2022) population has expanded to more than 8 billion people, while global energy throughput has skyrocketed to almost 180,000 TWh. This means that per capita use of energy has steadily increased from 6,000 kWh per person and year in 1800, over 7,000 kWh in 1900 to around 23,000 kWh today: an obvious biophysical correlate of the increase in wealth and the human ability "to get things done" during the same period.

More than 80 percent of today's global energy throughput (excluding traditional biomass) comes from the extraction and combustion of fossil fuels: oil (32 percent), coal (27 percent), natural gas (23 percent). In turn, the energy converters that currently lend power to human societies predominantly require this kind of fuel and would lose their value without their supply. The major exception concerns equipment running on electricity which, as a universal secondary energy carrier, can be generated from a broad range of primary energy sources. However, electricity currently only accounts for slightly more than a fifth of global final energy use.

15 Cf. York, R., and S.E. Bell (2019), Energy transitions or additions? Why a transition from fossil fuels requires more than the growth of renewable energy. In: Energy Research & Social Science 51, pp.40-43.

16 All data taken from https://ourworldindata.org, last accessed on 27 January 2024.

From this perspective, energy security still is and probably will be for some time to come, fossil energy security. Oil security is of particular concern. Oil still is the largest fossil energy source for mankind, and it also has very useful properties, especially for use in transport and by the military. Moreover, oil reserves are highly concentrated, with a few countries wielding significant geopolitical influence from their reserve positions. After the financial crisis of 2008/2009, cheap money from low interest rates plus technological advances allowed for a rapid expansion of U.S. production of shale oil. However, U.S. oil production is now expected to be approaching a plateau, which points to a rebalancing of power in the global oil market towards OPEC countries and Russia. Also, oil prices are consistently higher now than in the previous decade. Thus, the window of relatively cheap oil granted by U.S. shale seems to have closed. This turn of events is especially troublesome from the European perspective as Europe mostly relies on imports with limited indigenous oil positions left.

Similar conclusions can be drawn for many other extracted resources. In a world of 8+ billion people already in breach of planetary boundaries, resources in general are likely to gain in relative value. Countries with significant resource positions might therefore continue to gain in relative power, and vice versa. Top-ten resource holding countries include the USA, Canada, and Australia on the one hand-side, and Russia (by far the largest owner of natural resources), Saudi-Arabia, Iran, Iraq, China, India, Brazil on the other hand-side.[17] Europe has become a net importer for most natural resources, especially energy carriers. Moreover, Europe, as the region having industrialised first, and thus having exploited her own resource base first, will likely find it difficult to fundamentally reverse that trend. Recent US restrictions on LNG exports have underlined Europe's challenging position with respect to resource imports.

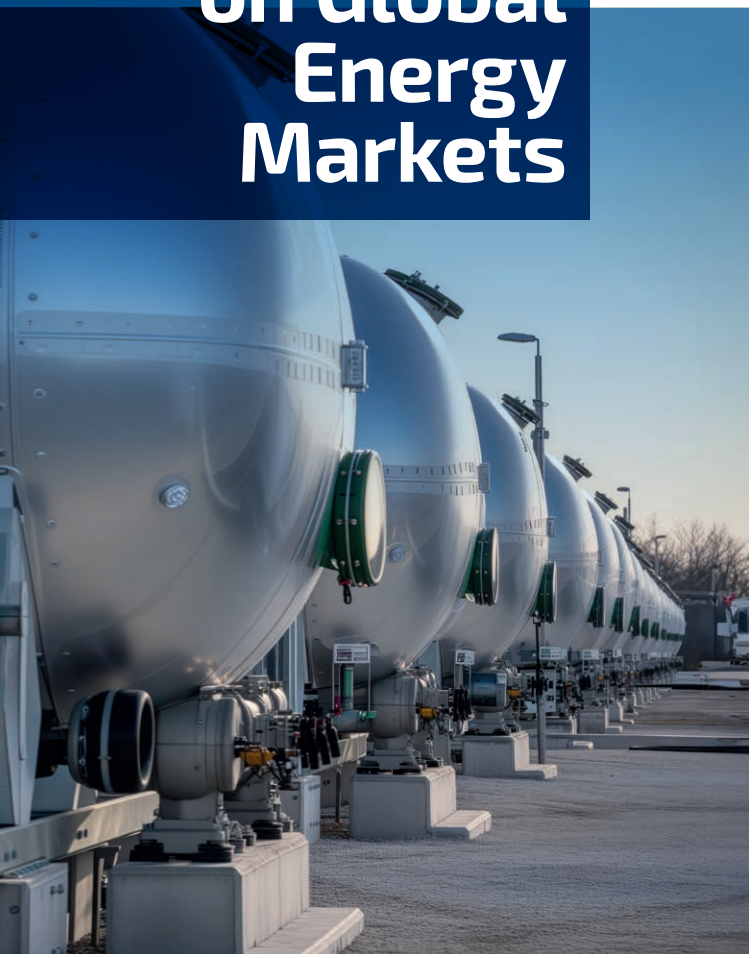
A rapid and global clamp-down of fossil fuels as required by the preamble of the Paris treaty would entail an energy transition that would differ strongly from the energy transitions of the past. While some energy carriers are supposed to be added (e.g. solar and wind energy flows, potentially nuclear energy flows from fission or fusion), other energy carriers shall quickly go out of use, and with them, the machinery that depends on their use. Such a reversal of the expansionary trend of global energy throughput would be unprecedented in modern history, and there is a good chance that it would entail a reduction of the productive potential of the world economy. Thus, a successful "global agenda on sustainability" can only be imagined with a "global agenda on mutual solidarity and redistribution".

On a country-level this means that there is a difference between countries that shift to new energy sources such as solar and wind, i.e. attempt to phase-out fossil fuels (and the associated equipment) fast (energy transition), and countries that merely grow those new technologies without placing major restrictions on the use of existing fossil capital (energy addition). By adopting a strict, unilateral, and unconditional mitigation strategy, the EU has firmly put itself into the former category, while other major actors such as e.g. the USA, China, or India, rather play the latter strategy. If the past is any guide, this asymmetry in strategy could lead to a redressing of global power balances. The growing impetus in Europe on restoring economic self-sufficiency, industrial prowess, and military power might therefore engender increasingly challenging contradictions with Europe's territorial climate goals.

17 Data taken from https://www.statista.com/statistics/748223/leading-countries-based-on-natural-resource-value/, last accessed on 27 January 2024.

Growing Uncertainty on Global Energy Markets

Prof. Dr. Hubertus Bardt, Managing Director and Head of Science at the German Economic Institute (IW)



Energy markets have always been characterised by changes of supply and demand and by political influences. Currently, fundamental long-term changes and short-term events significantly add uncertainty to the global energy markets. Global political and economic developments already have significant consequences for international energy suppliers and consumers and can lead to an additional burden.

The most important developments have their roots in climate policies and international conflicts in regions that are important for energy supply:

- International efforts to mitigate greenhouse gas emissions reduce the demand for fossil fuels. However, they remain dominant in global energy supply for the next decades. Different climate goals and energy policies lead to different energy prices in the respective countries – depending on the level of ambition and the availability of cheap renewable energies.

- The Russian attack on Ukraine has led to gas and electricity price shocks in Europe and price increases in Japan and North America which would have been even more severe if China had grown as projected. The additional demand for LNG provides new market opportunities for gas producers but increases costs for consumers in Europe and Asia. The higher price difference for consumers between Europe and the US will be long-lasting and is an incentive for energy consuming companies to invest into locations closer to the source of energy.

- Developing supply chains for renewable hydrogen provides new opportunities for countries that have the necessary natural preconditions. If production can be extended to hydrogen derivates or further chemicals, new competitors may arise. As long as traditional fossil resource producers have these opportunities, hydrogen and hydrogen-based products can (partly) substitute reduced demand for natural gas and crude oil.

- Renewable energies do not only depend on the availability of wind, solar radiation or other natural advantages, but also require different natural resources: Lithium and cobalt are essential for batteries, copper is necessary for wind turbines and the electricity grid, rare earth elements and other metals are essential for many modern technologies. Securing supply chains for these metals is a major political and economic challenge as long as China has a dominant market share.

- The conflict in the Middle East has the potential to affect the gulf region and therefore, to disturb global crude oil supply. The World Bank estimates that an escalating conflict could push the oil price up to more than 150 Dollar. This would lead to another energy price shock to the world economy, only two years after the gas price shock of 2021/22.

These developments come on top to traditional market trends: The OPEC always tries to manage the oil market, US supply has limited price peaks for more than a decade, global economic growth perspectives influence the international energy prices. The uncertainty is partly policy-driven and can theoretically be reduced by policymakers. However, the international (existing or potential) conflicts are real, and it cannot be expected that this would change fundamentally. And the shifts caused by climate policy can hardly be avoided as well. It is the nature of such fundamental changes as switching from fossil to renewable energies that the specific consequences cannot be predicted. If the high degree of uncertainty remains, governments and companies should focus on how to manage these uncertainties. Diversification of supply chains, developing new technologies, supporting transformation and international coordination must be placed on the political and entrepreneurial agenda.

