EUISS INTRA-EU WORKSHOP OUTCOMES

Starting with the end in mind: De-risked gallium, germanium, and rare earth value chains by 2030

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Date of event: 9 December 2024
Number of participants: 33
Organisations represented: European Commission, EU Member States, think tanks, research technology organisations, and industry, among whom material producers and consumers, including the semiconductor industry (see Annex B for the list of participants).

EXECUTIVE SUMMARY

1. The EU's current approach to reducing risks in critical raw material supply chains is not producing results fast enough. China retains a dominant position in the production of most materials that the European Commission and key industries designate as critical. Vital sectors such as defence, healthcare, green technology, and digital industries rely – often indirectly – on access to a broad range of mineral resources.

2. In December 2024, EUISS convened 33 key EU stakeholders to design supplementary policies ensuring a stable supply of three key materials – gallium, germanium, and rare earths – as well as their associated components by 2030.

3. Workshop discussions concluded that an integrated strategy combining 'promote,' 'protect,' and 'partner' measures could establish a vertically-integrated, China-independent supply chain by 2030. Targeting the entire supply chain is essential. Furthermore, participants concluded that introducing promote policies before protect policies is the best approach.

4. Participants view financial backing, including for mining and processing operations, as the most effective policy. Investing heavily in research, technological advancement, and workforce development is a 'no regret' measure. Two 'few regrets' measures – stockpiling and expediting permitting procedures – are viewed as highly effective with minimal downsides. Government investment, financial support for overseas operations, and joint security standards within the G7 and with partners are 'limited regret' options that could help bolster supply security by 2030.

5. A 'buy European' policy and the imposition of tariffs in coordination with G7 and partner nations are seen as 'moderate reward, high cost' measures. Participants do not regard ESG requirements as an effective means of strengthening material supply security.

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INTRODUCTION

2030 crisis scenario: China imposes a critical raw material export embargo

In early March 2030 the People's Liberation Army Navy (PLAN) finally blockades Taiwan. Washington responds, including on the economic front. Congress revives the Trading With The Enemy Act and uses it to ban all US-China trade. Washington pushes allies to cut off commercial ties to China, as well. Losing no time, the Bureau of Industry and Security (BIS) and the US Treasury introduce sweeping extraterritorial controls and sanctions to block all EU semiconductor and other tech-related exports to China.

Beijing retaliates. Its Ministry of Commerce (MOFCOM) decrees: No longer will critical raw materials, including gallium, germanium, and rare earths, or critical components that contain these materials such as wafers for semiconductor manufacturing and permanent magnets, be exported to any country imposing sanctions or complying with US (extraterritorial) sanctions. Beijing pulls the rug from under allied defence industries, banning exports of critical materials and components altogether for the duration of the conflict. After all, the CCP leadership fears that 'untrusted countries' will circumvent an otherwise targeted ban.

The EU's current policies to de-risk critical raw material supply chains are moving far too slowly. China dominates the production of the majority of the materials that the Commission and European industries deem critical. Much is at stake. Boosting European defence production to successfully deter Russia, especially at a time when the US security guarantee seems increasingly uncertain, depends on even greater volumes of these materials throughout the next five years. So does the continued functioning of the medical sector, and the EU's digital and green transitions. Defence, medical but also green, digital, and other vital industries rely on (often indirect) access to these materials.

Beijing continues to accelerate its weaponisation of these supply chains. Its de facto ban on the export of gallium and germanium to the United States, Japan and the Netherlands since the summer of 2023 is just one example. If geopolitical tensions boil over, European nations are likely to find themselves deprived of these essential building blocks for their security and prosperity. One conceivable trigger is a military conflict over Taiwan. But China's leverage does not start there. Prior to a crisis, Beijing can use the threat of cutting of supplies, to try to force the EU to grant concessions on trade, technology, security and other important policy areas.

In the first half of 2025, the EU Institute for Security Studies (EUISS) will publish a policy report that includes policy recommendations on how the EU and partners can 'fully de-risk' gallium, germanium, and rare earth supply chains before 2030. In completion of phase 1 of this research project, the EUISS brought together 33 key EU stakeholders on 9 December 2024 to formulate additional policies that

would guarantee supply of three critical materials – gallium, germanium and rare earths – as well as their related components, even in the case of a complete collapse of relations with China[1].

The goal of the workshop: co-design a maximalist policy package that can 'fully de-risk' EU supply chains for these materials by 2030. In our backcasting exercise, we defined 'fully de-risked' as reducing the EU's (direct and indirect) dependence on China for these materials to zero. Instead, by 2030 EU industries would entirely rely on domestic production and supplies from a diverse mix of partner countries, such as Canada and the Democratic Republic of Congo (DRC). The EUISS selected the year 2030 because the pace at which China has expanded its critical raw materials export curbs in the last two years signals that the EU may well be cut off by that date, or even before then – especially in the event of a geopolitical shock.

Beijing is already laying the groundwork for this. For example, in 2023 China began requiring export licenses for exports of unwrought gallium and germanium partially in response to US-led semiconductor export restrictions. China reduced exports across the board and halted supplies to the Netherlands, Japan, and the United States. Additionally, the Chinese government on 1 October 2024 introduced a 'traceability information system' that obliges 'enterprises in rare earth mining, smelting and separation, and the export of rare earth products' to 'truthfully record the flow' of their sales. This provides Beijing with the required economic intelligence to more effectively cut off supply to end-user targets with greater precision.

In addition, Beijing has expanded policies to bolster self-reliance while keeping the EU dependent. In 2020 Xi Jinping instructed the government to 'tighten international production chains' dependence on China [...] against foreigners who would artificially cut off supply to China'.

Why focus on gallium, germanium, rare earths?

We selected gallium, germanium, and rare earths and related components, such as semiconductor wafers and permanent magnets, based on the following criteria:

1. China dominates their production;
2. China is already weaponising these supply chains and is laying the groundwork for further action in the future;
3. The EU's security and prosperity already today depend on access to these critical materials and components derived from them;
4. The EU and partner countries at present have industries that (often indirectly) make use of these materials.

Take point 3: Gallium is used to produce semiconductors (wafers), LED-lighting, and photovoltaics. Optical fibres, infrared optics and satellite solar cells contain germanium. Rare earths are used to produce permanent magnets, among a range of other products. In turn, these components are vital for current EU and partner downstream industries to produce essential goods. Defence, space, medical, telecommunications, (wind) energy, and other critical sectors are notably dependent on these components and therefore indirectly on these materials.

Gallium, germanium, and rare earths (indirectly) are all used in vital end-use industries in the EU or partner countries at present (point 4). Therefore, vertically integrating upstream supply chains can in fact help improve EU security of supply. On the contrary, expanding material security of supply for critical products that are at present not produced in the EU or partner states at scale requires additional action. For example, expanding production of cobalt for batteries in the EU or in partner countries is unlikely to enhance EV security of supply (at least in the short term). After all, battery producers are still mostly based in China. Gallium, germanium, and rare earths and related components, namely semiconductor wafers and permanent magnets, on the other hand are all used by vital end-industries in the EU or partner countries at present. Even though this workshop focused only on how to de-risk supply chains for these three metals, many outcomes apply to a broader range of China-dominated materials.

[1] Our gratitude goes to Peter Handley, Founder at PHASE32 and Strategic Advisor, Energy, Climate and Critical Raw Materials at the Hague Centre for Strategic Studies (HCSS), for his review of the discussion paper,

Re- or friendshoring will take time. This makes a target of a China-free value chain in the second part of the 2020s even more difficult to achieve. By aiming for "fully de-risked" in 2030, the EU and its partners can partially de-risk these value chains in the years before.

Workshop participants include representatives from the European Commission, EU Member States, think tanks, research technology organisations, and industry, among whom material producers and consumers, including the semiconductor industry (see Annex B for the list of participants).

