FIIA REPORT

AUGUST 2023 / 74

# ENHANCING SMALL STATE PREPAREDNESS

## RISKS OF FOREIGN OWNERSHIP, SUPPLY DISRUPTIONS AND TECHNOLOGICAL DEPENDENCIES

**Mikael Mattlin, Shaun Breslin, Elina Sinkkonen, Liisa Kauppila, Björn Cappelin, Ines Söderström & Matt Ferchen**

**Illustrations: Tuuli Hypén**

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This FIIA Report is an outcome of the Academy of Finland funded project *Foreign acquisitions and political retaliation as threats to supply security in an era of strategic decoupling* (ForAc, funding decision 338145, website: https://sites.utu.fi/forac/en/), running from the end of 2020 through November 2023. The ForAc project has been based in the University of Turku and conducted in close cooperation with FIIA.

Reports can be ordered from the Finnish Institute of International Affairs.
+358 9 432 7721 / asiakaspalvelu@fiia.fi

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FIIA
FINNISH
INSTITUTE
OF INTERNATIONAL
AFFAIRS

Arkadiankatu 23 b
POB 425 / 00101 Helsinki
Telephone +358 (0)9 432 7000
Fax +358 (0)9 432 7799

**www.fiia.fi**

# CONTENTS

## Figures and Tables

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **AI** | artifical intelligence |
| **API** | active pharmaceutical ingredient |
| **CE** | *conformité européenne*, European conformity |
| **CFIUS** | The Committee on Foreign Investment in the United States |
| **CGN** | China General Nuclear Power Group |
| **Covid-19** | global pandemic that started in 2019 |
| **DIY** | do-it-yourself |
| **EFTA** | The European Free Trade Association |
| **EU/EEA** | Countries that are members of the European Union or part of the broader European Economic Area that also covers Iceland, Liechenstein and Norway |
| **F-35** | US fighter aircraft model F-35 Lightning II |
| **F/A-18 C/D** | US fighter aircraft model F/A-18 C/D |
| **FIRRMA** | The Foreign Investment Risk Review Modernization Act |
| **ForAc** | Academy of Finland funded research project based in the University of Turku (2020–2023) |
| **FDI** | foreign direct investment |
| **Fimea** | Finnish Medicines Agency |
| **GDPR** | EU General Data Protection Regulation |
| **He-3** | helium-3 |
| **He-4** | helium-4 |
| **HEMS/BEMS** | home/building energy management system |
| **HMDS** | Helmet Mounted Display System |
| **IEA** | International Energy Agency |
| **IoMT** | Internet of Medical Things |
| **IoT** | Internet of Things |
| **IPE** | International Political Economy |
| **IRA** | US Inflation Reduction Act |
| **M&A** | mergers and acquisitions |
| **MD** | medical device |
| **MRI** | magnetic resonance imaging |
| **NATO** | North Atlantic Treaty Organization |
| **NESA** | National Emergency Supply Agency |
| **ORD** | Operational Requirements Document |
| **PLA** | People's Liberation Army (PRC) |

| | |
|---|---|
| **PRC** | People's Republic of China |
| **QIST** | Quantum Information Science and Technology |
| **SMR** | small modular reactor |
| **TNC** | transnational corporation |
| **TTC** | EU–US Trade and Technology Council |
| **USD** | US dollar |
| **VC** | venture capital |
| **WTO** | World Trade Organization |

# ACKNOWLEDGEMENTS

The ForAc study aims to provide deep insights into how small states can enhance their preparedness and shield themselves from a range of risks. In this report we discuss *security risks* related to foreign ownership; potential *supply disruptions* related to high reliance on supply chains dominated by major powers; and *technological dependencies* when specific high-technology capabilities are controlled by major powers.

Such dependencies and vulnerabilities can conceivably be exploited by states as leverage and for the purposes of political retaliation in diplomatic conflicts and crises. The research theme has become pressing in the context of intensified strategic competition between major powers, "weaponized interdependencies" and efforts by foreign state-led economic organizations, especially from China, to acquire enterprises that possess critical technological know-how or perform vital tasks in national supply systems.

ForAc has combined three research areas in an innovative, interdisciplinary approach: supply security, economic statecraft, and strategic enterprise acquisitions. There have been critical knowledge gaps in their interlinkages as these areas have, until recently, tended to be studied separately. These gaps have urgent policy implications, which this project has addressed. The ForAc project has focused especially on Chinese economic statecraft, strategic acquisitions in the Nordic countries and supply security and technological vulnerabilities of small states.

A central part of the ForAc project involved key stakeholders. We conducted a series of methodologically innovative Delphi backcasting exercises with key experts and stakeholders both online (in Finland) and on-site in Stockholm. The authors of the report have been based at the University of Turku, FIIA and the Swedish Institute of International Affairs (UI) in Stockholm, as well as the University of Warwick and Yale University.

The authors would like to thank the Academy of Finland and our respective institutions for their support. We would also like to thank Mikael Wigell and the seminar group at UI's Swedish National China Centre for their comments on the draft report, Tuuli Hypén for creating the comic strips, Riina Kotilainen for proofreading Delphi materials, as well as FIIA's excellent in-house editorial team. Finally, a special thank you goes to all the stakeholders, who gave us their valuable time and contributed to the backcasting exercises.

# INTRODUCTION

**Mikael Mattlin, Shaun Breslin, Elina Sinkkonen, Liisa Kauppila and Matt Ferchen**

Our times have been called the age of geoeconomics.[1] The post-Cold War liberalist view, according to which interdependences supported a virtuous cycle of mutual gains, has given way to a realist-tinged view that regards economic interdependence as a potential security risk. The jury is still out over who or what started the vicious cycle towards increasing great power rivalry. Some point to the more domestic political economy orientation of states like the US and UK, which were once the main proponents of neoliberal free markets. More often the focus is on changes in China's domestic economy at the beginning of the 2010s, which saw the emergence of securitized economic interdependence, a trend that has intensified under Xi Jinping.[2]

Currently, China emphasizes greater self-reliance and has introduced strategies and policies (such as *Made in China 2025* and dual circulation) designed to reduce its dependence on foreign supplies and markets.[3] Similarly, the United States and the European Union have launched an array of policy initiatives, such as the American Inflation Reduction Act (IRA), and the EU's initiatives on economic security and investment screening, to shield their economies and promote their own manufacturing capabilities. Indisputably, there have been growing concerns regarding the potential for interdependence to be "weaponized" by making use of

1 Hsiung 2009; Mattlin and Wigell 2016.

2 Pearson et al. 2022.

3 García Herrero 2021.

either *choke points* (critical nodes in a network) or the *panopticon* tools available to those who control information flows.[4]

In this changing global environment, how can small open economies shield their critically important enterprises from strategic foreign acquisitions? How can they mitigate potential security risks in foreign ownership? How can they reduce supply chain and technological dependencies that may be exploited by major powers through sanctions and political retaliation? Furthermore, how can they do this, while still maintaining their open economies? This is a pressing dilemma during a time of increasing great power competition, economic warfare and technological decoupling.

## SECURITIZED ECONOMY

In recent years, China has used economic statecraft[5] to punish, or threaten to punish, several states, including the Nordic countries. For example, China has for political reasons restricted, or threatened to restrict, access to vital supplies such as rare earth metals (vis-à-vis Japan in 2010) and medical supplies during the Covid-19 crisis. China has also used economic statecraft to punish, or threaten to punish, a number of states in North America, Australia and Europe.[6] In its annual position paper published in September 2020, the EU Chamber of Commerce in China warned of European companies facing a threat of retaliation resulting from Beijing's political spats with their national governments, which might lead to sudden disruptions to their operations.[7]

One of the key dilemmas is knowing exactly what kinds of economic engagements are potentially dangerous, and which are benign. This is because threats and risks are, by their very nature, hypothetical and in the future. To be sure, past Chinese behaviour influences perceptions of the future. The way that Chinese leaders communicate their goals and capabilities is important as well. But so too is a general sense of mistrust that is perhaps as often generated by an evaluation of the nature of the Chinese political system as it is by things that are actually said and done.

Moreover, once the possibility – or even likelihood – of some sort of future malign action is accepted, it is difficult to identify where the list of vulnerable sectors ends. Does the fact that a sector has been identified

4 Farrell and Newman 2019;

5 Economic statecraft as a modern study area first developed largely as a study of the United States' use of economic statecraft, such as sanctions. See Baldwin 2020.

6 Mattlin 2021.

7 EU Chamber of Commerce in China 2020.

as strategically important for China mean that Chinese ownership in that sector on its own provides some sort of threat? It might be a commercial issue, but is it also a national security, or an economic security one? Furthermore, unlike national security, which has stricter limits (e.g., information that is formally labelled secret, with officially restricted and controlled access), the problem with a term like "economic security" – a term now actively used in Brussels – is that there are seemingly no natural boundaries to the term as economic activities permeate all of society. Any economic activity can then potentially be "securitized".[8] Here we have an example of a decision that is not only made on the relationship between commercial advantage and national security, but that is also based on potential futures.[9]

At the extreme, anything that helps make China bigger, stronger and more advanced can be perceived to be dangerous if the assumption is that a bigger, stronger and advanced China will at some point act in ways that undermine national security, or the national interest, even if it does not currently do so. From this perspective, anything and everything that is done by Chinese overseas actors will ultimately result in problematic outcomes. Cutting off all economic relations with China is not on any state's agenda. But even if we dismiss the extreme, working out where the boundaries lie between interactions that should be tolerated (or even encouraged), accepted with mitigations or rejected remains something of an inexact science.

And once a threat is in the future, it is very difficult to prove (or disprove). In 2022, the UK government used its new National Security and Investment Act to force a Dutch subsidiary of a Chinese company to sell its shares in a UK factory.[10] This was in part because a potential change in operations in the future might "undermine UK capabilities", and in part because the location of the factory meant that it might in the future gain "access to technological expertise and know-how" in other local companies, with national security consequences.

To be sure, there is more to this changing environment than only China; the consequences of the war in Ukraine make that abundantly clear. US measures such as the 2022 IRA have been perceived in Brussels as a new industrial policy that promotes US domestic actors at the expense of European ones.[11] Additionally, the EU–US Trade and Technology Council (TTC), which is supposed to serve as a discussion forum to coordinate

8 The trend is similar in China. For example, the 20th Party Congress work report discussed security in a variety of different forms. See also Drinhausen and Legarda 2022.

9 Ferchen and Mattlin 2023; Mattlin and Rajavuori 2023.

10 UK Government 2022.

11 *Financial Times*, 4 December 2022.

approaches to key global economic, trade and technology issues, has also stalled as similar interests with regard to China are counterbalanced by differences in approaches to regulation and taxation, for example. Consequently, in addition to posing a direct (potential) challenge, China has a secondary indirect impact as well, whereby it drives national regulatory changes that (potentially) discriminate against all non-national economic actors in some ways, and not only those from China.

Even within Europe itself, there are concerns about what appear to be inward-looking, protectionist and anti-competitive turns by some, such as Germany's 2022 €200 billion energy package to shield its businesses and consumers from higher energy prices.[12]

Nevertheless, it is China that is most often the focus of concern when it comes to identifying future insecurities. For many years, one of the justifications for welcoming China into the global political economy was that this would "socialize" China into the norms of the Western-led "liberal international order"; this, it was thought, would generate a domestic liberalizing change, make China more predictable and thereby more like a "normal" state in international interactions.[13] The irony is that in responding to the perceived challenge from China, Western states on both sides of the Atlantic have increasingly adopted economic policies that look quite similar to what China has been pursuing. For example, protectionist measures, activist industrial policies by states and massive state subsidies (that may even violate WTO rules) are now all more readily accepted. Instead, of China becoming more economically liberal, the supposedly liberal American and European economies risk gradually becoming more and more economically illiberal.[14] As they are not content with sharpening inward investment controls, even restrictions on the outward investments by European companies are now on the table – something that looks akin to selective capital controls.

12 The Covid-19 pandemic and the Ukraine war also drove home to Western audiences the dangers of excessive reliance on critical imports from one supply source that might no longer be available in a future conflict scenario, such as one over Taiwan. The issue of reducing dependencies on China also became a topical issue in the Finnish public debate led by Prime Minister Sanna Marin, who repeatedly brought up the issue in a manner that was uncharacteristic of Finnish politicians. Up until around 2019, the Finnish public debate on economic engagement with China had not been particularly active and had been rather timid. Mattlin 2020.

13 Campbell and Ratner 2018.

14 Ferchen and Mattlin 2023.

## RESEARCH FRAMEWORK

The ForAc project has combined research on risks related to foreign ownership, supply disruptions and technological dependencies. The research framework guiding our project is depicted in Figure 1.

According to our framework, State A (a major state) may exercise leverage over State B (a small state) in several different ways. This leverage can occur, e.g., through:

a) various forms of economic statecraft, including state-to-state sanctions, political retaliation, pressure, or inducements[15]
b) sanctioning or exercising political pressure on supply-security critical enterprises (Enterprise Y) in State B
c) strategic acquisitions of supply security-critical enterprises (Enterprise Y) in State B (provided that State A exercises effective control over the acquiring entity, Enterprise X)

Our report explicitly adopts a small-state perspective. But what do we mean by a "small state"?

Population and the size of the economy clearly do play at least some part in establishing the potential for influence in the international system. For example, calculations of what is worth doing to ensure or maintain

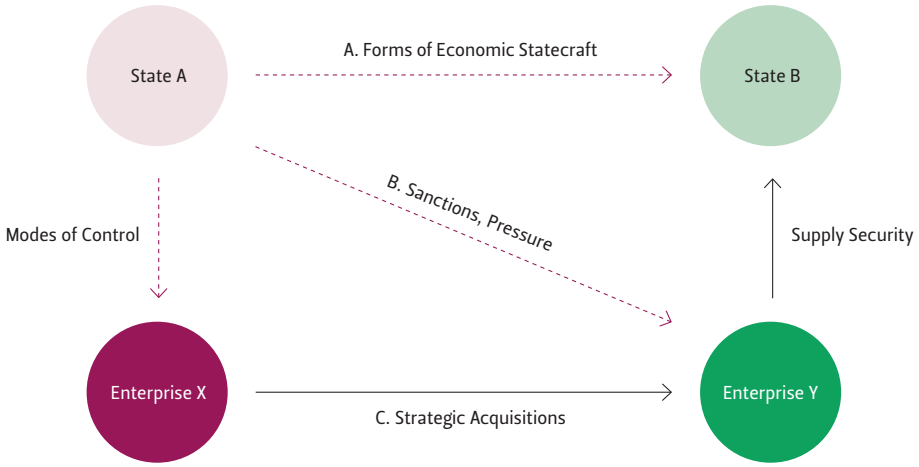



Figure 1. The ForAc project's research framework

15 Ferchen and Mattlin 2023.

access to a foreign market are likely to be influenced by how big and lucrative that market is. That said, there is a difference between the number of potential consumers and their individual and collective wealth. Is a smaller rich economy more "attractive" (and thus in some ways more powerful) than a larger but poorer one? Moreover, some small countries can and have been the home of innovations that have become world leading in their sectors. The oft-repeated designation of Finland as "the world's telecommunications test laboratory" might be a good example here.

Even so, clear differences exist in what individual states can do, particularly through unilateral action, to exercise what Susan Strange called "structural power"[16]: to change the global structures that everybody must operate within. This may entail changing the formal rules of the game, reforming the way that international institutions operate or – as in the case of some Chinese initiatives – introducing new governance organizations (such as the Asian Infrastructure Investment Bank). In addition, and more importantly for this project, it may entail the collateral impact of unilateral action on others: how a change in the way that a globally powerful state acts influences what other states and economies can do, and the way that all states and economies interact with each other.

To refer to a distinction between those states that are (or can be) ***system shapers*** and those smaller states that are ***system takers*** might be slightly too stark a dichotomization. But even if it is somewhat of an exaggeration, it is unarguable that the global consequence of unilateral action varies massively from state to state.[17]

The ability to shape or respond is also affected by the nature of national political economies, whereby those that are more open to the global economy (like our case studies) are likely to be more affected by shifts in the nature of global economic activity. The key question of this research project is: Is it possible for small states with open economies (like the Nordic countries) to offset vulnerabilities and reduce insecurities whilst maintaining their relatively high levels of economic openness? It is particularly relevant as one of the big powers in the global economy (China) has a less than fully open and liberal economy, and other (larger) powers now also seem to be turning towards more protectionist solutions to deal with their own insecurities and vulnerabilities. Small countries lack the comparative strengths of larger economies, such as large domestic markets, better possibilities for conducting active industrial policy and providing massive state subsidies to national champions or attracting new

16 Strange 1998.

17 For a classic study of the political economy of small states, see Katzenstein 1985.

investments from abroad.[18] Or is one of the tools (and/or costs) of pursuing greater security a "retreat" from the previously preferred openness?

The question of how small states with open economies can shield their national economies and supply chains while still maintaining their open economies has become pertinent in Europe as recent years have seen increasingly active efforts by foreign state-led economic organizations, especially from China, to acquire enterprises that possess critical technological know-how or perform vital tasks in national supply systems. Because of this, the European Union (EU) began to implement a screening mechanism for foreign investments as of October 2020.[19] In the spring of 2020, the EU Trade Commissioner urged EU member states to protect their companies from China taking advantage of the Covid-19 crisis to acquire them.[20] Even Sweden and the Netherlands – known for their liberal economic policies – have recently adopted measures to shield their enterprises from Chinese acquisitions.[21]

For the purposes of the project, we identified three key competences of great powers (investment leverage, supply chain dominance and core technology control), each of which is associated with a key small state vulnerability: security risks of foreign ownership, supply disruptions and critical technological dependencies (Figure 2)

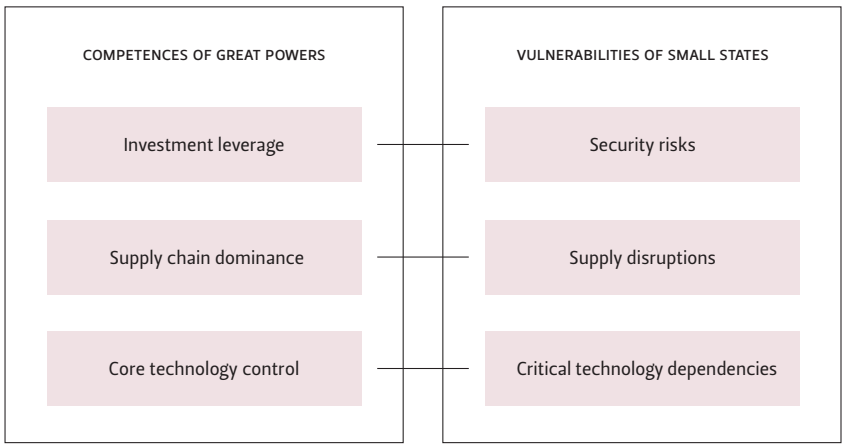



Figure 2. Great power competences and small state vulnerabilities

18 *Bloomberg*, 19 June 2023.

19 European Commission 2019. In 2018, the European Council also mandated the European Commission to negotiate a convention establishing a Multilateral Investment Court.

20 *Financial Times*, 12 April 2020.

21 See also Kauppila and Cappelin 2023.

On the first row, the category of *security risks* stands for a broad group of potential dangers to which small states' national and supply security systems are exposed due to great powers' *investment leverage*. With their greater resources to make investments in companies and real estate, great powers may gain effective control over assets that can be utilized to advance their own foreign policy aims – which may well compromise the national interests and security of small states.[22] This risk is more elevated the more the major state is able to exercise *de facto* control over its enterprises, as we noted in Figure 1.

On the second row, *supply disruptions* cover various types of disturbances in small states' flow security, that is, their ability to guarantee that goods, products, technologies and so on move to and from the country without major problems.[23] Given great powers' *supply chain dominance*, they are more capable than other actors in causing these issues through actions such as turning choke points and hubs into political weapons, as Farrell and Newman argue.[24] In the extreme, a single small state – or a group of states – may become a target of political retaliation, which is evident in the case of discrimination or sanctions.[25] In addition, over-concentration of supply may in itself create supply disruptions, even if all parties try to avoid them. This aspect is particularly relevant with regard to China, whose role in global production is extremely important.[26] It should however be noted that, due to the active reshoring of manufacturing in the context of strategic de-risking, the US is also increasing its share in certain sectors, such as the production of ion-exchange resins used in purifying water in industrial processes. As a result, a pattern of Sino-US dominance is beginning to appear in some of the fields in which production was previously concentrated in China.

The third-row category, *critical technology dependencies*, covers situations in which vast human suffering and/or economic losses may be caused by cut-offs in the availability and functioning of technology. Because of great powers' *core technology control*, there is a relationship of asymmetric interdependence that exposes small states to the goodwill and abilities of great powers in safeguarding the delivery, maintenance and information security of technological devices and their parts.

22 Farrell and Newman 2019.

23 See also Aaltola et al. 2013.

24 Ibid.

25 See, e.g., Bøje Forsby and Sverdrup-Thygeson 2022 for an overview of China's political retaliation in Scandinavia.

26 Today, China is also by far the largest trading country, accounting for some 15% of world goods trade.

Below we briefly discuss each of these competence-vulnerability combinations.

## DE-RISKING FOREIGN OWNERSHIP

One of the empirical focus areas of this report are foreign, especially Chinese, investments in supply security-relevant enterprises and entities in the Nordic countries (especially in Finland and Sweden), which have been especially exposed to Chinese acquisitions and political retaliation, given their small economies and previous permissive approach to foreign investments.[27] The Nordic countries have many innovative small- and medium-sized enterprises (SMEs) with advanced technology,[28] yet they have been relatively open to foreign investors over the past decades.

China's use of economic statecraft has gained urgency in the context of discussions surrounding US-China strategic decoupling (now de-risking), which may lead to bifurcated global supply networks and technological standards, with unclear consequences and vulnerabilities for the EU and its member states. Contrary to earlier readings of economic interdependence as a positive force that induces states to cooperate,[29] channels of global interdependence can also be turned into the service of foreign policy.[30] *Strategic de-risking* has become shorthand for a way to reduce the vulnerabilities of interdependence.

In the context of economic statecraft by China's party-state-led economy vis-à-vis foreign countries and enterprises, targeted foreign investments can be detrimental to supply security and make small states vulnerable to various forms of sanctions. However, they may also create business and/or political constituencies in the target economy, who benefit from these investments and therefore may come to act, consciously or unwittingly, as spokespersons for foreign interests. This was seen, for example, with Russian energy investments in Europe prior to full-scale war with Ukraine.[31]

27 With the exception of the far smaller countries Luxembourg and Malta, Finland has attracted the most Chinese investment per capita in all of Europe. Around 6% of the entire foreign-invested capital stock is Chinese investment. However, this is mainly due to two major acquisitions, both of which were among the country's largest ever corporate acquisitions by value.

28 For example, in the 2021 Global Innovation Index maintained by WIPO, Sweden was ranked second, while Finland was ranked seventh and Denmark ninth. WIPO 2022. The availability of venture capital for start-ups is also high in the Nordics.

29 Keohane and Nye 2012.

30 See e.g., Farrell and Newman 2019; Poutala et al. 2022.

31 See e.g., Wigell and Vihma 2016; Wigell and Soliz Landivar 2018.

The global economic system is not uniformly open. Acquisitions have been far easier to complete in small open economies in the EU than similar acquisitions would be in China, which actively shields its national industrial champions.[32] For example, Finland has since the 1990s applied regulatory scrutiny and restrictions on foreign ownership mainly in defence-related industries. While the screening of foreign acquisitions in defence-related fields has been compulsory, no foreign acquisition has yet been formally blocked.[33] The export of *dual-use technologies* (technologies that have both civilian and military applications) has, however, been more strictly controlled. It has therefore been easier for a Chinese strategic investor to get hold of key technologies by acquisition of enterprises rather than by purchase.

According to several scholars, strategic investments through state-linked business organizations form a central component of China's economic statecraft.[34] Recent research estimates that around 59% of Chinese majority acquisitions in Sweden,[35] and a roughly similar ratio in Finland,[36] have occurred in fields that are priority areas for the Chinese government, such as industries prioritized in the *Made in China 2025* report. The ratio is even higher if strategic emerging industries are included.

Defining supply security narrowly so that it only covers such actors as specific defence-related enterprises or key energy suppliers is thus clearly insufficient. Even after updates to its screening legislation, the latest of which introduced the possibility of employing more flexible mitigation measures,[37] Finland still maintains a relatively liberal foreign investment screening framework.

On the other hand, Sweden's upcoming foreign investment screening framework, which will take effect in December 2023, will mean a shift from a liberal to an onerous and highly restrictive one that in principle will also cover Swedish investors. Moreover, unlike the Finnish mechanism, the Swedish controls bring under scrutiny not only acquisitions but also the rising Chinese FDI trend of greenfield investments. Due to its broad scope, it is estimated that under the Swedish screening framework,

32 Hanemann and Huotari 2018.

33 In addition, if uncertain, acquiring companies have also been able to submit their acquisition to a voluntary review, the incentive being that the green light by the requisite authorities has legal force, and that the authorities must approve the acquisition unless clear and strong grounds exist to oppose it. Mattlin and Rajavuori 2023; Rajavuori 2019; Mattlin 2020; Kauppila and Cappelin 2023.

34 E.g., Babić and Dixon 2021. The complex merging of Chinese state and corporate interests, and their consequences, remains an under-researched area. Norris 2018.