Prof. Dr. Hubertus Bardt

NATO and the Energy Transition: Getting Ahead of the Curve

Michael Rühle, former Head of Hybrid Challenges and Energy Security Section at NATO, ret.

Michael Rühle

NATO is not an energy institution, but it is affected by the global energy landscape, notably the transition away from fossil fuels. To ensure that this energy transition does not find the alliance unprepared, allies need to embrace it. Several factors underscore the need for a new approach.

First, because of Russia's war against Ukraine, European NATO allies are currently facing an energy crisis. Russia had been weaponizing energy deliveries for a long time, but never as overtly as today. Many European allies had to look for different suppliers. Still, as a result of Russian cut-offs, energy prices in Europe have soared, and they are likely to remain very high for some time to come.

Second, NATO and EU member states made a conscious decision to become independent of Russian energy, and the speed with which Europe has cut out Russian gas from its energy imports has been impressive. The oil price cap and various other sanctions will deprive Russia of considerable financial revenue, but also of political leverage. Europe, which used to be Russia's main market, is no longer available.

Third, because of Russia's aggressive policies, NATO will increase its military presence on its eastern flank. Deterring Russian military adventurism will mean more forward-deployed NATO forces; forces that exercise more frequently and, therefore, will need lots of diesel and kerosene. In other words, just as NATO is getting rid of Russian fuel, its armed forces will need **more** fuel than in the recent past.

Fourth, the sabotage against the NordStream pipelines in September 2022 was a reminder that energy infrastructure remains vulnerable. This is also a concern for the military, since armed forces are almost entirely dependent on civilian infrastructure. Hence, enhancing the resilience of energy infrastructure has to be tackled with a new sense of urgency.

And this leads to the **fifth** point: the energy transition. The West is moving away from fossil fuels. Renewables play an ever-growing role in the energy mix. The electrification of transportation systems is underway; Sustainable Aviation Fuel or hydrogen fuel cells offer new opportunities. Extracting and burning fossil fuel is increasingly seen as a liability – in terms of the environment but also in terms of security.

Another major impetus for the energy transition is the need to address climate change, leading to the **sixth** point: Climate change will affect security in fundamental ways. Extreme weather events or sea level rise will lead to new challenges: migration, humanitarian disasters, perhaps even interstate conflict. Armed forces will have to adapt, as they may have to respond to major climate events more frequently. Moreover, an increasing number of military installations are impacted by severe weather events and some military equipment has failed due to changing climatic conditions. There is also a growing expectation among the public that the military, too, will do its share in mitigating global warming. After all, armed forces are a major polluter. Turning the armed forces "greener" thus offers reputational gains, but there are also operational considerations: more energy efficiency leads to a lesser logistical burden and fewer dependencies on fuel imports from potentially difficult suppliers.

However, there are caveats. NATO cannot compromise on operational effectiveness, nor on interoperability. Moreover, as NATO's armed forces embrace new technologies, one must take great care not to exchange the former fuel dependency on Russia with a new dependency in strategic minerals on China.

Over the past years, NATO allies have made a significant effort to better understand the energy and climate developments that shape their environment. To mention just some aspects of this ongoing work:

- NATO is revamping its fuel supply to ensure that the forces deployed in NATO's East will have sufficient fuel in all circumstances.
- NATO armed forces are getting rid of Russian fuel.
- NATO is working on an Operational Energy Concept to improve the planning processes within the military and promote energy efficiency in the armed forces.
- The Petroleum Committee is undertaking a major effort to look into the future of fuels for military applications.
- NATO has launched a new work strand to enhance the security of undersea infrastructure by bringing the military and infrastructure operators closer together.
- NATO is mainstreaming climate considerations into its defense planning process, its exercises, and its resilience work.

These are important pieces of the energy and climate puzzle, but still more must be done. NATO needs to have a clearer idea of how to decarbonize the military without compromising combat effectiveness or creating new supply chain dependencies. Allies need to better understand how the energy transition and legacy equipment can co-exist. And finally, NATO needs to create mechanisms that help it ensure that all Allies embark on the energy transition in a coherent manner, so that they can minimize risks.

All of this leads to one conclusion: To master the challenges of the energy transition, NATO needs a unifying approach – an "Energy Transition by Design". What does this mean in concrete terms?

- Setting up a mechanism that ensures coherence among Allies as they approach the green transition in their armed forces.
- Having regular exchanges among allies and with outside experts on the direction and challenges of the green transition.
- Maintaining a consistent overview of progress on national green defense efforts, e.g., through a best practices compendium on green defense-related work.
- Agreeing on voluntary guidelines to shape further work on the green transition.
- Using the NATO Defense Planning Process to help steer that process in the right direction.

NATO is an alliance of 31 sovereign nation states with Sweden expected to become its 32nd member in the near future. Hence, allies cannot tell each other how to run their respective national energy policies. However, NATO has almost 75 years of experience in military cooperation. Allies train together, develop and procure weapons together, and agree on standards. No other international institution has achieved this degree of security cooperation. Now is the time to use these tested mechanisms to embrace the energy transition, and to manage it in such a way that it results in a true "win-win" outcome: an alliance that is both "greener" and stronger.

Afro-European Hydrogen Cooperation

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10 Issues for an Equitable and Sustainable Foundation for Success

The global energy transition towards sustainable and clean sources of power is a paramount concern for both Africa and Europe. With their unique geographical positions and the significant potential of Africa for renewable energy generation, cooperation between the two continents presents a remarkable opportunity to drive the development and utilization of hydrogen as a key energy carrier.

However, the success of this cooperation hinges on establishing a cooperation model which considers the interest of both parties, learning from experience in the past to avoid new forms of resource colonialism. Only through proactive and comprehensive efforts can Afro-European hydrogen cooperation for a sustainable energy transition flourish and truly benefit both parties involved.

1. Energy security is key to prosperity. Energy is key to development. Industrial activity relies on the availability of energy in its various forms. Hydrogen plays a twofold role in the process of energy transition: Due to the natural fluctuation in renewable energy production by wind and solar, there is a need to store energy to cover the residual loads. Hydrogen could serve as a key energy carrier, storing and providing energy. Hydrogen could also play a role as a material needed in chemical production processes. Today, hydrogen used in industrial processes such as refining and ammonia production is produced by steam reforming of natural gas.

   Transitioning from conventional energy systems to an energy system based solely on renewable energy, increases a country's energy self-sufficiency and decreases global dependencies on countries that supply fossil fuels. It will reduce the domestic carbon footprint. However, it is quite clear that there are regions that will be able to export renewable energy and regions that will continuously depend on energy imports. Hydrogen could become a tradable good. In Europe, the process of converting existing and building new pipelines for hydrogen from the North Sea, the Netherlands and Belgium down to the industrial areas of North Rhine- Westphalia has already started to create the infrastructure that will allow this new way of energy trading. Africa has many regions with high potential for renewable energy production, which might become future hydrogen exporters.

2. The historical legacy of colonialism and Global North-South relations over resource exploitation need to be addressed. Colonialism began in Africa in the 14th century, with the primary objective of exploiting resources and accumulating wealth for the development of the colonial power at the expense of African peoples. Some European nations created colonial territories in order to harness Africa's natural resources without constraint to expand their own economic systems. While the first Western colonial powers to settle on the African continent were mainly interested in the trade of cotton, coffee, cocoa, diamonds, copper, rubber, and animals, the exploitation in the post-World War I period focused on minerals such as oil, natural gas, diamonds, uranium, copper, cobalt and gold. The post-World War II period – with the redistribution of territories respectively colonies mainly between France and England, followed by the quest and struggle of African countries for their independence – marked the beginning of a new order: countries gained "formal independence"

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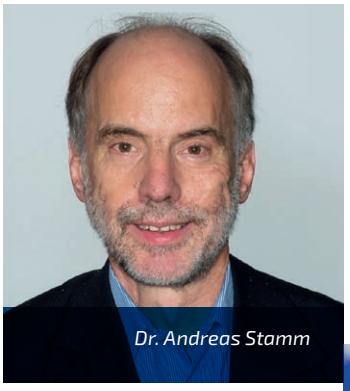
Dr. Andreas Stamm


Dr. Rita Strohmaier

but on unfair terms, including the exploitation of natural resources to the detriment of the domestic economies and local population. The situation referred to as neo-colonialism continues to this day, often in different forms, with enormous consequences for the countries and the environment.

