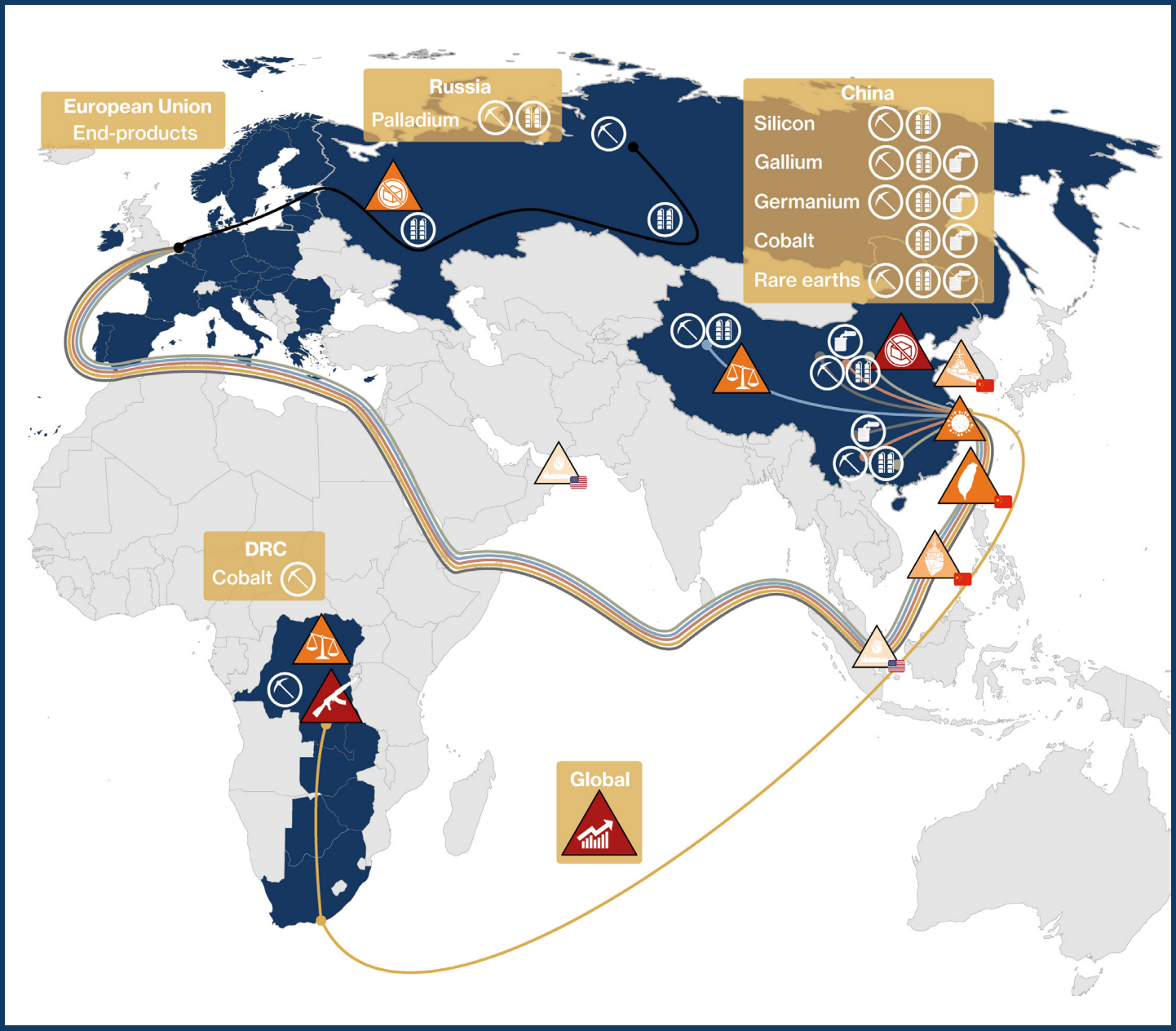
The Hague Centre
for Strategic Studies

Survey outcome

Threats to the supply of critical raw materials for semiconductors

Joris Teer, Mattia Bertolini

October 2022



The Hague Centre
for Strategic Studies

Survey outcome

Threats to the supply of critical raw materials for semiconductors

Authors:
Joris Teer, Mattia Bertolini

Contributors:
Saskia Heyster, Jeff Amrish Ritoe, Tim Sweijs and Jack Thompson

ISBN/EAN: 9789083254142
October 2022

© *The Hague* Centre for Strategic Studies. The research for and production of this expert survey has been conducted within the PROGRESS research framework agreement. Responsibility for the contents and for the opinions expressed, rests solely with the authors and does not constitute, nor should it be construed as, an endorsement by the Netherlands Ministries of Foreign Affairs and Defence.

This expert survey is part of an upcoming research report (*Reaching Breaking Point: The semiconductor and critical raw material ecosystem at a time of great power rivalry*), which will be published mid-October 2022. The research for the content of this document summarizing our survey outcomes was finalized on 1 September 2022. Events or developments that took place or were revealed to have taken place after this date have not been taken into account.

The authors thank all 49 respondents for their time and effort filling-out this relatively lengthy expert survey. 29 respondents agreed to be named in this document (see Expert survey respondents at the end of this document). In addition, the authors express much gratitude towards those experts who took the time to sit down for an interview to help prepare the expert survey. Those interviewees who gave permission will be mentioned in the publication of the aforementioned upcoming research report. Finally, a word of thanks to HCSS-data scientist Saskia Heyster, who visualised the survey outcomes in figure 1 and 2, and visual artist Jelle van der Weerd (odvl.nl), who made all the remaining visuals.

Table of Contents

Introduction 1

Survey methodology 8

Expert survey respondents 9

Survey Outcome – Raw Data 11

Introduction

"Undoubtedly, the U.S. side wants to use the products made by China's exported rare earths to counter and suppress China's development. The Chinese people will never accept this! [...] The US is doomed to be met with a slap in the face after it wakes up and stops dreaming."

Wu Yuehu, Commentator for China state newspaper the People's Daily, on 31 May 2019.[1]

"The unimpeded functioning of the Dutch economy in an effective and efficient manner."

The government of the Netherlands' definition of Economic Security.[2]

Both semiconductors and critical raw materials (CRM) have been described as *the oil of the 21st century*. Oil products have been central in mechanising the economy. Semiconductors play an indispensable role in powering the modern digital economy. Computers, smartphones, smart grids, automobiles and jetfighters all require chips. Notably, semiconductors play a key role in the energy transition, for instance, in new energy solutions such as solar and wind power. Without semiconductors no new semiconductors can be produced, as the design labs, foundries and equipment tools used to produce semiconductors require semiconductors as well. The production of these semiconductors relies heavily on vital CRM, without which in turn no semiconductors can be manufactured. The interlinking semiconductor and CRM supply chains are the foundation of today's world economy.

The interlinking semiconductor and CRM supply chains are the foundation of today's world economy.