35 Almén 2023.

36 Kauppila and Cappelin 2023.

37 Laki ulkomaalaisten yritysostojen seurannasta (2012/172) [Act on the Screening of Foreign Corporate Acquisitions (2012/172)].

as many as 1,000 acquisitions will have to be notified to the authorities in one year, whereas data on the existing Finnish framework show that only 35 cases were screened in 2022.[38] Overall, in comparison with the Finnish mechanism that mainly focuses on safeguarding supply security and preventing the outflow of dual-use products, the Swedish framework also has a distinct national security focus and, notably, it even seeks to consider the strategic intentions of investors.[39]

## DE-RISKING SUPPLY CHAINS

Beyond risks that stem from foreign ownership, there is also the broader question of dependence on foreign supply chains, technologies, and imports. For example, China accounted for 9% of Finnish imports in 2022, making it the third most important source of imports (the ratio is even higher in several EU countries). Whereas the EU's relationship with Russia was one of lopsided dependence confined mostly to energy products (gas, oil, electricity, nuclear material), the relationship between the EU and China is more one of true "complex interdependence"[40] with interwoven economic interactions across many domains that are deeply embedded in complex supply chains. On the import side, the EU is highly dependent on Chinese imports for certain medications (penicillin components, paracetamol), chemicals, rare earth minerals,[41] consumer electronics (e.g., laptops and mobile phones), as well as certain industrial components.[42]

Many of these dependencies are difficult to reduce in the short term. Even in the medium term, purely market-based solutions are unlikely to change the situation to any significant extent; rather, dependencies may even deepen if current trends are allowed to continue. As mentioned above, the dilemma for smaller states with relatively open economies is that most solutions that have been offered tend to revolve around various forms of protectionism and trade restrictions, as well as active industrial policies and subsidies, meaning distinctly illiberal economic policy measures. In EU policymaking circles, and especially in key capitals such as Paris and Berlin, the atmosphere has clearly turned more favourable towards a major role for the government in industries and, concurrently, more sceptical, even derisive, of those who still wish to maintain a belief in open markets, relatively free trade and market-based solutions. More

38 Kauppila and Cappelin 2023, 17; Mattlin and Rajavuori 2023.

39 Kauppila and Cappelin 2023.

40 Keohane and Nye 2012.

41 European Commission 2020a.

42 This also applies to Finland. Laakkonen et al 2023; Kaaresvirta et al. 2023.

specific policy solutions also tend to be highly industry-specific, requiring actions and legal changes at the level of both the EU and member states, as well as possibly Nordic solutions.[43]

What makes commercial sense for a company – a financially prudent sale, for example – might not make sense from a security perspective for a government. And while an individual transaction or interaction might not be a problem, the aggregation of a number of individual projects, particularly if they are in a single sector or part of a single supply chain, for example, might indeed generate insecurity. There is a potential disjuncture, then, between the source of economic security for individual companies and concerns about economic security (and perhaps other forms of security as well) for the economy or nation as a whole. Such decisions, especially once they move from the level of an individual firm to higher levels, including multiple companies or entire sectors, also become more political.

Governments certainly can and do directly intervene to block mergers and acquisitions. Across Europe, legislation has been or is being revised to increase the ability to act. But this still leaves the question of how, short of direct government action, economic actors can be encouraged to align with states' objectives – particularly once the focus moves away from ownership to other potential areas of insecurity. Evidence from South Korea and Japan shows that both states have had at best only limited success in persuading national companies to shift their production activities from China and re-shore them back home because it often makes no commercial sense for these companies to do so.[44] Conversely, if a government decides to support national companies in different ways to ward off unwanted attention or reduce their footprint in and dependency on China, how far should the state (and ultimately the taxpayer) go in supporting what are typically private actors seeking to maximize their commercial advantages and profits?

## DE-RISKING TECHNOLOGICAL DEPENDENCIES

When it comes to the emerging focus on ways that economic interdependence intersects with national security, no area has been more important than digital and other emerging technologies. Much of the recent focus on how countries can exploit, or be exposed to, "weaponized interdependence" has been linked to control over supply chains for crucial technology

43 Wigell et al. 2022b.

44 Katada et al. 2023.

inputs like semiconductors. Semiconductors, like many other technologies in today's world, have dual-use applications. The EU's dependency on advanced semiconductors produced by Taiwanese foundries (especially TSMC) is a case in point, given the non-negligible risk of interruption to these flows in a potential future conflict scenario in the Taiwan Strait.

However, there is also a risk for companies of being caught up in the technological rivalries between major states. For example, Dutch and Japanese firms have recently been at the centre of the US-China semiconductor spat, with the American government putting pressure on them to enact similar restrictions on the export of semiconductor manufacturing equipment and technology to China, as the US itself has enacted. This is especially relevant for small states, such as the Nordic countries, that have close military relations with the United States, and thereby are reliant on US and NATO military supply chains.

Similarly, competition for market advantage in new green energy generation and electric vehicles highlights not only how countries and firms can gain a leg up (often with government support) in the technologies of the future but how they may also be exposed to other powerful actors if they lose out in such competition. China's growing investments in R&D and consequent rapid scientific and technological advances may also mean that new dependencies will emerge in the future in fields such as medical equipment and AI-related applications. Graham Allison et al. argue that US technological leadership is not set in stone as China has become a serious competitor in AI, 5G, quantum information science (QIS), semiconductors, biotechnology, and green energy which are regarded as the foundational technologies of the 21st century.[45] The EU area for its part is falling behind China in key technologies, and "may not be able to maintain its technological competitiveness unless it continues to cooperate with the PRC".[46]

Some small states can and do have highly competitive high-tech firms or sectors, but in order to maintain their competitiveness they must increasingly consider what types of policies, including state support or protection, is necessary. As larger countries like China and the United States engage in their own high tech-focused industrial policies as well as targeted interventions into supply chains, small states will have to increase their own understanding and capacity to react and plan for the future. Small states are also vulnerable to so-called killer acquisitions, whereby a major state may actively use strategic acquisitions in order to "kill-off"

45 Allison et al. 2021.

46 Rühlig (ed). 2023, 9.

potential emerging competitors by buying them up, thereby preventing European companies from developing their own critical technology.[47]

## STRUCTURE OF THE REPORT

We explored the dynamics of how small states can or should respond to various challenges emanating from the activities of major states to enhance their preparedness through a series of backcasting Delphi scenarios conducted in Finland and Sweden in 2022–2023.

This introduction is followed by a methodological chapter explaining how we combined the Delphi method with backcasting (a more detailed methodological appendix is included at the end of the report). This section is important background for those who wish to understand how the research results were produced but can also be skipped if one is only interested in the substantive content of the report.

The rest of the report broadly follows the research framework outlined above, so that the three different bundles of future risk scenarios – one related to foreign ownership and investments, one to supply chains, and a final one on technological dependencies – are each dealt with in individual chapters. Each chapter reports on three different dystopian scenarios set in the future that were presented to Finnish experts. In addition, a separate report chapter summarizes the results of a similar backcasting exercise conducted with Swedish experts in Stockholm in October 2022 that provides a useful point of comparison. The chapters are written so that readers can also read just individual substance chapters.

The specific solutions offered in each case not only tend to be scenario-specific, but are often technical in nature too, produced by notable experts in each of the different fields. Key recommendations related to the scenarios are therefore provided in the conclusions of each individual chapter, rather than trying to collate them into a single general set of recommendations. In the concluding chapter we instead focus on drawing broader policy implications and making some general observations on the Delphi exercises.

47 Wigell et al. 2022a, 131–132.

# / 1

# 1. COMBINING THE DELPHI METHOD WITH BACKCASTING

**Liisa Kauppila and Elina Sinkkonen**

Today's world is characterized by great power competition as the United States and China are becoming strategic rivals in all aspects of global life. Given the simultaneous disintegration of the global governance system, technological development and proceeding climate change, small states must navigate in extremely uncertain and complex risk environments. Under these circumstances, producing knowledge to enhance small state preparedness is a challenging task that is difficult to undertake by using traditional research methods.

Firstly, since the key dynamics of international relations and the global political economy are changing not only radically but also at a fast pace, the past is not always a great compass for navigating future crises. Therefore, an explicitly futures-oriented approach is needed to anticipate potential dangers and seek efficient ways to prevent them from materializing. Secondly, as these future crises unfold due to a complex interplay of multiple factors, neither narrow disciplinary confines nor the skill sets of individual stakeholder groups are alone sufficient to identify and tackle them. Different types of experts must therefore be engaged in brainstorming ways to adapt to new risk environments.[48] Ideally, this means that members of such a social network build on each other's input and strengths.[49]

We applied the Delphi technique to explore ways of enhancing Finland's and Sweden's preparedness, while adhering to the above-mentioned practical requirements. The Delphi technique is a participatory

48 See also Elgabry et al. 2022.

49 E.g., Bereiter 2002, 174–210.

research method developed at RAND Corporation in the 1950s. It has been used in various applications to study multifaceted problems with high relevance to the future of states.[50] Typically, Delphi studies deal with research problems that cannot be addressed with exact analytical methods, but which benefit from "subjective judgments on a collective basis"[51]. In the past, the technique has been used to explore the effects of technology on the development of ballistic missiles,[52] detect early signs of future radicalization and terrorism,[53] and formulate national low-carbon visions,[54] for example.

In essence, Delphi is a way of facilitating group communication in an effective manner, thus enabling "a group of individuals, as a whole, to deal with a complex problem"[55]. Over the past decades, this has come to mean that various experts are invited to share their arguments in rounds of online questionnaires. During the process, the experts are also given the chance to learn from each other's answers and reconsider their original viewpoints. Their answers and possible comments are shared anonymously, which reduces the "bandwagon effect", that is, the human tendency to adapt to what others are doing, thinking or saying. This enables an equal exchange of ideas between different stakeholder groups: no one's status or charisma speaks louder than their arguments.[56] In the past, the purpose of the iteration process was to reach an *expert consensus*, but, over time, a broad spectrum of justified views – *dissensus* – has become an equally popular aim of Delphi studies.[57]

Unlike in most Delphi studies, our stakeholders were not asked to estimate the probability and desirability of certain images of the future; instead, their task was to propose means and measures that could be taken to *prevent* risky or outright dangerous futures from unfolding. In futures studies' terms, this meant that our application of the Delphi method relied on *backcasting*: a process that starts with forming an idea of how things should or might be in the future and then continues with connecting that future state with the present.[58] Specifically, our Delphi

50 See, e.g., Helmer and Rescher 1958; Dalkney and Helmer 1962; Helmer and Gordon 1964.

51 Linstone and Turoff 2002/1975, 4.

52 Helmer and Gordon 1964.

53 Van de Linde and van de Duin 2011.

54 Flood, Rogan and Revez 2023.

55 Linstone and Turoff 2002/1975, 3–4.

56 Linstone and Turoff 2022/1975, 4.

57 See, e.g., Steinert 2009; Tuominen et al. 2014; Wrath et al. 2013.

58 Robinson 1990, 820.

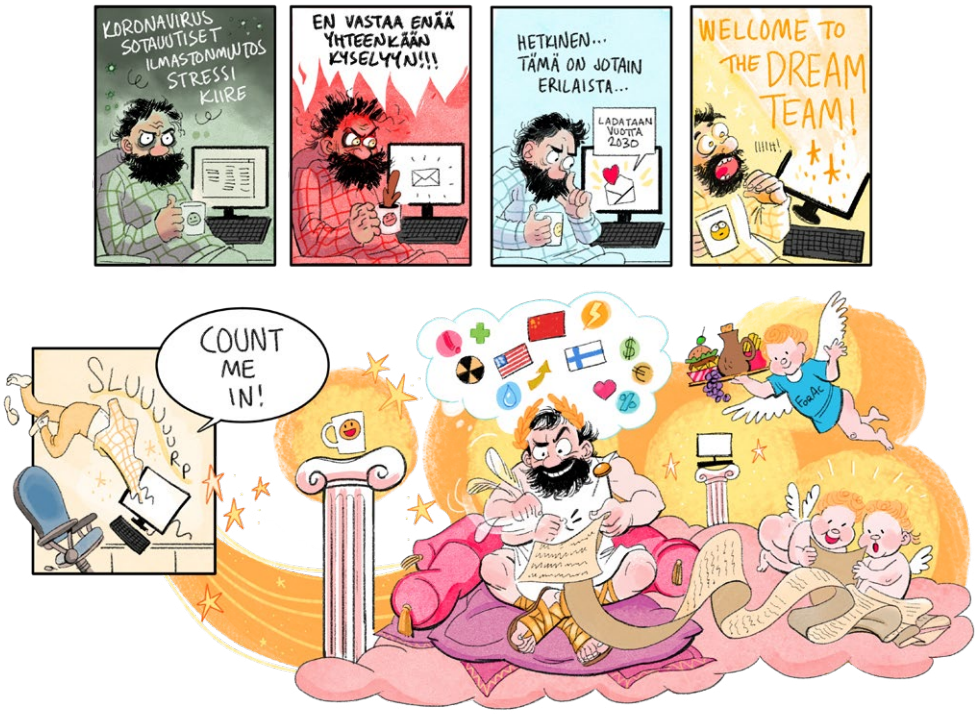



Figure 3. Comic teaser

experts were asked to "work backwards"[59] from dystopian mini scenarios that reflected our background research. Moreover, the proposed dystopias were presented as short comic art strips, aimed at immersing the experts in different target years (2027, 2030 and 2035). Although unconventional, the choice of various target years made it possible to engage the panellists with different types of risks, some of which are highly unlikely to materialize before 2035. Comic art also served the purpose of enhancing the level of the panellists' engagement and attracting their curiosity before the exercise started (Figure 3).

In addition to facilitating a study of tangible means, measures, and changes in support of policymaking, the methodological combination of Delphi and backcasting allowed us to run exercises that, in themselves, enhanced small state preparedness. More specifically, bringing together key stakeholders from across Finnish and Swedish societies to read the scenarios and debate them was a highly valuable social process of learning and "unlearning"[60]: a chance to raise awareness, shake established views and widen horizons. This is crucially important since even in small

59 Ibid.

60 Robinson 1988; 2003.

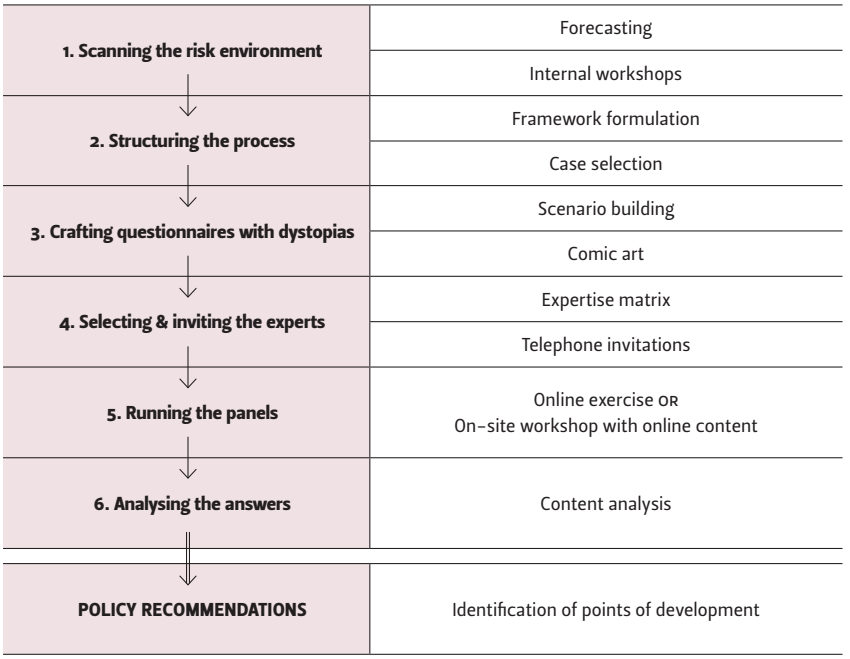



Figure 4. Overview of backcasting Delphi from dystopian imaginaries

countries, there is a risk that sectoral experts seldom exchange ideas beyond their own "bubble", meaning stakeholders with like-minded views and similar educational backgrounds. This may distort and hamper the understanding and tackling of complex problems related to small state preparedness.

ForAc's application of the Delphi method, *backcasting Delphi from dystopian imaginaries*, included six steps (Figure 4). In the following, we provide a brief overview of the process and our case selection, whereas a more detailed discussion is provided in the Appendix at the end of the report.

In Step One, a forecasting exercise was conducted to understand the overall risk environment in which small states – Finland and Sweden in particular – navigate. In Step Two, the broad frames of the Delphi process were designed. In Step Three, questionnaires with dystopian comics were developed with an artist. In Step Four, the experts were selected and invited to form diverse panels. In Step Five, the experts studied the mini-scenarios and proposed ways to avoid the dangerous or threatening situations depicted in the comics. In Finland, this step was conducted entirely online, whereas in Sweden, the experts attended an on-site workshop during which they shared their views online. In Step Six, the answers and their policy implications were analysed.

In all the three questionnaire rounds of the Finnish online exercise, we created one mini-scenario for each category: security risks 2027, supply disruptions 2030 and critical technology dependencies 2035. Since the Swedish workshop was a half-day event, only two empirical cases could be covered. Based on the host organization Swedish National China Centre's internal discussion on themes debated in Sweden, we selected one mini-scenario for the categories security risks 2027 and supply disruptions 2030 (Table 1).

In Finland, the process took place over a period of ten months and consisted of three questionnaire rounds. A new questionnaire was opened every four to five months: in late May 2022, mid-October 2022 and early March 2023. In Sweden, the onsite workshop took place in mid-October 2022.

| | **Finnish questionnaire 1** | **Finnish questionnaire 2** | **Finnish questionnaire 3** | **Swedish on-site workshop** |
|---|---|---|---|---|
| **Security risks 2027** | Acquisitions of technology companies (a mobile game company gathering personal data) | Transfers of real estate ownership (Arctic tourism and sports facilities) | Venture capital investments in start-up companies (quantum computing) | Acquisitions of technology companies (a mobile game company gathering personal data) |
| **Supply disruptions 2030** | Discriminatory practices limiting access to pharmaceuticals (antibiotics) | Sanctions on green transition materials, components and minerals (wind energy) | Political retaliation limiting access to components needed in critical services and industrial processes (water treatment) | Sanctions on green transition materials, components and minerals (wind energy) |
| **Critical technology dependencies 2035** | Maintenance of advanced military technology (F-35 fighter jets) | Cybersecurity of advanced health technology (home dialysis machines) | Supply of chemicals for advanced research and development activities (helium) | – |

Table 1. Case selection of the Finnish and Swedish Delphi exercises

/ 2

# 2. SECURITY RISKS OF FOREIGN OWNERSHIP 2027

**Liisa Kauppila, Elina Sinkkonen and Ines Söderström**

A notable share of global investment flows originates from the US and China. In 2021, their FDI outflows amounted to well over one third of the global total, with the US accounting for 24% and China for 14%.[61] In addition, investors from both countries acquire real estate and make venture capital (VC) investments in overseas start-ups. While these capital flows contribute positively to the economic development of many small states, they may also create foreign forms of ownership connected to potential security implications. Although American investments are generally associated with few concerns in Europe, Chinese investments are increasingly seen to open the door to violations of the host country's national interests and core values. Awareness of these security risks has greatly intensified along with the debate on China's strategic company acquisitions and controversial National Intelligence Law (2017), which obligates Chinese companies operating overseas to share intelligence with the government.[62] Yet especially Russia's attack on Ukraine and China's unwillingness to condemn the aggression have made some of these potential dangers feel more tangible, plausible and even immediate.

Reflecting the general wave of economic nationalism and protectionism, many Western countries have recently undertaken legislative reforms to shield their economies and societies from the negative effects of foreign ownership. In the US, President Obama's second term (2013–2017) witnessed a shift from a liberal investment policy to more extensive state

61 UNCTAD 2023. The figure for China is the total for Mainland China, Hong Kong and Macao.

62 National People's Congress 2017.

intervention in foreign investment.[63] As a continuation of this trend, in 2018 the Committee on Foreign Investment in the United States' (CFIUS) scope of action was expanded, and processes streamlined along with the introduction of the Foreign Investment Risk Review Modernization Act (FIRRMA). Similarly, the EU began to tackle the risks associated with Chinese acquisitions – especially in high-tech industries – by adopting an FDI screening framework in 2019 (EU 2019/452). Enacted in 2020, the regulation seeks to initiate and coordinate the screening of EU-bound investments "on the grounds of security or public order".[64] As a result, several member states have recently introduced and amended their national FDI controls, but since the framework does not obligate states to set up mechanisms or provide clear-cut criteria for screening, the EU can hardly be considered as one unit in this regard. The national practices on controlling real estate and venture capital investments are even more diverse, and the latter are typically not screened within the EU.

Finland too has critically examined and reformed its relatively liberal legislation on foreign ownership over recent years. Largely as a reaction to Russia's invasion of Crimea,[65] the country implemented two mechanisms to mitigate the risks of real estate acquisitions in January 2020. In particular, the Act on Transfers of Real Estate Requiring Special Permission (470/2019)[66] obligates non-EU/EEA investors to subject their real estate transfers to mandatory screening. The Act on the State's Right of Pre-emption (469/2019) allows the state to use its right of pre-emption in property transactions near strategic locations. Both acts were refined in January 2023. Amended FDI controls, in turn, were enacted in October 2020 as the revisions to the Act on the Screening of Foreign Corporate Acquisitions (172/2012) came into force. Apart from being drafted in the context of the EU screening framework, Chinese acquisitions did not constitute a major driver *per se* in the Finnish national process, and the Act's application is country-neutral.[67]

The three short-term scenarios extending up to 2027 pinpoint dilemmas that may be difficult for liberal democracies to tackle through current legislation – or possibly any form of monitoring and "sticks". Although the identified potential dangers are already debated, their likelihood may perhaps increase by the target year due to intensifying great power rivalry and the consolidation of Finland's status as a NATO country. The first

63 Lundborg Regnér 2022.

64 European Parliament and the Council of the European Union 2019.

65 Interview with a Finnish state official, Helsinki, 22 March 2022.

66 Laki eräiden kiinteistöhankintojen luvanvaraisuudesta 470/2019 [Act on Transfers of Real Estate Requiring Special Permission (470/2019)].

67 Online interview with the Ministry of Economic Affairs and Employment, 1 March 2022.

scenario deals with breaches of personal data gathered by foreign-owned mobile entertainment companies, whereas the second one focuses on the potential dual use of foreign-acquired real estate. The second scenario is set in the Arctic – the strategic importance of which is rising – not least because the polar regions are significant sites for operating and developing space and satellite technologies. The third case takes up a key risk created by the Sino-US tech war: brain drain from emerging technology fields such as quantum computing. Chinese venture capital investments are currently on the rise in Europe,[68] and in this scenario, an investor representing a VC firm is responsible for attracting talent to China – although many other forms of networking may naturally have the same result.

The panellists were given a one- to two-page-long briefing in Finnish on each sectoral case to contextualize the comic strips and present some of the crisis situations and/or facts we used as an inspiration when building the scenarios. These background briefings were collected into a file, which can be accessed on the ForAc project website.[69] Their key points are also summarized below, at the beginning of each section. These case descriptions are followed by the comic strips, after which we will discuss the policy suggestions given by the panellists.

## 2.1. ACQUISITIONS OF TECHNOLOGY COMPANIES: MOBILE GAME COMPANY GATHERING PERSONAL DATA

Foreign company acquisitions constitute a form of FDI that contributes significantly to the economic growth of many small states. For individual companies, these investments provide capital to develop and expand their core business and possibly a chance to enter new markets. Sometimes an acquisition is also the ultimate goal of establishing a company – or the only option to overcome financial problems. However, acquisitions also transfer technologies, data, products and services to foreign ownership. For this reason, buyouts of companies producing vital supplies and critical technology with dual-use potential have become riskified and increasingly regulated in the context of the Covid-19 pandemic and strategic decoupling.[70] Yet it is not obvious which technologies and products fall within these categories, and especially US authorities are now monitoring and blocking a growing variety of acquisitions, including investments in companies producing entertainment mobile applications that gather

68 Kratz et al. 2023.

69 ForAc report background page. Available at: https://sites.utu.fi/forac/fi/raportti/

70 Mattlin and Rajavuori 2023.

personal data.[71] Given the seemingly low-risk nature of such deals, these decisions have attracted global curiosity.[72]

In Finland, acquisitions of mobile game companies can be associated with risks similar to those of the entertainment deals blocked in the US. Many gaming applications – especially those with augmented reality (AR) features – gather geo-location data and use players' photos. Despite the rising awareness of smart device related cybersecurity risks,[73] such games as *Pokemon Go* are highly popular in different age groups,[74] including the reservist-aged population. For example, 71% of *Pokemon Go* players in the US were between 18 and 50 years old in 2016.[75] Although the Finnish Defence Forces have clear rules for the use of applications with potential impacts on operational security, violations occasionally take place.[76]

Since the mid-2010s, shares of at least nine Finland-domiciled mobile game companies have been acquired by Chinese enterprises.[77] The most noteworthy deal took place in 2016 when Supercell was sold to the technology giant Tencent,[78] which has, since then, also invested in other Finnish companies in the industry. Most – if not all – of these firms have continued their operations in Finland and, notably, their public image has not clearly changed. Since the amended Act on the Screening of Foreign Corporate Acquisitions (172/2012) focuses on screening non-EU/EFTA acquisitions with clear relevance for national security and supply security,[79] these investments have not been within the scope of systematic monitoring.

71 In 2019, the CFIUS cancelled the sale of the dating app Grindr – the "Tinder of the LGBT community" – to Beijing Kunlun Tech. The concern was, among other things, the potential leakage of the location, health and personal data of US government officials or members of the military reserve to China (O'Donnell, Baker and Wang 2019; Yang and Fontanella-Kahn 2020).

72 See, e.g., Sanger 2019; Birtles 2019; Wang and Shepardson 2023.

73 E.g., Traficom 2021.

74 While player statistics for Finland are not available, in Sweden alone 62,500 people used iPhone daily to play *Pokemon Go* in February 2022 (Statista 2022).