What would it take for the EU to achieve this more ambitious goal? We invited participants to think outside the box, by starting with the end in mind. They were asked to score ten EUISS policy options on a scale from 0 to 10, in terms of two criteria: (1) effectiveness in achieving the 2030 goal and (2) severity of negative consequences. Please see Table 1 for an overview, and Annex D for a full description of each policy option. In addition to ranking the options, many participants made use of the opportunity to provide detailed written comments on what negative consequences each policy option may have. Please find the full quantitative survey outcomes in Annex E. Participants did this in two surveys, one before and one after the four-hour discussion on the content of all policy options. What follows is a summary of the group's views, with a focus on the experts' definitive judgment in the final survey.

Table 1 Ten policy options

Policy	EUISS-proposed policy option	Shorthand	Promote,* protect,** partner***
Policy 1.	Build EU public-private strategic stockpiles	Stockpiling	Protect, promote
Policy 2.	State financial support (direct and indirect)	Financial support	Promote
Policy 3.	Direct state investment, including 'golden shareholder' function	State investment	Promote
Policy 4.	Fiscal support for overseas investments	Fiscal overseas support	Promote
Policy 5.	Large investment in research, innovation and local and foreign talent development	Research, innovation, and talent	Promote
Policy 6.	Streamline permitting	Streamline permitting	Promote
Policy 7.	Public-private 'Buy European' provisions	"Buy European" provisions	Protect
Policy 8.	ESG requirements in Europe and at the border	ESG requirements	Protect
Policy 9.	G7 and partner alignment on economic security standards in public procurement	G7+ economic security standards	Protect, Partner
Policy 10.	G7 and partner alignment on import tariffs	G7+ import tariffs	Protect, Partner
* Promote measures seek to bring online supply outside of China and other countries of concern through investment in the capabilities of EU and partner upstream industries.			

contributions in preparing the Delphi workshop, and additional expert support in this research project. In preparation of this Delphi workshop, the authors also conducted fifteen expert stakeholder interviews with EU policymakers, experts (e.g., thinktanks), and representatives of producers (e.g., mining and refining companies) and end-industries (e.g., semiconductor manufacturers). We thank all interviewees (see Annex C.) for generously sharing their knowledge and time with us. During phase 2, EUISS conducts expert interviews with policymakers, industry representatives and experts from important partner countries, namely Canada, the US, Australia, and Japan.

** Protect measures aim to ensure security of material supply in the EU and shield EU and partner industries from the effects of China's 'power trade' tactics, such as dumping and the weaponisation of material supply.
*** Partner measures seek to align these policies with a diverse mix of likeminded and non-likeminded partners, to promote or protect the production of materials or related components outside of China.
The authors assume that any build-up of upstream activity in Europe would need to be accompanied by a public education and acceptance campaign, as buy-in from European public is important. Moreover, measures to ensure recycling and a circular economy may be important in the long term but for the purpose of this exercise fall beyond the 2030 timeframe. As one participant suggested, this may include raising export tariffs and lowering import tariffs on waste carrying germanium, gallium, and rare earths.

Intra-EU Delphi workshop methodology (Afternoon, 9 December 2024)

EUISS asked participants to score ten EUISS policy options on a scale from 0 to 10 during a Delphi workshop, both in terms of their (1) effectiveness in making the 2030 goal a reality and (2) negative consequences. In addition, participants made use of the option to specify negative consequences of each policy option in detailed written comments.

Participants did this in two identical surveys, one before and one after the four-hour discussion on the content of all policy options. Participants filled out the pre-event survey after reading an EUISS discussion paper. This included background information on the current gallium, germanium, and rare earth production chain, a snapshot of what a friend-shored supply chain in 2030 may look like, a crisis scenario, and a detailed description of EUISS policy options (see textbox 1 for the scenario presented in the discussion paper).

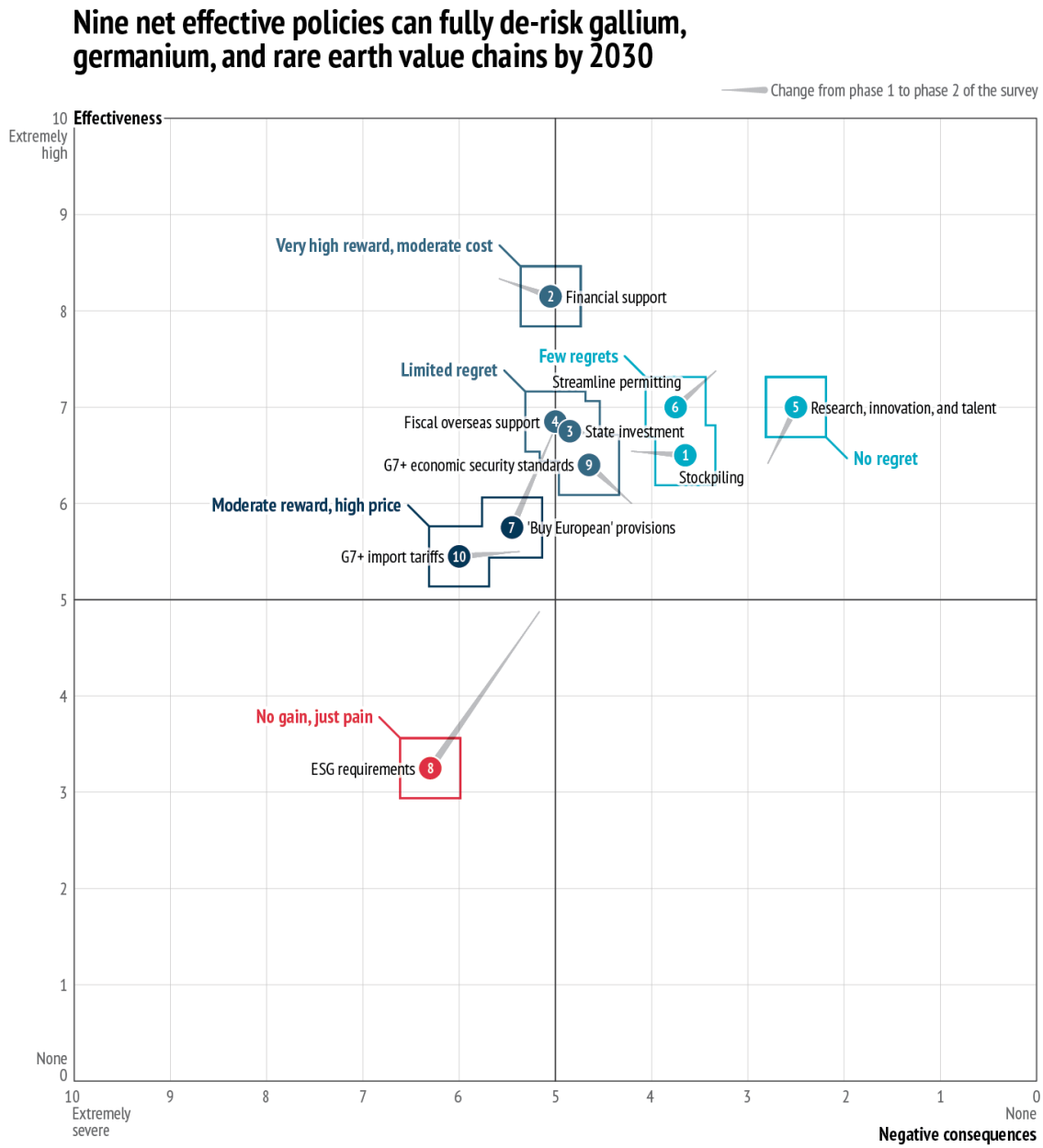
At the start of the workshop, we presented the outcomes of the pre-event survey. This was followed by an EUISS-moderated four-hour discussion on the effectiveness and negative consequences of each policy option, including on how each policy could be improved. At the close of the event, participants offered their definitive judgment on the policy package in a post-event survey.

24 out of the total 34 workshop participants filled out the pre-event survey, within the submission period (9:45am 29 November to 4:00pm 6 December 2024). Their answers to all quantitative questions can be found in Annex E. We received two late submissions. These last responses were not incorporated in the pre-event survey results, nor in the EUISS presentation during the workshop. However, we will leverage these insights, particularly the qualitative responses, in the final EUISS report.