Nowadays, supplies of the refined and processed CRM used to manufacture semiconductors are (indirectly) imported from the European Union's (EU) rivals, specifically China and Russia, and African countries with complicated political-economic or military contexts, such as the Democratic Republic of the Congo (DRC) and other states in Southern Africa. How sustainable will these dependencies prove to be in the next five and ten years? The breakdown of European-Russian trade in vital resources following Russia's invasion of Ukraine shows that economic ties between rival states, even if mutually beneficial and on the surface solely commercial, cannot be guaranteed.

1 Wu Yuehe, "United States, Don't Underestimate China's Ability to Strike Back," People's Daily Online, May 31, 2019, http://en.people.cn/n3/2019/0531/c202936-9583292.html.

2 "National Security Strategy" (Dutch Central Government, 2019), p.12.

War in Ukraine and European retaliatory sanctions after 15 years of deteriorating relations finally led European-Russian relations to reach breaking point in 2022.

Russia's war in Ukraine and European retaliatory sanctions after 15 years of deteriorating relations finally led European-Russian relations to reach *breaking point* in 2022 , meaning the moment when military-strategic challenges in the relationship became so overwhelming that:

1. Russia became unwilling to deliver the critical commodities on which European economies depend (i.e., natural gas and neon),
2. Military action by Russia in Ukraine became so consequential that the supply of an essential commodity to Europe has been disrupted (i.e., neon gas), and
3. European and partner sanctions against Russia (temporarily) inhibited the trade of a CRM for the production of semiconductors (i.e., palladium).

By drawing lessons from how Russia's war in Ukraine led European-Russian relations to reach breaking point, namely via an embargo, war-related disruptions in Ukraine, and European sanctions, specific threats can be identified that risk disrupting the supply of CRM from autocracies to Europe and its partners in semiconductor manufacturing in similar ways. The looming risk of CRM embargoes by rival states, interstate and intrastate war-related disruptions in Asia and Africa, and European and American sanctions disrupting the supply of CRM should be assessed carefully (see Table 1). These risks, in conjunction with structural geo-economic risks, may upend the supply of CRM for semiconductor production in Europe, Taiwan, the United States, and South Korea in the next five and ten years.

Table 1. Threats to the critical raw material for semiconductor supply chain.

	Theme	Region	Threat
1	Geopolitical	Eastern-Europe	Palladium export embargo by Russia
2	Geopolitical	East Asia	Gallium, Germanium, Cobalt, Rare Earth Element export embargo by China
3	Military	East Asia	People's Liberation Army naval blockade and/or invasion of Taiwan
4	Military	East Asia	Regional naval war in the East China Sea between China and Japan, South Korea and/or the US
5	Military	Southeast Asia	Regional naval war in the South China Sea between China and a Southeast Asian country and/or the US
6	Military	Southeast Asia and Persian Gulf	US blockade halting Chinese oil and gas imports (e.g., Malacca Strait or Strait of Hormuz)
7	Military	Southern Africa	Political instability or civil war in the DRC (or along transportation routes in Southern Africa)
8	Legal	Southern Africa and East Asia	Increasingly stringent EU and US ESG-regulation (e.g., disrupting imports from DRC-mined cobalt and China-mined Silicon)
9	Geo-economic	Global	Demand-induced resource shortage due to the energy transition and increase in semiconductor manufacturing
10	Geo-economic	East Asia	Events inside China such as pandemic-related lockdowns or work stoppages

The supply of semiconductors and end-products to the EU is likely to be strongly, negatively impacted by CRM supply disruptions, already in the next five but even more so in the next ten years.

Ranking risks: CRM-related threats to the supply of semiconductors survey outcome

The seriousness of the identified risks was gauged by 49 experts, ranking the ten threats both in terms of probability of occurrence in respectively the next five and the next ten years and level of impact (see Figure 1, 2 and Infographics *Critical Raw Material Risks*).

1. **The supply of semiconductors and end-products to the EU is likely to be strongly, negatively impacted by CRM supply disruptions, already in the next five but even more so in the next ten years.** A demand-induced shortage due to the energy transition, a CRM export embargo by China, and a People's Liberation Army naval blockade/invasion of Taiwan are deemed the top risks in the next ten years. It is likely that one or more risks materialises before 2032 and possibly even before 2027, as five risks were awarded a higher than 50% probability to materialise in the next five years and seven in the next ten years. Out of the ten risks, seven are expected to have a "high impact"[3] and three to have a "very high impact" (see Figure 1).[4] If even just one of these risks materialises, the respondents expect that this will have either a "high impact" or "very high impact" on the supply of semiconductors and end-products to the EU and, hence, the bloc's overall economic security.

2. **A demand-induced CRM shortage due to the energy transition is the threat that is deemed most likely to materialise in both the next five and ten years.** A demand-induced shortage due to the energy transition is a structural, "high impact" challenge facing the CRM landscape. Five out of six CRM assessed in this report have important functions in both semiconductor production and the transition to green energy, meaning the energy transition will put pressure on their availability for semiconductor production.

3. **The respondents fear that CRM embargoes enacted by China and Russia will aggravate shortages (see Figure 2), similarly to the imposition of a natural gas and neon gas (partial-)embargo by Russia in 2022.** As prices rise due to increased demand, the "more likely than not" risk of a palladium export embargo by Russia in both the next five and ten years, and the "more likely than not/likely" risk of a CRM embargo by China in the next ten years, are expected to aggravate disruptions in the supply of semiconductors and end-products to the European Union. The respondents with economic security expertise ranked a CRM embargo by China as the highest impact threat out of all the risks appreciated, whereas China, Japan, East Asia, and international security experts maintained that a Chinese CRM embargo is only a "high impact risk".

4. **Risks of military confrontation in the Indo-Pacific involving China and possibly the United States are considered the highest impact risks. They are, however, mostly still considered "unlikely" in the next five years and "less likely than not" in the next ten years – with the exception of a naval blockade/invasion of Taiwan**. Military risks involving China, such as (1) A naval blockade and/or invasion of Taiwan, (2) War in the East-China Sea, and (3) War in the South-China Sea are deemed the highest impact events by the overall respondents.[5] Whereas war in either the East-China Sea or South-China Sea