75 Statista 2016.

76 E.g., Bjurström 2019.

77 Business Finland 2023. The database is not comprehensive and only includes active FDI stocks.

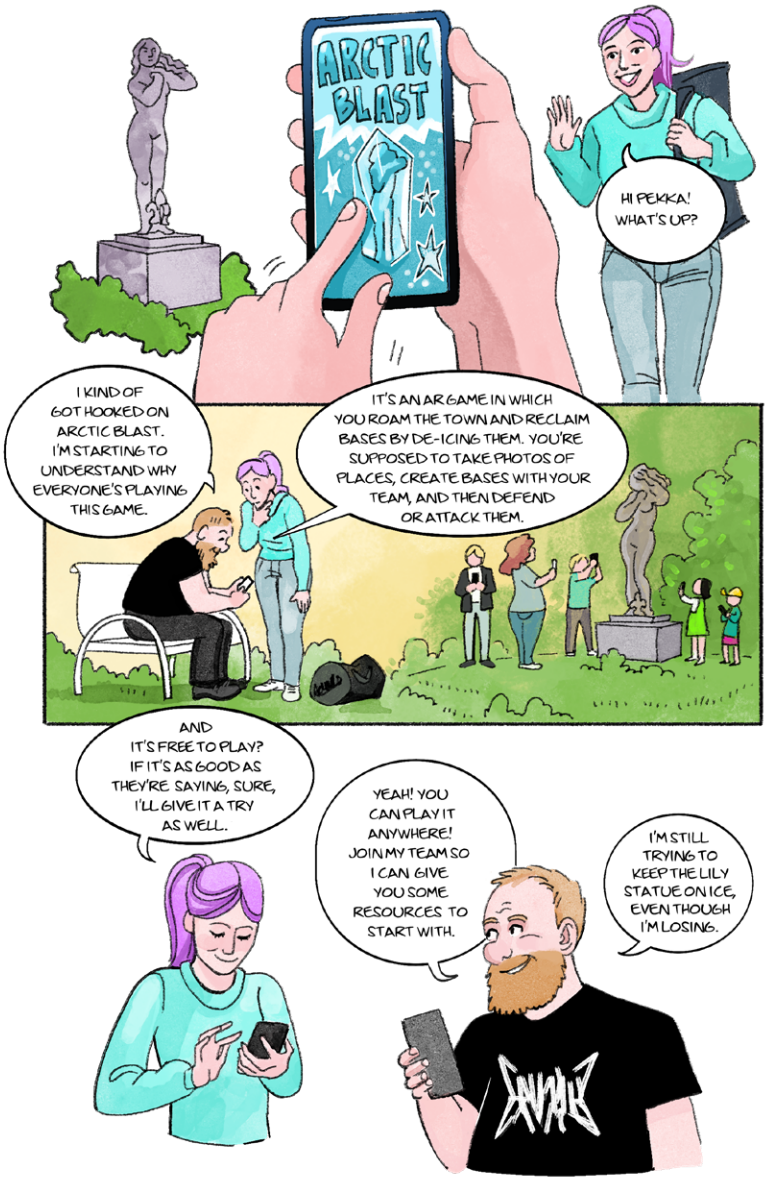
78 The company had been owned by a Japanese firm since 2013.

79 Ministry of Economic Affairs and Employment 2020.

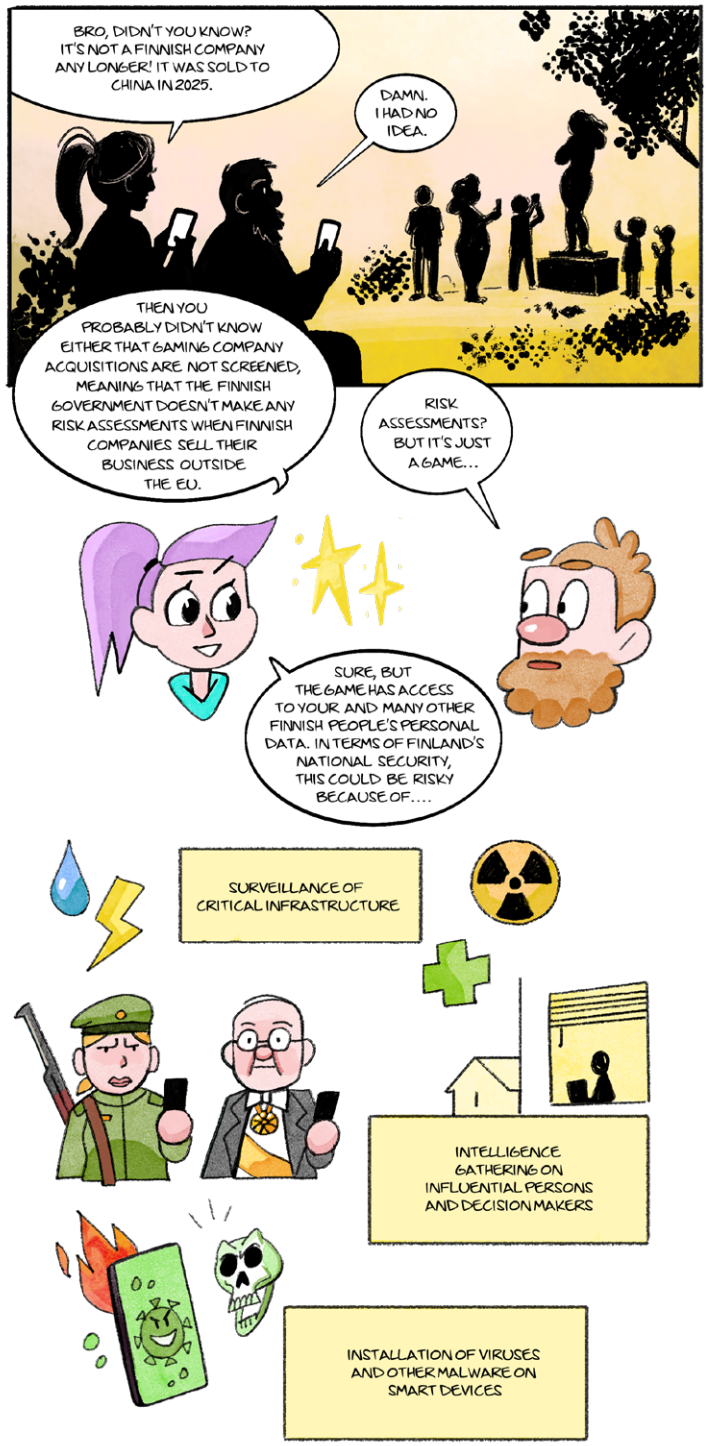
News
31 May 2027

## Company acquisitions:

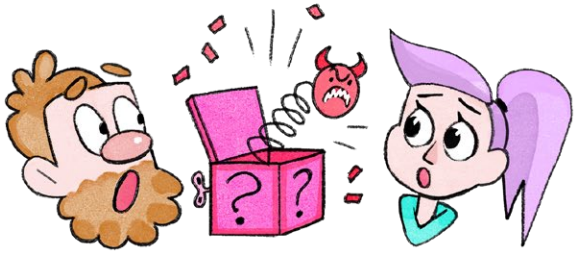
Chinese-owned gaming company shares Finnish citizens' personal data through a hit game




OH, THE APP IS ASKING FOR A LOT OF PERMISSIONS. HAVE YOU READ THE TERMS AND CONDITIONS?
DUDE, NO ONE EVER READS THEM. BUT THE COMPANY WAS FOUNDED BY LOVIISA NIEMELÄ, A FINNISH WOMAN WITH A STRONG TRACK RECORD OF EXPORTING FINNISH GAMES.
ONE COOL THING ILMATAR GAMES DOES IS TO ALWAYS INCLUDE SOME REFERENCES TO FINLAND IN ITS GAMES.
ILMATAR GAMES


BRO, DIDN'T YOU KNOW? IT'S NOT A FINNISH COMPANY ANY LONGER! IT WAS SOLD TO CHINA IN 2025.
DAMN. I HAD NO IDEA.
THEN YOU PROBABLY DIDN'T KNOW EITHER THAT GAMING COMPANY ACQUISITIONS ARE NOT SCREENED, MEANING THAT THE FINNISH GOVERNMENT DOESN'T MAKE ANY RISK ASSESSMENTS WHEN FINNISH COMPANIES SELL THEIR BUSINESS OUTSIDE THE EU.
RISK ASSESSMENTS? BUT IT'S JUST A GAME...
SURE, BUT THE GAME HAS ACCESS TO YOUR AND MANY OTHER FINNISH PEOPLE'S PERSONAL DATA. IN TERMS OF FINLAND'S NATIONAL SECURITY, THIS COULD BE RISKY BECAUSE OF....
SURVEILLANCE OF CRITICAL INFRASTRUCTURE
INTELLIGENCE GATHERING ON INFLUENTIAL PERSONS AND DECISION MAKERS
INSTALLATION OF VIRUSES AND OTHER MALWARE ON SMART DEVICES

MONITORING OF CROWD FLOWS



AND OTHER POSSIBLE UNPLEASANT SURPRISES THAT WE HAVEN'T EVEN THOUGHT OF!

The scenario sparked a large number of responses and a lively discussion between the panellists. While virtually all experts considered the scenario probable, maintaining that data security issues constitute an indisputable risk, several panellists considered it unlikely that Chinese ownership of technology companies in particular would result in national-security-threatening misuses of Finnish data – at least to any greater extent than those associated with technology giants like Meta that can either sell the data or become hacked. Some experts also underlined that the risks of the scenario are in fact materializing right now, and they may be less likely to unfold in 2027 due to the likely legislative changes and raised awareness – or, as one expert proposed, AI may have altered their nature. In proposing actual preventive means, the panellists typically focused on either the data protection issue or the risks of foreign – or Chinese – ownership, and far more comments fell in the former category. Those focusing on foreign ownership typically viewed carrots better than sticks. Limiting the freedoms of Finnish entrepreneurs was not considered desirable.

## Expert suggestions

*Legislative and regulatory changes*

Multiple panellists proposed making legislative and regulatory changes both within the EU and on a national level. For one, multiple experts argued for developing the scope and implementation of the EU's General Data Protection Regulation (GDPR). For example, greater restrictions were proposed to be set for the amount and types of gathered data and for transferring sensitive data outside the EU. Some panellists also stressed the need to require companies to provide clear and structured disclosures of the information they have gathered within the EU. It was also pointed out that users' rights to have their personal data erased could be expanded, and their permission for data collection could be asked on a more frequent basis. Moreover, one panellist envisioned obligating companies to prevent data misuse, including potential spying activities, with penalties for non-compliance. Intriguingly, one panellist also proposed demanding that high-risk applications used within the EU would also need to be located on an EU server.

Four panellists argued for enhancing broader international collaboration in the development of data protection regulations and their implementation. As one of them pointed out, the European GDPR should be replaced with a global one. However, another panellist proposed setting a more moderate goal by seeking to draft a regulation between the EU and G7. One panellist also underlined that such developments should not focus

on building walls between the West and China; instead, China should be kept actively informed about these changes.

Although the panellists were generally pessimistic about the potential of national screening efforts to mitigate the risks depicted in the scenario, a few experts argued for widening the scope of Finland's investment screening mechanism to cover such service providers as gaming companies – especially when their technological solutions have national security implications. Some panellists also underlined the need to keep up with technological development in defining the screened industries. Notably, one panellist argued for completely prohibiting foreign acquisitions of companies that gather and process large amounts of personal data. According to her/him, this may be the only effective way to overcome the lure of "becoming rich" by selling one's company to a risky investor. Moreover, an individual expert emphasized the need to vest counterintelligence officials with the necessary powers to oversee the use of high-risk applications.

Regulatory efforts were also proposed to make it more difficult to monitor critical infrastructure and use high-risk applications in certain places. For example, many experts suggested obliging companies to offer the option of disabling location sharing (i.e., geofencing) when necessary. In a similar vein, companies should make it possible to block their games from devices – something that parents should be able to do with all entertainment applications. Moreover, some panellists considered it necessary to ban smart devices and company phones from places like classrooms and military facilities. Initiating such changes would be made easier if, as one panellist proposed, Finland had a regulatory body that assessed new emerging technologies for their opportunities and risks.

Intriguingly, tighter regulation was also seen as a possible path to improve Finland's competitiveness: having a tighter than usual national regulatory framework could help to boost the domestic data protection industry. For example, one sectoral expert proposed creating a regulation that would obligate companies to fulfil certain software safety requirements to gain access to the Finnish market. That could, in turn, help Finnish companies to become trailblazers of data security. However, many others rejected extensive state regulation of the digital economy due to the potential discouraging effect it might have on entrepreneurship.

*Awareness raising and strategy work*

Several panellists emphasized the importance of enhancing public risk awareness concerning data collection, data usage and foreign acquisitions of technology companies. It was argued that both individuals and companies should be targeted, albeit in different ways. Pupils could be

reached by including "technology literacy" in the national curriculum and putting a heavy emphasis on raising their awareness of data footprints, as one panellist proposed in the guise of a joke: "in 2027, classrooms should have posters with meme dogs saying 'Int3rnet never 4gets'". The general population could be educated about "safe" applications and familiarized with MyData thinking, as one expert pinpointed. Sectoral experts, decision makers and companies, in turn, were proposed to be targeted by informing them about the risks of foreign acquisitions and enhancing their general level of technological understanding: without knowledge of the basic use of an application, it is difficult to absorb its potential dangers. In a similar vein, it was considered important that people are aware of what critical infrastructure is – and could potentially be.

Some of the more concrete awareness-raising efforts included national defence courses in which experts could learn and discuss potential sectoral risks. The issuance of certificates to companies that are deemed data secure was also viewed as a way to educate people about the importance of data security.

One panellist also underlined the need to formulate a technology strategy that would map the fast-developing technological playing field and outline critical and emerging technologies – along with their potential applications. Such a document would guide the national efforts to tackle the short- and long-term risks emerging from foreign uses of Finnish technologies and data.

*Incentivizing the supply of low-risk applications*

The panellists also argued for supporting the production of applications controlled by service providers associated with fewer risks. Since some experts generally considered Finnish companies' data security to be on a high level, it was proposed that carrots should be developed for domestic companies to stay in Finland – not only operationally but also in terms of their ownership. Here it was considered crucial to ensure the availability and sufficiency of domestic capital, but one panellist also argued for drafting a new innovation policy that would provide further support to Finnish technology companies. Data security would be at the core of this policy, which in practice would mean that such considerations would guide funding decisions and regulatory efforts. For example, as one expert argued, Finnish companies could focus on developing non-data collecting devices or solutions that deidentify data with innovative solutions: "What if the environment monitored by the smartphone (photos, contacts, location etc.) was first detected in a distorted form and therefore forced the user to take action to decode it?"

Some panellists also argued that application stores are part of the data protection problem: most entertainment applications can only be downloaded from two platforms, which also gather user data. To overcome this issue, the panellists proposed adopting technology neutrality – freedom of choice in technology – as the guiding light of application development. In that way, users could choose to download their applications from more secure alternatives, including ones not dominated by global technology giants or Chinese companies. This change would also ensure a level playing field for innovation and competition.

## 2.2. TRANSFERS OF REAL ESTATE OWNERSHIP: ARCTIC TOURISM AND SPORTS FACILITIES

Foreign ownership of real estate is a common phenomenon in an era of global economy. For potential investors, the ability to control the land and waters in which one operates adds to the market's attractiveness by mitigating investor risks. Yet the host country may be faced with security implications if the actual use of the acquired property contradicts its national interests and core values. Recently, the debate on such risks has focused on illegal intelligence and (refugee) espionage, location data gathering, sabotage planning, and the training and accommodation of troops.[80] Critical infrastructure has been at the heart of this discussion, but increasing attention is also paid to recreational facilities.[81]

In Finland, most non-EU/EEA real estate transfers have been made by Russians, whose purchases accounted for one third of the total in 2020–2021. Chinese acquisitions, in turn, amounted to only 6.5% of all non-EU/EEA deals during the same period.[82] Possibly the most notable Chinese transfer took place in 2017, when China Investment Corporation acquired the American-owned Logicor and its million square metres of warehouse space near Finnish transportation hubs.[83] However, Chinese investors have also expressed interest in high-end resorts, airports and science centres in the Arctic parts of Finland. These efforts have so far been largely unsuccessful, and only one hotel project has been realized in Rovaniemi. Nevertheless, the future prospects for Arctic real estate acquisitions remain open due to local decision makers' favourable stance on overseas investments and Chinese enthusiasm for Arctic travels. Moreover,

80 Interview with a Finnish state official, Helsinki, 23 March 2022.

81 Uggla 2022; Yle News 2018.

82 Ministry of Defence of Finland 2022.

83 See, e.g., Herrala 2017.

winter sports collaboration is a priority sector for Team Finland in China,[84] not least since the Chinese government anticipates that 50 million Chinese will practise winter sports by 2030.[85] Although trends do not automatically lead to investments, in 2015 Wanda Sports acquired the world's most renowned triathlon concept and brand Ironman to make the sport more popular in China.[86]

According to Finland's Act on Transfers of Real Estate Requiring Special Permission (470/2019), non-EU/EEA actors must be granted permission to purchase property if the transfer does not "complicate the organisation of defence, the surveillance and safeguarding of territorial integrity or the assurance of border control, border security or the maintenance of emergency stocks of critical supplies"[87]. However, purchases made by one housing share at a time and most transfers made with an EU/EEA spouse are exempted from screening. Moreover, based on the stipulations of the Act on the State's Right of Pre-emption (469/2019), the state may use its right of pre-emption in transactions near strategic locations if it is "necessary in order to ensure national defence, border control or border security or monitor and safeguard territorial integrity"[88]. Since January 2023 – after the panel was organized – the state has also been able to exercise this right to safeguard national security, and a clause has been added that makes it easier to expand the act's area of application. At the time of running the panel in October 2022, this right had been exercised twice: in the southern archipelago town of Kemiönsaari in May 2022 and near the Rovaniemi airport in Lapland in June 2022. A third instance took place in Imatra near the Russian border in March 2023.

84 Ministry of Foreign Affairs of Finland 2022.

85 Government of the People's Republic of China 2016; Li and Liu 2021.

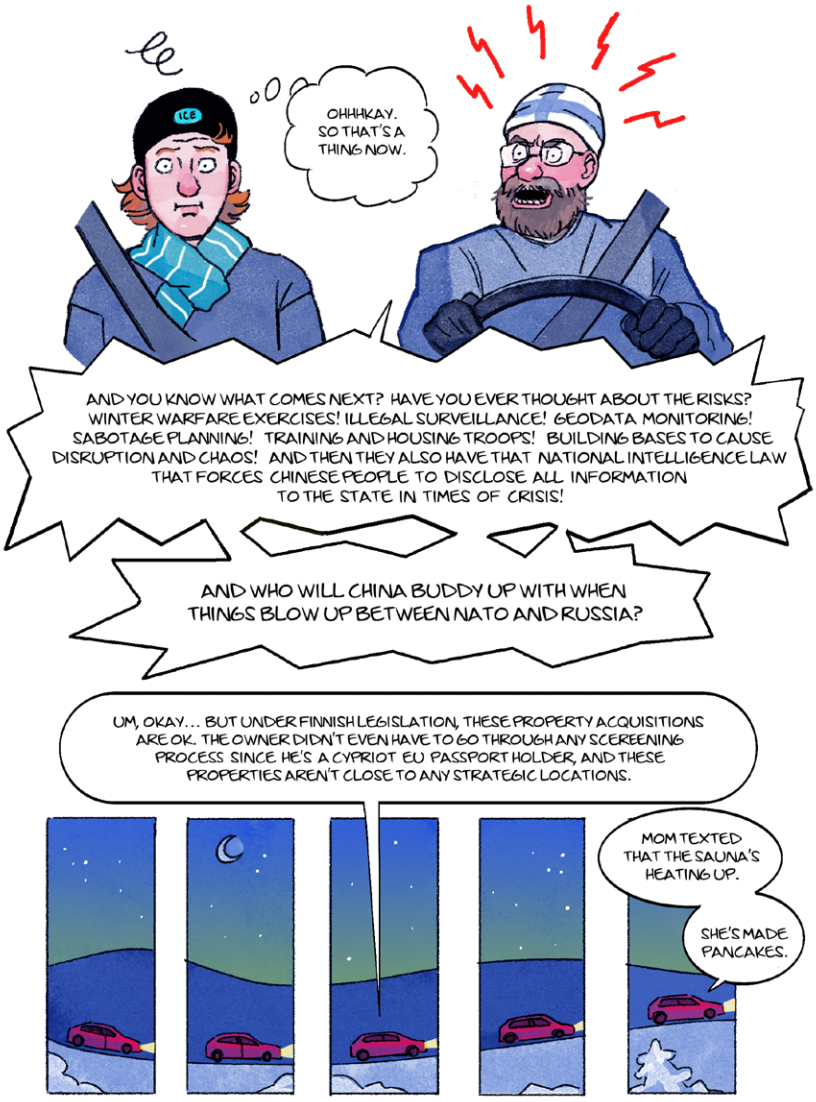
86 Ironman was resold to an American company in 2020.

87 Laki eräiden kiinteistöhankintojen luvanvaraisuudesta (470/2019) [Act on Transfers of Real Estate Requiring Special Permission (470/2019)].

88 Laki valtion etuosto-oikeudesta eräillä alueilla (469/2019) [Act on the State's Right of Pre-emption in Certain Areas 469/2019].


News
15 Dec 2027
Political retaliation:
New Chinese investments in Finland, Norway and Russia – Growing concerns about the dual use ofArctic properties
MOTEL
THERE'S MY ICEMAN!
HI DAD!
P
EKO RESORT
SKIS, SKI BOOTS, SKATES, RUNNING SHOES, REMOTE TRAINING EQUIPMENT... I'LL NEED TO UPGRADE TO A BIGGER CAR SOON.
HEH!
P
MY MATES WERE ALREADY ASKING IF I'D LIKE TO JOIN THEM FOR THE "NORWAY ULTRA COOL" COMPETITION THIS SPRING.
AND IF I DO WELL ENOUGH IN THIS ONE, WE'LL HAVE OUR NEXT COMPETITION BEHIND THOSE FELLS, IN RUSSIA.
ALL THESE DARN NEW BUILDINGS MADE IT HARD TO FIND A PARKING SPOT... WERE ALL THESE BUILT ONLY FOR THIS COMPETITION?
GOSH, NO! BUT THERE'S A WINTER SPORTS BOOM IN CHINA, SO I GUESS IT SHOWS HERE AS WELL.
STAFF HOUSE


LAKE INARI ICEMAN® 2027
ICEMAN® GOES RUSSIA
SKI
TROIKA INDUSTRIAL FACTORY POWER ZONE!
ICE
ICEMAN® NORWAY ULTRA COOL
A FEW YEARS AGO, A CHINESE COMPANY BOUGHT THE ICEMAN® CONCEPT, WHICH HAS NOW ROCKETED IN POPULARITY. AND NOW THAT THEY'VE GOT THEIR FACILITIES IN MINT CONDITION, DOMESTIC TOURISTS ARE GETTING INTERESTED IN IT AS WELL. BEFORE IT WAS JUST US SPORTS FANATICS!
HARUMPH. I DON'T LIKE IT ONE BIT.
WHAT'S GNAWING AT YOU? YOU'VE ALWAYS COMPLAINED THAT THERE'S NOTHING HERE! NOW WE HAVE ALL THIS HUSTLE AND BUSTLE! WHY ARE YOU STILL COMPLAINING?
I'M JUST THINKING ABOUT WHO OWNS ALL THESE PROPERTIES...
UNBELIEVABLE! I'VE BARELY MANAGED TO PUT MY SEATBELT ON, AND YOU'VE ALREADY TUNED INTO RADIO CONSPIRACY FM.
THE ECO RESORTS IN BOTH FINLAND AND NORWAY WERE BUILT BY THE CYPRIOT LI MING, AND ALL THE HOUSING SHARES FOR THE STAFF HOUSES HAVE BEEN BOUGHT ONE BY ONE.
AND IN RUSSIA, THEY HAVE A JOINT VENTURE. LI MING IS ALSO MARRIED TO A FINN, SO THIS IS BASICALLY A CHINESE-LOCAL, ... ERM... AN EU-LEVEL INITIA...
CHINA IS HOGGING UP LAPLAND!


ICE
OHHHKAY. SO THAT'S A THING NOW.
AND YOU KNOW WHAT COMES NEXT? HAVE YOU EVER THOUGHT ABOUT THE RISKS? WINTER WARFARE EXERCISES! ILLEGAL SURVEILLANCE! GEODATA MONITORING! SABOTAGE PLANNING! TRAINING AND HOUSING TROOPS! BUILDING BASES TO CAUSE DISRUPTION AND CHAOS! AND THEN THEY ALSO HAVE THAT NATIONAL INTELLIGENCE LAW THAT FORCES CHINESE PEOPLE TO DISCLOSE ALL INFORMATION TO THE STATE IN TIMES OF CRISIS!
AND WHO WILL CHINA BUDDY UP WITH WHEN THINGS BLOW UP BETWEEN NATO AND RUSSIA?
UM, OKAY... BUT UNDER FINNISH LEGISLATION, THESE PROPERTY ACQUISITIONS ARE OK. THE OWNER DIDN'T EVEN HAVE TO GO THROUGH ANY SCREENING PROCESS SINCE HE'S A CYPRIOT EU PASSPORT HOLDER, AND THESE PROPERTIES AREN'T CLOSE TO ANY STRATEGIC LOCATIONS.
MOM TEXTED THAT THE SAUNA'S HEATING UP.
SHE'S MADE PANCAKES.