27 participants filled out the post-event survey, of whom 20 had also filled out the pre-event survey. To make answers comparable across surveys, the below presentation on the post-event survey outcomes only takes into account the post-event survey responses of those that filled out both surveys. Their answers to all quantitative questions can be found in Annex E. The EUISS will still leverage the remaining seven responses, particularly the qualitative answers provided, in the completion of the final report. To ensure the anonymity of all participants, EUISS does not publish the answers of survey respondents to the qualitative questions. The respondents mostly (20 out of 27) filled out the post-event survey directly at the end of the event (9 December between 5:00 and 5:40pm), six within four days, and one only on 25 December.

WORKSHOP OUTCOMES

Conclusion 1: A combination of promote, protect, and partner measures can accomplish a vertically integrated, China-free value chain by 2030. No single policy offers a silver bullet, however. After all, no policy is deemed 'extremely effective', meaning a 9 or 10 score. Participants deem nine policies to be 'net-effective' (>5). Only four out of ten policies have 'high negative consequences' (>5). Participants stress that de-risking measures would need to target the entire supply chain. This is a precondition to achieving the 2030 goal. In addition, participants stress that introducing promote policies first is the best way forward.



Achieving security of supply requires vertically integrating industries, all the way from the current point of direct dependence on China to the extraction of raw materials. Participants note that reshoring or friend-shoring just one or several production steps in the value chain does not actually secure supply. This kind of scattered de-risking approach simply creates a new critical economic input for which the EU directly relies on China. For example, in addition to dominating permanent magnet production, approximately 90% of all rare earth refining takes place in China. Even if the EU on-shores permanent magnet-making, Beijing could still (threaten to) weaponise the supply of materials needed to produce

these components. Therefore, securing supply requires that EU and partner industries move their entire supply chain outside of China.

Introducing measures in the correct order and at the right time is of the upmost importance. Many participants advocate first generating supply outside of China (promote), and only then shielding EU markets (protect) from China's power trade tactics, such as its flooding of the market with below market-price products and its weaponisation of supply. Both promote and protect measures should be coordinated with partners (partner). If production does not yet take place outside of China at scale but the EU and its partners already disincentivise supply from China, steep price increases, and perhaps even shortages, may occur. This is especially true in today's constrained gallium and germanium markets. China has already capped the exports of these materials. Even worse, China could aggravate shortages caused by a protect-first-promote-later strategy by retaliating early, for instance by artificially cutting off supply to the EU.

Conversely, if the EU introduces promote measures first, but does not adopt protect measures soon after, then Beijing is in a strong position to undercut vulnerable competitors. China could simply flood the market with cheap components and materials to put EU and partner production out of business. In short, participants find that promote measures should kickstart EU and partner production. Protect measures ought to follow soon after to ensure the longer-term financial viability of EU and partner producers.

Conclusion 2: Providing various forms of financial support, for example to support mining and processing activities (Policy 2), stands out as by far the most promising tool to achieve a China-free value chain by 2030. After all, Policy 2 seeks to tackle head-on the main obstacle to greater self-sufficiency: China's predatory pricing. However, participants expect it to come at a relatively high cost (>5).

Financial Support (Policy 2) is the only policy rated to have a very high effectiveness

Several participants argue that introducing financial support tools (Policy 2) is necessary for EU material producers to 'just' maintain their current production capacity. Energy-intensive industries in the EU face financial challenges, because of Russia's gas blackmail and decisions by EU governments to reduce domestic energy production. Ruling out financial support may undermine more than a few business cases. Even worse, the EU may even lose the limited production capacity it has at present.

Other participants voice concern about the high costs of the policy, since creating greater security of supply requires moving not one, but a whole range of upstream (e.g., mining, refining, component-making) industries out of China. This would put more pressure on already strained government budgets throughout the EU, perhaps even contributing to inflation. In addition, mining and refining industries compete for public de-risking funding with other critical industries, such as the pharmaceutical and semiconductor industries. Participants also warn of the risk of investing in companies that have not proven themselves in the marketplace. Others express concerns that a loosening of state aid rules would make the playing field in the EU more uneven.

Finally, some participants fear that financial support may spark subsidy races with partner countries. Partners also encourage and incentivise their industries to move material supply chains out of China. Many of these partners, including the US, Canada, Australia, and Japan, are better equipped to expand

material production at various stages of the supply chain. For one, the first three have lower energy costs, a lower population density, and less stringent environmental regulations.

Conclusion 3: One 'no regret' and two 'few regrets' policies should be implemented without delay. High effectiveness (8>X>6) and very low negative consequences (<3) characterise investment in research, innovation, and talent (Policy 5.). Two 'few regrets' options, namely stockpiling (Policy 1.) and streamlining permitting (Policy 6.) are considered to be highly effective (>6) with low negative consequences (3<X<4).

One 'no regret' and two 'few regret' option should be implemented without delay

Extensive investment in research, innovation and local and foreign talent development (Policy 5) can help the EU and partners overcome key (technical) capability gaps. It has one important weakness: Policy 5 may not produce results before 2030. Investment in innovation, domestic talent development and attracting foreign talent can help the EU and partners overcome important technical obstacles to de-risking material value chains. Importantly, technological breakthroughs can strengthen the ability of EU industries to efficiently extract gallium and germanium from zinc concentrates. These investments can also have positive spillovers into other domains.

Yet, many innovation and training efforts will materialise after the 2030 target, especially if these investments do not focus on projects with a relatively high technical readiness level (TRL). The skilled workforce shortage in science, technology, engineering and mathematics (STEM) plagues many industries. Solving it through domestic talent development is an important, but longer-term project. Attracting foreign talent is an effective alternative that may produce results sooner. However, this may prove difficult in industries, like mining and refining, in which the EU's current global standing is limited. Relying on foreign talent may also go hand-in-hand with (unwanted) technology transfer, including to China.

Without a more efficient, streamlined permitting process (Policy 6), the 2030 de-risking goal is almost certainly out of reach. Even though participants overall judge negative consequences to be limited, some stress that expediting the permitting process may lead to environmental pollution and aggravate health-related risks. Consultation processes for local populations will have to be shorter too. This may lead to greater societal resistance, as industries like mining remain unpopular in Europe. Politicians, industry leaders, and experts could address these concerns by stressing the 'overriding public interest' of these projects, especially as Europe's security situation deteriorates rapidly[2].

Stockpiling (Policy 1) can protect the EU against immediate effects of supply disruptions. This is especially true for critical sectors like the defence industry. For them, these materials and components are 'high value, low volume' commodities. Likewise, stockpiling can help kickstart production outside of China. Industry representatives have less faith in stockpiling than policymakers and think tankers.

For 'high value, low volume' commodities, stockpiling may even be a medium-term solution, provided that these materials are not subject to corrosion. So far, Japan and the United States appear to have

[2] Survey outcomes.

succeeded in dealing with China's de facto export boycott of gallium and germanium, partially by relying on (private) stockpiles. The volumes are key. Demand for rare earth permanent magnets for wind turbines reaches several hundred thousand tons in France alone. Stockpiling at this scale would likely be expensive. In these situations, the business case for upstream industries to stockpile may be weak, without fiscal support or a price floor for upstream producers. At the other extreme, participants note that the production of European semiconductor manufacturers only relies on several hundred kilograms of an ultra-pure gallium derivative per year.

Yet, it is important to note the limits of Policy 1's effectiveness. Stockpiling buys EU industries time but does not solve upstream dependencies on China in the absence of other policies. In the end, a stockpile of an ultra-pure gallium derivative will have to be replenished, which at present requires access to China-produced unwrought gallium. Filling the stockpile may still contribute to vertically integrating value chains, however. The stockpiling authority can serve as a stable buyer of materials produced outside of China, for example through guaranteed offtake from EU and partner industries at a minimum price.