3 Threat 1, 2,3,4,6,9,10

4 Threat 5, 7, 8

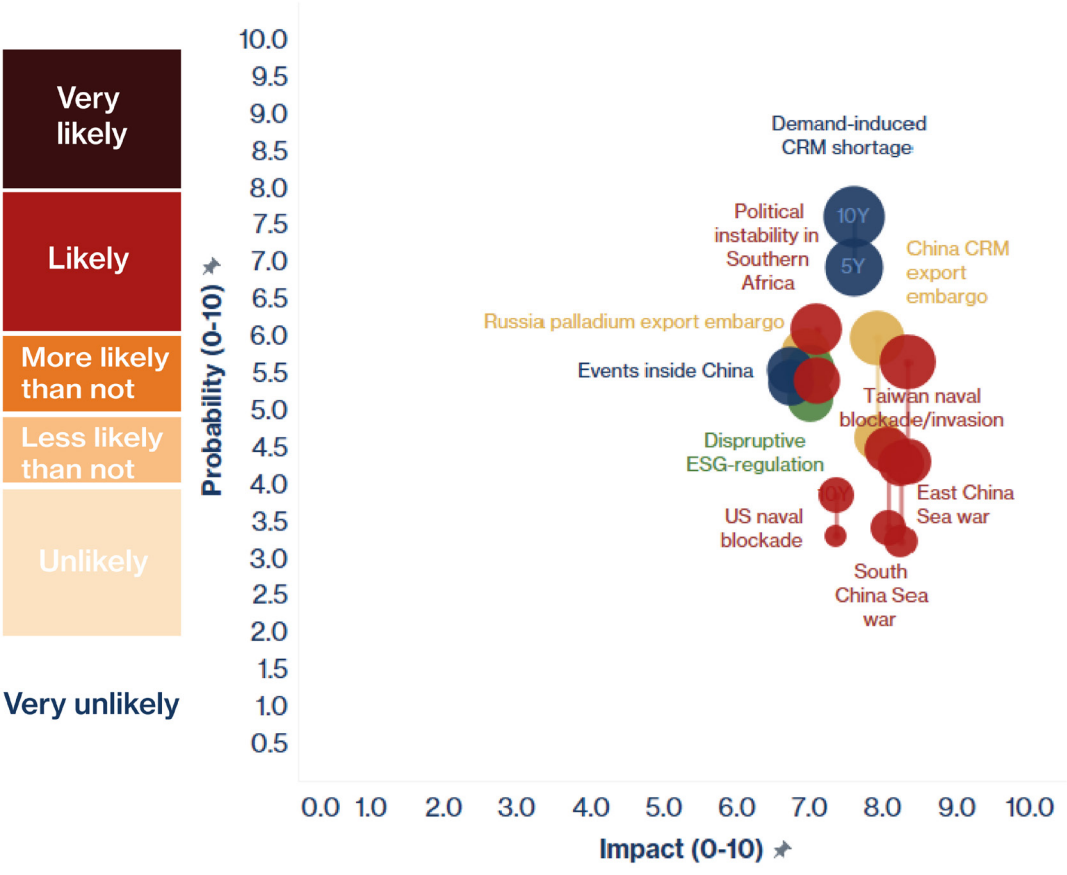
5 All expected to have a "very high impact".

Respondents judge the chance of a naval blockade and/or invasion of Taiwan to be higher than 50% in the next ten years.

is deemed to be "less likely than not" in both the next five and ten years, the odds of a naval blockade and/or invasion of Taiwan passes the respondents' threshold from "less likely than not" in the next five years to "more likely than not" in the next ten years – meaning a higher than 50% chance of occurrence. A PLA naval blockade or invasion of Taiwan is expected to have the greatest impact on the supply of semiconductors or end-products to the European Union out of all the risks that were surveyed. However, the judgment of respondents with East Asia expertise differs from the overall group as they maintain that the risk of an invasion of Taiwan is "unlikely" before 2027 and still "less likely than not" before 2032. An American maritime blockade of the Strait of Hormuz or the Strait of Malacca to choke China's supply of petrochemical products is, unlike a Taiwan scenario, considered an "unlikely" event by the overall respondents, both before 2027 and 2032.

5. **Political unrest or even intrastate conflict in Southern African states are likely to disrupt the supply of cobalt (see Figure 2).** Political unrest in Southern Africa, another military threat, is deemed "more likely than not" to disrupt the supply of CRM for semiconductors in the next five years, and "likely" to do so in the next ten years. This would have a "high impact" on the supply of semiconductors and end-products to the EU and hence the EU's economic security.

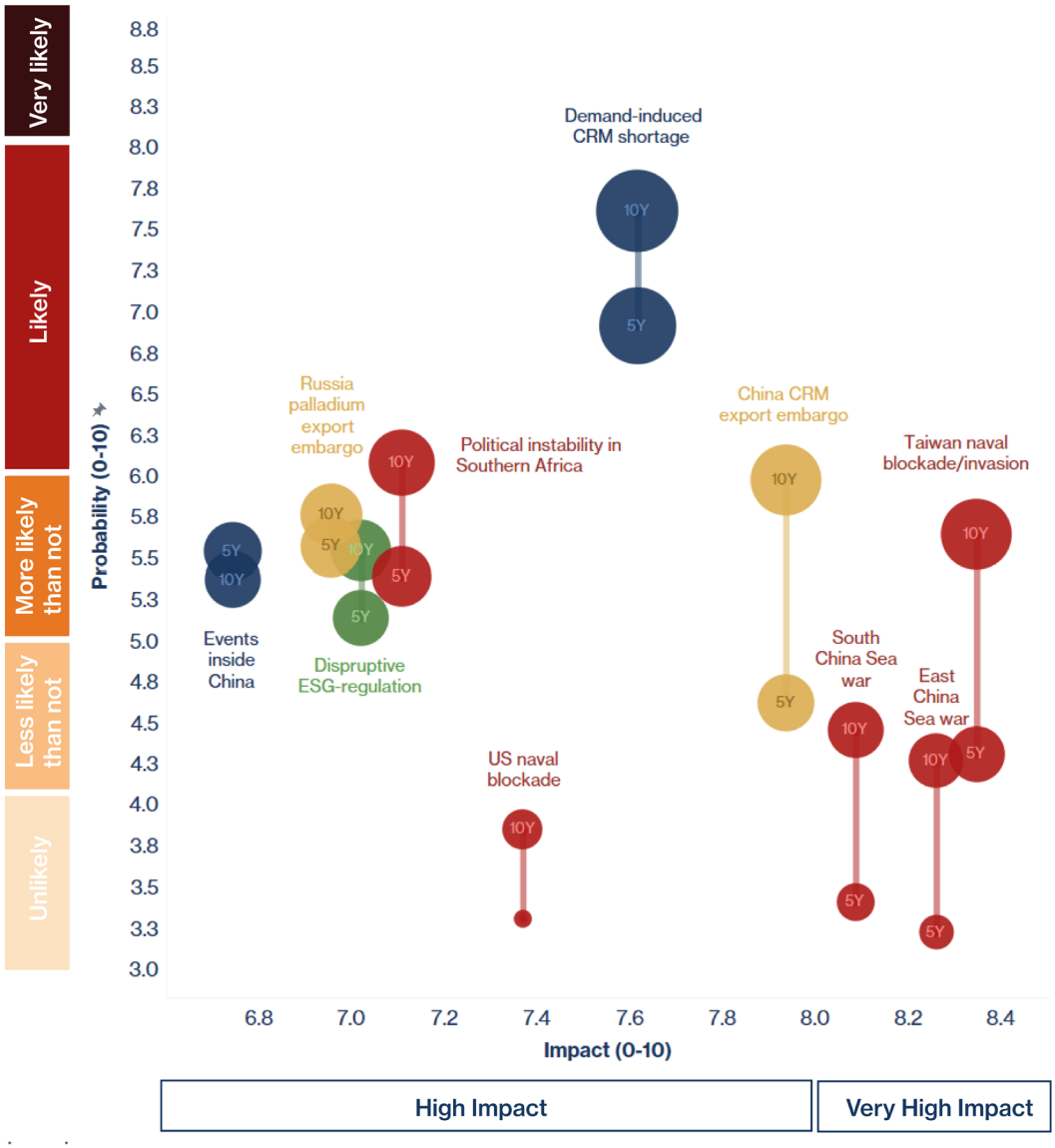
Figure 1. Survey outcome: All CRM-related semiconductor risks are either "high" or "very high" impact



6. **ESG-related regulation and sanctions by the United States and the European Union were awarded a higher than 50% probability of causing a "high impact" disruption in the supply of CRM for semiconductor production.** Economic security experts found that ESG-related regulation was "less likely than not" to affect the supply of CRM to Europe in both the next five and ten years. International security and China, Japan, and East Asia experts, however, found the risk to be "more likely than not" to materialise in the next five and ten years.