I GOT A BIT TENSE THERE, MY SHOULDERS ARE SO STIFF...
YOU SHOULD GO AND VISIT MY PAL, HE'S A SPORTS MASSEUR.
I'LL KEEP DRIVING YOU TO THOSE COMPETITIONS, OF COURSE...
COOL!
YOU WANT A SAUNA DRINK?
SURE, BUT HEY DAD...
...WHAT WERE YOU SAYING EARLIER ABOUT THOSE PROPERTIES? HOW COULD THIS TYPE OF OWNERSHIP, OR ITS RISKS, HAVE BEEN AVOIDED?
THE PANCAKES ARE GETTING COLD, MY DEARS!
Hyrdn23

Given the debate on the risks of Russian real estate acquisitions, many panellists were familiar with the theme of the scenario, and it sparked various suggestions. Since the storyline purposely left open the explicit risks that might materialize by 2027, the panellists also speculated on the potential intentions of the imaginary Chinese investors. Most notably, one expert identified a pattern of investments benefitting China's space ambitions, whereas another emphasized intelligence gathering.

Although the plausibility of the scenario was not questioned, its likelihood divided opinions. Some considered the scenario unlikely due to Finland's enhanced risk awareness and sufficient legislation. Others emphasized the lack of Chinese strategic interest in small Arctic properties – at least during the time frame of the scenario. Multiple experts also downplayed the risks stemming from such foreign-owned non-critical infrastructure as sports and travel facilities. These viewpoints were, however, questioned by other panellists: Finland's NATO membership was seen as likely to motivate Chinese and Russian intelligence activities, the Finnish legislation was considered too liberal, and China's potential preparations for future military actions were considered possible in 2027. Moreover, the High North was viewed as a likely scene for increasing Chinese interest due to the region's strategic location, resources and the country's past efforts to acquire distant Arctic properties with dual-use potential. The risks related to non-critical and non-strategically located properties and infrastructure, in turn, were underlined by referring to the case of Airiston Helmi, a Russian-acquired Finnish resort in the media associated with possible plans for dual-use activities.[89] One sectoral expert also highlighted the potential problems that malicious owners can cause by not paying the maintenance charges or electricity bills during the cold winter months.

## Expert suggestions

*Awareness raising and social debate*

Multiple panellists underlined the need to initiate a whole-of-society debate on broader geopolitical and China-related risks. As stressed by one panellist, the highest political leadership should "lead the way" by taking a clear stance on the long-term risks of collaborating with authoritarian states. Moreover, as noted by several experts, emphasis should be put on raising the risk awareness of municipal-level decision makers: they sell municipality-owned plots and plan land use – and may hence also be subject to political influence. Two experts also proposed that social

89 See, e.g., Yle News 2018.

debate should aim at initiating an attitude change: not everything needs to be on sale, and foreign capital is not always needed. The importance of engaging the Sámi Parliament and reindeer owners' associations was also underlined: this would provide the Indigenous Sámi population with a chance to give – or not give – their UN-recognized "free, prior and informed consent" (FPIC) to foreign forms of ownership.

Multiple experts also argued for the importance of defining "critical infrastructure". One panellist explicitly highlighted the need to take into account technology-related considerations, whereas another proposed drawing inspiration from Switzerland's way of defining, weighting and priority listing different types of infrastructure.[90]

*Legislative and regulatory changes*

First, the panellists proposed developing the current screening practice and rules – but not the scope of controls. For one, screening could focus more on identifying the cumulative effects and spatio-temporal patterns of investments, which could be supported by compiling a comprehensive database on foreign-owned properties. Moreover, as underlined by one panellist, long-term risks should also be emphasized in the screening process. Overall, it was suggested that the authorities should be vested with wider powers to conduct these clearances, and that acquirers could be obliged to report the beneficial owner at the risk of heavy penalties. This could possibly be done by implementing a reverse burden of proof, whereby the acquirer should demonstrate that the ownership structure and funding are "acceptable". Noteworthily, some steps in these directions were already taken in the 2023 amendments: the screening authorities were given wider access to other state institutions' information. Moreover, while it was not made a systematic practice, it is now possible for them to demand that acquirers report the origins of the funding for the properties.[91]

Second, multiple experts proposed expanding the scope of screening and the state's right of pre-emption. Screening could cover transfers made by (non-Finnish) EU and EEA citizens and their foreign spouses. In this way, the transfers made by golden passport holders, EU dummies and parties of sham marriages could be brought under scrutiny. Moreover, a few panellists suggested bringing one-by-one purchases of flats within the scope of screening. As for the state's right of pre-emption, it was proposed that the area of application should be expanded and the state's authority to intervene on national security grounds made easier – such

90 See Federal Office for Civil Protection 2017; Federal Office for National Economic Supply 2023.

91 Laki eräiden kiinteistönhankintojen luvanvaraisuudesta annetun lain muuttamisesta (1098/2022) [Law amending the Act on Transfers of Real Estate Requiring Special Permission (1098/2022)].

changes were also implemented in the 2023 amendments.[92] On a related note, the panellists also underlined the need to grant the state broader rights of inspection after purchases.

However, a few sober-minded experts underlined that more extensive screening is not a panacea. Even if virtually all acquisitions were screened, only those that evidently complicate the organization of Finland's national defence or supply security could be blocked. As one panellist aptly put it:

> *Not all responsibility can be shifted solely onto restrictions imposed by authorities. Having suspicions or an unpleasant feeling about certain acquisitions is not enough to block transfers or take over properties. Instead, there must be something tangible. In Finland, all decisions can be appealed, and the courts must be convinced by the authorities' justifications. Mere citizenship is currently not enough to prevent acquisitions. Although the current general atmosphere demands "blood in the arena", this is not delivered based on public uproar, and that is why Finland differs from authoritarian states.*

Third, multiple panellists proposed forbidding some foreign real estate transfers. The scope of the suggested limitations varied, however: some panellists referred to an unspecified group of "foreigners", whereas others either underlined "non-EU/EEA nationals", "some countries" or the "Chinese". The related suggestions included limiting the share of foreign ownership to either below 50% or to 50/50 joint ownership schemes with Finnish/EU actors. Intriguingly, one panellist also proposed adhering to the principle of reciprocity: foreigners should only be sold real estate if their respective countries allow Finns to buy real estate.[93] One option would also be to apply nationality-based limitations only on real estate with strategic value, as proposed by an individual expert. Moreover, two panellists also suggested lowering the barrier for expropriating real estate. Here inspiration could be drawn from municipal expropriations.

Fourth, the experts also argued for making complementary legislative changes. One panellist underlined that Finland should have a separate act that would make it possible to refer to national security in certain situations. In that way, Finland would not only rely on a set of individual laws whose stipulations do not enable intervention without complex tailor-made solutions. Moreover, it was proposed that Finland's dual

92 Laki valtion etuosto-oikeudesta eräillä alueilla annetun lain muuttamisesta (1099/2022) [Law amending the Act on the State's Right of Pre-emption in Certain Areas (1099/2022)].

93 Currently, neither China nor Russia allow the transfer of real estate to foreigners.

citizenship and some EU countries' golden passport schemes should be abolished, or that the former should only apply to EU and NATO member countries. The potentially significant risks stemming from foreign owners' intentional payment defaults could be tackled by legal tools that enable the transfer of liability, takeovers and redemption. Foreign owners could also be asked to deposit securities.

The panellists also mentioned other complementary legislative changes that were seen to reduce foreigners' ability and willingness to acquire properties in Northern Finland. One expert proposed reassessing mining taxation, owners' royalties, entrepreneurs' obligations, the requirements for evaluating the impact of land use on forests and biotopes, and the ownership regulations concerning state actors. Moreover, it was underlined that Finland should ratify the Indigenous and Tribal Peoples Convention – ILO Convention 169 – since it would grant the Sámi extended rights over land use in Lapland.

*Promoting other types of investments*

Several panellists underlined the need to balance the effects of potential ownership limitations with other types of investments. The most common suggestion was to offer foreign investors long-term leases. Moreover, the panellists referred to "better carrots" to incentivize domestic and EU investments. For example, tax breaks could make it more feasible to invest in Finnish companies. Finally, systematic marketing efforts could be targeted at Western countries to attract investments in Finland.

## 2.3. VENTURE CAPITAL INVESTMENTS IN START-UP COMPANIES: QUANTUM COMPUTING

Venture capital investments contribute significantly to the growth potential of promising companies by bringing in not only additional financing but also investors' expertise and networks. Generally, they constitute a form of foreign ownership that is associated with fewer risks to host countries than FDI and real estate acquisitions. Yet VC investors often have broad informational rights, and they gain at least indirect access to emerging technologies, innovations and data – an aspect that has clear security implications.[94] Moreover, many VC investors demand the right to a seat on the company's board of directors despite their potentially small ownership share.[95] It is also possible that the networks created through VC

94 de la Bruyère and Picarsic 2022.

95 Bochner and Simmermann 2016.

investments are used to attract talent to larger companies – especially in such technology fields as quantum computing, which are characterized by intense competition between great powers, small research communities and a global shortage of talent.[96]

The importance of quantum computers has been compared to that of the internet. Their computing power exceeds the capacity of current supercomputers, which enables them to model very complex phenomena. Notably, most contemporary encryption software could potentially be decrypted with quantum technology, which would have wide-ranging implications for the banking sector and national security.[97] Post-quantum encryption software is already being developed, and in the future, quantum computing power could be utilized to develop new encryption software. In other words, the forthcoming quantum era might not completely disrupt encryption, but it is reasonable to estimate that it would have destabilizing effects. These developments also explain the current competition for quantum supremacy – a race in which China leads in quantum encryption,[98] while the US has the computers containing the largest amount of cubits.[99] The quantum research community is worried that this rivalry may limit scientific openness, which in turn may slow down scientific development.

The Finnish quantum cluster is significant in the European context. In 2020, VTT Technical Research Centre of Finland and IQM, one of a few Finnish companies building quantum computers, acquired the country's first quantum computer. The Finnish state also supported the project with EUR 20 million,[100] and IQM received a VC investment from Chinese Tencent.[101] Generally, the Finnish cluster focuses on superconducting qubits, which is one of the main technical solutions for building quantum computers.[102] Qubits are sensitive to external disturbance, which causes reliability issues. Computing errors are then corrected with error correction software. The quality of qubits is central to well-functioning quantum computers, and the mere size of a computer tells little about its computing power. The new Unimon qubit, developed by researchers

96 Cf. Viljanen 2020; Cyranoski 2018.

97 Yunakovsky et al. 2021; Covers and Doeland 2020.

98 Smith-Goodson and Moorhead 2019; Yin, Li and Liao et al. 2020.

99 Smith-Goodson and Moorhead 2019.

100 Finnish Government 2020.

101 IQM 2020.

102 Viljanen 2020.

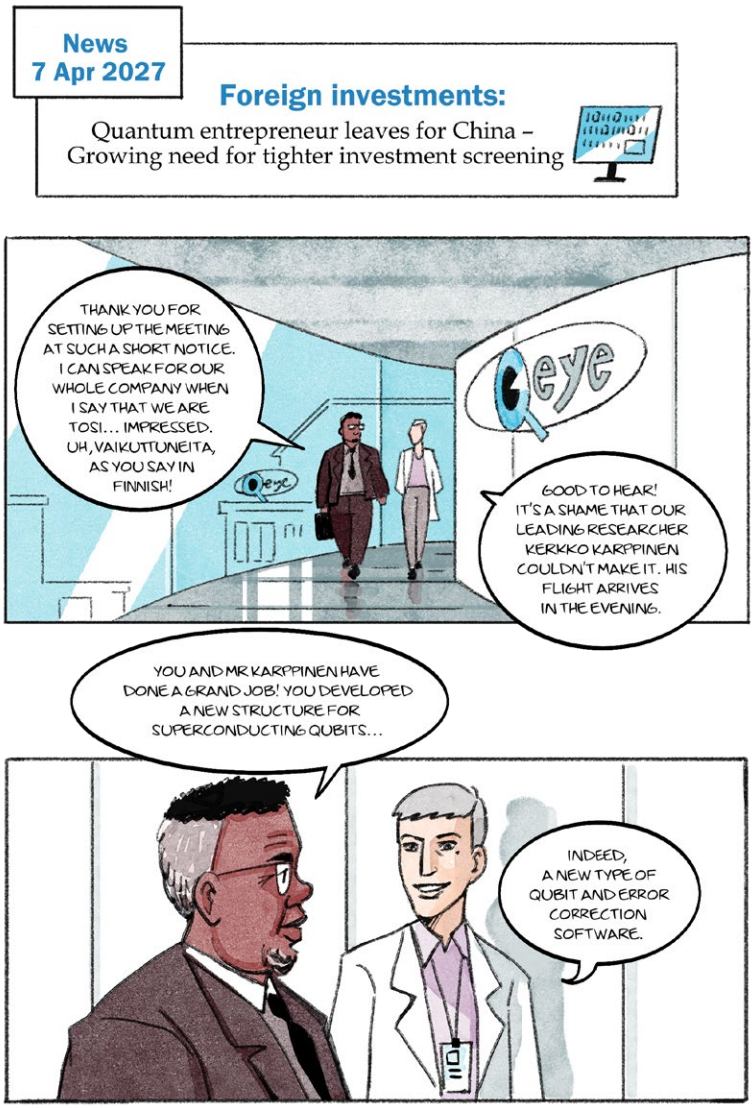
from Aalto University, IQM and VTT in 2022, can be expected to increase the accuracy of quantum computations.[103]

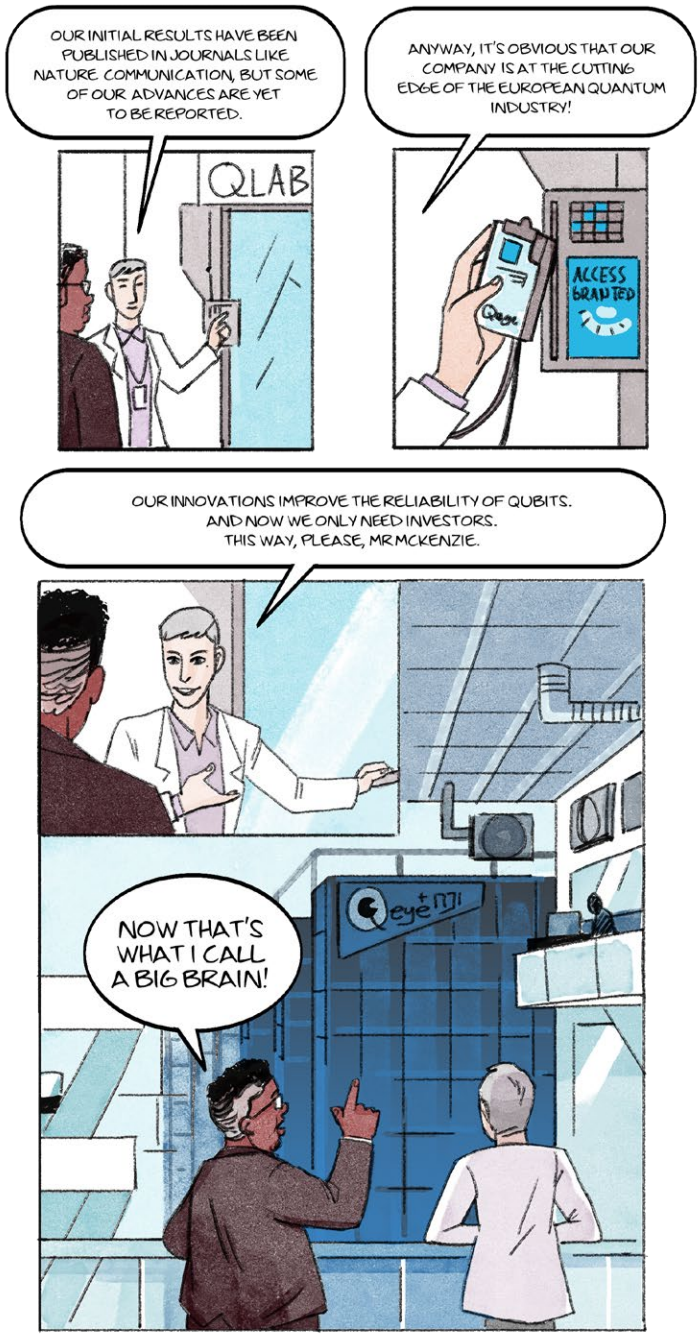
Due to its success, the Finnish quantum cluster can be anticipated to receive significant VC investments in the future. Generally, Finland-bound VC investments are not monitored: the ownership share such investors obtain remains below 10%, which is the legislative threshold for screening non-EU/EFTA FDI.[104] Yet the pressure for legislative changes is likely to increase due to the above-mentioned security implications and rising levels of Chinese VC investments in Europe – and possibly due to the fact that they largely fly under national radars.[105]

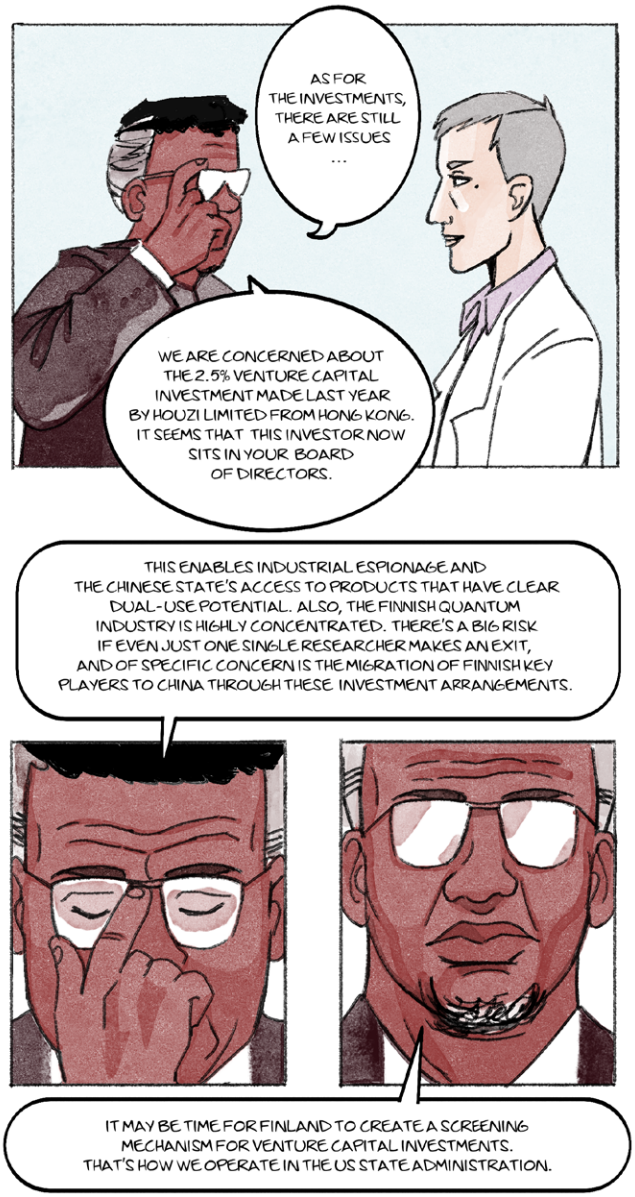
103 Hyyppä et al. 2022.

104 Laki ulkomaalaisten yritysostojen seurannasta (172/2012) [Act on the Screening of Foreign Corporate Acquisitions (172/2012)].

105 Kratz et al. 2022.


News
7 Apr 2027
Foreign investments:
Quantum entrepreneur leaves for China –
Growing need for tighter investment screening
THANK YOU FOR SETTING UP THE MEETING AT SUCH A SHORT NOTICE. I CAN SPEAK FOR OUR WHOLE COMPANY WHEN I SAY THAT WE ARE TOSI... IMPRESSED. UH, VAIKUTTUNEITA, AS YOU SAY IN FINNISH!
Qeye
GOOD TO HEAR! IT'S A SHAME THAT OUR LEADING RESEARCHER KERKKO KARPPINEN COULDN'T MAKE IT. HIS FLIGHT ARRIVES IN THE EVENING.
YOU AND MR KARPPINEN HAVE DONE A GRAND JOB! YOU DEVELOPED A NEW STRUCTURE FOR SUPERCONDUCTING QUBITS...
INDEED, A NEW TYPE OF QUBIT AND ERROR CORRECTION SOFTWARE.


OUR INITIAL RESULTS HAVE BEEN PUBLISHED IN JOURNALS LIKE NATURE COMMUNICATION, BUT SOME OF OUR ADVANCES ARE YET TO BE REPORTED.
QLAB
ANYWAY, IT'S OBVIOUS THAT OUR COMPANY IS AT THE CUTTING EDGE OF THE EUROPEAN QUANTUM INDUSTRY!
ACCESS GRANTED
OUR INNOVATIONS IMPROVE THE RELIABILITY OF QUBITS. AND NOW WE ONLY NEED INVESTORS. THIS WAY, PLEASE, MR MCKENZIE.
NOW THAT'S WHAT I CALL A BIG BRAIN!

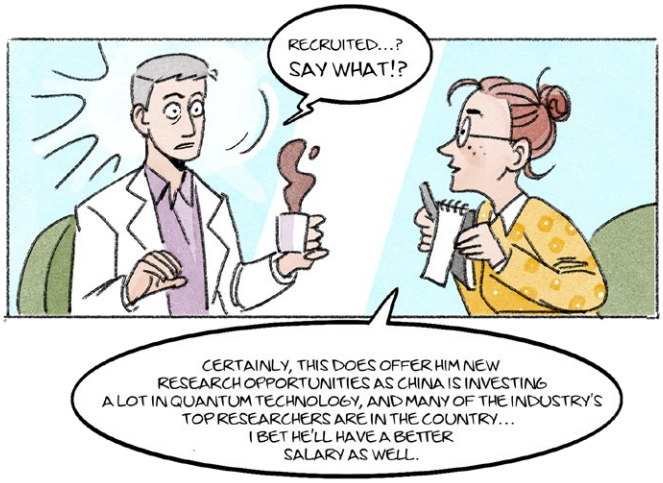

AS FOR THE INVESTMENTS, THERE ARE STILL A FEW ISSUES ...
WE ARE CONCERNED ABOUT THE 2.5% VENTURE CAPITAL INVESTMENT MADE LAST YEAR BY HOUZI LIMITED FROM HONG KONG. IT SEEMS THAT THIS INVESTOR NOW SITS IN YOUR BOARD OF DIRECTORS.
THIS ENABLES INDUSTRIAL ESPIONAGE AND THE CHINESE STATE'S ACCESS TO PRODUCTS THAT HAVE CLEAR DUAL-USE POTENTIAL. ALSO, THE FINNISH QUANTUM INDUSTRY IS HIGHLY CONCENTRATED. THERE'S A BIG RISK IF EVEN JUST ONE SINGLE RESEARCHER MAKES AN EXIT, AND OF SPECIFIC CONCERN IS THE MIGRATION OF FINNISH KEY PLAYERS TO CHINA THROUGH THESE INVESTMENT ARRANGEMENTS.
IT MAY BE TIME FOR FINLAND TO CREATE A SCREENING MECHANISM FOR VENTURE CAPITAL INVESTMENTS. THAT'S HOW WE OPERATE IN THE US STATE ADMINISTRATION.


IN ANY CASE, LET'S DISCUSS THIS FURTHER!
WORKING LATE AGAIN! I KNEW I'D FIND YOU HERE AT THE OFFICE... IT TOOK AN HOUR LONGER BECAUSE THERE WAS SOME HASSLE AT THE AIRPORT.
HOW DID IT GO WITH MCKENZIE?
LATER
PRETTY WELL, ALTHOUGH HE SADLY DIDN'T GET TO MEET THE WORLD FAMOUS MR KARPPINEN. WE'LL CONTINUE OUR NEGOTIATIONS.


SORRY, HONEY. I SEEM TO BE IN HIGH DEMAND.
DAMN! I FORGOT I HAVE AN INTERVIEW SCHEDULED FOR TOMORROW. FIRST THING IN THE MORNING... UH, IS THERE ANY CHANCE YOU COULD GO IN MY PLACE?
SURE, JUST ASK NICELY ...


IN THE MORNING
PHEW! 6'MORNING! SORRY FOR BEING A TAD LATE... AND THANKS FOR THE COFFEE, YOU'RE TOO KIND!
YOU GUYS HAVE A REALLY NICE OFFICE HERE...
IS IT OK IF I SNAP A FEW PHOTOS?


UH, I HAVE QUITE A FEW QUESTIONS HERE...
I GUESS THE MOST INTERESTING THING HERE IS THAT THE QUANTUM COMPUTER IS SO POWERFUL THAT IT CAN BREAK ENCRYPTION SYSTEMS BASED ON TRADITIONAL IT EXPERTISE IN BANKS, THE MILITARY AND STATE ADMINISTRATION...
SO, UH, HOW HAVE THESE TYPES OF RISKS BEEN ADDRESSED WHEN YOU HAVE BEEN SEEKING INVESTORS?
WELL, FIRST OF ALL...
ACTUALLY, I'M SORRY...! COULD WE TALK ABOUT BRAIN DRAIN FIRST? AS IT SEEMS, IF I GOT THIS RIGHT, A HONG KONG INVESTOR HAS JUST RECRUITED YOUR TEAM'S LEADING RESEARCHER KERKKO KARPPINEN TO A CHINESE FIRM!