The participants identified key challenges to making stockpiling a success. These are: identifying the right item to stockpile (meaning the current direct dependency on China) in close coordination with industry; the limited shelf-life of some material derivatives; the short-term risk of driving up prices (or perhaps even depriving EU industry) of materials especially in already (geopolitically) constrained gallium and germanium markets; retaliation by China; selecting industries that have priority access to the stockpile; establishing a competent authority that manages the inflow and outflow of the stock; ensuring that stockpiling obligations for private (up-, mid-, and downstream) companies do not endanger their competitiveness globally; and creating a business case for storage companies, especially in markets where demand for materials and components is low.

Consider the first challenge: identifying the right material to stockpile for an extended period. Direct dependencies on China are not fixed. For example, the EU still relies on China-supplied gallium today to produce gallium wafers, which are used to produce semiconductors. But China is rapidly expanding its domestic production of wafers. If China's overproduction of wafers crowds out EU production in the future, then EU industry may come to rely on China for this key component. This would make a stockpile of gallium derivatives to produce wafers pointless, as the dependency has moved downstream. In short, carefully identifying the item that should be stockpiled and continuously monitoring changes in the supply chain is necessary for a successful stockpiling policy (Policy 1).

Conclusion 4: State investment (Policy 3), fiscal overseas support (Policy 4), and G7+ economic security standards (Policy 9) offer 'limited regret' options to help strengthen security of supply by 2030. They are characterised by high effectiveness (>6) and only moderate negative consequences (5>X>4).

State Investment (Policy 3) can produce a structural business case by ensuring investor stability, in the same way that JOGMEC contributes on behalf of the Japanese government3. Some participants deem Policy 3 even more helpful than financial support (Policy 2) because they suspect that EU producers would need structural support instead of a one-off capital injection.

[3] JOGMEC stands for the Japan Organization for Metals and Energy Security.

Yet, some participants argue that state investment (Policy 3) is expensive and potentially wasteful. Others point out that the EU and its Member States, unlike the Japanese government, lack the required flexibility and expertise.

Participants note that state investment (Policy 3) comes with many of the same risks as other financial support tools, but also additional ones. Like financial support (Policy 2), state investment runs the risk of investing in companies that have not proven themselves in the marketplace. The EU and partners would pick winners rather than create a China-proof, level-playing field (for example through tax benefits for upstream producers) for EU and non-EU industrial players. Similarly, several participants warn that direct state investment puts pressure on EU and Member State budgets and may even lead to subsidy races between likeminded countries.

The participants also foresee negative consequences specific to state investment (Policy 3). Participants argue that EU institutions and Member State governments lack the technical expertise and industry insight to play a constructive role as a 'golden shareholder'. Some participants fear that the decision-making processes of institutions behind a European version of JOGMEC, the Japan Organization for Metals and Energy Security, would be too slow to respond to Chinese counteractions, given the many levels at which decisions are taken in the EU.

The participants find that fiscal overseas support (Policy 4) can complement policies that seek to promote production inside the EU. Many point out that investing in third countries with lower energy prices and regulatory burdens will improve the de-risking business case. Yet, questions about the future geopolitical alignment, political stability, and Environmental, Social and Governance (ESG) checks and balances of third countries remain.

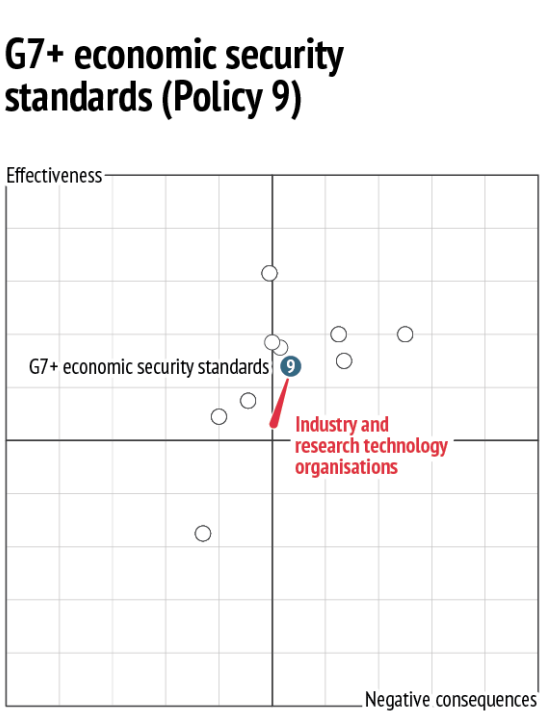
Almost all the EU's partners, from Canada to the Democratic Republic of the Congo (DRC), impose less stringent environmental regulations, fewer reporting obligations, and shorter consultation processes on industries. Many partners face far lower energy costs than the EU. Furthermore, likeminded countries, such as Canada and Australia, are developing their own policies to stimulate material production. Fiscal overseas support (Policy 4) can make use of synergies with these projects to help achieve the 2030 goal.

Yet, some participants warn that moving production from China to other third countries gives the EU less control. As great power tensions increase, Washington and Beijing will push more countries to take sides. Today's nonaligned countries, like Malaysia or the DRC, may in the future no longer be as welcoming to cooperation with EU industry. If a conflict over Taiwan breaks out, for instance, many countries will be forced to take sides. This may result in the loss of EU investments in third countries, and perhaps even of industrial expertise.

Then there are other events that may endanger EU-sponsored investments. Countries with weaker governance, for example the DRC, may face political instability, or even civil war, putting investments at risk. Resource nationalism is on the rise around the world, with more countries resorting to trade restrictions for materials. For example, Indonesia has banned the export of unwrought nickel. In an extreme case, a third-country government may nationalise EU-supported projects if they perceive the benefits of these project to be insufficient. Finally, the EU and its Member States have fewer tools to ensure ethical conduct in the projects in which they invest abroad. As a result, EU-supported projects

risk becoming mired in scandals. This is especially true in countries where environmental and human rights regulations are lax.

Introducing G7 and partner economic security standards in public procurement (Policy 9) enables EU and partner governments to stimulate production in trusted countries. Unlike Policies 2 and 3, Policy 9 can achieve this without distorting competition between likeminded partners. Important questions remain, such as whether Trump 2.0 would consider a multilateral and slower approach. Participants warn of negative consequences: price hikes early on, retaliation by China, a loss of EU upstream industry competitiveness vis-à-vis likeminded partners, and strained relations with non-G7+ countries. Notably, EU industry representatives express even more doubts and a preference for 'Buy European' provisions (Policy 7) instead.



EU and Member State public procurement processes are powerful tools to incentivise greater production outside of China. Public institutions can require that firms which aspire to execute public projects use components and materials produced by reliable partners. For example, governments investing in offshore wind can set the requirements to which wind turbine manufacturers should adhere. EU governments can therefore include clauses that guarantee offtake of strategic products manufactured by EU and partner industries. Governments can, for instance, demand that downstream industries use minimum shares of components, such as permanent magnets, and materials, for example rare earths, produced in G7+ countries. At the same time, Policy 9 heavily penalises the reliance on products from foreign entities of concern, including China. The G7 and key partners together make up over 60% of global GDP. This produces scale.

Nevertheless, participants also outline limits to Policy 9's effectiveness. The United States is a well-placed player to onshore materials production. Some expect Trump 2.0 to pursue a unilateral industrial policy, heavily focused on achieving immediate results. From the US perspective, G7 and partner negotiations on common standards will likely be too slow. After all, China already halted germanium and gallium exports to the US in 2023. Others warn that Policy 9, while helpful, misses the mark. After all, consumer markets, not public procurement, generate most of the demand for components and materials.

In addition, participants outline possible negative consequences. First, if the EU and partners introduce Policy 9 before sufficient supply outside of China comes online, prices for related materials and components may increase quickly. Products may even become scarce. Second, designating China, Russia and others as 'foreign entities of concern' may lead Beijing to retaliate sooner. After all, China's leadership may become convinced that its material leverage over others will decrease over time. Third, the United States, Canada and Australia may outcompete EU producers at multiple stages of the value chain because of lower energy prices, more mineral deposits, and looser environmental regulations. Finally, spearheading G7 and partner economic security standards (Policy 9) may lead to disillusionment in third countries, such as India, even when they are invited to join the public procurement regime. After all, these countries would be rule-takers rather than rule-makers.