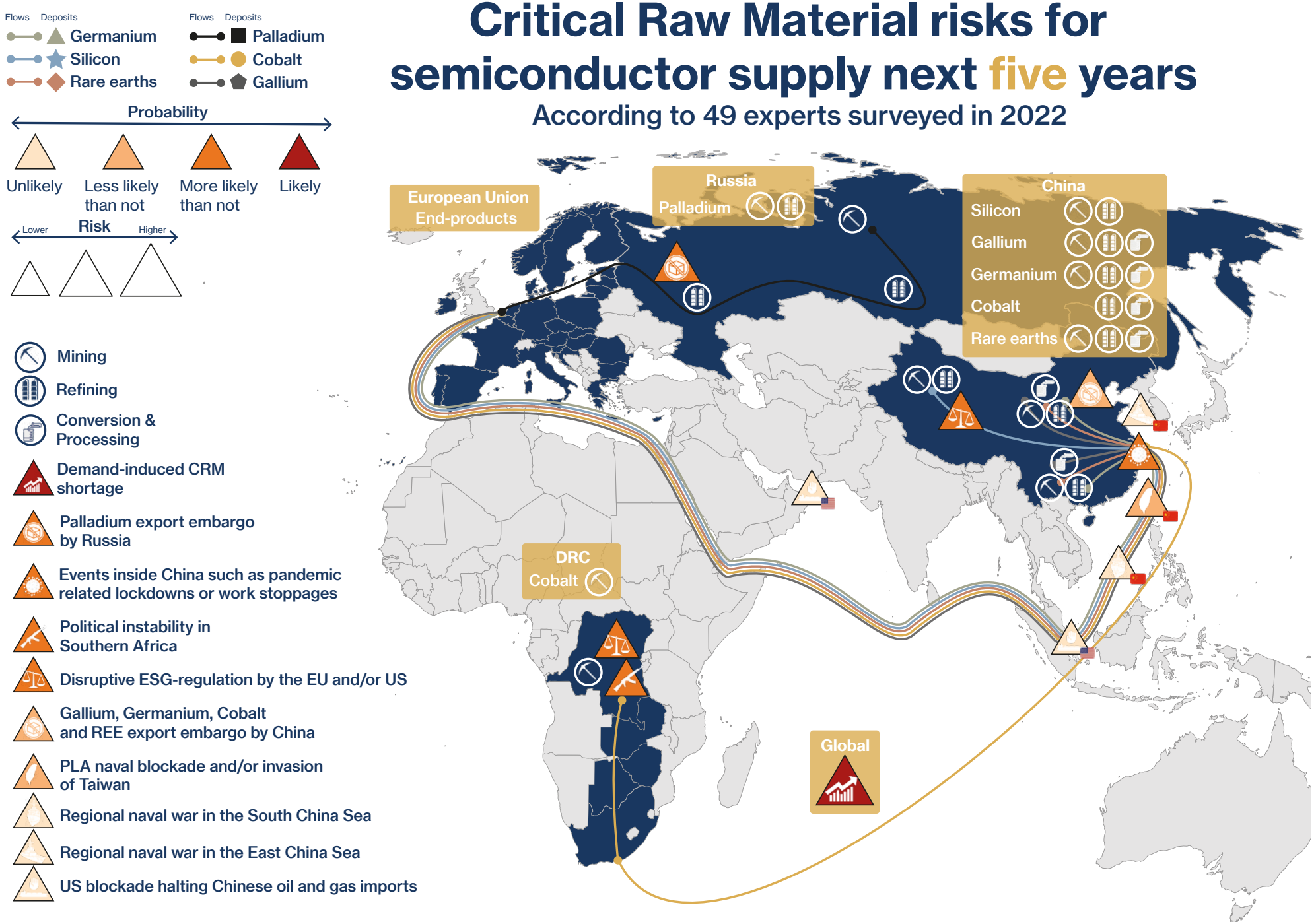
7. **Finally, events inside China such as pandemic related lockdowns are deemed "more likely than not" to disrupt the supply of CRM already in the next five years, and are expected to have a "high impact" on the supply of semiconductors and end-products to the European Union.** Economic security experts on average ranked the probability and impact of events inside China disrupting the supply of CRM both before 2027 and 2032 higher than international security experts and East Asia experts.

Figure 2. Survey outcome: Seven out of ten threats are considered (at least) "more likely than not" to materialise over the next ten years