3. Faced with historic exploitation of Africa, the post-independence generation, with greater connection and interaction with the global world, seeks to create its own development path by correcting the current inconsistency of being rich in natural resources, yet poor and underdeveloped. The right to self-determination implies that Africans are in control of their destiny in the international order and exercise the full right to permanent sovereignty over natural resources, for the purpose of achieving continental development. Building on the concept of African Renaissance and Pan-Africanism, the African Union adopted Agenda 2063 in 2015 as a continental roadmap for structural transformation, inclusive growth, and sustainable development. China has risen over the past three decades as one of the main cooperation partners and largest investors in Africa in terms of total capital. This fact, combined with globalization and the emergence of a multipolar world with new actors initiating or strengthening their cooperation with Africa, provides African countries with a number of options respectively partners to make the best use of their natural resources through setting up good deals based on the win-win principle. The wave of military coups in the Sahel, particularly the coup in Niger, resulting also from the changing geo-political order, threatens the Afro-European energy cooperation, and resonates as a call for an equitable and sustainable Afro-European Hydrogen Cooperation, learning from past experiences.

4. To ensure that Afro-European hydrogen cooperation operates on an equitable footing, it is crucial to acknowledge historical imbalances and disparities. Europe has long been a champion and beneficiary of scientific and technological progress, while African countries, despite being storehouses of natural resources, have faced challenges – including because of European colonialism and different forms of exploitation – in developing its own industries. Recognizing this disparity is essential to promote a shared vision of cooperation based on fairness and mutual benefit. Translating this awareness into concrete actions for technology transfer, research collaboration and programs for education and industrialization projects related to all types of hydrogen is paramount.

5. An equitable and sustainable partnership should be the guiding principle for Africa-Europe hydrogen cooperation. Both Africa and Europe possess valuable assets: natural resources, technological expertise, and market potential. By strengthening cooperation and ensuring knowledge transfer, European countries can support Africa in developing its hydrogen infrastructure and mastering critical technologies, while Africa can contribute

its abundant renewable energy resources. For instance, the recently launched research project "H2Global meets Africa" is exploring the question of how to establish sustainable hydrogen partnerships between Africa and Europe, focusing on integrated value chains, local economic development, and supporting trade opportunities.[18]

6. Bridging the knowledge gap and setting up the infrastructure for local transformation and exploitation of the hydrogen value chain is a crucial aspect of equitable cooperation. Europe, with its technological expertise and research capabilities, can assist Africa in capacity building (particularly in industrial policymaking and technology and market assessment), promoting research and development, education and training, and establishing sustainable hydrogen systems. A model of an Afro-European network of centres of excellence, addressing different components of the hydrogen value chain, could be established in different regions of the continent to support collaborative research projects, joint ventures for the exploitation and commercialization of results, to bridge the knowledge gap and foster innovation on both continents, while contributing to local development. Such a model breaks up the pattern of exploitation of natural resources with their export, transformation and reimportation on the continent, with immense losses in the value chain.

7. Equitable cooperation must support the just transition of countries and ensure that the benefits derived from Afro-European hydrogen projects are equitably shared. These include economic benefits, job creation, and access to affordable green energy. Many countries in Africa are already following a dual and gradual approach, taking into account their own decarbonization needs in industry and transport in addition to exports. Local off-takers not only strengthen the domestic economy, but also reduce some of the uncertainties still inherent in global hydrogen trade. The use of green hydrogen in fertilizer or synfuel production potentially generates more sustainable employment opportunities than of its use in energy plants. It also increases the international competitiveness of countries and gives them a comparative advantage when it comes to carbon-border adjustment mechanisms such as the one introduced by the EU last year. To this end, transparent, inclusive and accountable frame-works should be put in place to ensure that local communities and vulnerable groups benefit directly from projects. Instruments should include mandatory oversizing of energy projects and seawater desalination plants to feed into local energy and water grids, direct payments from hydrogen export revenues to affected citizens, local content requirements especially for FDI-based projects, shared ownership (e.g. energy community initiatives), and targeted investment programs

18 https://www.h2-global.de/project/analysis-research

8. Sustainability must be realized along the entire value chain. In addtion to social and economic development aspects, planetary boundaries must be taken into account when transforming our global energy supply chains. This applies both to the availability of the required resources – e.g., the amount of iridium requirement for PEM-electrolysers. Politics tend to focus on carbon dioxide emissions, but all emissions should be considered. Life cycle assessment is a scientifically sound and valuable tool for dealing with the numerous impacts of technologies. However, when several criteria, are considered this often leads to ambiguous results. For example, when ecological and economic aspects are considered simultaneously, clear optima do not always emerge. Even with purely ecological criteria, we are faced with trade-offs. What is good for climate protection may be a problem for resource depletion. Here, scientists can prepare decisions by narrowing down the range of choices, e.g. by identifying pareto fronts for conflicting criteria and communicating them transparently.

9. An equitable foundation for Africa-Europe hydrogen cooperation requires policy harmonization and regulatory support. Collaboration between African and European governments, regional organizations, and institutions is crucial to establish a common regulatory frame-work and facilitate trade and investment. This can create a level playing field and remove unnecessary barriers that may hinder cooperation.

   Furthermore, there should be a greater harmonization of instruments at national and European level for green hydrogen cooperation with Africa. Germany, for example, pursues an integrated and coordinated approach, bringing together different ministries involved in hydrogen cooperation with Africa, including the Federal Foreign Office and the Federal Ministries of of Education and Research (BMBF), for Economic Affairs and Climate Action (BMWK), and of Economic Cooperation and Development (BMZ). Other institutions involved include implementing agencies such as KFW[19] and GIZ[20], as well as embassies, the German Economic Exchange Service (DAAD), and research institutions such as Fraunhofer and Helmholtz institutions, DLR[21], FZJ[22], KIT[23], WASCAL[24], and SASCAL[25]. This way, diplomacy and financial, economic, academic and research cooperation on hydrogen can be combined more effectively. The portfolio of cooperation schemes includes, inter alia, the PtX Development Fund (BMZ[26]) to assist local value creation, the PTX Growth Fund (BMWK[27]) to support pilot projects, and GH2 research grants (BMBF[28]) to foster knowledge development.

10. Technology options for further hydrogen development should be kept open. Besides electrolysis, there is a variety of other options such as blue or turquoise hydrogen. However, new emerging technologies such as hydrogen from plasmalysis of biogas from waste treatment plants or pyrolysis of plastic waste or sewage sludge are hardly considered in the political discussion. Given the different options for producing and using hydrogen, it may be important not to undermine technological development by limiting the perspective to a single hydrogen production pathway.

19 Kreditanstalt für Wiederaufbau
20 Deutsche Gesellschaft für internationale Zusammenarbeit
21 Deutsches Zentrum für Luft- und Raumfahrt
22 Forschungszentrum Jülich
23 Karlsruher Institut für Technologie
24 West African Science Service Centre on Climate Change and Adapted Land Use
25 Southern African Science Service Centre on Climate Change and Adaptive Land Management
26 Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
27 Bundesministerium für Wirtschaft und Klimaschutz
28 Bundesministerium für Bildung und Forschung

11. New and unexpected uses of technology in rural Africa should be embraced. Technology has the potential to revolutionize rural Africa and address various socio-economic challenges. Decentralized hydrogen systems are one example: Deploying small-scale hydrogen production units in rural Africa can ensure energy security and energy access in off-grid regions. These units can use renewable energy sources, such as solar or wind, to produce hydrogen, which can be stored in gas cylinders or metal hydrates. Hydrogen systems can be used not only as emergency generators, but also for power generation, cooking, and even transport. Promoting energy security and empowerment of rural communities requires engineering that takes into account the needs of these communities in the development of hydrogen-based decentralized systems. Such systems might include mobile applications for energy management, hydrogen fuel cells to power farming equipment, and hydrogen-powered generators for health and education facilities.

In conclusion, Africa-Europe hydrogen cooperation can act as a catalyst for equitable partnerships and clean energy development. By operating on an equitable footing and embracing new and unexpected uses of technology, particularly in rural Africa, this cooperation can unlock numerous opportunities for sustainable development, economic growth, and social progress. Together, Africa and Europe can leverage their strengths, bridge the technology gap, and ensure that no one is left behind in the pursuit of a cleaner, more equitable future. By addressing historical inequalities, fostering an equal partnership, bridging the knowledge gap, ensuring a fair distribution of benefits, and establishing supportive policies, Africa and Europe can maximize the potential of hydrogen energy to uplift both regions.

On the German Ability for Strategy Making

Prof. Dr. René Bantes, Head of Technology Analysis and Strategic Planning (TASP), Fraunhofer Institute for Technological Trend Analysis INT

Prof. Dr. René Bantes

"Strategy making" or the German term "Strategiefähigkeit" means "to define goals and priorities, to act strategically and to take responsibility for these acts."[29] To be able to engage in strategy making therefore requires two main capabilities:

1. To be able to anticipate future developments, and to derive actionable knowledge out of the results.
2. To be able to act in a way that influences the outcome of what you are acting upon.