RECRUITED...?
SAY WHAT!?
CERTAINLY, THIS DOES OFFER HIM NEW RESEARCH OPPORTUNITIES AS CHINA IS INVESTING A LOT IN QUANTUM TECHNOLOGY, AND MANY OF THE INDUSTRY'S TOP RESEARCHERS ARE IN THE COUNTRY... I BET HE'LL HAVE A BETTER SALARY AS WELL.
SO WHAT I WANT TO ASK YOU IS: HOW COULD THIS SITUATION HAVE BEEN AVOIDED?
Hyperion23

The scenario sparked long and detailed suggestions and evoked a lot of discussion between the panellists. Especially brain drain, the key risk of the scenario, was commented on actively, and most respondents considered it impossible to prevent completely – at least with any means that would not violate human rights. Some found that China's increasingly authoritarian policies and practices have reduced the country's lucrativeness in the eyes of Finnish experts, and, consequently, the risk for brain drain from Finland to China is smaller – despite China's advancements in quantum computing. The broader discussion also included definitional elements, and the essence of "brain drain" was debated: does it constitute brain drain if a researcher leaves overseas to gain experience? Does brain drain occur only if they do not return to Finland within a certain time period? Moreover, a few participants remarked that the scenario was not that futuristic but rather described current realities. Based on the voluntary question asked after the main panel questions, nobody found the scenario unlikely, but a few experts contested the link between VC investments and brain drain. Others, in turn, argued that talent is attracted with any method, including investment activities.

## Expert suggestions

### *Enhancing the competitiveness of research and business environments*

Several panellists suggested enhancing the competitiveness of Finnish research and business environments as a key method to prevent excessive brain drain from the country – either through investment arrangements or in general. For one, the funding prospects of Finnish companies and researchers should be improved by developing domestic and EU-level funding mechanisms and practices, especially in critical sectors. Further EU-level cooperation would also be needed in identifying emerging technology fields and finding funding for companies in these areas.

Although some respondents emphasized that Finland probably cannot ever compete with salaries, others underlined that higher pay could persuade Finnish experts working abroad to return to the country. However, as many experts highlighted, Finland's assets include a high standard of living, welfare state services, a clean environment and a healthy work-life balance, which are not always found elsewhere. Consequently, taking care of these broader characteristics would maintain Finland's competitiveness in the eyes of key experts.

Panellists also emphasized that international collaboration can improve the Finnish research environment by providing new opportunities for researchers. Especially closer technology cooperation with democratic

countries – and the US in particular – would be valuable. Here it was underlined that Finland already has a partnership with the US in Quantum Information Science and Technology (QIST), and its scope could be broadened.

Educational policies and practices also play a key role in enhancing Finland's competitiveness and securing a sufficient pool of talent. Quantum technology related subjects should be designated as focus areas in higher education. Especially the intake of students in quantum physics should be increased in universities. The Academy of Finland could start promoting researchers' return to Finland after overseas research stays. It would also be possible to develop mechanisms that make it more difficult for researchers to move to certain authoritarian countries – and even penalize actors that choose to work for/with Chinese companies that are deemed unsuitable.

*Organizational practices*

Organizations can do a lot to prevent espionage and loss of key talent. While the problem of limited domestic funding was widely recognized, it was also pointed out that by being aware of geopolitical tensions, companies can make informed decisions on partnerships and investments. In particular, there would be room for sharing information on the possible downsides of accepting Chinese investments and reporting influencing attempts from any country. Intriguingly, one panellist even suggested for organizations to engage in "knowledge defence courses". They could be organized in the spirit of the Finnish national defence courses, which aim at improving cooperation between people in different sectors of society and facilitating their networking.

When hiring new employees, companies in strategic sectors could apply restrictive criteria to such aspects as citizenship to avoid espionage. Employment contracts could include non-compete and non-disclosure agreements. However, as underlined by one panellist, their effectiveness can be questioned: breaking such agreements is not necessarily costly enough to prevent breaches of contracts.

The ways in which work and research are structured and facilitated matter as well. Companies should avoid situations in which any one employee becomes irreplaceable or holds too much critical knowledge. Even individual teams should not become too important. While this guideline might be difficult to follow in practice, the gold standard for companies should be to "divide and rule": when someone decides to leave, it is better to lose only this one person rather than the whole team. Moreover, maintaining a good working atmosphere and paying competitive salaries are of crucial importance – and perhaps so too is the ability to make a

counter-offer to someone who considers leaving. Punitive measures and restrictions divided respondents, but some panellists still suggested the surveillance of employees in critical sectors.

Multiple discussants pointed out that there will always be rotten apples among employees – in that sense, the problems described in the scenario cannot be completely avoided. Yet, by highlighting shared democratic values, it is possible to prevent the spread of selfish behaviour.

*Legislative and regulatory changes*

Multiple panellists proposed making changes to Finland's investment screening mechanism. Although one panellist proposed blocking investments from companies that operate from authoritarian states, others mainly proposed widening the scope of monitoring. For one, the threshold for screening could be lowered since initial funding rounds in emerging technology start-ups often fly under the radar. More industries could also be screened; currently, investments in such fields as space technologies are monitored better than others. In addition, greenfield investments should be brought under scrutiny because they can compromise national security interests. Altogether, these changes would also facilitate better tracking of and information gathering on Chinese investments by expanding the pool of studied cases.

As technologies develop rapidly, laws should be reviewed frequently to ensure legislation does not become outdated. One expert emphasized that the current screening mechanism already covers a lot, possibly even a situation in which a VC investor gets a seat on the board of directors, but even then, technological development creates challenges for legislators:

> *Foreign investment screening should be more extensive if we want to prevent problematic foreign influence over security-critical companies. Getting a board membership with a 2.5% investment indicates that the investor from Hong Kong uses disproportionate influence in this quantum technology company. The Act on the Screening of Foreign Corporate Acquisitions also acknowledges situations in which foreign investors exert an influence that is larger than their ownership share. Nevertheless, the most significant problem at the moment is that emerging technologies are not screened efficiently in Finland, although such monitoring is more developed in some other countries.*

## 2.4. DISCUSSION

The three scenarios of this chapter sparked somewhat different answers from the participating experts. While most, but not all, comments concerning the game company and quantum computing scenarios underlined the importance of protecting the rights and freedoms of entrepreneurs to sell their companies and accept any job offers, the suggestions put forward in the real estate acquisition case called for enhancing the authorities' powers to protect the Finnish soil from the potentially malicious activities of foreign actors. This division is unsurprising, given that the freedoms of individuals constitute the core of liberal democracies' foundational values, and territorial integrity is at the heart of Western conceptions of national security. Moreover, the immediate nature of the "Russia threat" most likely influenced the panellists' views on real estate acquisitions.

Overall, a key dilemma that connects all the scenarios is to find a balance between tightening legislation to mitigate the security risks of investments and maintaining a healthy economic development boosted by foreign flows. In all three cases, it became obvious that although more rules and regulations may be needed, and they can sometimes provide instant benefits, regulatory tightening also has both economic and moral consequences. From an economic perspective, restrictions would have a negative impact on the investment climate, and they could potentially reduce the number of foreign investments.[106] Morally, if restrictions are taken too far, Finland's identity as an open economy will be at risk. If Finland, for example, developed its legislation reciprocally to correspond to that of China and Russia and forbade these nationals from acquiring real estate, what consequences would this have for Finland's open and democratic system? Such changes could start a slippery slope of further country/citizenship-based restrictions. More broadly, if democracies start to imitate authoritarian countries in their legislative reforms, how well-grounded will their criticism of authoritarianism be?

In sum, balancing between national security and an open democratic system is a great challenge as openness always comes with some vulnerabilities. Perhaps the key is to find the most essential targets of development – such as removing exceptions from the real estate legislation, lowering the threshold for screening and bringing greenfield investments within its scope – and advance with them while continuing the whole-of-society debate for any further changes.

106 See also Kauppila and Cappelin 2023.

## Mitigating security risks of foreign ownership: Key takeaways

### Legislative and regulatory changes

**Developing national FDI controls**
- Screening a broader scope of industries, including the game industry
- Screening greenfield and venture capital investments
- Prohibiting acquisitions of companies gathering and processing large amounts of personal data

**Developing national real estate transfer controls**
- Screening transfers of EU/ETA citizens and their foreign spouses
- Screening one-by-one purchases of flats
- Screening cumulative effects and spatio-temporal patterns of investments
- Prohibiting transfers of all foreigners, non-EU/ETA nationals or the Chinese (especially if the target has strategic value)
- Limiting investments to below 50% or to 50/50 joint schemes with Finnish/EU actors

**Developing the EU's General Data Protection Regulation (GDPR)**
- Obligating companies to
  - ask permission for data collection more frequently
  - prevent data misuse
  - locate high-risk applications on an EU server

**Vesting authorities with wider powers to oversee foreign ownership**

### Awareness raising, strategy work and social debate

**Enhancing public risk awareness**
- Initiating
  - MyData thinking in the society
  - "knowledge defence courses" with a technology focus
  - efforts to educate municipal-level decision makers on geopolitical risks

**Mapping critical infrastructure and technologies**
- Formulating a technology strategy
- Drawing inspiration from Switzerland's model on categorising infrastructure

### Incentivizing low-risk alternatives

**Guiding investments in Finnish companies that develop non-data collecting devices and solutions deidentifying data**

**Incentivising long-term leases of real estate**

### Enhancing the competitiveness of research and business environments

**Maintaining Finland's special characteristics (e.g., welfare state services)**

**Broadening technology cooperation with democratic countries**

**Designating emerging technologies as focus areas in higher education**

### Organizational practices

**Sharing information on the downsides of Chinese investments**

**Reporting influencing attempts**

**Applying restrictive criteria to citizenship in strategic sector companies**

**Including non-compete and non-disclosure agreements in contracts**

**Surveillance of employees in critical sectors**

/ 3

# 3. SUPPLY DISRUPTIONS 2030

**Elina Sinkkonen, Liisa Kauppila and Ines Söderström**

The underlying assumptions that used to prevail on trade and interdependence are fundamentally changing. For a long time, globalization and technological development supported a trend towards optimized demand-driven supply chains, with lower inventories and just-in-time deliveries.[107] A business-driven logic seeking lower costs and economic efficiencies trumped national concerns related to domestic production and security. While such a logistics system enables economic and less wasteful manufacturing, the scarcity of inventories can turn out to be problematic in times of supply disruptions. In recent years, the world has experienced three major shocks that have greatly influenced the way supply chain resilience and economic interdependence are viewed globally: First, the Sino-US trade war during the Trump administration raised tariffs on Chinese exports. Next, the Covid-19 pandemic halted production and logistics. Finally, the Russian war of aggression against Ukraine manifested the geopolitical risks of dependence on an autocracy.

There are also more deep-seated trends beyond the headline events. Increasing great power rivalry and rising protectionism have brought back strong state actors in the economic sphere, and Western countries have altered their industrial policies. The US has introduced policies to build up US-based manufacturing capacity to avoid supply security risks,[108] and the European Commission frequently talks about increasing self-reliance in critical raw materials, medicines and alike.[109]

In a world characterized by great power competition and increasingly complex and vulnerable supply chains, the anticipation of supply security crises has also become difficult. Preparing for supply disruptions requires

107 Christopher and Ryals 2014.

108 The White House 2021.

109 European Commission 2023a; Miglierini 2023.

funds for stocks and their supervision, which in Finland are organized through the National Emergency Supply Agency (NESA). Stockpiling, however, is not a sufficient strategy as complex risks create the need to adopt a whole-of-society approach to crisis preparedness. Moreover, there are limits to the amount and types of goods that can and should be stored in the national preparedness stock, and there are critical goods which are not part of the current stockpiles. As a society, Finland needs to have a continuous discussion about the nature of its current and future supply security risks and efficient ways to mitigate them. In the future, risks are likely to materialize in sectors that are not currently listed as the National Emergency Supply Agency's core themes.

The three cases selected for the scenario exercises on the broader theme of supply disruptions vary in terms of likelihood and scope. They present imaginary future situations in which the Finnish government's ability to guarantee sufficient critical supplies and services might be compromised. With heightened political tensions, the challenges or threats are not limited to China-related potential harms and dangers but extend to issues emerging from third countries' bilateral relations with China, possibly placing a country like Finland in a difficult position.

The mid-term target year 2030 was chosen because all the cases involve characteristics that need some time to mature before they can pose serious problems to Finnish society, even though the first scenario, which deals with the risks of antibiotics dependency, could materialize in the Finnish healthcare sector on a smaller scale already today. Over a longer timeframe, antibiotic resistance is likely to worsen, which highlights the importance of drugs such as our example antimicrobial vancomycin that can be used against resistant bacteria. In the second case, we look at the energy transition and wind power in particular. As Finland aims at becoming carbon neutral by 2035, large-scale green energy projects must be operational by then. Since wind power plays a key role in Finland's national strategy for reaching this aim, a number of new wind farms must be under construction by 2030. In our third scenario, we focus on potential dangers that threaten water management processes, which are crucial for the functioning of municipal water supply systems and basic industrial manufacturing processes. By focusing on membrane technology, we selected a concrete example that is already now a domain of great power rivalry – and whose application in the Finnish context is likely to increase over time.

The Delphi panellists were given a one- to two-page-long briefing in Finnish on each sectoral case to contextualize the comic strips and present some of the crisis situations and/or facts we used as an inspiration when building the scenarios. These background briefings were collected into

a file, which can be accessed on the ForAc project's website.[110] Their key points are also summarized at the beginning of each section. These case descriptions are followed by the comic strips, after which we discuss the policy suggestions given by the panellists.

### 3.1. DISCRIMINATORY PRACTICES LIMITING ACCESS TO PHARMACEUTICALS: ANTIBIOTICS

Modern medicine relies on antibiotics. Around a third of patients in Finnish hospitals take antibiotics in conjunction with medical operations, the most extensive of which could not be performed at all without intravenous antibiotics because the risk of infections would be too high.[111] The supply chains of antibiotics suffer from weakening resilience: the production of antibiotics is not very profitable as it relies on old patents. The economic incentives to develop new products are few because antibiotic resistance limits the distribution of new drugs. Due to the above, many companies have left the whole industry, and production is heavily concentrated on the China–India axis.[112] As an example of the weakening supply chain resilience, an explosion in a single Chinese factory that produces the active pharmaceutical ingredient (API) of piperacillin–tazobactam led to global delivery problems in 2017.[113]

According to estimates, more people will die due to antibiotic resistance than cancer in 2050.[114] While many antibiotic products can be replaced, there are medicines such as vancomycin that are hard to replace because they are wide-spectrum medicines that can be used for hospital-acquired infections.

A European Commission–funded study from 2021 reports that medicine shortages have become more frequent in recent years.[115] Finland stocks antibiotics (mandatory reserve supplies) to cover average demand for ten months, which is partly why no serious shortages have yet occurred. There have been talks about stockpiling antibiotics and other medicines on the EU level, but no union-wide system is in place at the moment.[116]

110 ForAc report background page. Available at: https://sites.utu.fi/forac/fi/raportti/

111 Review on Antimicrobial Resistance 2014.

112 European Commission 2021.

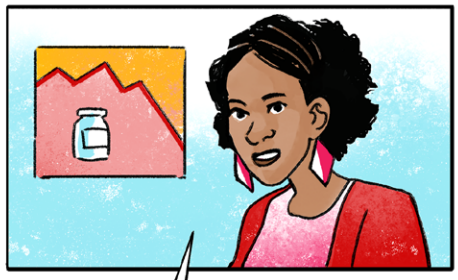
113 Access to Medicine Foundation 2019; Davis 2017.

114 Review on Antimicrobial Resistance 2014.

115 European Commission 2021; European Commission 2020a, 5; European Commission 2020b, 11, 30.

116 Miglierini 2023.


News
1 Feb 2030
Political retaliation and preferential practices:
Antibiotic reserves at critically low levels in Finnish hospitals
PHEW... HOME AT LAST!
TIANXIA, TURN ON THE TV... AND SWITCH ON THE SAUNA!
KLIK
UUTISET+
ok, Esa!
This is Plus News Finland, good evening!

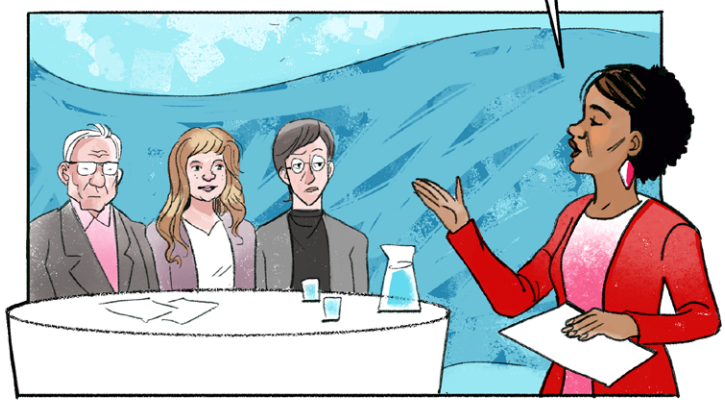


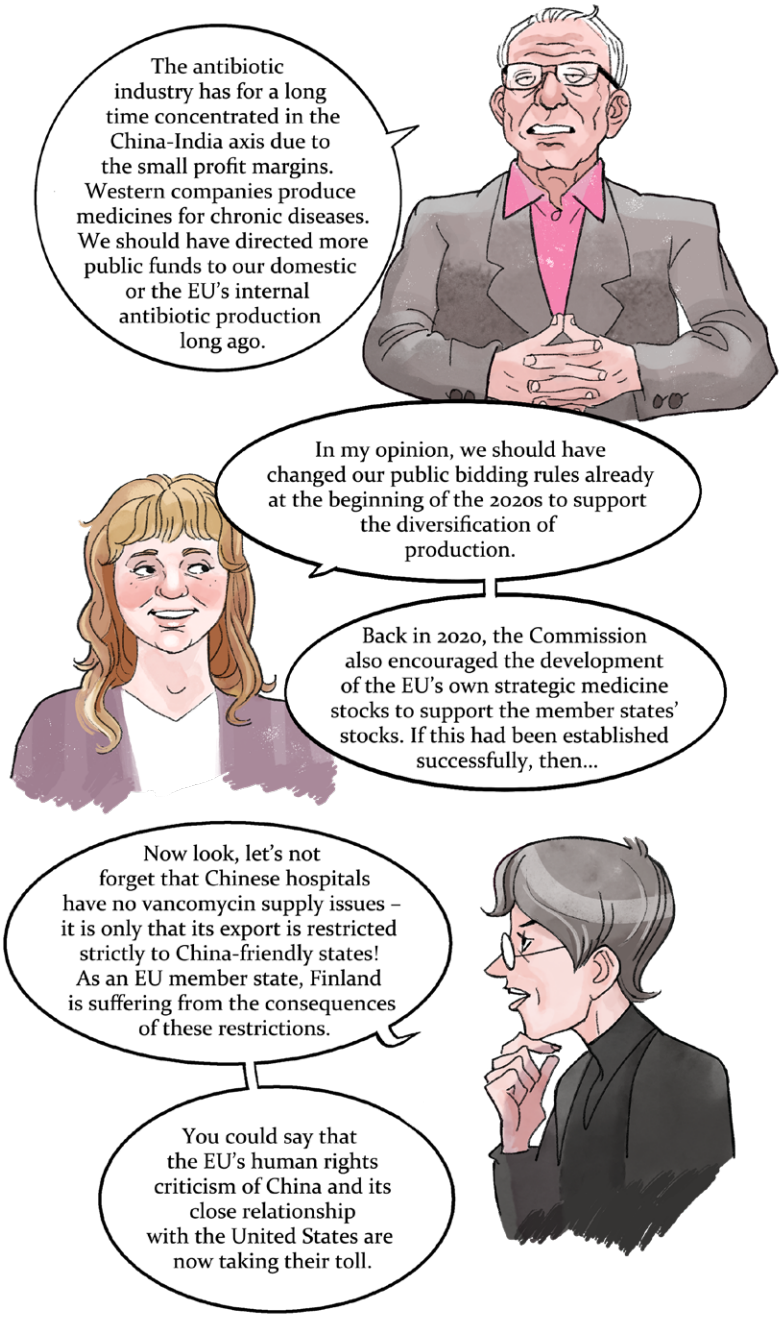
Our top story today: Finnish hospitals are struggling with critically low reserves of the vancomycin antibiotic, which is commonly used to treat illnesses such as pneumonia and blood poisoning.

In recent years, vancomycin has become more important due to the spread of antibiotic-resistant strains of bacteria. The Chinese-Indian supply chain for vancomycin was disrupted in last July following an explosion in a Chinese factory. Since December, Finnish hospitals have been supplied from the National Emergency Supply Agency's reserves.

If the availability of antibiotics does not improve, commonly curable diseases will soon threaten human lives. There is also a risk of considerable decrease in surgical operations as the vancomycin shortage has also increased the demand for antibiotics used in surgeries, contributing to their supply disruptions as well.

Next up, we have The Daily Debate, in which our commentators tackle the situation.




The antibiotic industry has for a long time concentrated in the China-India axis due to the small profit margins. Western companies produce medicines for chronic diseases. We should have directed more public funds to our domestic or the EU's internal antibiotic production long ago.
In my opinion, we should have changed our public bidding rules already at the beginning of the 2020s to support the diversification of production.
Back in 2020, the Commission also encouraged the development of the EU's own strategic medicine stocks to support the member states' stocks. If this had been established successfully, then...
Now look, let's not forget that Chinese hospitals have no vancomycin supply issues – it is only that its export is restricted strictly to China-friendly states! As an EU member state, Finland is suffering from the consequences of these restrictions.
You could say that the EU's human rights criticism of China and its close relationship with the United States are now taking their toll.


YEAH, I'M HOME FROM WORK. HOW'S IT GOING AT THE HOSPITAL? IS MIRA COMING HOME TODAY?
...HUH? BUT WASN'T IT SUPPOSED TO BE SOMETHING THAT'S EASILY TREATABLE?
WHAT DO YOU MEAN THERE'S NO MEDICINE AVAILABLE?
Dear experts, how could this situation have been avoided?
Hyden23

The case of EU-wide dependency on China and India in the production of antibiotics has been covered in the media and is widely known.[117] Consequently, this topic evoked numerous concrete suggestions, indicating that our panellists found the topic easy to comment on. They were rather unanimous in their views in terms of suggested solutions. Only the issue of tightening the compulsory stockpiling requirements as a solution to supply chain problems evoked a few differing viewpoints. There were fewer responses to other panellists' comments than in the other topics. According to the voluntary question asked after the main panel questions, nobody found the scenario unlikely.

On a broader level, the panellists noted that China creates problems due to its size and overall importance, not (only) due to malicious activities. For example, one panellist argued that "few would claim that China intentionally started the coronavirus pandemic, but by under-investing domestically, it indirectly contributed to it." Another linked the antibiotic supply chain case to the broader discussion on the EU's strategic autonomy and its definition, pointing out that "strategic autonomy (also) means developing European education, academic knowledge and research. With these, we will be able to react quickly to situations such as the Covid-19 pandemic, which created a need to develop new vaccines."

**Expert suggestions**

*Diversification of production and increasing self-reliance*

The diversification of production in various ways was the most often mentioned theme among all the suggestions. Panellists recommended bringing (parts of) the essential medicine production to the EU countries, G7 states or other friendly countries (friendshoring). It was also suggested that partnerships should be created with countries that develop medicines. On the other hand, panellists recommended decoupling supply chains from authoritarian states and, more precisely, decreasing trade with China. The suggestions on diversification often included comments about subsidies for production and/or accepting higher medication prices as part of the diversification efforts. The need to continue mapping out critical production and supply dependencies was also mentioned in this context.

One panellist pointed out that the diversification of antibiotic production should not be restricted to APIs or medicines:

> *In particular, EU-level supply chain resilience and production prices should be on sustainable levels especially when it*

117 Hiilamo 2021; Matikainen and Tolsa 2023.

*comes to microbial medicines and cytotoxins, which require special production facilities, as well as IV medications. Yet it is not enough to produce APIs in Europe if the supply chain contains critical actors or material producers in countries outside the union. Furthermore, we should also investigate the dependencies related to the machinery needed in medical production.*

*Legislative and regulatory changes*

The legislative and regulatory suggestions covered both domestic and EU-level actions. On the domestic front, it was suggested that Finnish healthcare districts should be responsible for their own emergency stockpiling. Multiple panellists supported the easing of the regulation of new medicines to improve market access. Measures such as lifting patents and licensing new medicines were also mentioned.

On the international front, panellists suggested measures such as unifying regulation with other countries and creating larger market areas, which would improve profitability and help medical companies enter the antibiotics markets. One suggestion was to introduce cross-licensing for medicines between the EU and the US.

*Improving market conditions and the existing system of emergency stockpiling*

The suggestions to improve market conditions included measures such as providing public investment support for sectors in which competition is too limited to enable diversified sources of products. The profitability concerns related to public tendering processes were also mentioned many times. One panel member found it important to maintain a continuous discussion on what "critical" means in the context of medicines so that necessary mechanisms can be created to ensure the supply of the needed materials.

The Finnish emergency stockpiling system received praises, and many panellists mentioned its upkeep and improvement as priorities. It was suggested that EU factories should maintain reserves of critical components. There was some disagreement on whether the stockpiling obligations should be increased to cover more medicines or larger quantities of the stockpiled products, or whether more emphasis should rather be placed on making it more lucrative for medicine producers to enter/stay in the market. Increasing producers' responsibilities could push companies further away from antibiotics production.

### 3.2. SANCTIONS ON GREEN TRANSITION MATERIALS, COMPONENTS AND MINERALS: WIND ENERGY

The war in Ukraine has speeded up Europe's green transition, which requires huge amounts of energy transition metals. Currently, lithium, nickel, cobalt, manganese and graphite are crucial to battery performance. Rare earth elements are needed to produce permanent magnets for wind turbines and motors for electric vehicles, and electricity networks need a huge amount of copper and aluminium.

Ironically, the reliance on wind energy may actually increase Europe's dependency on China. Of the materials needed in wind energy projects, only 1% is produced in the EU area. The EU's role is only significant in the assemblage of wind turbines, in which its global share is 58% (China's is 23%). Furthermore, China plays an important role in producing the rare earths and critical minerals (54%) needed for wind turbines, as well as in the supply chains of processed materials (41%) and components (56%).[118] China has invested in mining across the world, and its role in processing and refining is significant.[119] Even many of the materials mined in Europe are processed elsewhere, which means that the dependencies on external actors are not restricted to raw material acquisition.