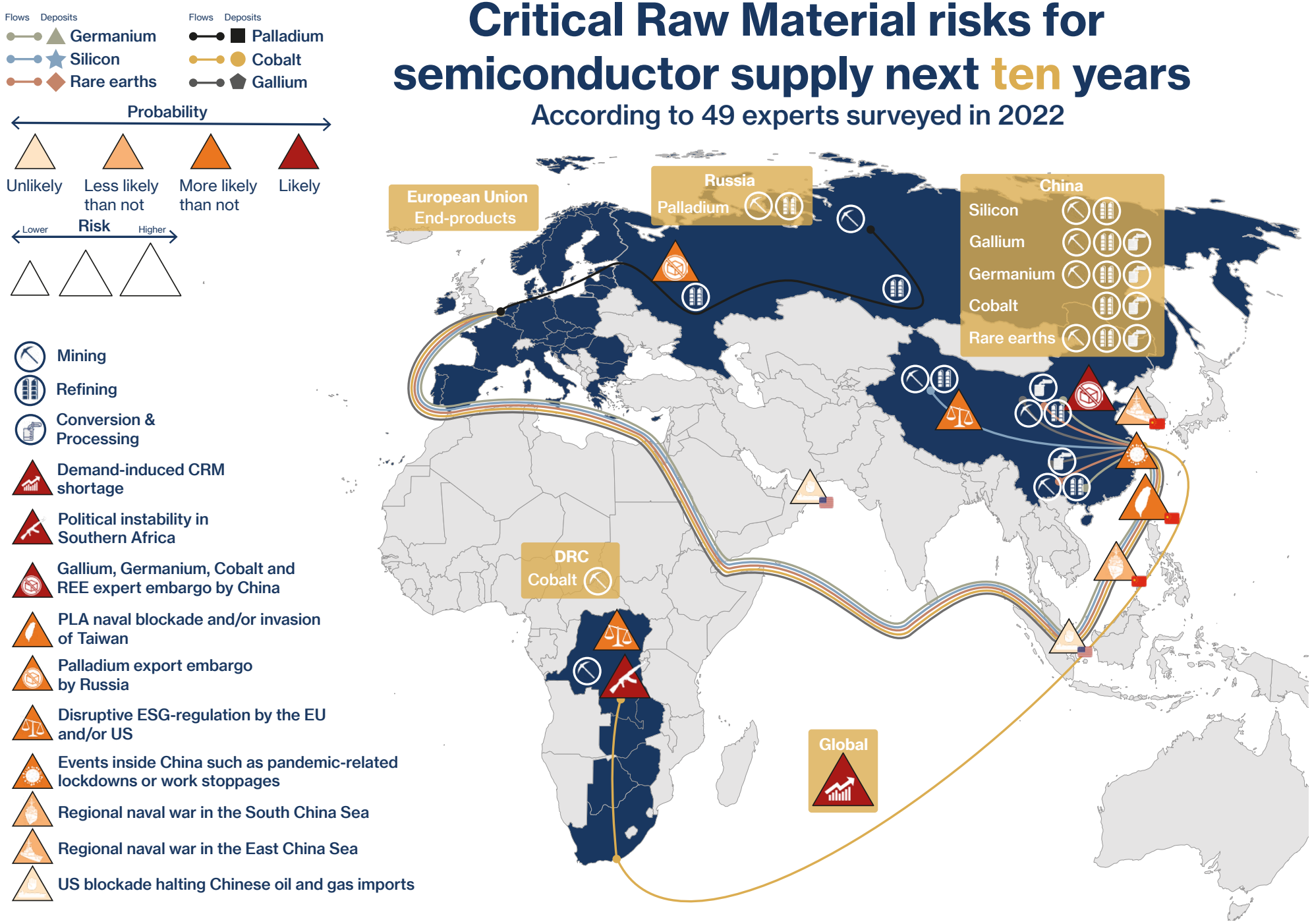
Critical Raw Material risks for semiconductor supply next five years

According to 49 experts surveyed in 2022



Critical Raw Material risks for semiconductor supply next ten years

According to 49 experts surveyed in 2022



Survey methodology

The ranking of the risks (i.e., probability * impact) was brought about through a foresight survey filled out by a group of 49 experts from different fields of expertise and work, of whom 29 are named (see Appendix). Respondents ranked the identified ten risks in terms of probability of occurrence in both the next five and ten years. Respondents were also asked to assess the impact that these scenarios would have on the supply of semiconductors and end-products to Europe (see section Survey Outcome).

Respondents filled out 30 questions ranking the probability in five years, the probability in ten years, and the impact for each of the ten threats (see Figure 1 and 2). 'Probability' is defined as the chance of an event occurring. 'Impact' is defined as the impact an event would have on the supply of CRM to the EU or its partners in semiconductor manufacturing (e.g., Taiwan), and therefore also the supply of semiconductors to the EU.

For each question, respondents scored probability or impact on a scale from zero to ten. Zero indicated "extremely unlikely" or "extremely low impact", while ten indicated "extremely likely" or "extremely high impact". The numerical probability responses were categorised in six categories, namely very unlikely (0.0-2.0), unlikely (2.01-4.0), less likely than not (4.01-5.0), more likely than not (5.01-6.0), likely (6.01-8.0), and very likely (8.01-10.0). The numerical impact responses were similarly categorised in five categories, namely very low impact (0.0-2.0), low impact (2.01-4.0), medium impact (4.01-6.0), high impact (6.01-8.0), and very high impact (8.01-10.0).

Ranges	Probability	Impact
0,0 - 2,00	Very unlikely	Very low impact
2,01 - 4,00	Unlikely	Low impact
4,01 - 5,00	Less likely than not	Medium impact
5,01 - 6,00	More likely than not	Medium impact
6,01 - 8,00	Likely	High impact
8,01 - 10.0	Very Likely	Very high impact

Responses were excluded when a respondent mentioned not to have the expertise needed to answer a specific question. The survey was conducted from the last week of May until the end of June 2022.

Expert survey respondents

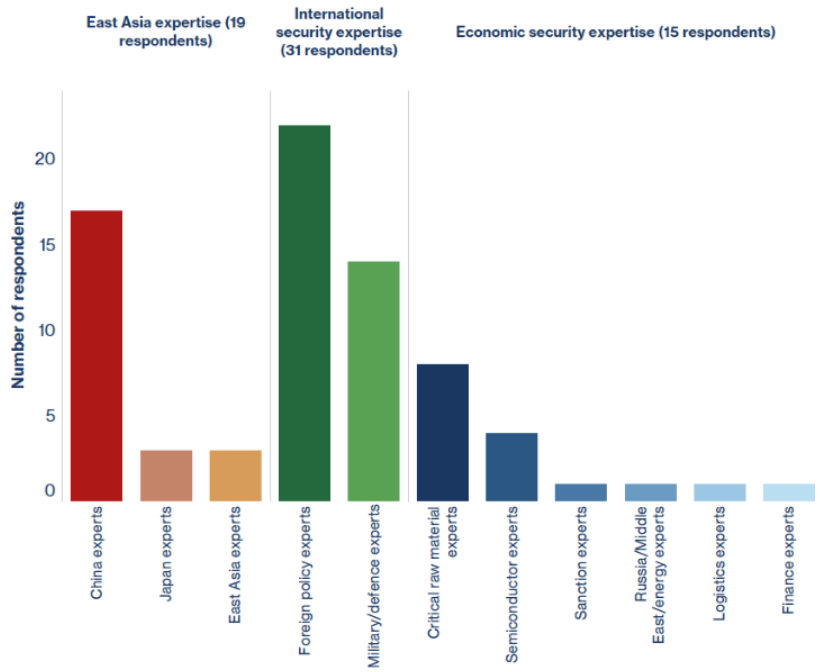
Note: This list is not exhaustive. Only the participants that stated they were willing to be mentioned in the report are listed. It does contain the majority of respondents (29 out of 49).