Looking back in time it is not overly complicated to find glaring examples of otherwise clever people completely misjudging future technological developments. The inventor of the machine gun, Hieram Maxim, is quoted of having said "It [the machine gun] will make war impossible"[30]

The CEO of IBM in 1943 famously expected that the worldwide demand for computers will be around five, and the academy of sciences in Saint Petersburg once concluded that crude oil has no use at all.

It is easy to look back and make fun of these expectations in retrospection. But we can also use them as cautionary tales motivating the use of structured and scientifically sound futures analysis when we engage in strategic decision making.

29 S. Angenendt (2021), Der Weg zur Strategiefähigkeit (Friedrich-Ebert-Stiftung), in: https://www.fes.de/themenportal-flucht-migration-integration/artikelseite-flucht-migration-integration/der-weg-zur-strategiefaehigkeit.

30 As cited in: A. LaFrance (2016), People Thought Machine Guns Might Prevent Wars (The Atlantic), in: https://www.theatlantic.com/technology/archive/2016/01/maxim-guns/428253/.

History tells us that there are three main sources of bad anticipation:

- Missing knowledge about a change, an innovation, an invention and/or its application potential.
- A lack of imagination with regards to the impact of the change, the innovation or the invention.
- (Un)Conscious ignorance of information that we do not want to acknowledge.

All three can be partially avoided by using foresight analysis. Structured and science-based foresight can provide strategy making with sound, structured and unbiased analysis of possible futures as the foundation of political decision making. It should be a standard prerequisite in long term decision making.

We have to conclude nevertheless that even if such analysis is available, the mere presence does not automatically lead to it being reflected in the political process. Strategy making requires as a prerequisite next to the sound future analysis, a clear reflection of one's own responsibility and ability to act. Typically, this reflection exceeds the more academic process of futures analysis, because it not only reflects the analysis of capabilities but also a political debate regarding the responsibilities.

If we apply these more fundamental reflections to the analysis of German strategy making abilities, we can describe the aforementioned basis for the strategy making in broad terms rather easily:

- The causes of the main challenges Germany will be facing in the next decades are pretty obvious, and there is a sufficient amount of information regarding them: climate change, demography, loss of biodiversity, water shortage, economic risks, pandemic risks, political polarization.
- These causes produce a broad variety of global and regional symptoms, like mass migration, regional conflicts, hunger, exceeding social inequalities and so on.
- Technology is at the same time a source for many and a possible solution to some of the problems. Technological advances in areas like artificial intelligence, synthetic biology, new materials or quantum technologies will provide powerful capabilities for the price of uncomfortable ethical, legal and social consequences.

The requested clear reflection of the own (German) responsibility and ability to act delivers a twofold picture. Germany is the fourth biggest economy in the World (by measure of the GDP) and the biggest economy in the European Union. But even with that being the case, we have to realize that when it comes to the causes of most of our future challenges, we cannot change them on our own, and at the same time they cannot be changed without our participation.

When we look at the symptoms produced by the many challenges Germany faces there are opportunities and requirements for Germany to define its own goals and priorities, and act unilaterally or in a suitable regional coalition.

This sounds very obvious, but when we apply this recognition future trends on Germanies capabilities as a guiding principle, the resulting action space for strategy making becomes twofold.

- We have to recognize that Germany cannot unilaterally act on the causes of the challenges it faces. To do so would be a waste of resources.
- In areas where we can act on the symptoms of our challenges we have to do so, unilaterally if necessary.

This twofold action space requires a matching twofold mindset. Germany has to act more "Dutch" on the "causes level" focusing on multilateral, pragmatic action, searching for, and initiating coalitions, accepting that not everything will always be done the way we would do it if we were on our own. On the symptoms level we have to be more "American", acting on our own terms on things we can change, with clarity of purpose, and willing to accept the responsibility.

The same applies to the development and use of technology. We are not, and will not be, in the driver's seat for the development of many of the key future technologies, neither in the realm of military technology nor in the realm of civil technology. We are nevertheless a substantial actor in the scientific world, and have a technologically and economically strong base, that enables us to be a substantial partner in multilateral technology coalitions. Again, we need the twofold mindset: Engage in coalitions to advance the "big" technology topics, and avoid spending resources on hopeless endeavors and jump on topics where substantial progress is possible unilaterally.

At the moment in both, the technological and the political action space, Germany is to shy for the latter and too proud for the former.

Foresight and Strategic Capability in Foreign and Security Policy

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Observers like to pose the question of Germany's strategic capability with a certain disdain – don't other countries such as France or the United Kingdom look more confidently at their international role and interests? Isn't China focussing its strategies on goals much further into the future? Can Germany even keep up with this, given its cautious strategic culture, which attaches such great importance to integration, law and multilateral cooperation that clear strategies are hardly politically viable?

This cliché has been dissolving in recent years, in a phase of geopolitical competition that the German government has long since incorporated into its foreign policy thinking. The paradigm of integration is historically well-founded, creates consensus, and is the frame-work for a stable and successful foreign policy. However, we are concerned here with the role of strategic foresight as part of strategic capability. Unfortunately, it is still true that the use of foresight methods is not a matter of course.

Political decision-makers do not like to think about unpleasant future scenarios. Well-worn bureaucratic paths and a constant crisis mode – the word of the year 2023 in Germany – often hinder the routine application of careful foresight.

"Strategic capability" is a hopeful but complex term. Does it include a proper analysis of the risks and threats that a state needs to counter? In Germany, this can be found in many places inside and outside the government. Is it about clear priorities that also remain visible in individual dealings with partners and competitors? This is where Germany finds it more difficult to make its strategies coherent, as diverse partnerships, international networking and good diplomatic relations are important foundations of German foreign policy. German strategies therefore often resemble "as well as" political plans. And even if strategic documents are repeatedly used as a point of reference for legitimizing political action, the strict implementation of political guidelines is often a matter of luck.

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The National Security Strategy from the summer of 2023 is a successful document because it links different policy areas and establishes the geopolitical paradigm with a view to tough global competition, not just economic competition. However, it leaves one somewhat perplexed when it comes to listing numerous known political packages of measures and elegantly avoids possible international crises. Foresight did not necessarily take place in the run-up to the NSS, but can now be applied to the future issues of the security environment described. The NSS offers various starting points for this. There is a lot for foresight to do, particularly in the links between security policy and climate change in crisis regions or in the area of security policy aspects of resilience in the face of future technological and social developments.

Systematic foresight and planning are core elements of strategic capability. The context for strategic planning today is a phase of growing complexity and the alarmingly rapid impact of international trends and upheavals on the foreign policy agenda. Security policy implications in many policy areas and interactions between various transformation projects of the Federal Government make this complexity even more tangible in everyday political life. Climate protection, energy security, supply chain resilience and access to technology are also interdependent at the security policy level. And last but not least, elections in France and the USA threaten to bring even more nationalist and populist parties to power, which will put traditional alliances to the test. It is therefore important to include various causal factors in planning for the future and to take a look at possible major disruptions in the political environment – this can be enabled by systematic foresight in an open discourse.

Foresight is an exchange about possible futures, its methods are controlled, participative, open. It differs from quantitative forecasts and looks further into the future. However, different foresight tools can be combined: Just as qualitative scenario work can also utilize quantitative data collection, the more open thinking in foresight exercises can also create impulses for the quantitative models for early crisis detection, for example, for which the researchers must also determine what they are looking for.

In the Federal Government, there are now people in almost all ministries who are familiar with the tools of foresight; in many departments and authorities, civil servants are intensively discussing scenarios, carrying out Delphi projects and future workshops or setting up subject-specific trend analyses or horizon scanning processes. The Federal Foreign Office and the Federal Ministry of Defense work together on early crisis detection, while the latter has a number of strong providers of foresight methods in the Planning Office, METIS at the University of Munich, the Federal Academy for Security Policy (BAKS) and the Leadership Academy in Hamburg. There are scenario projects at the Federal Ministry for Economic Affairs and Climate Action, an ideas laboratory at the Federal Ministry of Finance , a think tank at the Federal Ministry of Labour and

Social Affairs, horizon scanning at the Federal Environment Agency and foresight as part of the Alliance for Transformation at the Federal Chancellery, to name but a few.

But strategic foresight is not applied with the same level of commitment everywhere. Although there is demand for cross-departmental networking, it is still too rarely considered in projects. This is largely due to the principle of departmental independence, a constitutional provision in Germany and, in the ministries, the hierarchical orientation towards their own management. Government foresight in Germany is best described in a study by the Fraunhofer Institute for Systems and Innovation Analysis on the "Institutionalization of Strategic Foresight" from June 2022.

However, there is reason for optimism: for example, a interdepartmental group for Strategic Foresight has existed in the Federal Chancellery for several years which actively supports dialogue within the government. The BAKS, an interdepartmental training center within the remit of the BMVg, but responsible to the houses of the Federal Security Council, has foresight in its portfolio. Its Center for Strategic Foresight (of which the author is a member) offers training in foresight methods for federal civil servants. The center networks with its 400 or so alumni, project partners and those responsible for foresight. It also initiates interdepartmental foresight projects, including a series of workshops with the German Institute for International and Security Affairs. The discussion about foresight in the federal government is therefore picking up speed, also thanks to increasing international networking.