Conclusion 5: 'Buy European' provisions (Policy 7) and introducing G7 and partner tariffs (Policy 10) are two 'Moderate reward, high price' policies. Participants deem these policies to be net-effective (>5). Yet, both come with high negative consequences (>5). They may help contribute

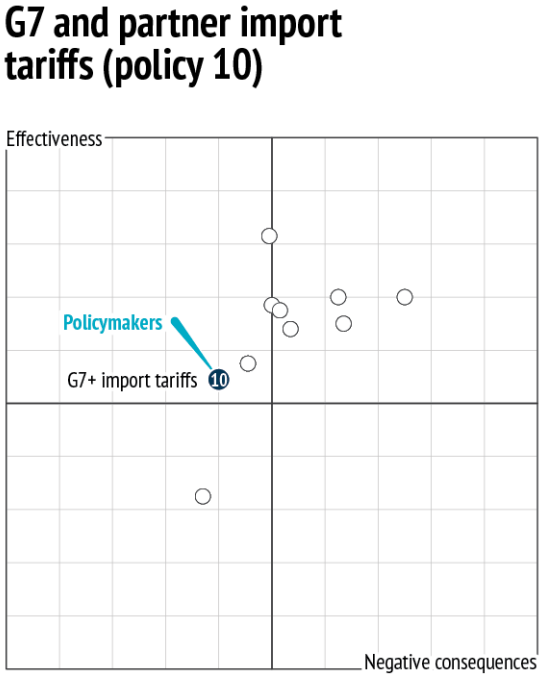
to reaching the 2030 goal, but only if the EU can introduce them at the right time and overcome their potentially severe negative consequences.

'Buy European' provisions (Policy 7) may help spur greater material production in the EU, but it is unlikely that supply chains can be vertically integrated within the EU alone. Participants warn that Policy 10 leads to price increases, shortages, reciprocal protectionism by partners like the US and Canada, and retaliation by China. Industry representatives expect 'Buy European' provisions to have few negative consequences.

The EU at present does not have the required industries to reproduce the entire gallium, germanium, and rare earth supply chains that China currently dominates. As a result, 'Buy European' provisions (Policy 7) in public procurement and for private companies are likely to lead to higher prices for businesses and consumers (even more so than Policy 9). It may even lead to shortages, including in critical sectors such as defence industries. This is especially true if the policy is not preceded by promote policies for EU industries. Some participants warned that downstream companies in the EU will face higher costs, perhaps even impeding their ability to compete globally. This is especially true in highly competitive global markets such as semiconductor manufacturing. EU industry already faces high costs, due to labour and energy prices in the EU, as well as stringent environmental regulations.

Key partners and rivals are also unlikely to respond positively to 'Buy European' provisions (Policy 7). The UK, US, Norway, Canada, Japan and Australia are all seeking a way out of overdependence on China. 'Buy-European' provisions may lead them to implement or expand similar policies. This could asymmetrically damage the EU's interests. After all, many of these countries are better positioned to produce materials, especially at the mining stage. One participant argues that in an extreme case partners may close their markets to EU-components and materials altogether. Finally, China may retaliate because of the exclusion of its below-market-price products.

Participants expect G7 and partner import tariffs (Policy 10) to have more downsides than benefits, especially if introduced in the absence of promote measures. Even though these tariffs may protect EU and partner industries in the medium term, it comes at a high cost. Policymakers expect Policy 10 to have more severe negative consequences, but also to be more effective.

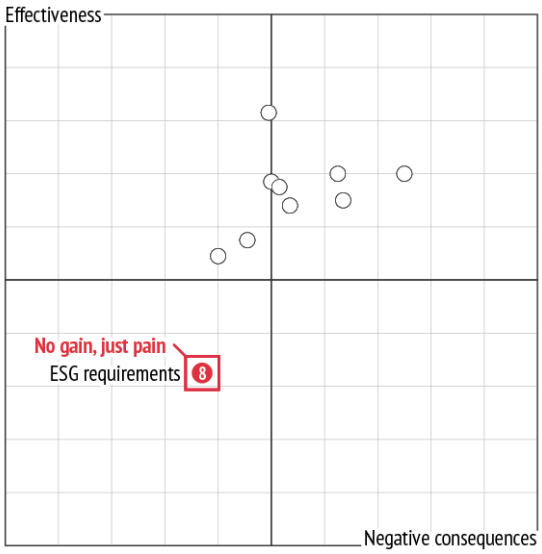


Key challenges are identifying the right material or component on which to impose tariffs and dealing with higher prices for materials and components, especially in the short term. In turn, this would lead to reduced competitiveness of EU mid- and downstream industries. These effects would be especially severe if G7+ governments adopt Policy 10

before sufficient supply outside of China has come online. Other risks are a backlash from nonaligned countries left out of the zero-tariff trade regime, and retaliation and tariff circumvention by countries of concern, including by China.

Conclusion 6: Participants do not consider ESG requirements (Policy 8) an effective tool to create greater material security of supply. This is the only policy that participants consider as offering 'No gain. Just pain'. After all, Policy 8 stands out with by far the lowest expected effectiveness (<4) and the highest negative consequences (>6).

Introducing more ESG requirements (Policy 8) is deemed the worst option to achieve the 2030 target.



Effectiveness is low because participants expect that Chinese producers will likely be able to (whether in practice or on paper) live up to ESG requirements, whereas many other developing nations will not.

At the same time, some participants expect ESG requirements to come with severe negative consequences. These include inflationary pressures and potentially even shortages, a weakening of the competitiveness of EU upstream industries in global markets, disengagement of EU companies from emerging markets ('cut and run' instead of 'stay and behave' behaviour), limiting EU industry capacity for actual investments because of reporting requirements, industry leaving the EU for destinations with fewer reporting requirements (for example the US and Canada), and growing alienation of Global South countries because of perceived unfair trade restrictions for their products. One participant mentions that both the corporate sustainability due diligence directive (CSDDD) and the carbon border adjustment mechanism (CBAM) pose hurdles for EU industry to expand material production, while the positive ESG-impact of these policies remains questionable.

Conclusion 7: Some participants propose additional policies. To achieve vertical integration, they advocate establishing likeminded industry networks, a loosening of state investment rules, and setting up a joint G7 and partner development fund to invest in upstream industries outside of China. Finally, one participant advocates a G7+ stockpile information sharing and management system and to control investments from 'foreign entities of concern' in upstream industries.

Participants propose promote, protect and partner policies of their own. On promote and partner, the EU and partners should seek to establish joint downstream, midstream, and upstream industry networks, to ensure that vertical integration can take place outside of China. Current policy initiatives, like the European Chips Act, fail to take into account the entire value chain including the production of semiconductor materials. Furthermore, participants argue that the EU and partners should loosen state aid rules to invest in 'cross-industry supply chain resilience platforms' or in specific strategic companies. Some participants advocate setting up a joint development fund with G7+ partners, to invest in 'multiple mining and refining companies' outside of foreign entities of concern. The EU would be a co-investor in these efforts.

On protect and partner policies, some propose to establish a 'G7+ stockpile management platform'. participants argue in favour of governments and strategic industries sharing information on the stock levels for various materials, streamlining the process to procure components and materials from likeminded partners, and helping to coordinate the release of stock in times of crises. In addition, 'FDI and ownership of stocks' in EU and partner upstream industries should be carefully controlled.

CONCLUSION

The EU's efforts to secure critical raw material supply chains are not producing results fast enough, leaving Europe vulnerable to supply disruptions. China dominates the production of essential materials. A breakdown in relations could threaten European security and economic stability. To address this, the EUISS convened 33 key stakeholders to develop policies ensuring the supply of gallium, germanium, and rare earths. During this Delphi workshop, participants designed a policy package to fully de-risk EU supply chains by 2030, consisting of a mix of 'promote,' 'protect,' and 'partner' measures.