1. Frank Bekkers, Director of the Security Programme at HCSS
2. Jonathan Berkshire Miller, Senior Fellow on the Indo-Pacific at the Macdonald Laurier Institute
3. Giliam Bresser, Military Advisor at the Dutch Ministry of Foreign Affairs
4. Ties Dams, Research Fellow at the Clingendael Institute
5. Zsuzsa Anna Ferenczy, EU-China Expert and Assistant Professor at National Dong Hwa University
6. Maurice Fermont, Former Business Europe Political Secretary at the European Parliament
7. Philip Geurts, Oil analyst at BloombergNEF
8. Tobias Gehrke, CRM Expert Research Fellow at the Egmont Institute
9. Josanne van Gorkum, Strategic Policy Advisor at the Dutch Ministry of Defense
10. Wendela Haringhuizen, Strategic Advisor Security Policy at the Dutch Ministry of Foreign Affairs
11. Valérie Hoeks, Managing Partner at China Inroads
12. Jeroen de Jonge, Business Director Naval and Maritime at TNO
13. Julian Kamasa, Senior Researcher at the Center for Security Studies
14. Ed Kronenburg, Former Dutch Ambassador to China
15. Tom Middendorp, Former Chief of Defense of the Netherlands Armed Forces
16. Stephen Nagy, Senior Associate Professor at the International Christian University in Japan
17. Jagannath Panda, Director Indo-Pacific ISDP in Sweden
18. Irina Patrahau, Strategic Analyst focusing on Critical Raw Materials and the Geopolitics of Energy at HCSS
19. Jan van der Putten, Former China Correspondent at Volkskrant and Current China Contributor at De Groene Amsterdammer
20. Michel Rademaker, Deputy Director and Critical Raw Material Expert at HCSS
21. Jeff Amrish Ritoe, HCSS Subject Matter Expert on Energy and Raw Materials
22. Henk Schölte Nordholt, Sinologist and Independent Advisor on China
23. Henne Schuwer, Former Dutch Ambassador to the United States
24. Benjamin Sprecher, CRM Expert and Guest Researcher at Leiden University
25. Friso Stevens, HCSS China and East Asia Affairs Specialist
26. Fons Stoelinga, Former Dutch Ambassador to India
27. Tim Sweijs, Director of Research HCSS
28. Paul Verhagen, HCSS Subject Matter Expert focusing on China-US competition and semiconductors
29. Martijn Vlaskamp, Juan de la Cierva Incorporación Research Fellow at Barcelona Institute of International Studies and Natural Resources Expert

The Critical Raw Material risks for semiconductor supply foresight survey

The 49 respondents

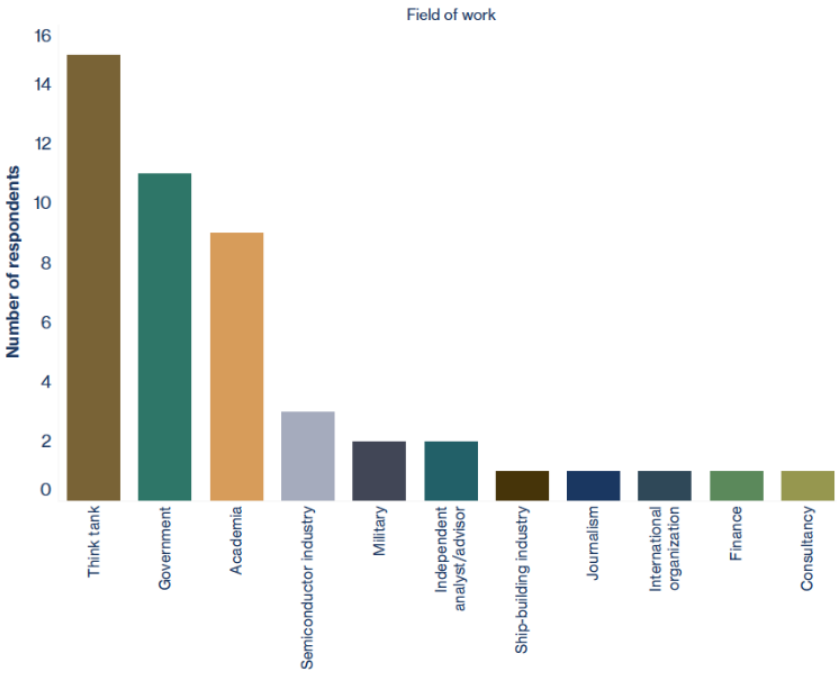
Respondents' field of expertise



The foresight survey was filled out by 49 experts, who were asked to choose the area(s) of knowledge that best describe(s) their expertise, their sector of current/former employment and whether their names could be mentioned in the report (without connecting their identities to their answers). The group of respondents is diverse, as it contains respondents with expertise on China, Japan, Russia, military/defense, critical raw materials, semiconductors and other topics. The respondents come from a variety of sectors of employment such as the thinktank world, government, academia, industry and the military.

The respondents have different levels of seniority: some are early/mid-career specialists whilst others are (retired) senior diplomats (e.g., former Dutch ambassadors to China, India and the United States), thinktank directors and military commanders (e.g., a former Netherlands Chief of Defence). The full list of the experts who indicated they could be mentioned as respondents (29 out of 49) can be found in the annex. The respondents are mostly Dutch nationals, but some experts from other European states, the Americas and the Indo-Pacific region also participated.

Respondents' field of work



Survey Outcome – Raw Data

Overall Outcome

- Geopolitical risks
- Geoeconomic risks
- Military risks
- Legal risks

Question	Impact	Years	Probability	Total
Palladium export embargo by Russia	6,957	5	5,574	38,779
Gallium, Germanium, Cobalt REE export embargo by China	7,936	5	4,625	36,705
Demand-induced resource shortage	7,617	5	6,918	52,697
Events inside China	6,745	5	5,542	37,377
PLA naval blockade/invasion of Taiwan	8,348	5	4,313	36
Political instability in DRC	7,109	5	5,396	38,357
War in East China Sea	8,261	5	3,229	26,676
War in South China Sea	8,087	5	3,417	27,630
US blockade halting Chinese oil and gas imports	7,370	5	3,313	24,412
Stringent ESG-regulation	7,021	5	5,143	36,109
Palladium export embargo by Russia	6,957	10	5,766	40,111
Gallium, Germanium, Cobalt REE export embargo by China	7,936	10	5,979	47,452
Demand-induced resource shortage	7,617	10	7,612	57,983
Events inside China	6,745	10	5,375	36,253
PLA naval blockade/invasion of Taiwan	8,348	10	5,646	47,130
Political instability in DRC	7,109	10	6,083	43,245
War in East China Sea	8,261	10	4,271	35,281
War in South China Sea	8,087	10	4,458	36,054
US blockade halting Chinese oil and gas imports	7,370	10	3,854	28,404
Stringent ESG-regulation	7,021	10	5,551	38,975

China, Japan, East-Asia Experts

Geopolitical risks

Geoeconomic risks

Military risks

Legal risks

Question	Impact	Years	Probability	Total
Palladium export embargo by Russia	6,611	5	4,778	31,586
Gallium, Germanium, Cobalt REE export embargo by China	7,684	5	4,474	34,377
Demand-induced resource shortage	7,158	5	6,737	48,222
Events inside China	6,263	5	5,316	33,294
PLA naval blockade/invasion of Taiwan	8,684	5	3,842	33,366
Political instability in DRC	6,944	5	5,111	35,494
War in East China Sea	8,579	5	4,125	35,388
War in South China Sea	8,474	5	3,263	27,651
US blockade halting Chinese oil and gas imports	6,842	5	3,579	24,488
Stringent ESG-regulation	6,684	5	5,105	34,125
Palladium export embargo by Russia	6,611	10	5,389	35,627
Gallium, Germanium, Cobalt REE export embargo by China	7,684	10	5,684	43,679
Demand-induced resource shortage	7,158	10	7,316	52,366
Events inside China	6,263	10	5,211	32,634
PLA naval blockade/invasion of Taiwan	8,684	10	4,789	41,593
Political instability in DRC	6,944	10	5,778	40,123
War in East China Sea	8,579	10	3,947	33,864
War in South China Sea	8,474	10	4,158	35,233
US blockade halting Chinese oil and gas imports	6,842	10	3,632	24,848
Stringent ESG-regulation	6,684	10	5,684	37,994