According to the International Energy Agency (IEA), the long-term prospects for the supply of raw lithium are grim especially with regard to lithium chemicals as China produces around 60% of lithium chemicals as well as 80% of lithium hydroxide.[120] Lithium hydroxide is used in electric cars and batteries for energy storage. In stationary batteries, used to balance the fluctuations in wind energy production, lithium can be replaced with other metals such as vanadium. Ten per cent of global vanadium reserves reside in the Nordic countries.[121]

The European Commission has expressed worries about the EU's dependence on raw material imports. It states that the EU should diversify its sources of critical minerals and increase production in Europe to improve self-sufficiency and avoid becoming too dependent on any one actor.[122] After the scenario exercise was held, the Commission published an update to its lists of critical and strategic raw materials. It also set new goals for the EU to ensure secure and sustainable access to raw materials so that by 2030, "not more than 65% of the Union's annual consumption

118 European Commission 2020b, 11, 30.

119 IEA 2022, 11–12.

120 IEA 2022, 140–142.

121 Eilu et al. 2021, 6.

122 European Commission 2020a.

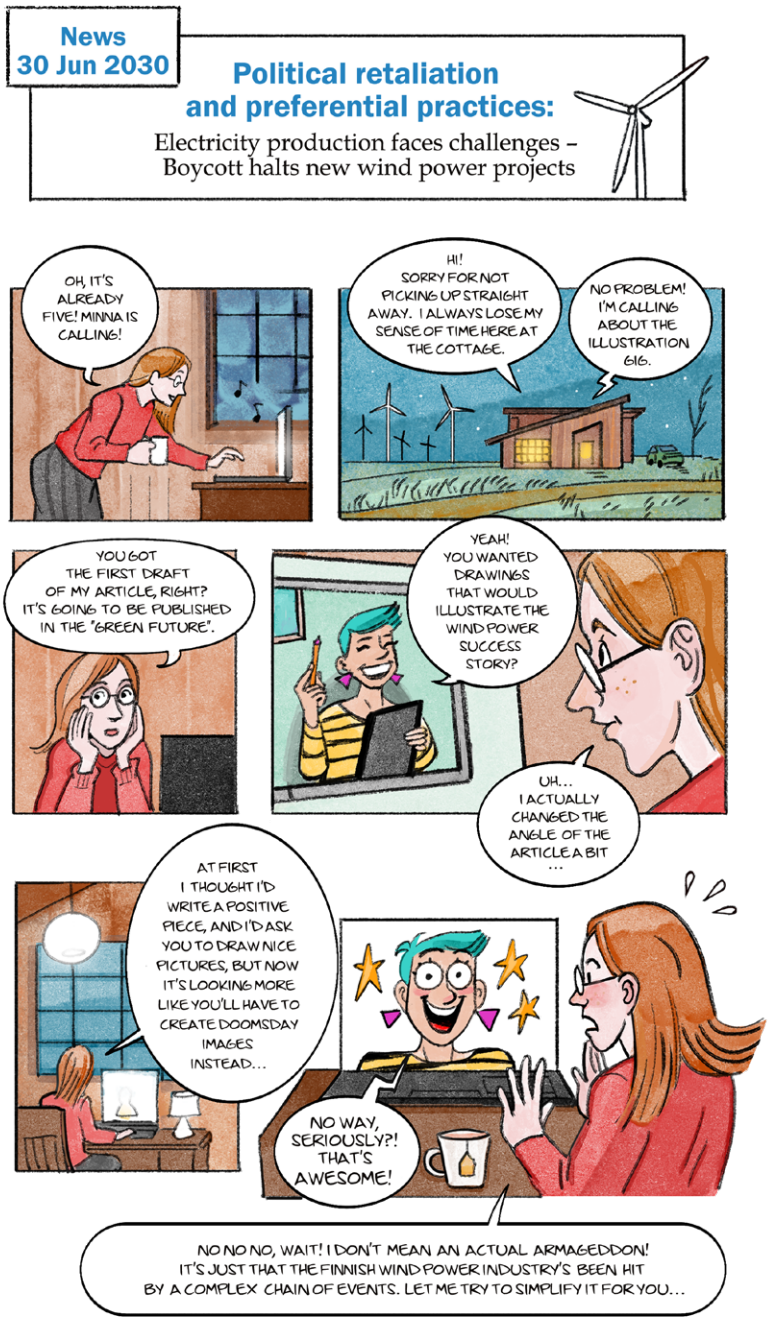
of each strategic raw material at any relevant stage of processing is from a single third country."[123]

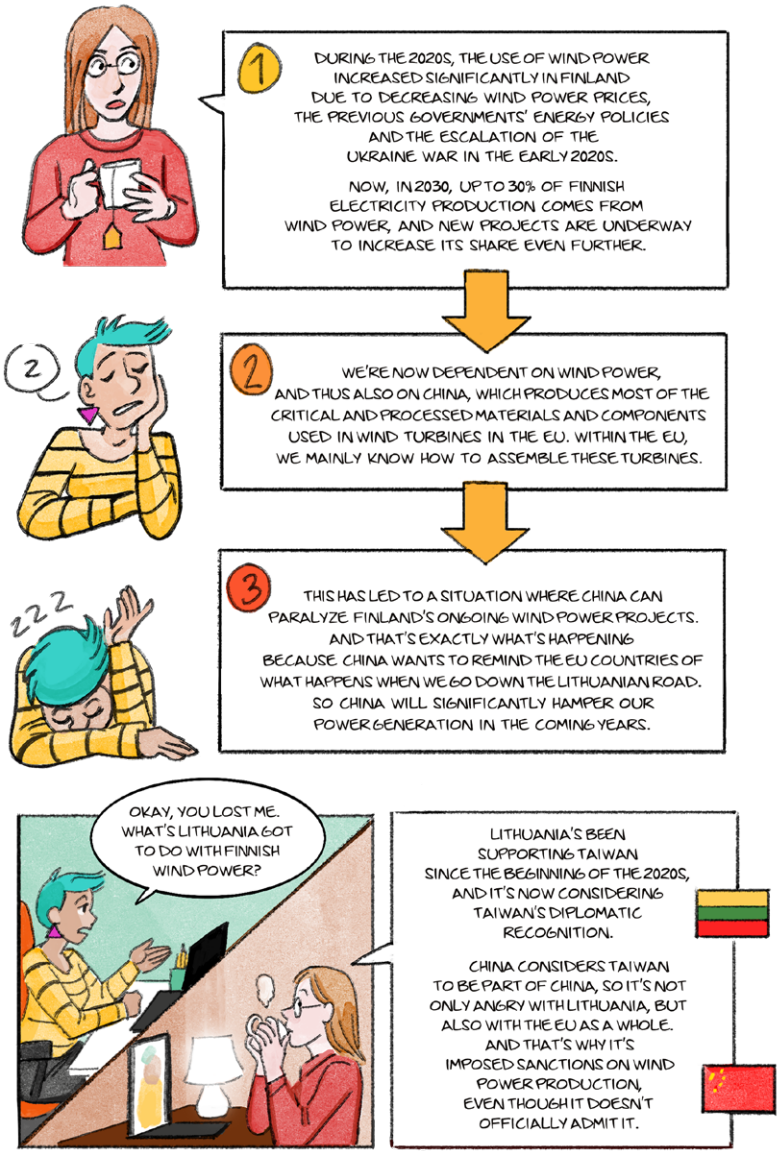
In Finland, emission-free energy options are increasingly important, with 52% of electricity consumption in 2020 produced by renewable energy. In a poll conducted by the Finnish Broadcasting Company in 2019, multiple parties supported increasing the amount of wind power to 30% of total production by 2030.[124] There are multiple projects supporting the EU's aim of improving its self-sufficiency of raw materials and the green transition more broadly. The Finnish National Battery Strategy 2025 was published in 2021 with the aim of creating a battery cluster that would support the "Finnish transition to a low carbon model of economic growth".[125] At the moment, Finland has two projects related to lithium and its refinement.

123 European Commission 2023a.

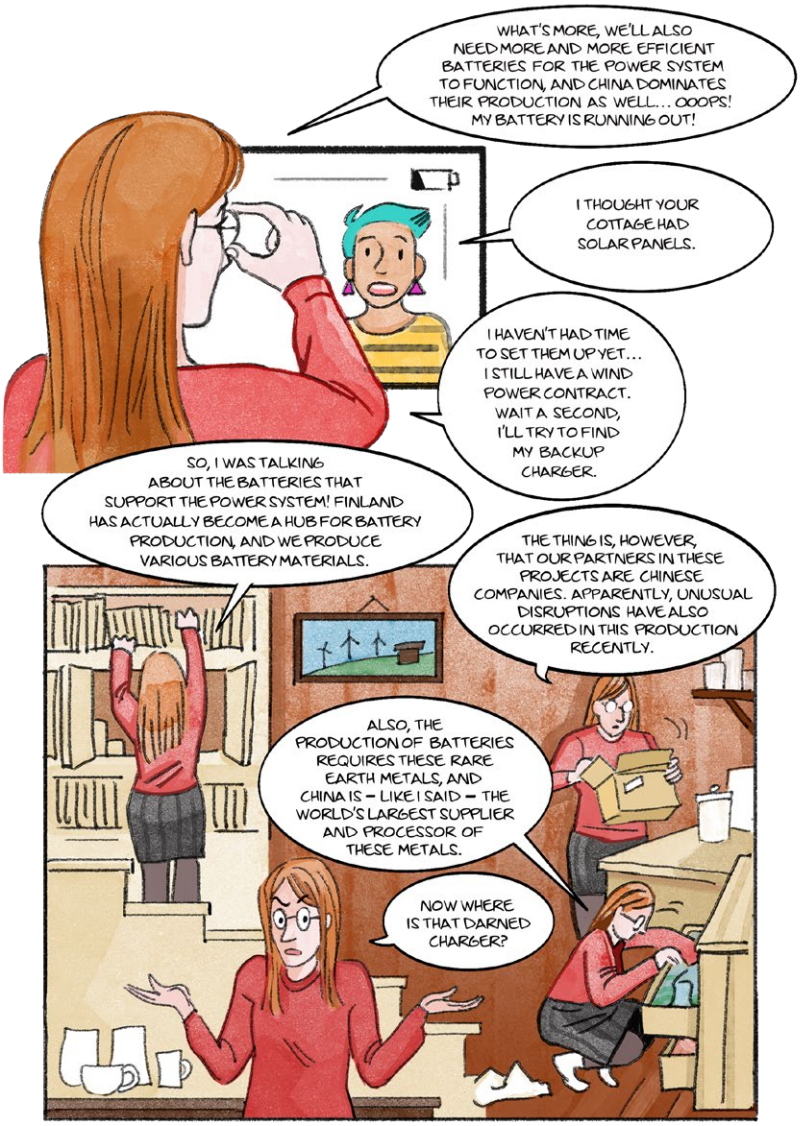
124 The Finnish Broadcasting Company 2019.

125 Finnish Ministry of Economic Affairs and Employment 2021.


News
30 Jun 2030
Political retaliation and preferential practices:
Electricity production faces challenges – Boycott halts new wind power projects
OH, IT'S ALREADY FIVE! MINNA IS CALLING!
HI! SORRY FOR NOT PICKING UP STRAIGHT AWAY. I ALWAYS LOSE MY SENSE OF TIME HERE AT THE COTTAGE.
NO PROBLEM! I'M CALLING ABOUT THE ILLUSTRATION 616.
YOU GOT THE FIRST DRAFT OF MY ARTICLE, RIGHT? IT'S GOING TO BE PUBLISHED IN THE 'GREEN FUTURE'.
YEAH! YOU WANTED DRAWINGS THAT WOULD ILLUSTRATE THE WIND POWER SUCCESS STORY?
UH... I ACTUALLY CHANGED THE ANGLE OF THE ARTICLE A BIT ...
AT FIRST I THOUGHT I'D WRITE A POSITIVE PIECE, AND I'D ASK YOU TO DRAW NICE PICTURES, BUT NOW IT'S LOOKING MORE LIKE YOU'LL HAVE TO CREATE DOOMSDAY IMAGES INSTEAD...
NO WAY, SERIOUSLY?! THAT'S AWESOME!
NO NO NO, WAIT! I DON'T MEAN AN ACTUAL ARMAGEDDON! IT'S JUST THAT THE FINNISH WIND POWER INDUSTRY'S BEEN HIT BY A COMPLEX CHAIN OF EVENTS. LET ME TRY TO SIMPLIFY IT FOR YOU...


1
DURING THE 2020S, THE USE OF WIND POWER INCREASED SIGNIFICANTLY IN FINLAND DUE TO DECREASING WIND POWER PRICES, THE PREVIOUS GOVERNMENTS' ENERGY POLICIES AND THE ESCALATION OF THE UKRAINE WAR IN THE EARLY 2020S.
NOW, IN 2030, UP TO 30% OF FINNISH ELECTRICITY PRODUCTION COMES FROM WIND POWER, AND NEW PROJECTS ARE UNDERWAY TO INCREASE ITS SHARE EVEN FURTHER.
2
2
WE'RE NOW DEPENDENT ON WIND POWER, AND THUS ALSO ON CHINA, WHICH PRODUCES MOST OF THE CRITICAL AND PROCESSED MATERIALS AND COMPONENTS USED IN WIND TURBINES IN THE EU. WITHIN THE EU, WE MAINLY KNOW HOW TO ASSEMBLE THESE TURBINES.
3
ZZZ
THIS HAS LED TO A SITUATION WHERE CHINA CAN PARALYZE FINLAND'S ONGOING WIND POWER PROJECTS. AND THAT'S EXACTLY WHAT'S HAPPENING BECAUSE CHINA WANTS TO REMIND THE EU COUNTRIES OF WHAT HAPPENS WHEN WE GO DOWN THE LITHUANIAN ROAD. SO CHINA WILL SIGNIFICANTLY HAMPER OUR POWER GENERATION IN THE COMING YEARS.
OKAY, YOU LOST ME. WHAT'S LITHUANIA GOT TO DO WITH FINNISH WIND POWER?
LITHUANIA'S BEEN SUPPORTING TAIWAN SINCE THE BEGINNING OF THE 2020S, AND IT'S NOW CONSIDERING TAIWAN'S DIPLOMATIC RECOGNITION.
CHINA CONSIDERS TAIWAN TO BE PART OF CHINA, SO IT'S NOT ONLY ANGRY WITH LITHUANIA, BUT ALSO WITH THE EU AS A WHOLE. AND THAT'S WHY IT'S IMPOSED SANCTIONS ON WIND POWER PRODUCTION, EVEN THOUGH IT DOESN'T OFFICIALLY ADMIT IT.


AWWH, OKAY. DOES THIS MEAN I HAVE TO DRAW POLITICIANS AND MAPS? I'M SORRY, BUT THAT MIGHT COST A LITTLE EXTRA.
HMMM... WOULD YOU BE ABLE TO DEPICT SUPPLY SECURITY?
NOOOOO! I COULDN'T! PLEASE, WORK WITH ME HERE! I NEED SOMETHING TANGIBLE!
YOU COULD MAYBE BASE YOUR ILLUSTRATIONS ON THE BASIC ELEMENTS OF WIND POWER! CHINA DOES NOT CONTROL THE WIND ITSELF, BUT IT DOMINATES ALMOST EVERYTHING ELSE RELATED TO WIND TURBINE PRODUCTION — EXCEPT FOR THEIR ASSEMBLY. AT THE MOMENT, CHINA REFUSES TO DELIVER MATERIALS, COMPONENTS AND SPARE PARTS, REGARDLESS OF ITS CONTRACTS.
AS I SEE IT, IT'S VERY DIFFICULT TO START OUR OWN TURBINE PRODUCTION. FIRST, WE'RE NOT ABLE TO PRODUCE THEM AS COST-EFFECTIVELY AS CHINA DOES. SECOND, WE LACK SIGNIFICANT QUANTITIES OF RARE EARTH METALS SUCH AS NEODYMIUM, PRASEODYMIUM AND DYSPROSIUM. THESE METALS ARE NEEDED FOR WIND TURBINE MAGNETS, FOR EXAMPLE
Nd
Pr
Dy


WHAT'S MORE, WE'LL ALSO NEED MORE AND MORE EFFICIENT BATTERIES FOR THE POWER SYSTEM TO FUNCTION, AND CHINA DOMINATES THEIR PRODUCTION AS WELL... OOOPS! MY BATTERY IS RUNNING OUT!
I THOUGHT YOUR COTTAGE HAD SOLAR PANELS.
I HAVEN'T HAD TIME TO SET THEM UP YET... I STILL HAVE A WIND POWER CONTRACT. WAIT A SECOND, I'LL TRY TO FIND MY BACKUP CHARGER.
SO, I WAS TALKING ABOUT THE BATTERIES THAT SUPPORT THE POWER SYSTEM! FINLAND HAS ACTUALLY BECOME A HUB FOR BATTERY PRODUCTION, AND WE PRODUCE VARIOUS BATTERY MATERIALS.
THE THING IS, HOWEVER, THAT OUR PARTNERS IN THESE PROJECTS ARE CHINESE COMPANIES. APPARENTLY, UNUSUAL DISRUPTIONS HAVE ALSO OCCURRED IN THIS PRODUCTION RECENTLY.
ALSO, THE PRODUCTION OF BATTERIES REQUIRES THESE RARE EARTH METALS, AND CHINA IS – LIKE I SAID – THE WORLD'S LARGEST SUPPLIER AND PROCESSOR OF THESE METALS.
NOW WHERE IS THAT DARNED CHARGER?


THE DRAFT YOU SENT ME MENTIONED FINNISH LITHIUM AND VANADIUM MINES, THE STORAGE POTENTIAL OF HYDROPOWER PLANTS AND THE POSSIBILITIES OF NUCLEAR POWER. WHY WON'T THESE SOLVE THE PROBLEM?
YOU KNOW, IT'S REALLY HARD FOR ME TO BELIEVE THAT A HIGH-TECH COUNTRY LIKE FINLAND IS UNABLE TO PRODUCE THESE THINGS ITSELF!
YEAH, THE LEVEL OF DEPENDENCE IS QUITE UNBELIEVABLE...
KIRSI? YOUR VOICE IS BREAKING UP ...
HEY, MAYBE I COULD HAVE CONTACTED AN EXPERT FOR THIS ARTICLE...
...AND ASKED THEM HOW THIS COULD HAVE BEEN AVOIDED?
HELLOOO? DID YOU RUN OUT OF POWER? A FORETASTE OF THINGS TO COME?
Hyperia73

Russia's war of aggression against Ukraine was clearly an instance that contextualized the wind power scenario for many of the panellists (problems associated with dependencies on authoritarian countries were often mentioned), and the topic was easy for the experts to comment on. Their suggestions concentrated on the diversification of energy sources but varied in content. A few respondents found the scenario unlikely.

Respondents recommended further analysis of risks and dependencies and ensuring technical know-how in important industries such as wind power. The questions that addressed the recycling of green minerals and mining in Finland evoked differing views. There was also discussion on whether Finland or Chinese actors' investments in Finland have any relevance to China. One panellist argued partly for the sake of discussion that Chinese investments in Finland, or in the Finnish battery cluster in particular, are not unequivocally a risk to Finland. The panellist continued by stating that the more investments China makes in Finland, the higher its threshold will be to act against Finnish interests. Another panellist countered this logic by asking whether China really thinks this way, or whether we only construct such ideas based on our own thinking. After all, the assumptions many people had about Russia turned out to be misplaced. When it comes to Chinese investments abroad, does even their total value in all countries bear relevance to China? The first panellist agreed that the Finnish economy is so small that it does not matter to China, but at least currently bilateral diplomatic relations do matter, even though this might not be the case in the future.

## Expert suggestions

*Diversification of sources and increasing self-reliance*

The diversification of energy sources was mentioned from various angles. Our respondents were in favour of the diversification of essential products, components and raw materials. Decreasing the use of energy sources dependent on China was one view. On the other hand, measures to improve self-sufficiency in the energy sector were part of the often-mentioned solutions.

The EU played a role in multiple suggestions aiming at decreasing dependencies in the energy supply chain. Panellists suggested that the manufacturing of strategic products should be moved back to the EU or partner states, and that a common EU-level energy supply system should be established. More cautious proposals wished to ensure access to minerals through close cooperation with the EU and allied states. Some experts worried about foreign ownership and proposed that the ownership of

energy producers should stay within the EU. Funding programmes within the union were also mentioned among the efforts to increase self-reliance.

The green technologies and the best energy palette for Finland evoked discussion. There were a few nuclear power supporters among the experts. They saw nuclear power as an efficient way of improving self-sufficiency and wanted to increase its share because the goal of wind energy covering 30% of electricity production might be too ambitious. In addition to traditional nuclear power, small modular reactors (SMRs) were seen as a future energy solution.

The measures aiming at improving the supply security of critical raw materials divided respondents. Many experts argued that few reasons exist to oppose mining in Finland under the current circumstances in which the EU countries are heavily dependent on Chinese materials and refining. They preferred investments to enable the mining of rare earths in Europe instead of depending on China. One panellist phrased the dilemma: "Supply security and self-reliance are in contradiction with nature preservation already now. Is it better to mine battery metals in Finland or import them from Russia or Africa? These issues will need to be decided now." Green energy storage solutions and their investment environment were also discussed, and the diversification of sources was supported. Experts hoped for investments in the Finnish battery cluster from domestic or "friendly" actors.

The recycling of critical materials was an often-mentioned topic, and the need for know-how on the recycling of wind power components in Finland was emphasized. While some were hopeful about the potential of recycling, others offered sobering comments pointing out that recycling can only play a role around 30 years after the building of a wind power station. As one expert put it:

> *Dependencies on Chinese rare earths are an important point. Europe should invest in its own material production. Wind power plants can be recycled, but their operating time is 30 years, which means that recycled material will be available from 2040 or 2050 onwards. Consequently, at the current building stage, there is a need for new materials. Building wind energy to cover 30 to 50% of electricity consumption requires power-to-heat systems and green hydrogen or hydrogen derivatives, including heat and hydrogen storages. Investing in green hydrogen at the same rate as wind energy is a challenge, as is the need to consume electricity flexibly. Batteries are needed, but if consumption flexibility functions well, the need for batteries will mostly concern the transportation sector*

*(electricity contracts based on exchange electricity and home/building energy management systems (HEMS/BEMS)[126]).*

Finally, some experts were hopeful that innovations could help in the diversification efforts. Innovations in new energy storage capabilities and new energy sources such as hydrogen were mentioned.

*Legislative and regulatory changes*

A few responses concentrated on the legal or regulatory aspects. As some panellists viewed SMRs as a promising future technology, they suggested that the legal landscape should be investigated to remove any regulatory obstacles. They also promoted flexibility in giving out permits for SMRs. The supervision of foreign ownership structures might also require legislative changes. One panellist suggested tariffs on products that use Chinese critical materials to improve domestic or EU-level production.

*Improving market conditions*

One panellist suggested the establishment of a new energy market system, which would ensure the profitability of secure energy production. Multiple participants favoured the stockpiling of raw materials and components. This is something that the EU Commission mentioned in its "Proposal for establishing a framework for ensuring a secure and sustainable supply of critical raw materials", which was published after the Delphi exercise was held.[127] In addition, it was suggested that the efficiency of energy transfers should be improved within the Nordic countries or even the whole EU, and that local-level energy saving plans should be created to manage consumption.

## 3.3. POLITICAL RETALIATION LIMITING ACCESS TO COMPONENTS NEEDED IN CRITICAL SERVICES AND INDUSTRIAL PROCESSES: WATER TREATMENT

Modern societies rely on efficient water management processes. Although 71% of the earth's surface is covered by water, it cannot be used for public services and industrial processes without treatment. China and the US are global leaders in water treatment technologies, and great power rivalry is clearly visible in the sector. Membrane and ion exchange technologies are specific examples of related global dependencies on Chinese

126 Home/building energy management systems are integrated, computerized systems for controlling energy-related equipment such as heating, ventilation, air conditioning, lighting and power systems and alike.

127 European Commission 2023b.

and American companies, and major national investments and company acquisitions have further concentrated their supply chains.[128] The scenario focuses on the former solutions, which rely on water membrane filters and offer an energy-efficient and sustainable alternative for wastewater management. At the moment, the US is their largest and China the second largest exporter,[129] and especially China's market share can be expected to further increase in the midterm: it has been among China's national development goals since 2012, and, notably, it was listed in the Made in China 2025 policy paper published in 2015[130].

Although membrane-based solutions are currently piloted and used in Finland, they do not yet constitute the primary water treatment method in municipal water supply plants, for example. However, by the end of the decade, their popularity is likely to increase substantially.[131] Moreover, their application is not limited to public utility services since they are also widely used in places where water must be reclaimed from wastewater streams, such as ships.

Given the critical nature of water management technologies, disruptions in their supply can have a major impact on the functioning of Finnish society. This poses a major challenge to stockpiling, which is the main way to manage sudden supply disruptions. Currently, no statutory regulations are in place that obligate Finnish suppliers of water management components to maintain compulsory buffer stocks, and the contents of the NESA's emergency stockpiles are classified for security reasons. According to an expert interview, it is however likely that the Finnish stockpiles do not include all the critical components used in water management processes.[132] In any case, awareness of the nature of Finland's national crisis preparedness in this field is low, even within the industry itself.

128 Interview with a Finnish water management expert, 19 Dec 2021. The US and China's strong standing is also evident in the number of global patents, scientific articles and citations to them, e.g., Wang and Wang 2019.