This process of deepening government foresight must now build up and strengthen its own momentum in order to become part of Germany's strategic culture over many legislative periods. It is therefore desirable that foresight is increasingly used in the run-up to political strategy formulation, that more posts are created for this purpose and that the respective heads of government directly request the use of foresight. The attention of ministers, state secretaries and the respective department heads is still an important criterion for success for those responsible for foresight in the departments. Joint departmental projects could then be developed in and with the ministries themselves. Strategic foresight and dialogue on this could thus become the norm, and therefore an important building block in foreign policy strategy capability.

The Workshop

European Energy Security 2040. The Bonn Future Lab Strategic Foresight Workshop

The International Security Forum Bonn 2023 concluded with the Bonn Future Lab on Strategic Foresight (BFL). In a collaborative workshop atmosphere, selected young talents from academia and the professional world had the opportunity to explore techniques and methods of strategic foresight and apply them to the topic "Global Energy Transitions." The workshop consisted of two virtual workshop sessions before the start of the International Security Forum Bonn and two full workshop days in presence on the days following the content-rich panel discussions at the ISFB. Specifically, the participants used the scenario technique to analyze Europe's energy security in 2040 and derive strategies for a predetermined set of European and extra-European actors.

What is Strategic Foresight?

Strategic Foresight is a method-based way to systematically explore possible future trajectories to prepare for possible future developments and, if and where possible, contribute to shaping them.

Organizations and individuals often use it to cultivate "Futures Literacy," meaning their ability to reflect on the different ways the future can unfold, based on various actions or paths taken in the present, and to create awareness of their ability thereby – or, according to the specific case, inability – to influence it. The goal of strategic foresight is, therefore, not the integrity of the methodologically constructed futures but rather the creation of an

analytical awareness of recognizing possible future opportunities and risks already in the present. In this sense, it is a central concern of strategic foresight to systematically detect and overcome analytical blind spots and biases towards the possibilities of systemic change.

In this quality, strategic foresight distinguishes itself from forecasting techniques whose purpose is empirical data-driven prognoses for future developments of quantitative indicators, such as exchange rates, weather, or business turnover. One of the many methods and techniques that can be applied in a strategic foresight process is the Scenario Technique, which is used to create alternative future scenarios within a time horizon that usually ranges between 10 and 15 years. The development of these scenarios is based on alternative future projections of those exogenous factors that influence the development of a given object of analysis and that sometimes are adjusted by the distorting effects of highly unlikely and unexpected disruptive events ("black swans" or "wild-cards").

Generally speaking, the technique consists of the following phases, in each of which a range of different techniques and methods can be applied according to the scope, focus, and objective of the foresight exercise:

1. **Environmental Analysis**
2. **Futures Development**
3. **Futures Transfer**
4. **Strategy Development**

The Workshop

At the Bonn Future Lab on Strategic Foresight 2023, the object of analysis was Europe's energy security. Energy security was understood as including three aspects: energy supply security, environmental sustainability, and economic competitiveness, requiring a stable and secure energy supply and distribution infrastructure within the territory of the European Political Community.

The workshop series aimed to develop different scenarios on what Europe's energy security will look like in the year 2040 to stimulate awareness of the many possible future developments Europe's energy security can take and the implications this has for Europe and other global actors. By formulating future-oriented strategies based on the developed scenarios, awareness of these actors' possibilities of influencing or adapting to future developments was also created.

To overcome cognitive biases and blind spots as much as possible, the actors for which the implications of Europe's energy security scenarios in 2040 were analyzed and strategies created included European and extra-European actors. These were the European Union's Commission, the Federal Republic of Germany, the United States of America, and the Russian Federation. Including the latter two has enabled the workshop participants not just to show the many different ways a possible future pathway could take but also what it means for non-European actors, how they can prepare to influence or react to it, and what this, in turn, means for Europe.

Environmental analysis

The workshop's first phase consisted of identifying trends, drivers, and factors of influence on Europe's energy security in 2040. After an introductory expert input on the topic "energy security," the participants carried out a STEEPL/PESTEL analysis, which, as the acronym suggests, is used to specifically look for trends, drivers, and factors in the fields of society, technology, economy, ecology, politics, and law.

To this purpose, the participants were divided into four groups, each assigned to one of the four areas: society and economy, technology, ecology, and (geo-)politics and law. Each participant scouted the thematic areas assigned to their groups for trends, drivers, and factors relevant to Europe's energy security in 2040.

In a second step, each group discussed its findings and conducted a vote on which trends, drivers, and factors have the most considerable influence on Europe's energy security in 2040. Each group presented their prioritized findings in the workshop plenum.

In the final voting, each participant voted on the trends, drivers, and factors identified by the other group, and the three to five most important trends and drivers per group were prioritized.

These were:

A. Geopolitics and Law

- Energy Union / European Green Deal
- Supply security of critical raw material
- National climate policy

B. Economy and Society

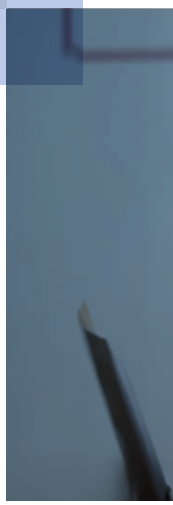
- Energy dependency (import)
- Growing energy demand
- Innovation potential and implementation potential of economic actors

C. Technology

- Cyber attacks
- New energy carriers/sources
- Resource competition by states and other actors
- Breakthrough in storage technologies for solar and wind energy

D. Ecology

- Higher numbers and intensity of extreme weather lead to a more significant pressure to realize the energy transition.
- Extreme weather conditions leading to damages to critical infrastructure)
- Water scarcity (affecting hydrogen and nuclear energy)
- Discovery of so far unknown crucial resource deposits
- Increasing scarcity of natural raw materials (e.g., natural graphite)



Finally, the trends, drivers, and factors were consolidated and, where necessary, reformulated for clarity. This was done by eliminating redundant factors and by reformulating all identified trends, *drivers*, and factors of influence into more concise and formulated neutral *factors of influence.*

This was a critical step insofar as trends describe continuous, observable movements that already imply a specific direction of change – just like drivers that describe trends with a powerful influence on other trends. Factors of influence, on the other hand, describe external factors that can influence the development of a particular object of analysis without already implying a specific direction of movement or change for the factor.

For example, the identified trend *"higher number and intensity of extreme weather events,"* which describes an observable and continuous movement of change, was reformulated as the factor of influence *"extreme weather events"* that allowed for the formulation of alternative future projections in the next step (i.e., *increase* in extreme weather events vs. *decrease* in extreme weather events).

As a final result of the environmental analysis, the identified factors of influence were:

A. Geopolitics and Law
- European climate policy
- EU/EPC access to (energy-relevant) resources (geopolitical)

B. Economy and Society
- European energy dependency (import)
- European innovation and implementation potential

C. Technology
- Cyber security
- Innovations in energy production and storage technologies

D. Ecology
- Extreme weather events
- EU/EPG access to strategic critical minerals (geological)

Futures Development

In the second phase, these factors of influence were used to develop alternative future scenarios for Europe's energy security in 2040. This was done in three steps: formulation of future projections for each factor of influence, impact analysis for each factor of influence, and scenario development.

Future projections formulation

In their groups, participants specified and described their two factors of influence. This included a concise description of the factor, the state where it is currently in its past developments, and the direction it seems to be developing. For example, for the factor *"extreme weather events"*, it has been specified that it is understood as the intensity, duration, and frequency of extreme weather events, and it observed that such events have, at the current state, been increasing in frequency.

Participants then formulated two to three alternative projections on how each factor might develop until 2040. The projections were deliberately prepared as distinct from one another to account for as many future developments as possible, even if some might be considered unlikely at the current state. For each projection, plausible reasons were listed for the factor that might evolve this way.