International Security Experts

Geopolitical risks

Geoeconomic risks

Military risks

Legal risks

Question	Impact	Years	Probability	Total
Palladium export embargo by Russia	7,207	5	5,633	40,599
Gallium, Germanium, Cobalt REE export embargo by China	7,931	5	4,667	37,011
Demand-induced resource shortage	7,759	5	7,065	54,811
Events inside China	6,966	5	5,600	39,007
PLA naval blockade/invasion of Taiwan	8,464	5	4,333	36,679
Political instability in DRC	7,379	5	5,452	40,229
War in East China Sea	8,250	5	2,933	24,200
War in South China Sea	8,286	5	3,200	26,514
US blockade halting Chinese oil and gas imports	7,321	5	2,967	21,720
Stringent ESG-regulation	6,793	5	5,258	35,719
Palladium export embargo by Russia	7,207	10	5,967	43,001
Gallium, Germanium, Cobalt REE export embargo by China	7,931	10	6,000	47,586
Demand-induced resource shortage	7,759	10	7,710	59,816
Events inside China	6,966	10	5,467	38,078
PLA naval blockade/invasion of Taiwan	8,464	10	5,667	47,964
Political instability in DRC	7,379	10	6,355	46,894
War in East China Sea	8,250	10	3,867	31,900
War in South China Sea	8,286	10	4,357	36,102
US blockade halting Chinese oil and gas imports	7,321	10	3,857	28,240
Stringent ESG-regulation	6,793	10	4,867	33,060

Economic Security Experts

Geopolitical risks

Geoeconomic risks

Military risks

Legal risks

Question	Impact	Years	Probability	Total
Palladium export embargo by Russia	6,929	5	5,154	35,709
Gallium, Germanium, Cobalt REE export embargo by China	8,533	5	4,643	39,619
Demand-induced resource shortage	7,400	5	6,733	49,827
Events inside China	7,133	5	6,000	42,800
PLA naval blockade/invasion of Taiwan	8,214	5	3,786	31,097
Political instability in DRC	7,286	5	5,214	37,990
War in East China Sea	8,143	5	3,357	27,337
War in South China Sea	7,714	5	3,357	25,898
US blockade halting Chinese oil and gas imports	7,000	5	3,857	27,000
Stringent ESG-regulation	7,600	5	4,400	33,440
Palladium export embargo by Russia	6,929	10	4,615	31,978
Gallium, Germanium, Cobalt REE export embargo by China	8,533	10	6,214	53,029
Demand-induced resource shortage	7,400	10	7,600	56,240
Events inside China	7,133	10	5,500	39,233
PLA naval blockade/invasion of Taiwan	8,214	10	5,143	42,245
Political instability in DRC	7,286	10	6,214	45,276
War in East China Sea	8,143	10	4,286	34,898
War in South China Sea	7,714	10	4,357	33,612
US blockade halting Chinese oil and gas imports	7,000	10	3,857	27,000
Stringent ESG-regulation	7,600	10	4,867	36,987

Raw Data

	Geopolitical risks						Geoeconomic risks						Legal risks		
Respondent #	Probability 5: Palladium export embargo by Russia	Probability 10: Palladium export embargo by Russia	Impact: Palladium export embargo by Russia	Probability 5: Gallium, Germanium, Cobalt REE export embargo by China	Probability 10: Gallium, Germanium, Cobalt REE export embargo by China	Impact: Gallium, Germanium, Cobalt REE export embargo by China	Probability 5: Demand-induced resource shortage	Probability 10: Demand-induced resource shortage	Impact: Demand-induced resource shortage	Probability 5: Events inside China	Probability 10: Events inside China	Impact: Events inside China	Probability 5: Stringent ESG-regulation	Probability 10: Stringent ESG-regulation	Impact: Stringent ESG-regulation
1	5	5	3	3	3	7	8	8	3	3	3	3	3	3	3
2	4	5	5	1	2	7	6	8	7	5	3	5	3	4	3
3	2	3	6	2	4	8	7	7	6	8	5	7	6	6	7
4	7	7	7	7	7	7	7	7	7	5	7	7	6	6	8
5	7	7	9	6	7	9	7	9	9	5	6	8	7	8	8
6	2	2	3	3	4	7	8	8	8	3	2	2	2	2	7
7	3	4		2	3		6	6		2	2		2	2	
8	8	8		5	5		9	9		5	5		7	7	
9	3	3	5	6	9	8	3	8	9	9	9	9	5	5	9
10	8	9	8	5	6	8	6	7	8	5	7	8	7	8	6
11	2	2	7	2	3	8	8	9	9	10	10	4	3	5	6
12	8	7	8	6	7	9	9	8	6	8	7	8	6	6	6
13	8	4	7	3	5	8	8	9	7	5	5	8	0	0	7
14	7	8	10	5	7	9	8	8	10	4	7	7	6	5	8
15	2	3	4	3	7	10	6	6	4	2	3	7	2	5	7
16	5	5	7	3	4	8	6	7	8	7	6	8	7	6	6
17	4	3	8	5	7	8	5	8	8	4	3	8	3	3	6
18	3	5	8	4	5	8	6	7	7	4	3	3	7	8	8
19	6	6	7	6	6	7	6	6	7	7	7	6	4	2	8
20	7	7	6	3	4	7	9	10	9	3	3	5	4	5	7
21	4	8	7	3	6	9	10	10	10	7	2	8	10	7	9
22	3	2	2	2	3	4	4	5	4	0	0	0	2	2	3
23	6	7	8	5	8	8	8	7	7	6	6	6	8	8	6
24	5	7	8	6	8	9	7	8	9	7	7	8	4	5	9