129 Volza Grow Global 2023.

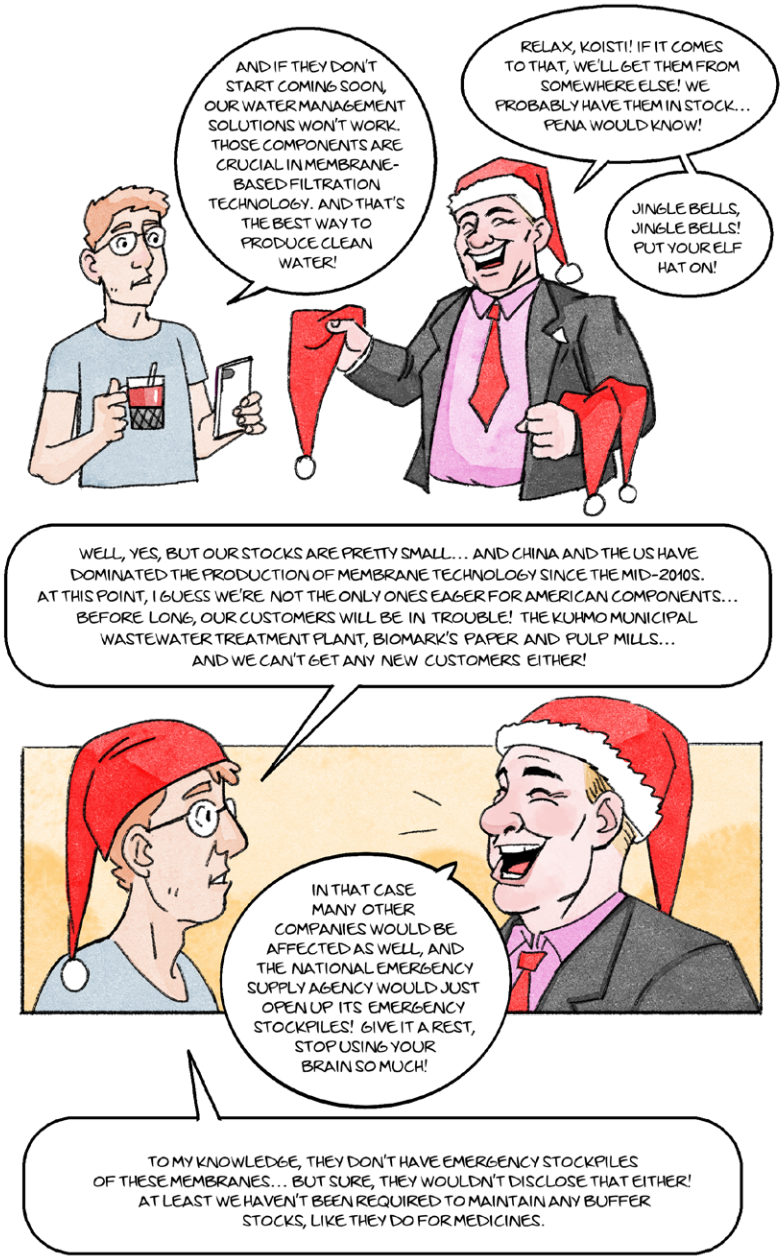
130 State Council of the PRC 2015.

131 Future Market Insights 2022. For a more general discussion on the possible future role of membrane technology in Finnish water management processes, see AFRY 2020.

132 Interview with a Finnish water management expert, 19 Dec 2021.


News
13 Dec 2030
Political retaliation:
China imposes sanctions on water management tehcnology – Is our water supply and sewerage heading towards a crisis?
H2O
Our main story on tonight's Daily Debate concerns the Taiwan Strait crisis.
China has recently strengthened its presence in the area, establishing a new biodiversity research station and conducting large-scale military exercises. US intelligence also believes that the hacker group responsible for the cyberattack that paralyzed Taiwan's power grid in November was supported by the Chinese government.
However, the US has refrained from sending patrols to the area. Instead, the Turner administration imposed extensive economic sanctions on China at the end of November...
Today, we imposed an unprecedented package of financial sanctions!
... The EU has also joined this effort. The extent of China's retaliatory sanctions and their impact on Finland's supply security are only beginning to be understood, but experts are particularly concerned about the vulnerability of supply chains.


Our studio guests today are political experts, professors Mattgren and Harju...
HERE'S YOUR GLÖGG. I'LL PUT IT ON H2O TECH'S TAB, RIGHT?
UH, YEAH,
PUT THE PHONE AWAY, KOISTINEN! THE WORKDAY IS OVER! WE'VE WRAPPED UP THE FINAL QUARTER! COME ON, TIME TO SWITCH FROM WATER TO SOMETHING STRONGER, HAHA!
jingle bells jingle bells
WATER'S WHAT MATTERS
NO, BUT... IT'S JUST THAT WE'RE STILL NOT GETTING ANY WATER FILTRATION MEMBRANES FROM CHINA.


AND IF THEY DON'T START COMING SOON, OUR WATER MANAGEMENT SOLUTIONS WON'T WORK. THOSE COMPONENTS ARE CRUCIAL IN MEMBRANE-BASED FILTRATION TECHNOLOGY. AND THAT'S THE BEST WAY TO PRODUCE CLEAN WATER!
RELAX, KOISTI! IF IT COMES TO THAT, WE'LL GET THEM FROM SOMEWHERE ELSE! WE PROBABLY HAVE THEM IN STOCK... PENA WOULD KNOW!
JINGLE BELLS, JINGLE BELLS! PUT YOUR ELF HAT ON!
WELL, YES, BUT OUR STOCKS ARE PRETTY SMALL... AND CHINA AND THE US HAVE DOMINATED THE PRODUCTION OF MEMBRANE TECHNOLOGY SINCE THE MID-2010S. AT THIS POINT, I GUESS WE'RE NOT THE ONLY ONES EAGER FOR AMERICAN COMPONENTS... BEFORE LONG, OUR CUSTOMERS WILL BE IN TROUBLE! THE KUHMO MUNICIPAL WASTEWATER TREATMENT PLANT, BIOMARK'S PAPER AND PULP MILLS... AND WE CAN'T GET ANY NEW CUSTOMERS EITHER!
IN THAT CASE MANY OTHER COMPANIES WOULD BE AFFECTED AS WELL, AND THE NATIONAL EMERGENCY SUPPLY AGENCY WOULD JUST OPEN UP ITS EMERGENCY STOCKPILES! GIVE IT A REST, STOP USING YOUR BRAIN SO MUCH!
TO MY KNOWLEDGE, THEY DON'T HAVE EMERGENCY STOCKPILES OF THESE MEMBRANES... BUT SURE, THEY WOULDN'T DISCLOSE THAT EITHER! AT LEAST WE HAVEN'T BEEN REQUIRED TO MAINTAIN ANY BUFFER STOCKS, LIKE THEY DO FOR MEDICINES.


HMMM.
MY PAL NIEMINEN AT THE POLYTECHNIC SPOKE OF SOME OTHER WAYS OF PURIFYING WATER. MAYBE I OUGHT TO GIVE HIM A CALL...
JEEZ, KOISTINEN, IT'S TEN O'CLOCK ON A FRIDAY NIGHT, AND WE'RE HAVING THE COMPANY'S CHRISTMAS PARTY, SO COULD YOU PLEASE JUST CHEER UP A BIT!
HEY! I COULDN'T HELP BUT OVERHEAR WHAT YOU WERE TALKING ABOUT! IT'S SUPER INTERESTING! KOISTINEN, IN YOUR OPINION, HOW COULD THIS SITUATION HAVE BEEN AVOIDED?
OH, SURE, UHH....
YOU GOT THIS KOISTINEN! JINGLE ALL THE WAY!
VOI ETTÄ PUHAST VETTÄ
WATER'S WHAT MATTERS

Water management technology is not among the best-known domains of great power rivalry and strategic derisking. Moreover, China's strong position in this field can be viewed as a highly specific example of the country's key role in global supply chains. Against this backdrop, it is unsurprising that this topic is not discussed in the media, and the scenario itself was inspired by an expert interview.[133] Most likely, the less familiar nature of the case made it harder for the panellists to propose concrete preventive measures since they gave a comparatively smaller number of answers.

However, the unfamiliarity of the case encouraged some panellists to climb up the "ladder of abstraction"[134], which resulted in them asking more general questions, such as "Is it even possible to identify all the kinds of dependencies Finland has – even to the extent that it would be possible to prioritize which ones to reduce?" In a similar vein, another panellist viewed the case as a wake-up call that we tend to take many critical things for granted.

A handful of panellists commented on the actual content and plausibility of the scenario, and their opinions were clearly divided. Given that water management techniques are many, and that the comic strip and backgrounder mentioned only two, some panellists argued that the scenario was either too narrow in scope or focused on technologies that are currently less critical in the Finnish municipal water management processes. Nevertheless, the increasing significance of these example technologies was often acknowledged. Another reservation expressed by an individual expert was related to the lifespan of membranes: they emphasized that supply disruptions must last longer before issues arise. As a side note, one expert also underlined that the area in which Finnish water supply plants may in fact have more critical dependencies on Chinese components is their digitalized control and management systems.

Other panellists considered the scenario more plausible – or at least useful. For one panellist, the scenario and the expert views served as a good starting point for a more detailed discussion within the industry. Another added that the risks of potential disruptions could already materialize now. One expert also brought up the potential impact of such problems on electricity production since it relies on ultra-pure water, that is, water purified of all possible contaminants.

133 Ibid.

134 Hayakawa 1939.

## Expert suggestions

*Diversification of supply chains and increasing self-reliance*
Multiple panellists underlined the need to ensure Finland's independence from China, other authoritarian states and superpowers in water management technologies. Others merely underlined the need to avoid Finland's involvement in Sino-US great power rivalry by not joining the US' sanctions schemes, for example. As one expert suggested, a concrete way to reduce the country's dependency on China or the US would be the reshoring of water management components back to the EU. This would fall within the scope of the EU's strategic autonomy and call for investments in the EU's production capabilities and know-how, and extra costs should therefore be accepted. Multiple experts also noted that, on the level of individual companies focusing on specific technologies, supply chains should be diversified to reduce dependency on any single country. These efforts could be incentivized through regulation and subsidies – and initiated based on improved supply chain stress tests.

While the domestic production of all the critical components of water management processes may not be a feasible goal, increasing Finland's ability to react to sudden supply disruptions could potentially be safeguarded through 3D printing. Yet such a capacity would necessitate the building of a flexible cross-sectoral national system, as proposed by an individual panellist:

> *For decades, I have been emphasizing that the Finnish Defence Forces and other state and municipal organizations should turn to 3D printing and produce their equipment themselves whenever it makes sense. If one truly gains an understanding of the domains in which it is most beneficial to meet one's own needs through self-reliant production, it is possible to identify plenty of key components that can be printed without extra costs – especially if production and logistics costs are included. Through such a process, it is possible to establish a local production capacity that can always be redirected to critical needs.*

On the level of companies, trade partnerships and common projects could ensure access to larger stocks and therefore provide a strategy that would contribute to better crisis preparedness for domestic actors.

Finland's national capacity to react in a crisis is also dependent on ensuring that there is research, development and knowledge on the production, installation and maintenance of specific technologies in Finland

or the EU. It takes time to create new knowledge, and it is crucial to decide who is responsible for allocating educational responsibilities in a manner that supports Finland's supply security. Moreover, a major attitude change must take place: supply chain reliability must be emphasized along with profitability considerations.

*Legislative and regulatory changes*

The suggested legislative changes revolved around stockpiling regulations. Several panellists argued that all the critical components of water management processes should be included in the NESA's emergency stocks by law. A related suggestion, made by multiple experts, was to obligate companies to ensure sufficient stocks through mandatory reserve supplies, as is the case with antibiotics. One panellist proposed the development of mechanisms and legal tools to take over means of production in the event that foreign ownership becomes an issue.

Another proposed solution was international stockpiling, which would mean shared emergency stockpiling with friendly (Nordic) states, for example.[135] This suggestion should be understood against the backdrop of the sector's current realities: Finnish water supply plants use various water management solutions, and to ensure the provision of critical services across the country, national stockpiling would therefore need to cover a wide variety of critical components. Cross-border stocks would make it more realistic to achieve this goal.

*Awareness raising and strategic foresight*

Enhancing awareness of potential supply disruptions was viewed as one of the key means to prevent such crises from unfolding. To begin with, all dependencies in the field of water management should be mapped in detail, and extensive risk analyses should be conducted by engaging all key stakeholders, as proposed by multiple panellists. Such analyses should set standards for the minimum quantity of critical products maintained in stock and the amount of time that a plant or a company must be able to operate under all circumstances. Solutions to mitigate the risks should then be sought with the help of strategic foresight both nationally and regionally in Europe, and here the scenario exercise at hand was seen as a fruitful example. Moreover, such risk analyses would offer tools to think about national priorities. Which risks are worth taking, and how much are we ready to pay for stockpiling different things? In essence, this process would be a balancing act that should now be undertaken in Finland.

135 See e.g., Wigell et al. 2022b.

*Enhancing adaptability*

Two vocal panellists brought up the issue of adaptability to manage problems emerging from supply disruptions. Water supply plants should collaborate more, and some of them could possibly be merged. They could also have shared stocks. When selecting and designing water management processes for individual plants, adaptability should be a key attribute. In other words, the ability to transform the chosen solution into another should be considered to reduce excessive dependency on one technique or the product of a single producer.

## 3.4. DISCUSSION

Against the background of intensifying great power competition, the Covid-19 pandemic and the war in Ukraine, our expert participants demonstrated readiness to act in all scenarios: doing nothing was not an option. At the very least, awareness of risks should be raised. Panellists recognized that the enhancement of supply security would be costly. Respondents who leaned towards protectionism supported solutions that would restrict international trade, increase tariffs and provide subsidies for domestic or EU-level production. Legislative changes would be needed for the state to be able to take over means of production should foreign ownership become an issue. The US has promoted a similar strategy in its relation to China and encouraged this approach for the EU countries as well. Conversely, those in favour of a more liberal take on national preparedness tried to solve the issues by diversifying the sources of goods rather than blocking exports from certain countries. Adaptability and awareness of risks, rather than drastic changes in supply chains, were identified as key factors.

A third group of panellists tried to solve the issues with innovations or technical solutions: "Replace antibiotics with new medicines. Do not buy Chinese rare earths but rather produce your energy with SMRs. Produce membranes with 3D printing." How realistic or scalable such suggestions are varies case by case. For example, it has proven very difficult to replace antibiotics with something else, although there is always room for more research. SMRs, on the other hand, can certainly solve part of the energy puzzle, but this will not erase the original problem. Although 3D printing is a promising industry, it is costly since one piece of equipment cannot be used for a wide variety of products.

As expected, there were case-specific differences in risk awareness. The case of antibiotics was well known, the water management issues were less familiar, and the rare earth dependencies lay somewhere between

these two. However, we should not assume that Finland would necessarily be better prepared for a better-known risk – even in a sector in which both domestic and EU-level know-how is available. The familiarity of a case may even make it more difficult to solve the issue as it has lost its novelty value. At the other end of the awareness spectrum, more awareness raising would be needed to reach an adequate level of national preparedness in the water management industry.

### Tackling supply disruptions: Key takeaways

**Diversification and increasing self-reliance**

**Diversifying the national energy portfolio and its components**
- including small modular reactors (SMRs)

**Increasing the adaptability of technical solutions to enhance compatibility**

**Friendshoring the production of strategic and critical products**
- bringing the essential medicine production to the EU/G7/friendly countries
- maintaining ownership of energy producers within the EU
- reshoring the production of water management components back to the EU

**Establishing a common EU-level energy supply system**

**Subsidising the production of critical products and accepting higher prices**

**Improving supply chain stress-tests in a broader range of strategic areas**

**Legislative and regulatory changes**

**Unifying national regulations to create larger market areas**
- cross-licencing medicines with other countries

**Lifting patents and enabling easier licensing of new medicines**

**Removing legislative obstacles from new energy options, including SMRs**

**Incentivizing supply chain diversification on company-level through regulation**

**Improving market conditions and the existing system of emergency stockpiling**

**Developing public tendering processes by**
- placing quality considerations and stability over price considerations
- setting quotas for individual producers to avoid supply chain concentration

**Developing national and Nordic emergency stocks**
- stockpiling critical components of water management processes and raw materials and components of energy production nationally
- creating mandatory reserve supplies of water management components nationally/with Nordic countries/other friendly states

**Imposing tariffs on products using Chinese critical materials**

**Integrating the Nordic/EU energy markets to improve energy transfers**

**Awareness raising and strategic foresight**

**Conducting extensive risk and dependency analyses in wind power and water management industries**

/4

# 4. CRITICAL TECHNOLOGY DEPENDENCIES 2035

**Elina Sinkkonen, Liisa Kauppila and Ines Söderström**

Technological development has wide-ranging implications for great power politics and people's everyday lives. In recent years, the definition of dual-use technology has widened to cover many general-purpose technologies, which blurs the boundaries between economic and military activities. Due to increased great power rivalry, the spread of general-purpose technologies and related materials is facing multiple challenges, which may hinder global technological development and raise the costs for everyone.

The US and China are in the midst of a technology war. In October 2022, the Biden administration ordered a blockade on the export of advanced chips and related software, and the tariffs imposed during the Trump presidency are still in place. How much China's technological development will be hindered by the chip war remains to be seen, but advanced chips are needed for almost all high-tech products. More broadly, the technology war does not provide circumstances that would allow efficient technology transfers and development globally if scientists in the two superpowers try to solve the same issues without access to advancements made in the other block. In many emerging technologies, we do not yet know what kind of innovation environment will bring the best results. Chinese researchers based in China are among the world's leading scientists in multiple areas such as quantum communication and advanced battery production.[136] For small and medium-sized countries, the technology war causes multiple headaches not limited to the rising costs of technology. What if one superpower develops important and useful high technology in one sector and the other one in another sector? Can third

136 Howell 2023; Huld 2022.

countries access both technologies, or will bloc politics further limit the spread of innovations?

General dependencies can also decrease national preparedness. In a small country like Finland, there are multiple technological dependencies in high-tech sectors, and it might even be impossible to cover all these fields with Finnish or European solutions. High-tech sectors often have less leeway to reduce dependencies than sectors in which changes to legislation or stockpiling can significantly help, as described in the previous chapters. With the funding realistically available for enhancing Finnish supply security or other forms of preparedness, it might be difficult to mitigate some of the risks associated with high technology. The concrete actions will likely involve diplomacy and other forms of international cooperation, the results of which are less certain than in cases in which the problem can be solved with money only.

The longer-term target year 2035 was chosen as all the cases entail characteristics that need time to mature before they can pose serious problems to Finnish society. The first case focuses on advanced military technology, and more precisely on F-35 stealth fighter maintenance. Finland will receive its first F-35 fighter jets from 2026 onwards, so any issues in their maintenance will materialize after that. In the second case, we look at the digitalization of healthcare and home dialysers in particular. Given the sparse public resources, lack of personnel and increasing number of patients with such chronic diseases as type II diabetes, Finland has set an aim to increase the share of home dialysis treatments up to half of the patients by 2025,[137] and most likely, it will be making notable home dialyser purchases by 2035 to cover the needs of the rising number of chronic kidney disease patients.[138] In our third scenario, we examine one of the EU's critical raw materials, helium, and the consequences of its shortage. In addition to various current uses of "ordinary" helium, its rare form helium-3 is used in quantum technologies and fusion energy – two fields in which research and development is only about to take off on a larger scale. Moreover, given the extraterrestrial abundance of helium-3, experimental mineral exploration in space may be beginning around 2035.

The panellists were given a one- to two-page-long briefing in Finnish on each sectoral case to contextualize the comic strips and present some of the crisis situations and/or facts we used as an inspiration when building the scenarios. These background briefings were collected into a file, which can be accessed on the ForAc project website.[139] Their key points

137 Finnish Society of Nephrology 2021, 33.

138 It is estimated that the number of Finnish dialysis patients will rise to 2,600 from the current 2,000 by 2035.

139 ForAc report background page. Available at: https://sites.utu.fi/forac/fi/raportti/

are also summarized below, at the beginning of each section. These case descriptions are followed by the comic strips, after which we will discuss the policy suggestions given by the panellists.

### 4.1. MAINTENANCE OF ADVANCED MILITARY TECHNOLOGY: F-35 FIGHTER JETS

General-purpose technologies tend to spread widely, whereas prestige technology, which includes the most advanced military technologies, spreads slowly and often only among allies.[140] For small states, it would be very difficult to build the production facilities and employ the necessary people to launch domestic production of stealth fighters. The increased complexity of military technology has made it harder to close the technological gap with the most advanced countries simply by investing more resources in defence. In contrast to the early 20th century when technological know-how from commercial sectors was more directly applicable to the military sphere, today's military high technology involves the efforts of large teams of scientists whose expertise is increasingly tacit.[141] In addition, the process from military high-tech innovations to industrial production comes with its own hurdles.

In December 2021, Finland announced that it would buy 64 of Lockheed Martin's F-35A fighter jets to replace its Boeing F/A-18 C/D Hornets. The first batch of F-35 fighters is scheduled to arrive in 2026. According to the Finnish Air Force, the F-35 maintenance chain will consist of a modified version of the global maintenance system with additional critical domestic maintenance capabilities and spare parts for crisis situations as well as participation in a multinational maintenance network.[142] At the time of this scenario exercise, Finland had officially informed NATO of its willingness to join the organization but had not yet formally applied for membership.

The F-35 fuselage has been designed to accommodate three different jet types: F-35A, F-35B and F-35C. This has forced Lockheed Martin to make certain compromises.[143] Moreover, the purchase of the F-35 fighters also includes aspects that are simultaneously advantages and disadvantages. First, the fighters have been bought while their development is still in progress. This is an advantage because the development costs can

140 Drezner 2019.

141 Gilli and Gilli 2018/2019.

142 Finnish Air Force 2021.

143 Tuominen 2022.

be divided among multiple customers. On the other hand, any problems in the product development may decrease the reliability of the fighter. Second, Lockheed Martin aims to increase the production drastically up to 3,000 fighters,[144] and large-scale production strains both the production facilities and the maintenance chains. National fleets have a target availability rate for the number of fighters that should be operational at a given moment. In 2021, the US failed to reach its availability rate due to a lack of spare parts.[145] Finland bought 64 fighters partly because an estimated 20–30% of the planes will always be unavailable due to maintenance, and meeting the Finnish defence needs requires a sufficient number of operational fighter jets.[146] In general, the use of complicated technology may decrease reliability because complexities increase vulnerabilities. For example, each F-35 pilot has an individualized HMDS helmet (Helmet Mounted Display System),[147] meaning that a broken helmet could in itself lead to supply security issues as the delivery times for new helmets are long.

In 2021, the Pentagon reported that the F-35 fleet failed to meet all the requirements of the Joint Strike Fighter Operational Requirements Document (ORD) in areas concerning general reliability and maintenance.[148] The details of critical flaws are secret, but according to *Defence News*, seven such flaws occurred in 2020.[149] In May 2021, an independent evaluation of the Joint Strike Fighter programme concluded that the programme had not funded software testing sufficiently to ensure that flaws were removed before the products were delivered to customers. The software issues have concerned the logistics information systems designed to help organize the spare part orders.[150]

144 Congressional Research Service 2022.

145 Losey 2022.

146 *Lentoposti* 2019.