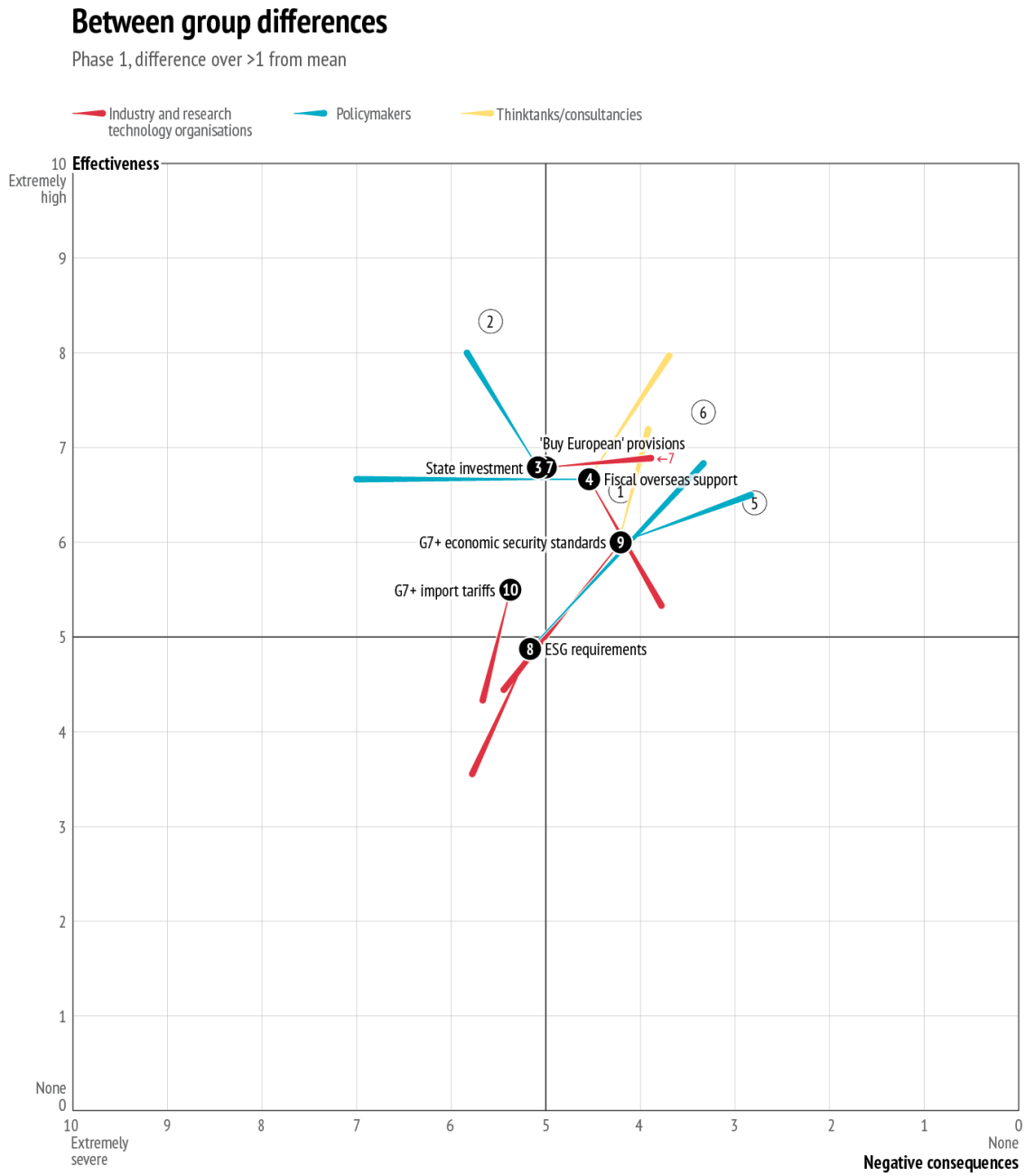
Providing financial support, including for mining and processing, was identified as the most effective strategy, as it counters China's predatory pricing tactics, though at a high cost. Other recommended measures include investing in research, stockpiling, and streamlining permits, which are all considered low-cost, high-benefit options. State investment, fiscal overseas support, and G7+ economic security standards offer moderate benefits with some drawbacks. 'Buy European' provisions and G7-aligned tariffs may help but come with high costs. Participants see ESG requirements, finally, as ineffective. Additional proposals are deepening industry networks with partner countries, easing state investment rules, creating a joint G7 development fund for non-China upstream industries, setting up a G7+ stockpile management system, and tighter controls on foreign investment.

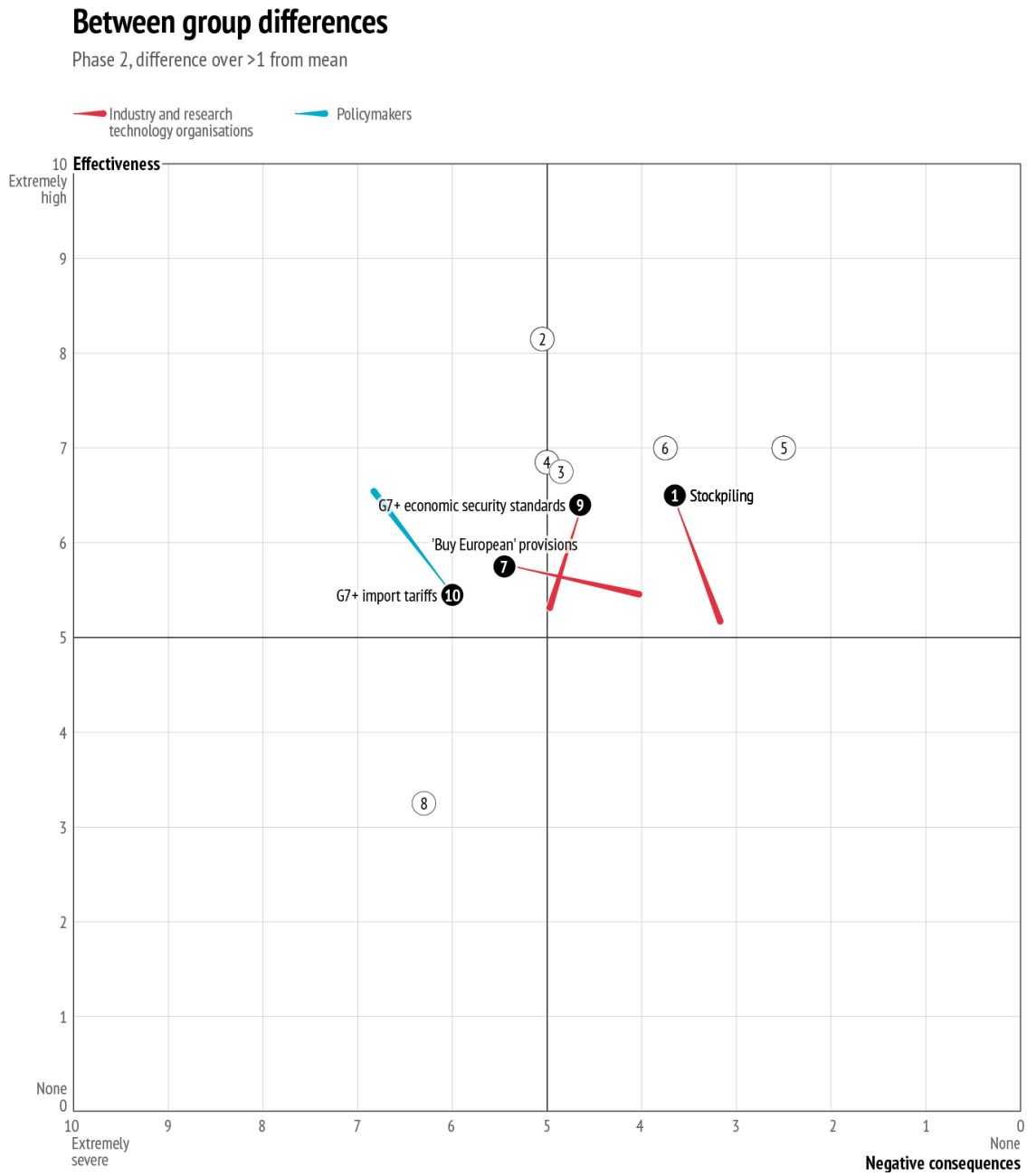
In Q2 of 2025, the EU Institute for Security Studies will publish a policy report, including a list of policy recommendations, on how the EU and partners can 'fully de-risk' gallium, germanium, and rare earth supply chains before 2030. It should be stressed that the phase 1 workshop took place prior to Donald Trump's second inauguration in January 2025. The geopolitical context and in particular the debate around critical raw materials has evolved quickly since then, even touching on major European interests in Ukraine, Danish territory in Greenland, and directly impacting key partners such as Canada.