(Geo-)politics and law

1. Factor of influence "European climate policy"

Current Situation	Projections (2040)	Explanations
■ Climate neutrality until 2050 is pursued ■ Green Deal, Critical Raw Material Act, Hydrogen Strategy	a) Climate goals are exceeded	■ CCS breakthrough ■ Natural disasters reinforce green transition
	b) Climate goals are achieved	■ Political continuity
	c) Climate goals are not achieved	■ Focus on other policy areas due to urgencies ■ Swing to the right/social backlash ■ International climate goals are not observed

2. Factor of influence "EU/EPC access to (energy-relevant) resources (geopolitical)"

Current Situation	Projections (2040)	Explanations
■ Scarcity of critical resources ■ Protectionism ■ Unequal distribution of resources ■ Market-price-driven	a) Weaponization of energy resources	■ Radical right-wing EU
	b) Trade within blocks	■ Political polarization ■ Friend-shoring
	c) Return to the free market – everyone trades with everyone	■ WTO strengthened ■ No protectionism

Society and economy

3. Factor of influence "European energy dependency (import)"

Current Situation	Projections (2040)	Explanations
Strong dependency on extra-European countries: ■ Uranium (Kazakhstan, Niger) ■ Gas/LNG (Russia, USA, UAE) ■ Petrol (Middle East) ■ Coal (Russia)	a) High dependency remains/Shift towards other energy sources and regions	■ Coal phase-out ■ New technologies (hydrogen) ■ Strong orientation towards renewable energies ■ Growing energy demand
	b) Dependency decreases	■ Investments in new technologies (energy autarky) ■ Growing energy efficiency

4. Factor of influence "European innovation and implementation potential"

Current Situation	Projections (2040)	Explanations
Potential exists, but framework conditions are improvable ■ Financial resources ■ Technical resources ■ Education But: ■ Bureaucracy ■ Missing digitalization ■ Risk adversity	a) Potential is successfully exploited	■ Europe – IRA/deregulation ■ Less risk adversity (cultural change) ■ Investments in digitalization ■ Competitive pressures
	b) Untapped (sinking) potential	■ Overregulation ■ Demographic change ■ Fierce global competition ■ Shortage of skilled professionals ■ Changing interest rate policies

Technology

5. Factor of influence "Cyber security"

Current Situation	Projections (2040)	Explanations
■ Understood as the protection of critical infrastructures from cyber attacks ■ Relative protectability of infrastructure ■ Continuous attacks	a) Protectability decreases	■ China invests in cyber security and Europe doesn't ■ Brain-Drain
	b) Protectability increases	■ Europe makes decisive progress in quantum technologies ■ Europe prioritizes developments in more fields than just energy security ■ Regulated information flows ■ Brain-Gain

6. Factor of influence "Innovations in energy production and storage technologies"		
Current Situation	**Projections (2040)**	**Explanations**
■ Specific innovations, e.g.: Solar energy, wind energy, nuclear energy, storage energy ■ Not understood as disruptive innovations, e.g., warp drive	a) Stagnation of innovations	■ Brain-Drain ■ Less international cooperations ■ Less public funding
	b) Great innovation leaps	■ Europe creates new research infrastructure ■ Brain-Gain

Ecology		
7. Factor of influence "Extreme weather events"		
Current Situation	**Projections (2040)**	**Explanations**
■ Understood as the intensity, duration and frequency of extreme weather events ■ Extreme weather events have been increasing in frequency ■ Risk premiums have been raised ■ Total loss amounts have increased	a) Very strong increase	■ SSP[31] 3: Regional Rivalry ■ SSP 5: Fossil fuel development
	b) Strong increase	■ SSP 2: Middle of the road
	c) Moderate increase	■ SSP1: Sustainable Development

8. Factor of influence "EU/EPG access to strategic critical minerals (geological)"		
Current Situation	**Projections (2040)**	**Explanations**
■ Strategically important minerals can be found mostly outside of Europe ■ High concentration of these minerals in a few regions ■ Decreasing quality certain metals ■ EU obtains 100% of rare earths from China	a) Access improves	■ Improved access through technologies ■ Discovery of new critical mineral deposits ■ Demand patterns change (definition of "strategically important")
	b) Access remains the same	■ Lack of willingness (political willingness, willingness of citizens) ■ Quality of strategic critical minerals is not competitive

31 For the projection of this factor, the participants have referenced some of the climate change scenarios developed in the IPPC Sixth Assessment Report on climate change from 2021, which are called Shared Socioeconomic Pathways (SSP)

Impact Analysis

Subsequently, the groups presented their results in the plenum to establish a common understanding of the factors and their projections. After that, the participants returned to their groups and determined the degree of impact that the two factors of influence in their thematic area had on the factors of influence in the other areas. For this purpose, a numeric scale ranging from 0 to 5 was used, in which the value 0 describes the absence of any direct impact by one factor on the other and the value five the existence of a robust direct impact (see Fig. 1).

The results of each group were then compared in the plenum and consolidated in an impact matrix that shows the impact each factor of influence has on every other factor.

Figure 1

Direct impact of / on		1 European climate policy	2 EU/EPC access to (energy-relevant) resources (geopolitical)	3 European energy dependency (import)	4 European innovation and implementation potential	5 Cyber security	6 Innovations in energy production and storage technologies	7 Extreme weather events	8 EU/EPG access to strategic critical minerals (geological)	Row sum	Column sum	Quotient	Product
1	European climate policy		2	3	2	0	3	1	0	11	15	0,73	165
2	EU/EPC access to (energy-relevant) resources (geopolitical)	3		3	0	1	1	0	0	8	11	0,73	88
3	European energy dependency (import)	3	3		1	0	1	0	1	9	14	0,64	126
4	European innovation and implementation potential	2	0	3		2	3	0	0	10	9	1,11	90
5	Cyber security	1	1	0	2		3	0	1	8	3	2,67	24
6	Innovations in energy production and storage technologies	3	2	3	2	0		0	1	11	14	0,79	154
7	Extreme weather events	2	0	0	1	0	1		1	5	1	5,00	5
8	EU/EPG access to strategic critical minerals (geological)	1	3	2	1	0	2	0		9	4	2,25	36
	Column sum	15	11	14	9	3	14	1	4				
	Product	165	88	126	90	24	42	5	36				

Scale Impact
0 no impact
1 weak impact
2 medium impact
3 strong impact

Looking at the row totals, this impact matrix allows us to understand for each factor the total degree of impact it has on the other factors, and which factors are the most influential or driving factors, meaning that their future evolution is likely to have a significant impact on how different factors might evolve. Analogously, the column total shows us how all other factors impact each factor and which factors are the most influenced or driven. The matrix further allows us to understand each factor, whether it is a factor that drives other factors (quotient smaller than 1) or is driven by the other factors (quotient more significant than 1). Last, the matrix shows us to what degree the factors are mutually interconnected in the sense of driving and driven factors (product between row total and column total).

As can be seen (Fig. 3), the two most interconnected factors were "European climate policy" and "Innovations in energy production and storage technologies", meaning that the ways they develop in the future will be central to Europe's energy security scenarios in 2040. As both of them are net-driven (passive) factors, their future development will be considerably influenced by other factors, such as the European access to energy-relevant resources, the European energy dependency, and the use Europe will make of its outstanding innovation and implementation potential. A look at the interrelation between those two factors reveals that the two are highly interrelated, suggesting that the European climate policy dramatically impacts the development of innovations in energy production and storage technologies and vice versa.

On the other hand, "extreme weather events" and "cyber security" are the two least interconnected factors of influence, suggesting that their future developments alone will not be distinguishable traits of the diverse scenarios on European energy security in 2040. At the same time, both of them clearly are not driving (active) factors of influence, meaning that their future evolution will not be influenced much by the other factors considered within the given time horizon. Instead, they directly impact how the most interconnected factors of influence will develop, such as the European climate policy (for extreme weather events) and the development of innovations in energy production and storage technologies (for cyber security) (Fig. 2).

Figure 2

Descriptor		RS	CS	Q	P
7	Extreme weather events	5	1	5,00	5
5	Cyber security	8	3	2,67	24
8	EU/EPG access to strategic critical minerals (geological)	9	4	2,25	36
4	European innovation and implementation potential	10	9	1,11	90
6	Innovations in energy production and storage technologies	11	14	0,79	154
1	European climate policy	11	15	0,73	165
2	EU/EPC access to (energy-relevant) resources (geopolitical)	8	11	0,73	88
3	European energy dependency (import)	9	14	0,64	126

RS = row sum
SS = column sum
Q = row sum / column sum
P = row sum x column sum

low interdependency
medium interdependency
high interdependency

Scenario Development

Based on the insights derived from the impact matrix, the participants proceeded to bundle the different projections of the factors of influence into consistent scenarios in the plenum.

This was done starting from the strongest drivers with the lowest degree of interdependence and then slowly moving downwards to the more interdependent and driven factors. In this order, one projection was chosen for each factor, and attention was paid to the projections being mutually consistent (Fig. 3).