	Geopolitical risks						Geoeconomic risks						Legal risks		
Respondent #	Probability 5: Palladium export embargo by Russia	Probability 10: Palladium export embargo by Russia	Impact: Palladium export embargo by Russia	Probability 5: Gallium, Germanium, Cobalt REE export embargo by China	Probability 10: Gallium, Germanium, Cobalt REE export embargo by China	Impact: Gallium, Germanium, Cobalt REE export embargo by China	Probability 5: Demand-induced resource shortage	Probability 10: Demand-induced resource shortage	Impact: Demand-induced resource shortage	Probability 5: Events inside China	Probability 10: Events inside China	Impact: Events inside China	Probability 5: Stringent ESG-regulation	Probability 10: Stringent ESG-regulation	Impact: Stringent ESG-regulation
25	8	8	8	6	7	7	7	7	7	8	8	8	8	7	7
26	7	9	4	4	5	8	8	7	9	4	3	7	7	7	8
27	8	9	9	8	8	8	8	8	9	9	9	8	8	8	8
28	8	5	9	8	9	9	9	10	10	8	3	9	7	8	9
29	4	3	5	5	4	5	7	7	7	4	4	6	6	5	8
30	4	2	4	2	4	7	7	9	8	5	8	8	2	4	7
31	8	8	9	5	8	8	5	8	8	7	5	8	8	9	8
32	5	5	7	6	7	8	7	8	9	6	7	6	6	6	6
33	7	7	9	6	7	9	6	7	8	8	6	9	8	9	8
34	9	7	9	7	8	9	7	8	9	3	1	7	5	6	8
35	8	8	7	5	5	7	6	8	6	5	5	5	6	6	4
36	7	8	6	7	7	7	8	8	7	7	7	5	5	7	8
37	6	7	8	6	7	8	8	9	9	7	8	8	6	7	8
38	5	7	9	3	7	9	3	7	7	2	5	7	8	9	9
39			9			10	8	8	8			8	5	8	7
40	3	2	6	2	6	8	6	6	8	2	2	8	1	1	8
41	8	8	8	4	9	10	7	8	8	8	8	6	4	4	9
42				7	8	9	7	8	9	7	8	9	6	7	9
43	7	7	6	2	2	7	8	7	8	3	3	8	3	3	7
44	6	6	7	4	6	7	6	7	6	5	6	7	4	5	6
45	5	5	5	6	7	7	5	5	5	6	6	6	8	9	5
46	1	7	9	6	8	7	7	7	8	4	4	4	1	1	2
47	8	7	5	7	8	8	7	6	6	7	7	7	3	5	5
48	5	5	9	7	7	9	8	8	9	8	8	9	4	4	9
49	6	4	10	3	3	9	7	7	8	9	9	9	9	9	10

	Military risks														
Respondent #	Probability 5: PLA naval blockade/ invasion of Taiwan	Probability 10: PLA naval blockade/ invasion of Taiwan	Impact: PLA naval blockade/ invasion of Taiwan	Probability 5: Political instability in DRC	Probability 10: Political instability in DRC	Impact: Political instability in DRC	Probability 5: War in East China Sea	Probability 10: War in East China Sea	Impact: War in East China Sea	Probability 5: War in South China Sea	Probability 10: War in South China Sea	Impact: War in South China Sea	Probability 5: US blockade halting Chinese oil and gas imports	Probability 10: US blockade halting Chinese oil and gas imports	Impact: US blockade halting Chinese oil and gas imports
1	4	5	3	3	3	3	3	6	3	4	5	3	3	3	3
2	2	4	10	3	4	5	1	2	10	2	3	9	1	2	9
3	3	5	8	8	9	7	2	2	5	3	3	6	3	3	8
4	7	6	7	5	8	9	5	6	9	5	6	9	5	5	8
5	5	8	8	7	8	8	5	8	8	5	8	8	5	6	7
6	2	3	7	5	5	6	1	1	9	1	1	7	0	0	9
7	1	3		1	2		1	1		0	1		1	1	
8	3	6		7	7		3	4		2	2		2	2	
9	3	3	7	4	7	9	3	3	7	3	3	7	3	3	8
10	5	8	8	8	8	6	4	5	8	6	8	8	2	3	8
11	1	1	9	2	4	9	0	1	10	0	0	10	1	1	5
12	6	6	9	6	7	8	6	6	8	6	6	8	5	6	8
13	2	6	7	1	4	8	3	5	8	2	6	8	3	3	5
14	2	3	10	4	4	8	1	2	10	1	2	10	2	4	8
15	1	3	10	4	8	6	1	1	10	1	1	10	2	3	2
16	4	5	9	7	7	6	4	5	8	5	6	8	3	4	8
17	1	2	8	6	7	9	1	2	8	1	2	7	1	1	2
18	4	6	8	5	5	5	4	5	6	3	5	7	4	5	6
19	4	4	8	5	5	5	4	4	8	4	4	6	4	4	8
20	3	4	8	7	8	7	2	3	8	2	2	8	2	3	7
21	6	9	10	8	7	10	2	7	10	1	3	7	5	7	10
22	5	7	8	3	3	3	5	6	9	5	6	8	2	2	2
23	3	6	10	6	7	6	1	3	9	2	4	8	1	1	7
24	6	8	9	3	4	7	1	2	9	2	3	10	2	4	8

	Military risks														
Respondent #	Probability 5: PLA naval blockade/ invasion of Taiwan	Probability 10: PLA naval blockade/ invasion of Taiwan	Impact: PLA naval blockade/ invasion of Taiwan	Probability 5: Political instability in DRC	Probability 10: Political instability in DRC	Impact: Political instability in DRC	Probability 5: War in East China Sea	Probability 10: War in East China Sea	Impact: War in East China Sea	Probability 5: War in South China Sea	Probability 10: War in South China Sea	Impact: War in South China Sea	Probability 5: US blockade halting Chinese oil and gas imports	Probability 10: US blockade halting Chinese oil and gas imports	Impact: US blockade halting Chinese oil and gas imports
25	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
26	6	7	9	5	5	7	3	4	8	3	4	8	3	4	8
27	8	8	9	7	7	8	6	6	8	8	8	8	8	8	8
28	9	6	9	6	8	8	7	8	9	7	9	9	3	5	9
29	4	4	7	6	6	6	2	2	8	3	3	8	2	2	6
30	8	9	8	7	8	9	2	4	9	2	3	9	2	3	7
31	5	8	8	5	7	8	3	5	8	3	5	8	3	7	8
32	6	8	5	5	5	8	2	2	7	4	6	7	2	2	7
33	9	10	10	4	4	9	6	7	8	4	5	8	7	8	9
34	7	8	9	5	6	9	6	7	9	5	6	7	6	7	9
35	5	7	9	4	4	5	2	4	9	2	3	9	1	2	10
36	5	8	8	6	8	7	4	6	6	5	7	8	7	5	7
37	4	5	8	6	5	7	8	6	8	6	7	9	6	5	8
38	8	9	9	5	5	5	5	8	9	6	9	9	3	7	9
39				7	8	8									
40	1	5	8	6	7	8	1	2	8	1	2	8	1	1	8
41	3	7	10	8	8	6	2	6	10	2	6	10	2	6	9
42	6	7	10				6	7	10	6	7	10	6	6	8
43	2	2	8	8	8	9	0	0	9	0	0	9	2	2	8
44	3	4	7	6	7	6	4	5	7	3	4	6	3	5	6
45	2	3	10	5	5	5	2	3	8	2	3	8	1	2	8
46	0	0	9	3	3	8	0	0	8	0	0	9	1	1	9
47	7	8	7	6	6	6	4	6	7	7	7	6	6	6	6
48	6	8	8	8	8	9	8	8	9	8	8	9	6	6	9
49	2	1	10	5	5	8	1	1	10	3	4	10	8	1	9

The Hague Centre
for Strategic Studies

HCSS
Lange Voorhout 1
2514 EA Hague

Follow us on social media:
@hcssnl

The Hague Centre for Strategic Studies
Email: info@hcss.nl
Website: www.hcss.nl