In addition to the workshop, the final report will leverage consultations with global experts and policymakers. Specifically, EUISS interviewed key policymakers, experts, and industry representatives from the EU and its partners, most notably Japan, Australia, Canada and the United States. Interviewees were asked to reflect on all ten policy options discussed in this report and the intra-EU workshop outcomes. As a result, the conclusions and recommendations for the EU of the EUISS in the final report are based on an understanding of current EU and partner industry strengths and weaknesses, and their policy preferences - in the new geopolitical context.

ANNEX A: PRE-WORKSHOP AND POST-WORKSHOP SURVEY 'BETWEEN GROUP' OUTCOME DIFFERENCES

In the course of the workshop, industry & research and technology organisations, think tankers and consultancies, and policymakers, reached far greater consensus. The pre-workshop survey shows far greater differences between groups than the post-workshop survey. Industry, think tankers, and policymakers found common ground on state investment (Policy 3), fiscal overseas support (Policy 4), and ESG requirements (Policy 8). On four policies, opinions remain divided.





In the pre-workshop survey, the groups still had significant disagreements on either the effectiveness or the negative consequences of seven out of the ten policies[4]. In the closing survey, only four such disagreements remained. Differences of opinion on the negative consequences and effectiveness of G7+ economic security standards in public procurement (Policy 9) and G7+ import tariffs (Policy 10) remain but have become considerably smaller. Industry and RTOs, unlike the other groups, continue to believe that the negative consequences of 'Buy European' (Policy 7) provisions are limited.

Before the workshop, the groups still disagreed substantially on the effectiveness and negative consequences of fiscal overseas support (Policy 4) and ESG requirements (Policy 8). Policymakers warned that fiscal overseas support would have severe negative consequences (=7), while industry doubted the

[4] A significant disagreement is defined as a > +1 or < -1 difference between the mean of the subgroup, for example 'policymakers', and the mean of overall participants.

measure's effectiveness (<6). In the pre-workshop survey, policymakers had highlighted ESG requirements as a 'no regret' option with a high effectiveness (>6) and limited negative consequences (<4). Industry and RTOs, on the other hand, had designated this policy as 'No gain. Just pain' from the start. After the workshop, both groups deemed this policy both ineffective and counterproductive to the security of supply goal.

ANNEX B: WORKSHOP PARTICIPANTS (9 DECEMBER 2024)

The authors would like to thank the following experts for participating in our Delphi workshop, either by filling out both the pre-event and post-event surveys – or just one of the two. This list is not exhaustive. Only Delphi workshop participants that stated they were willing to be mentioned in the report are listed. It does list the majority of respondents (or only their affiliation) to the pre-event survey (20 out of 24) and to the post-event survey (20 out of 27).

Phase 1 and 2

1. AL BARAZI, Siyamend | Head of Unit, Mineral Economics, German Mineral Resources Agency (DERA) at the Institute for Geosciences and Natural Resources (BGR)
2. VAN DEN BOSSCHE, Patrick | Strategic Advisor, Green Transition, Agoria
3. BOUVET DIT MARECHAL, Marie| Analysis Officer, The Atomic Energy and Alternative Energies Commission (CEA) at the French Observatory of Mineral Resources for Industrial Sectors (OFREMI)
4. CHRISTOU, Michalis | Senior Expert, European Commission - Joint Research Centre (JRC)
5. VAN DONGEN, Myrte | Strategic Sourcing & Procurement, Trade Compliance, ASML
6. GUSTAFSSON, Marcus | Policy Officer – China, European Commission – DG Trade
7. HANDLEY, Peter | Founder, PHASE32
8. HENRY, Philippe | Managing Director, SA Jean-Goldschmidt international/HYDROMETAL
9. HOBHOUSE, Caspar | Research Analyst, EUISS
10. DE JONGE, Daan | Project Director – Critical Minerals and Multi-Commodity, Benchmark Mineral Intelligence
11. MICHEL, Benoit | Project Officer, CapTech Technologies for Components and Modules (TCM), European Defence Agency (EDA)
12. MOREIRA, Ursula | Trader, Nyrstar
13. PATRAHAU, Irina | Strategic Analyst, Energy and Raw Materials, The Hague Centre for Strategic Studies (HCSS)
14. RUHLIG, Tim | Senior Analyst, Asia - Global China, EUISS
15. SEAMAN, John | Research Fellow, French Institute of International Relations (Ifri)
16. SPATAFORA, Giuseppe | Associate Analyst, EUISS
17. TEER, Joris | Research Analyst, Economic Security and Technology, EUISS
18. ZON, Jasper van | Global Head of Corporate Affairs, Nyrstar
19. Anonymous | Representative, the Federation of German Industries (BDI)
20. Anonymous | Representative, the European Commission

Phase 1 only

21. RABBIE, Julian | Quantum Technology Strategist, TNO

Phase 2 only

22. ALVES DIAS, Patricia | External Consultant, European Commission
23. CHIMITS, François | Senior Economist, MERICS
24. CORDER, Giovanni | International Trade Manager, European Semiconductor Industry Association (ESIA)
25. GERMAIN, Marianne | General Manager BU GaN & CEO, Soitec Belgium NV, SOITEC

Phase 1 (late submissions)

26. ALVES DIAS, Patricia | External Consultant, European Commission
27. GAUß, Roland | Innovation Director, EIT RawMaterials

ANNEX C: EXPERT INTERVIEWEES

The authors would like to thank the following experts for giving an expert interview to help design the intra-EU workshop, including the survey. This list is not exhaustive. Only the expert and stakeholder interviewees that stated they were willing to be mentioned in the report are listed. It does contain the majority of people interviewed (14 out of 15).

1. ALVES DIAS, Patricia | External Consultant, European Commission
2. BOURG, Stéphane | Director of the French Observatory of Mineral Resources for Industrial Sectors (OFREMI)
3. BOUVET DIT MARECHAL, Marie| Analysis Officer, The Atomic Energy and Alternative Energies Commission (CEA) at the French Observatory of Mineral Resources for Industrial Sectors (OFREMI)
4. CARRARA, Samuel | Scientific Project Officer, European Commission (JRC)
5. CHIMITS, François | Senior Economist, MERICS
6. CHRISTOU, Michalis | Senior Expert, European Commission - Joint Research Centre (JRC)
7. DAQUINO, Giuseppe G. | Materials CapTech Chair @ European Defence Agency
8. HANDLEY, Peter | Founder, PHASE32
9. MAGNANI Nicola | Policy Officer, European Commission
10. MICHEL, Benoit | Project Officer CapTech Technologies for Components and Modules (TCM), European Defence Agency (EDA)
11. MOREIRA, Ursula | Trader, Nyrstar
12. PATEY, Luke Anthony | Senior researcher, Danish institute for International Studies
13. SCHNIPPERING, Maximilian | Head of sustainability, Siemens Gamesa
14. ZON, Jasper van | Global Head of Corporate Affairs, Nyrstar

ANNEX D: TEN POLICY OPTIONS

Policy 1: Build EU public-private strategic stockpiles

Build strategic stockpiles covering minimum one year of the (direct) material or component consumption for defence/space/semiconductor/telecommunications/wind energy and other critical industries. The EU also introduces minimal requirements for commercial stockpiles for companies operating in strategic sectors. In addition to guaranteeing supply, stockpiles can be used to ensure purchases for EU or partner producers of materials and components. They thereby contribute to investor stability and support stable prices for material producers ('counter price gouging').