Figure 3

Factor of influence:	Scenario 1	Scenario 2	Scenario 3	Scenario 4
7. Extreme weather events	a) very strong increase	a) very strong increase	a) very strong increase	a) very strong increase
	b) strong increase	b) strong increase	b) strong increase	**b) strong increase**
	c) moderate increase	**c) moderate increase**	c) moderate increase	c) moderate increase
5. Cyber security	**a) Protectability decreases**	**a) Protectability decreases**	**a) Protectability decreases**	a) Protectability decreases
	b) Protectability increases	b) Protectability increases	b) Protectability increases	**b) Protectability increases**
8. EU/EPG access to strategic critical minerals (geological)	a) Access improves	**a) Access improves**	a) Access improves	a) Access improves
	b) Access remains the same	b) Access remains the same	**b) Access remains the same**	**b) Access remains the same**
4. European innovation and implementation potential	a) Potential is successfully exploited	**a) Potential is successfully exploited**	**a) Potential is successfully exploited**	a) Potential is successfully exploited
	b) Untapped (sinking) potential	b) Untapped (sinking) potential	b) Untapped (sinking) potential	**b) Untapped (sinking) potential**
6. Innovations in energy production and storage technologies	**a) Stagnation of innovations**	a) Stagnation of innovations	a) Stagnation of innovations	**a) Stagnation of innovations**
	b) Great innovation leaps	**b) Great innovation leaps**	**b) Great innovation leaps**	b) Great innovation leaps
1. European climate policy	a) Climate goals are exceeded	**a) Climate goals are exceeded**	a) Climate goals are exceeded	a) Climate goals are exceeded
	b) Climate goals are achieved	b) Climate goals are achieved	**b) Climate goals are achieved**	**b) Climate goals are achieved**
	c) Climate goals are not achieved	c) Climate goals are not achieved	c) Climate goals are not achieved	c) Climate goals are not achieved
2. EU/EPC access to (energy-relevant) resources (geopolitical)	**a) Militarism of energy resources**	a) Militarism of energy resources	a) Militarism of energy resources	a) Militarism of energy resources
	b) Trade within blocks	**b) Trade within blocks**	b) Trade within blocks	**b) Trade within blocks**
	c) Return to the free market – everyone trades with everyone	c) Return to the free market – everyone trades with everyone	**c) Return to the free market – everyone trades with everyone**	c) Return to the free market – everyone trades with everyone
3. European energy dependency (import)	**a) High dependency remains/Shift towards other energy sources and regions**	a) High dependency remains/Shift towards other energy sources and regions	a) High dependency remains/Shift towards other energy sources and regions	**a) High dependency remains/Shift towards other energy sources and regions**
	b) Dependency decreases	**b) Dependency decreases**	**b) Dependency decreases**	b) Dependency decreases

Following this specific order has allowed us to determine the projections for those factors, which, as explained above, are relatively independent of the projections of the other factors and substantially impact how they will evolve. The projections for the successively listed factors were then chosen in a way that allowed to maintain consistency with the projections of the driving factors.

This approach was repeated four times to create four different scenarios. Each time, the projections were made in the same order. Still, attention was paid to developing a high diversity between the four other projection bundles while always maintaining consistency among the projections within a bundle.

The four different bundles of projections created in this way served as the analytical fundament for the scenario description. This was achieved via storytelling. In this step, each group was assigned to one of the four projection bundles and created a narrative description for those bundles that illustrates in a plausible and comprehensible way how even the more ventured future projections materialize in 2040 within a consistent story. These stories can take the form of fictitious interviews, descriptions of a day in the life of a person living in the future, newspaper reports, social media posts, and other written or audio-visual formats.

This representation of complex interrelations between factors in an understandable and memorable story adds a sense of reality and dynamicity to the relatively static methodological output of the previous steps and phases, making them more relatable to the stakeholders and stimulating a discussion on the scenarios. In this way, it is an essential part of cultivating futures literacy.

Finally, a headline that best conveys the essence of the scenarios was added to each description, and the scenarios were presented in the plenum. The four scenarios constructed in this way are the following.

Scenarios: European Energy Security 2040

Scenario 1: All roads lead to Moscow

The war in Russia and Ukraine ever continues, while Europe is hit by a dramatic increase in extreme weather events and a severe drought. The resulting water shortage leads to difficulties in cooling nuclear power plants, further exacerbating an energy crisis in Europe. Donald Trump's return to the presidency of the United States is characterized by a lack of strategic leadership and a turning away from global climate cooperation.

Europe, weakened by the sustained effects of climate change, has to deal with never-ending attacks on governments, industries, and civil society's cyber infrastructure. Cyber and information security is further threatened by Russia's renewed aggression against the Baltic States, which European Nations do not have the capacity to act against. In the wake of the governments' inability to deliver, right-wing populists have gained strength in multiple national and European elections. The cemented polarization in European societies impedes long-term, future-oriented solutions to urgent problems. The swing to the right and nationalism furthermore leads to an exodus of innovation and skilled workers, crises of international cooperation, and thus a vicious cycle of deterioration in Europe's economic and political stability. The urgency of a uniform climate policy is being pushed further and further into the background by the election results. Pressing global environmental problems remain being ignored and climate targets are not attained.

The last chance of a turnaround to sustainable energy was seen in a hydrogen mission in Morocco, a heavy-handed approach to urge the North African nation into energy cooperation. Tragically, it failed due to unstable political support from Europe's polarized capitals. Energy and resource policies are being atomized, and proxy

wars flare up in resource-rich regions worldwide. Every country is trying by force to cover its supply shortages of depleted raw materials. In a populist accord and the publics' outcry for cheap, not green, energy, cooperation with Russia – after decades of conflict – is getting rewarmed.

Scenario 2: Sustainability and efficiency through AI

Thanks to the massive promotion of artificial intelligence, Europe achieved its sustainability targets in 2040. While AI now draws through all aspects of lives, observers see the most crucial step into artificially supported governance in the establishment of the EuroAI StrategoHub, a central AI tool consulting advising the commission and parliament and, every quarter, laying out strategic plans for all matters of policy. For example, European energy consumption per capita and emissions consumption were reduced by 1.9% last year (2039–2040). This means that the annual climate protection target was exceeded for the third year in a row. According to EuroAI, further optimizations are expected for the following year. Luckily, extreme weather events across Europe have increased less than expected.

The AI strategic hub also points to the enormous importance of protection against cyber-attacks. For example, 23% more attacks were detected than in the previous year. However, only 70% could be fended off. This means the European ability to protect against cyber-attacks is worse this year than last, a significant threat to technologically supported governance. This mode of action has not only been followed by European governments but also made its way into companies' executive boards quickly. The AI has submitted according legislative proposals.

Dependence on critical minerals has also been significantly reduced. The Critical Mineral Act was passed in 2030, which stipulated money flows in technological investment. It was aimed not only at exploring new regions of supply worldwide but also at identifying various new chemical materials and synthetically producing them so that Europe's external dependence on critical minerals is significantly reduced by 2040. This Critical Mineral Act has now been fulfilled. Seventeen alternatives have been found for five minerals, and production has been tarnished. In this respect, energy imports from neighboring economic blocs have been reduced by 4% compared to the previous year. With the intense use of generative AI, significant innovative steps have been taken in energy generation and storage. Europe is thus increasingly managing to reduce its general energy dependency significantly.

Scenario 3: We are drowning, and it's the others' fault

Germany's North is hit hard by extensive flooding from rivers like the Elbe and the ever-stormy North Sea. Unlike in previous years, when an extensive and technologically advanced system of dams and compensation areas prevented more extensive damage, this system failed. While being reminded of flood catastrophes from the 2020s, experts are working hard to find the reason behind the technological failure. A cyberattack originating in Beijing seems likely.

Germany and Europe find themselves in a contradictory position: Driven by solid innovation leaps in the technology sector, the continent manages to meet and exceed the critical targets for climate action and stable green energy production set out. This achievement is the fulfillment of especially Germany's unwavering commitment to tackling climate change and transitioning towards a sustainable energy future. By effectively harnessing technological advancements, Germany did not only reduce its carbon footprint but also paved the way for other European nations to follow suit.

However, despite Europe's success in net zero, the world continues to face the consequences of extreme weather events and global climate change caused by a lack of international cooperation and the increasing fragmentation of global trade. The scarcity of natural resources critical for the energy and technology industries further exacerbates the situation, resulting in the forming of conflicting and contained blocs on the world stage. While Europe is self-reliant and climate-neutral, other parts of the world, like China, did not follow suit. Reversing the impacts of climate change is unimaginable, and effective mitigation and adaptation have failed due to international fragmentation. Extreme weather events have become frequent, and their impact is high not only in poorer regions of the world. Despite noticeable soft power gains due to its green energy independence, Europe has become the target of increasing hybrid attacks from adversaries. The considerable reliance on (network) technologies for energy production and climate mitigation efforts made it vulnerable to malign interference.

Scenario 4: Europe – Climate Champion of Hearts

Not the global, but the visible increase in extreme weather conditions and events in the Global North forced the European Union to push on towards achieving its climate targets. Due to the pressure, they fell back on existing technologies and invested heavily in wind power plants, solar energy, etc. This led to success in the 2040 goals and a short-term secured energy supply. Nevertheless, investment in research and development of new technological paths in energy generation and climate adaptation missed out. Counting heavily on technologies from the 2020s impeded the exploitation of innovative potential in Europe and is seen to provoke second-tier problems.

One of the key challenges resulting from that strategy is the remaining reliance on critical raw materials. Here, the resource situation in the EU member states remains dire, making the supranational association of states heavily dependent on imports. In particular, strategic raw materials such as neodymium, indium, lithium, cobalt and rare earths, which are essential for innovative technical achievements, are still only available to a limited extent and far from the continent with a targeted resource strategy only emerging in recent years. The EU is trying to cover its import requirements with imports from the US. Nevertheless, limited access to strategic critical minerals remains the Achilles heel that makes the EU vulnerable to geopolitical tensions.