Policy 2: State financial support (direct and indirect)

Provide subsidies along the value chain including grants, low/zero-interest loans, fixed (low/subsidized) energy prices, tax exemptions and rebates for production in Europe and for downstream purchases of materials produced in Europe or from allied/partner/'trusted' vendors. A guaranteed, EU-wide price floor will be established for eligible producers of mined and refined materials. Export credits will be directed to help European products to compete on overseas markets. Fiscal support also includes the allocation of (increased) defence budgets to ensure resilience of defence production chains all the way to the component and even material level (akin to the US Defense Production Act).

Policy 3: Direct state investment, including "golden shareholder" function

Establishment of an independent state/EU agency that would co-invest directly in mining, refining, processing, and key component manufacturing, in support of European companies both in Europe and abroad. The agency functions as a golden shareholder. In addition to capital injection, the agency offers expertise and long-term investor stability to counter price shocks and other challenges.

Policy 4: Fiscal support for overseas investments

Provide concessional, low-interest and zero-interest loans through EU investment and development banks (in the context of Global Gateway) to support European firms investing in resource extraction, refining, processing, and component manufacturing overseas. Provide export credits for European technology, materials and knowledge that strengthen supply chain linkages with strategic partner countries.

Policy 5: Extensive investment in research, innovation and local and foreign talent development

Massively increase spending on research and innovation in related science, technology and engineering fields and liberalising visa-regimes for countries that produce high levels of STEM-graduates (e.g., India). These measures are meant to ensure Europe has the skills base necessary to sustain the operation of the complete supply chain. Such funding would be directed towards European higher education (engineering schools and technical training and research institutes). This includes allocation of (increased) defence budgets to rapidly expand applied research agencies (to match the investments of the US Defence Advanced Research Projects Agency, DARPA).

Policy 6: Streamline permitting

Fast-track permitting for material extraction, processing, and component-manufacturing in Europe to ensure timely roll-out and reduce investor uncertainty.

Policy 7: Public-private 'Buy European' provisions

Include 'Buy Europe' material (e.g., rare earths) and component (e.g., permanent magnet) requirements/ offtake agreements in public procurement contracts (e.g., for weapon systems, wind turbines, satellites and other strategic products). Link public financial support for private downstream industries (e.g., European Chips Act support for the semiconductor industry) with obligations to conclude offtake agreements with European parties for components and/or materials.

Policy 8: ESG requirements in Europe and at the border

Include strong internal Environmental, Social and Governance (ESG) requirements and apply them to imports to level the playing field for European producers. Furthermore, extend the scope of the Carbon Border Adjustment Mechanism (CBAM) to include emissions from overseas processing and refining. Such measures are aimed to ensure environmental and social protection and public acceptance in Europe while supporting competitiveness on the European market.

Policy 9: G7 and partner alignment on economic security standards in public procurement

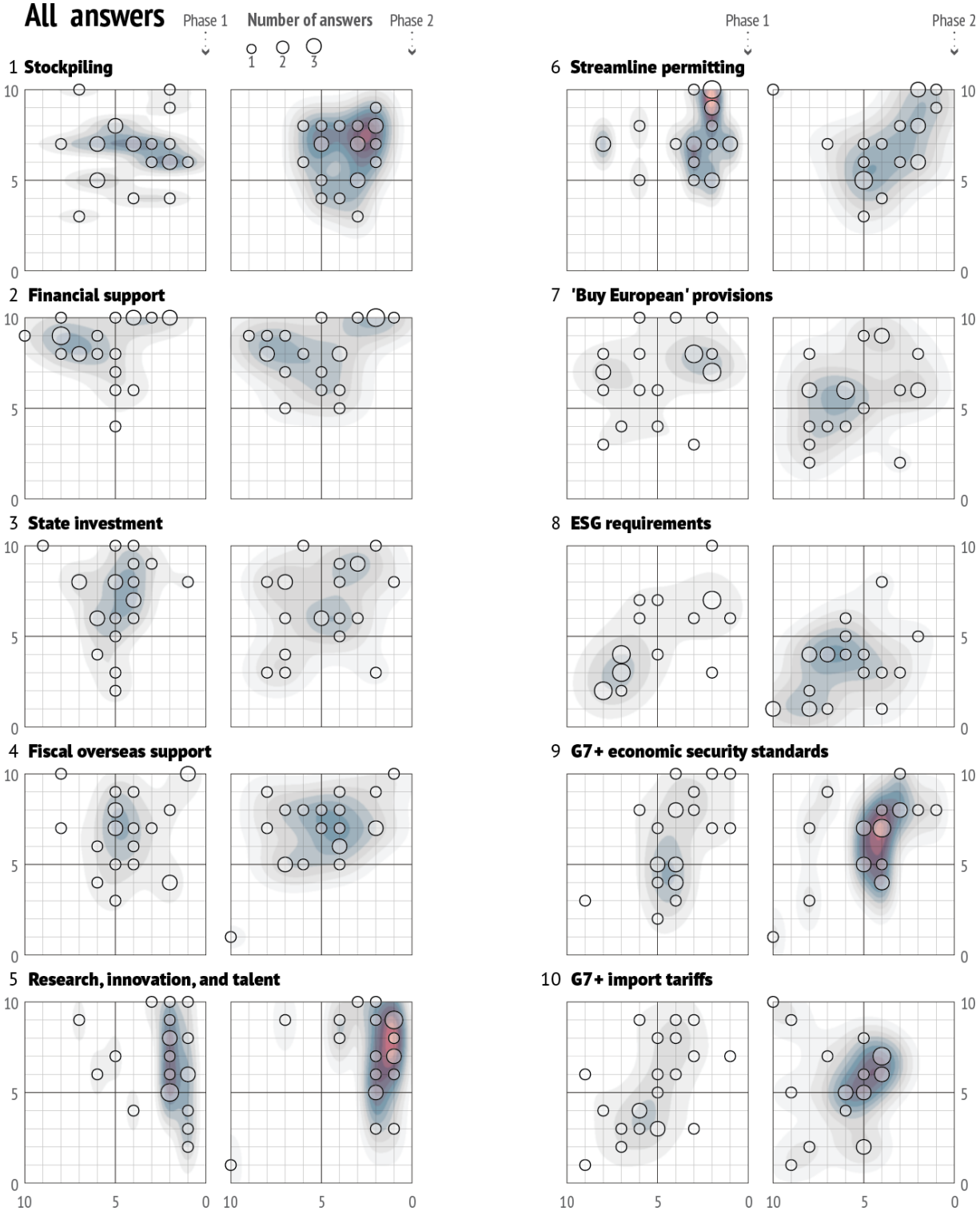
Geopolitically align material and component clauses in public procurement (e.g., for weapon systems, wind turbines, satellites and other strategic products) procedures within the G7 and other likeminded partner (e.g., South Korea) economies. The goal is to stimulate critical material and component production in trusted countries. The adoption of these trustworthiness/reliability clauses obliges companies bidding for government projects to use almost exclusively components/materials from G7 and likeminded (e.g., Taiwan) – but if need be also not likeminded (e.g., DRC) – partner countries. Using components and materials from 'foreign entities of concern', namely China, Russia, Iran and North Korea, is heavily penalised in the bidding process for EU, EU Member State, G7 and partner projects/tenders.

Policy 10: G7 and partner alignment on import tariffs

Together with the G7 and other partners, introduce high import duties on raw/refined materials and related components from 'foreign entities of concern', most importantly Chinese and Russian suppliers, to counterbalance Beijing's price distorting policies and mitigate geopolitical risks. A zero-tariff regime would be applied to imports from Free Trade Agreement-countries and those with which the EU has concluded a specific strategic partnership that includes critical minerals, even if their production does not live up to the highest ESG-criteria.

ANNEX E: PRE- AND POST-EVENT SURVEY OUTCOMES

Answers to phase 1 and phase 2 quantitative questions



06 March 2025