One exception to technological deadlock is the area of cyber security. The EU has been able to take an optimistic but cautious view, following Estonia's cyber security standards as a guiding country for the whole Union. The EU is thus more resilient to hybrid threats and cyber-attacks today.

While the achievements in green, stable, and sustainable energy are pioneering and recognized around the globe, the EU seems to be a climate champion of the past. Prioritizing old available technologies instead of fostering visionary innovation and sustained overregulation has led the continent into an ecological and economic dead end for which new ideas for ways out are necessary.

Futures Transfer: Implications, risks and opportunities

Having derived alternative future scenarios, each group was assigned to one of the four actors: the United States of America, the European Union, the Federal Republic of Germany, and the Russian Federation.

Taking the perspective of these actors, each group analyzed the most desirable scenario to determine, for each projection, the scenario's implications on Europe as well as the risks and opportunities it brings for the actor assigned to the group. In the next step, the groups voted on the risks and opportunities deemed most desirable or avoidable for their actor (highlighted in the tables below in bold).

In this step, analyzing the risks and opportunities that alternative future scenarios on European energy security in 2040 entail for not just Europe or Germany but also for extra-European actors such as the US and Russia had the great benefit of creating an awareness of how relevant the future development of Europe's energy security can be for other actors. It consequently gave an idea of what their interests could be in this regard and how they could behave in future and maybe already now to influence or adapt to the developments in this field. It thereby sheds light on potential analytical blind spots that could lead analysts to look at the topic from a strictly European point of view, potentially neglecting the complex interplay between endogenous and exogenous factors.

Strategy Development: Backcasting and strategy template

This analysis of the most desirable scenario provides the basis for the last phase of the workshop, in which the groups defined a strategy that could allow their actor to best work towards the realization of a given projection or implication thereof and to avoid or utilize the resulting risks or opportunities.

To this end, each group first derived two strategic goals within the fields of safety and security policy, foreign policy, development policy, economic and innovation policy, and climate policy. Using the Backcasting technique, each goal was backtracked in five-year steps from 2040 to today, defining for each intermediate step the milestones, measures, and participating actors necessary to achieve the goal.

Lastly, each group formulated a strategy for the actor assigned to them for at least one of the two strategic goals, specifying from what influence factors and their projections the strategic goal was derived ("drivers of change"), how it will impact Europe's energy security in 2040, as well as milestones, actors who need to be involved in its pursuit, and potential obstacles and counterforces within the analyzed scenario.

Strategies

Germany

Germany's strategy is aimed at maximizing the impact achieved by its potential for innovation while containing the risks associated with a fragmented and compartmentalized global community, ongoing climate change, and cyber security vulnerabilities. The rapid expansion of Germany's advanced sustainable energy infrastructure should be prioritized. Not only will this foster energy autonomy in and of the European Union, but it will also enable further development of leading technology by utilizing the energy surplus to stay ahead of other nations in the race for the next breakthrough. Meanwhile, it quickly loosens the reliance on energy and resource imports from adversaries and 'problematic partners' in an increasingly competitive international environment. A gain in soft power influence is a passive component of this. It should be leveraged by any means possible: holding international conferences focused on climate and technology or engaging in multilateral diplomacy in other ways. Ideally, this effective leading by example fosters sustainability, and climate action concentrates on mitigating the impact of global environmental change at the same time.

Regarding the risk posed by cyber security threats, more and increasingly targeted cooperation with partners to attract and train talent will be crucial. Germany will not be able to completely shield itself from attacks posed by foreign actors, necessitated by its exposure to technology and its likely dependence on digital infrastructure to efficiently distribute its supply of sustainable energyits likely dependence on digital infrastructure to efficiently distribute its supply of sustainable energy. Hence, redundancy in the systems and a broader societal resilience must be built up.

European Union

Triggered by resource shortages and economic pressure, a twofold strategy is proposed for the European Union. The main goal is to build a global bloc of supportive and like-minded actors centered on Brussels. The vehicle leading there is massive investment, development, and reliance on Artificial Intelligence. From the present, resource-rich countries have to be tied to the European community to sustain its medium-range need of critical supply and keep competitors from them. Measures to be taken for this bloc integration are scholarship programs, economic exchanges, and military exchange programs.

The other side of the strategy coin is the implementation of wide-ranging AI. Starting from the 2020s, Europe has to develop a goal-oriented process, starting from fundamental interdisciplinary research and comprehensive legal prearrangements. In a bottom-up, subsidiary movement and pilot studies, the EU's nations, companies, and civil society can engage in a motivating competition on developing and implementing functional and supporting – not deciding – AI solutions, which propose options for action in various fields always having a set of agreed on goals in the digital mind. This positive and ethically escorted movement, sustained by the bloc's resource inflow and brain gain, leads to implementing strategic AI assistants on ever higher levels, advising the commission and parliament, and manufacturing new chemical bonds for energy security.

United States

The main goal of the United States is to make Europe dependent but not weak. To sustain Europe's dependency on the US regarding security policy, the US strategy should aim to strengthen the NATO alliance with its own investment. The EU's greater resilience due to an increased cyber protection capability makes the EU a stable and willing partner for the US. At the same time, the US should aim its strategy at assuming a dominant position in energy supply and not autonomously retreating from a hegemonic position in most global policy. At the technological level, the USA should take more support measures to strengthen its technological innovation and then export it to the EU. This can be supported via scholarship programs and the resulting simplified attraction of a skilled workforce from the EU into the American economy. The export of know-how and smart grid technologies, in turn, makes the EU more dependent on the US for technology and resources.

The export of fossil energy, CCS technology, and green hydrogen also drives the strategic creation of dependencies. Here, the USA should position itself as a resource power and use a technology embargo against potential opponents to create possible energy dependency of the EU on the USA.

Russia

Russia is aimed to reestablish itself as the sole guarantor of energy supply in Europe by 2040. To achieve this, one of the core objectives of Russian trade and foreign policy is to halt the European energy transition and create incentives for trade in fossil fuels. The challenge here is to break up the European consensus on climate protection, which can be achieved through disinformation campaigns and establishing and supporting pro-Russian actors within the EU.

These measures should be supported by a policy of rapprochement and confidence-building measures, which involve actors from politics, business, and society. Concessions in connection with the war in Ukraine are unavoidable here and must be negotiated accordingly with the EU. At the same time, European resilience in critical resources should be weakened to strengthen the demand for Russian raw materials. Due to the European orientation towards the USA, which is pursuing its own geopolitical interests, Russian sovereignty should be maintained through a consistently high defense budget and corresponding military strength.

The first easing of anti-Russian sanctions should occur in 2025, which will be achieved through the support of pro-Russian forces in the EU Parliament. Monetary support should also be provided to pro-Russian actors in the US political system, and elections should be influenced accordingly. By 2030, a friendly relationship with the EU and its civil society actors should have been established. The first new bilateral energy supply contracts between Russia and EU member states can be negotiated. In addition to easing economic tensions, there should also be a rapprochement in the cultural and education sectors. In 2035, long-term supply contracts with the EU as a buyer community should be strived for, which aim to maximize Europe's dependence on Russia in 2040 and exclude energy cooperation with other third countries.

Conclusions and Outlook

Using strategic foresight to understand how Europe's energy security might look like in the year 2040 has given the participants precious insights into the interrelated factors that we need to look out for when starting to develop energy security strategies already in the present, such as Europe's access to raw materials, the occurrence of extreme weather events and Europe's innovation potential. A closer look at these factors has, moreover, allowed to construct four possible scenarios on how Europe's energy supply might look like in 2040. While these scenarios might not claim to predict the possible futures with accuracy, they have allowed us to understand that a multitude of possible futures exist that we have to prepare for or even influence.

Moreover, the foresight process has made clear how different future scenarios appeal to other actors and in certain aspects. They have increased the awareness of the stakes extra-European actors have in the future of Europe's energy security and their possibilities to influence future developments to their advantage. While some of the insights might not be very surprising, such as Moscow's interest in maximizing Europe's energy dependency, a look at how the projected factors of influence can be leveraged in their strategies allowed to take a more detailed look at the concrete possibilities of each actor. For example, potential attempts by Russia to increase its reputation in Europe could be seen as a strategic step to secure long-term energy supply contracts in the future, especially if coupled with domestic interferences in US elections that could contribute to an alienation between Russia and the US.

All this has allowed us to increase our capacity to consider the complex interdependencies between endogenous and exogenous factors and their potential to influence different future trajectories. Specifically, the workshop has contributed to training the young bright minds of today and the possible leaders of tomorrow in futures literacy, hoping to cultivate a future-oriented strategic culture in relevant national and international organizations of tomorrow.

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