147 Tuominen 2022.

148 The Office of the Director, Operational Test and Evaluation DOT&E 2021, 50.

149 Insinna 2020.

150 DOT&E 2021, 48–53.

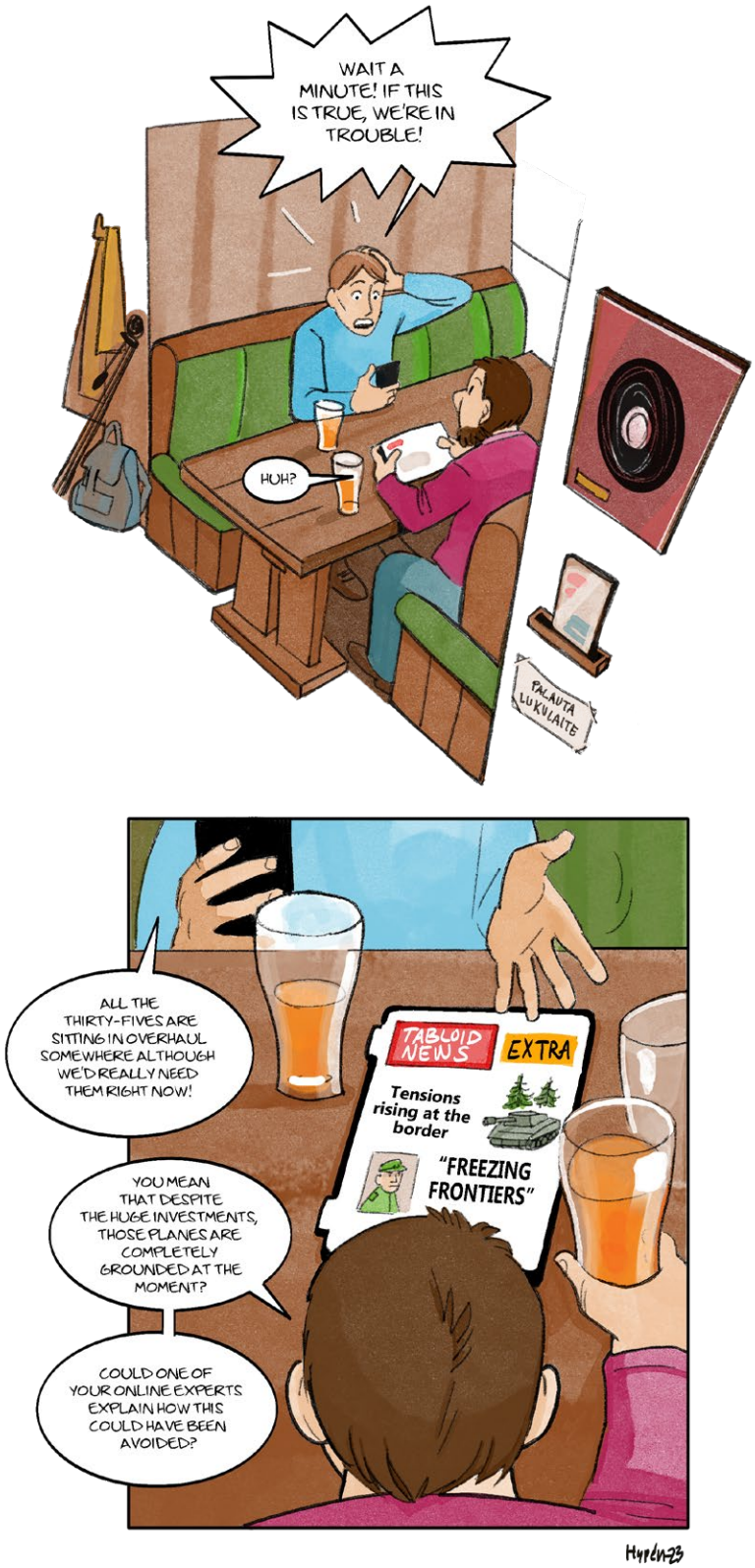
**News**
**15 Apr 2035**

## High-technology risks:

Problems in fighter jet maintenance chains lead to a drop in availability rates


NOPE, THAT'S THE OLDER MODEL.
WHAT ABOUT THOSE?
HMM. NO, NOT THOSE EITHER.
AND WE CLIMBED ALL THE WAY UP HERE TO GET A GOOD LOOK AT 'EM.
DEAR ME, NOT MUCH OF AN AIR SHOW WITHOUT A SINGLE ONE OF THOSE THIRTY-FIVES OF YOURS.
DO YOU FANCY A PINT?
I DON'T GET IT. FINLAND'S HAD THEM FOR YEARS. WE ORDERED 64 OF THEM. YOU'D THINK THAT THEY'D MANAGE TO BRING A FEW OF THEM TO THE SHOW. IT'S WEIRD.
PUB O'MALLEY


WHAT'RE YOUR FIGHTER ENTHUSIASTS SPECULATING? DID THE FLYING ACES LOSE THEIR PLANE KEYS THIS MORNING?
SOMEONE ON THE FORUM IS SAYING THAT LOCKHEED MARTIN IS PERFORMING MAJOR MAINTENANCE ACTIVITIES, AND THAT THE FINNISH FLEET'S AVAILABILITY RATES ARE LOW... BUT I THOUGHT WE WERE SUPPOSED TO MAINTAIN THEM IN FINLAND.
F35 KETJU
FIGHTER JET FRIENDS.FI
VOTE ★TURNER
Rullis: Lockhead bit off more than it could chew. That's what happens when you sell too many planes in relation to your production and maintenance capacity.
Besserwi$$er: And Mericans have nothing to worry about, it's just that Turner has no interest in supporting the defence industry if its products are going abroad. RIP, I say.
Hornetti86: And, of course, Finland decided to buy planes that were still pretty much in the development phase when they were bought.
Rullis: Thanks, Turner. Salute to you.


WAIT A MINUTE! IF THIS IS TRUE, WE'RE IN TROUBLE!
HUH?
PALAUTA LUKULAITE
ALL THE THIRTY-FIVES ARE SITTING IN OVERHAUL SOMEWHERE ALTHOUGH WE'D REALLY NEED THEM RIGHT NOW!
YOU MEAN THAT DESPITE THE HUGE INVESTMENTS, THOSE PLANES ARE COMPLETELY GROUNDED AT THE MOMENT?
COULD ONE OF YOUR ONLINE EXPERTS EXPLAIN HOW THIS COULD HAVE BEEN AVOIDED?
TABLOID NEWS
EXTRA
Tensions rising at the border
"FREEZING FRONTIERS"
Hyden23

Finland's decision to select the F-35 model was still recent, and the case was widely covered in the media prior to May 2022, when the scenario exercise took place. The scenario raised strong opinions, sharp remarks and counterarguments. Generally, many panellists were strongly for or against the F-35 selection, and many of those who favoured the F-35s saw no problem in any part of the procurement or in high-tech dependencies. One panellist commented on the scenario as follows:

> *All this has already been taken into account in the current procurement process. It might be an interesting topic to speculate, but then we would need to broaden the speculations to cover everything and think about situations in which nothing but bicycles work. North Korea does not have such problems, but their living standards are slightly lower than ours.*

Another panellist was of the opposite view and found that the F-35s were simply the wrong choice: "You cannot do anything about this when the big mistake has already been made. The fighter jets should have been bought from Sweden or Germany and France. So now we are wondering what to do." The likelihood of the scenario also divided views as some found it very unlikely and others entirely probable.

**Expert suggestions**

*Increasing self-reliance in maintenance*

The panellists recommended ensuring both sufficient domestic maintenance know-how and domestic production of spare parts. The recycling of critical components and spare parts was offered as a partial solution. Multiple panellists also supported the stockpiling of spare parts. One suggestion was to keep the old Hornets as a backup reserve. Some were hopeful that security of supply could be enhanced through closer communication with the manufacturer. Another means mentioned was to ensure that there would be enough domestic funds to compete for key components in times of crisis.

To move to the next level of increased self-reliance, it was proposed that the whole domestic military industry should be developed, not only the production related to high-end products such as fighter jets. One suggestion was to manage the military-industry partnerships with the "big players" and find a niche for Finland in these chains. One panellist saw that a combination of high and low tech would produce the best results in terms of security of supply:

> *This scenario focuses on a single world-class technology. All modern weapons systems are very expensive for a small country, and while you must have them, you should also equip yourself with DIY "wood gasifier technology". The Finnish Defence Forces and private companies should jointly produce domestic weapon technologies. . . . We have motivated people to defend the country. To save young people's lives, we should initiate a mass production of drones, robotics, intelligent explosives, mechanics etc. using domestic components that are easy to stockpile. Circuit boards and software would need to be developed jointly with other Nordic countries. The whole industry should take Israel as an example.*

To diversify the supply chain, other experts preferred to unite forces with other EU countries and build common maintenance and production capabilities. The diversification of the military industry across NATO countries was also suggested, as well as the creation of technological co-dependencies and partnerships with other F-35 users. Some participants also emphasized that self-reliance in maintenance would require maintaining a high education level and developing domestic high-tech education to tackle the challenge of operating with high-tech military equipment.

*Regulation and tendering*

Ensuring maintenance partnership when making contracts was an often-mentioned means, and another one was to demand that companies demonstrate awareness and consideration of maintenance procedures in crisis times before they commit to contracts. Yet it was also noted that contracts had already been made in a manner that would make ending up without an operational fleet highly unlikely. However, it is not certain how maintenance-related resources would be divided under scarcity.

As part of the domestic military industry development mentioned above, one panellist suggested changes to the investment regulations:

> *Business and non-profit organizations' participation in national defence has been made very difficult. For example, the codes of ethics for investors practically prevent investments in the arms industry. . . . The existence of the defence industry should not be made more difficult – rather, it should be supported by allowing "defensive arms" as a category that can be funded. Entrepreneurs are hard-working and investors greedy, so the private sector could build a big ecosystem on domestic and regional defence needs.*

*Diplomatic means*

Experts suggested that Finland should use diplomatic means to avoid being left alone with maintenance issues. Such diplomatic measures included strengthening relations with the US, other NATO allies and the Nordic countries. Some advised pleading directly to US decision makers and fighter jet manufacturers to give priority to Finnish defence. Multiple panellists also considered NATO membership to be helpful in solving fighter jet maintenance problems as allies engage in deeper maintenance cooperation, and they can develop arms-industry co-production with the US. This would enhance Finnish arms-industry capabilities.

## 4.2. CYBERSECURITY OF ADVANCED HEALTH TECHNOLOGY: HOME DIALYSIS MACHINES

Health technology plays a crucial role in shaping the future of healthcare. Digital services, AI, robotics and the Internet of Medical Things (IoMT) shake the foundations of the field by facilitating cost-effective and individualized solutions that enhance patients' quality of life and reduce the strain on the healthcare system.[151] The IoMT – the network of medical applications and devices connected to the internet – in particular challenges the idea of hospitals as care sites by enabling the remote monitoring and control of the treatment of such illnesses as chronic kidney disease. By connecting home dialysers to a network, patients are saved from travelling to hospitals, and their ability to lead a normal life is improved.[152] At the same time, hospitals can reallocate their limited economic and staffing resources to other needs.[153]

Given that disturbances and security breaches in such life-supporting devices as dialysers can be fatal, the field is heavily regulated. Notably, cybersecurity now constitutes a key criterion in the EU's Medical Devices Regulation (EU 017/745), and medical software is placed in the highest risk class.[154] Moreover, any producer entering the common market must guarantee that its health technology conforms to the EU's safety criteria through a CE (*conformité européenne*) marking, and the compliance of

151 Healthtech Finland 2022.

152 Rosner et al. 2017.

153 Finnish Society of Nephrology 2021, 10. Most Finnish patients receive haemodialysis treatments at hospitals, and, at the moment, their travel costs amount up to EUR 11,000 per person per year. In 2015, trips to dialysis units constituted 10% of all the travelling costs compensated by the Finnish Social Insurance Institution although only 2% of the beneficiaries were dialysis patients. Finnish Society of Nephrology 2021, 10; Tillman and Maunula 2015.

154 See the Regulation of the European Parliament and the Council on Medical Devices (EU 2017/745), https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0745.

products belonging to higher risk classes must be verified by a European expert institution.[155] Yet there are gaps as CE markings may sometimes be missing, and some European expert institutions are lax in their practices.[156] Therefore, there is room for complementary national controls, and the key Finnish authority in this regard is the Finnish Medicines Agency (Fimea).

Finland depends heavily on foreign health technology, including dialysers. The US is the market leader in the broader health technology sector, but China is catching up: by 2022, its global market share amounted to 20 per cent.[157] Moreover, China's standing can be expected to strengthen in the future as digital health innovations and related AI solutions have recently been listed as strategic focus areas of the government.[158] Given the exceptionally high proportion of chronic kidney patients in China,[159] the government's aim to reach high-tech self-sufficiency and efforts to use dialysis exports as a form of soft power in African countries,[160] domestic home dialyser production can be anticipated to intensify – to the extent that Chinese companies are likely to participate in the future tendering processes of the Finnish wellbeing service counties (*hyvinvointialue*).

155 Nylund and Ruokoniemi 2018.

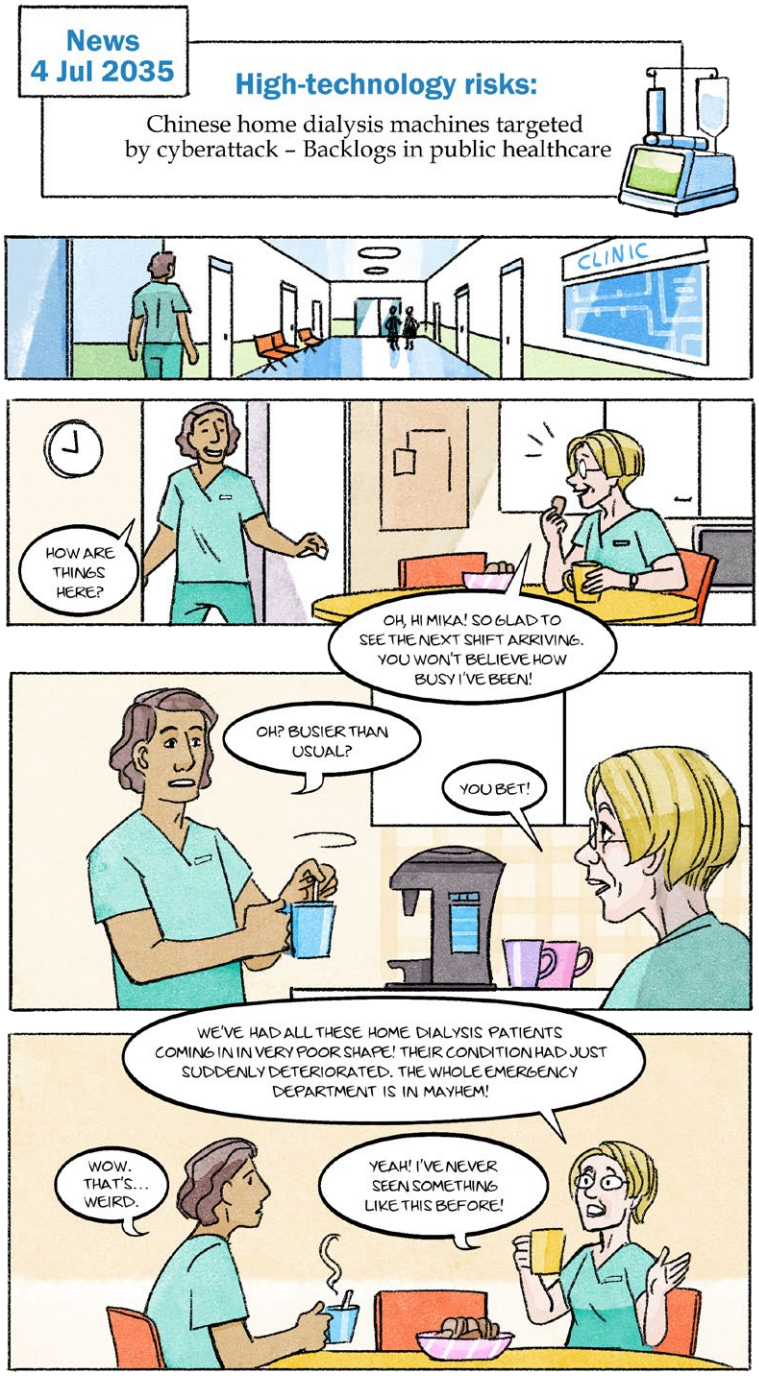
156 Interview with a Finnish health technology expert, Helsinki, 23 March 2022.

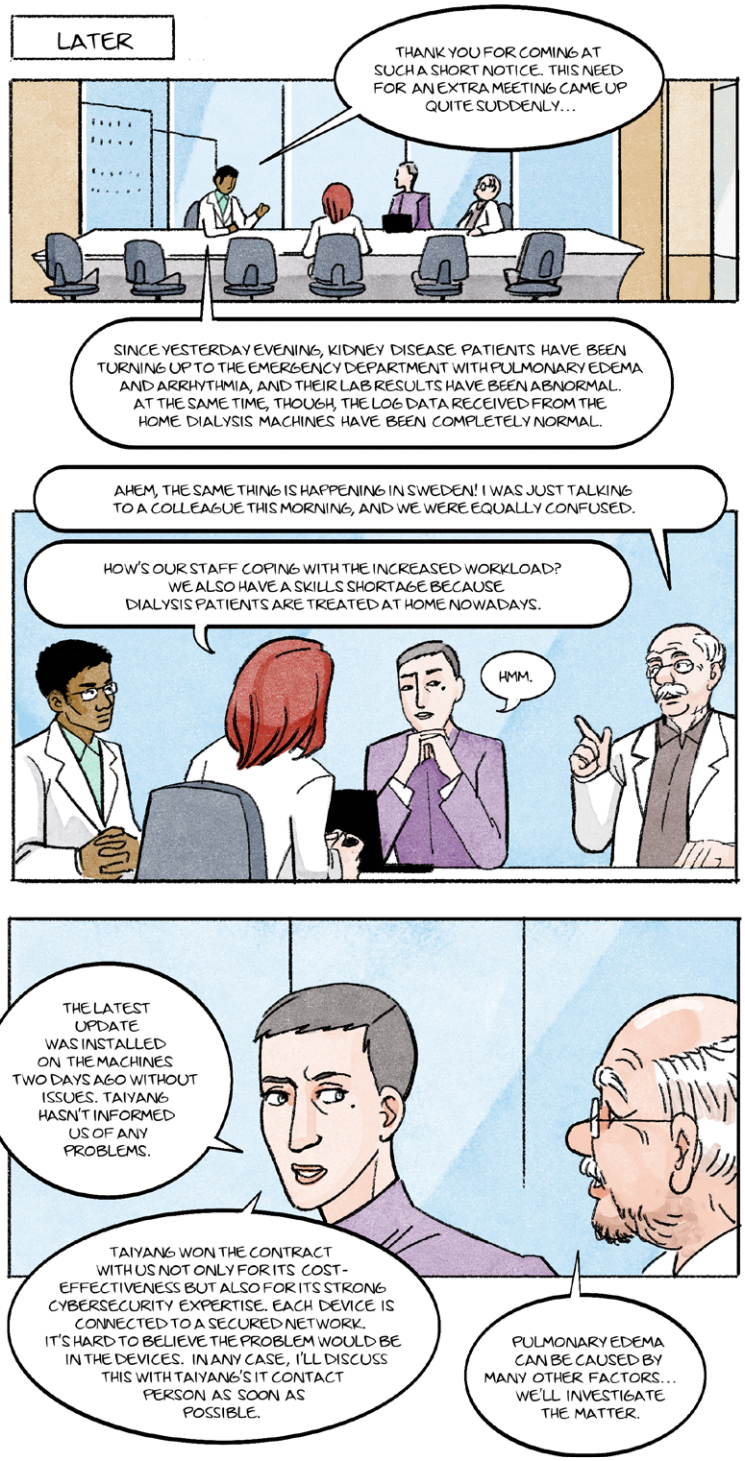
157 Li 2022.

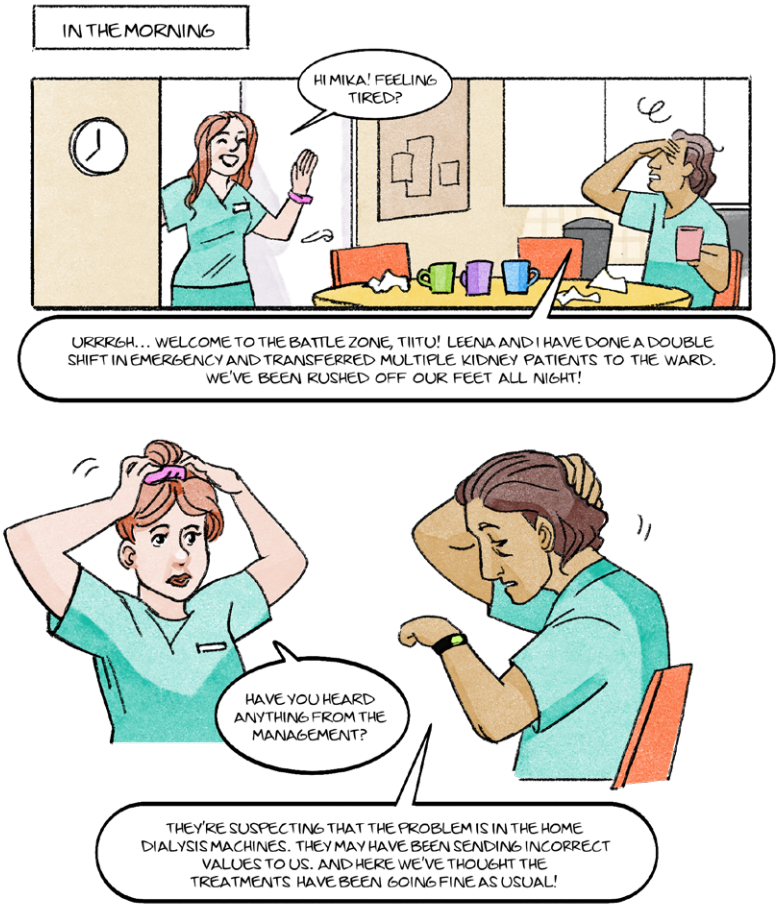
158 National Development and Reform Commission 2020.

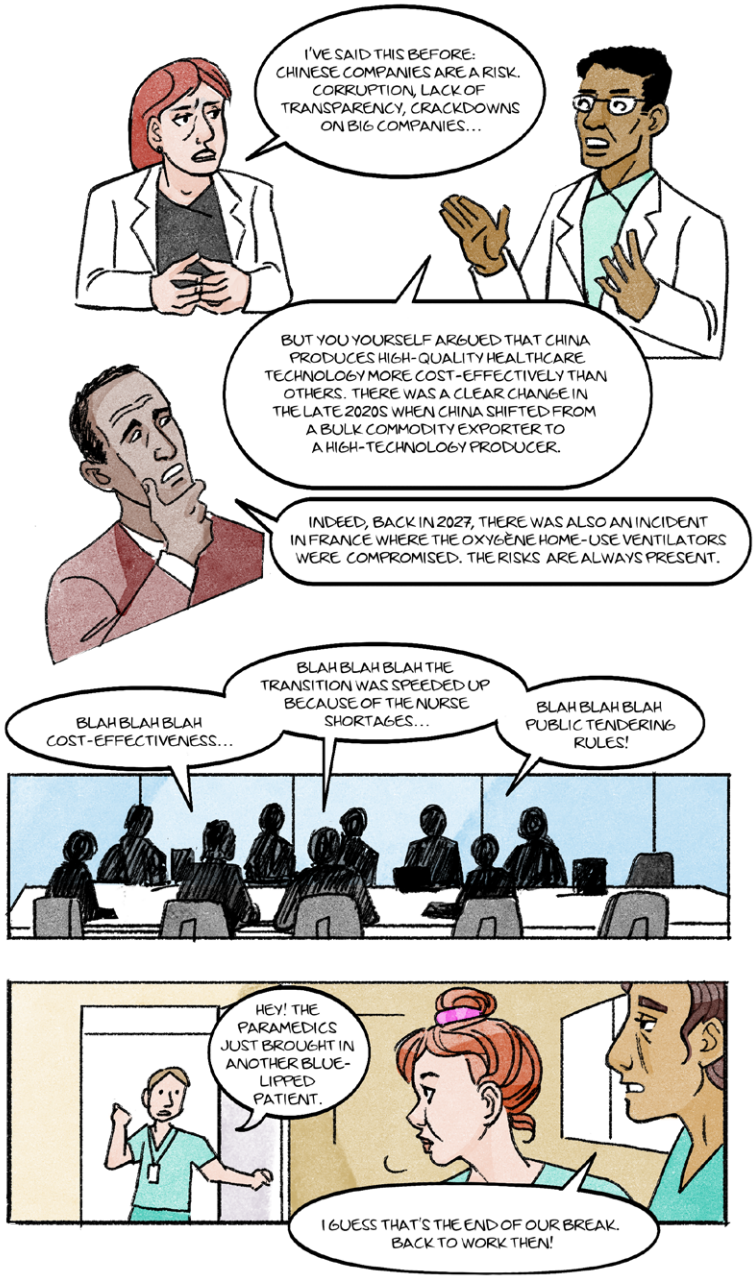
159 Guanyan baogaowang 2021.

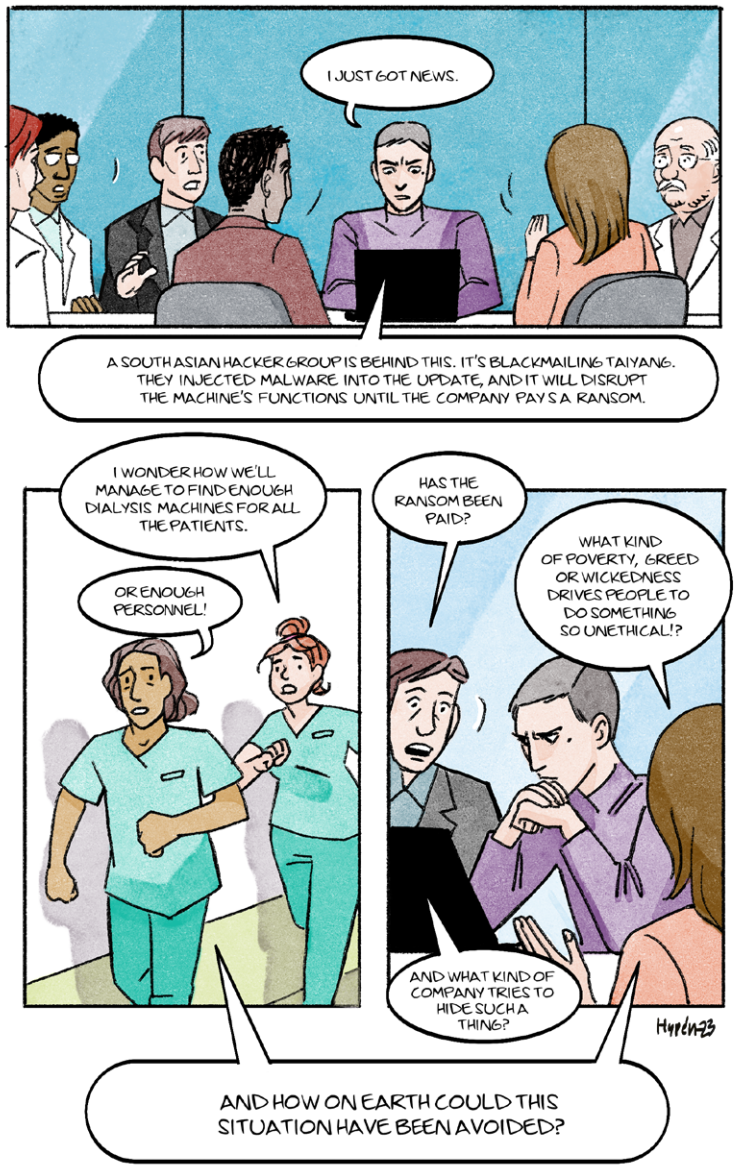
160 CTGN 2019.


News
4 Jul 2035
High-technology risks:
Chinese home dialysis machines targeted by cyberattack – Backlogs in public healthcare
CLINIC
HOW ARE THINGS HERE?
OH, HI MIKA! SO GLAD TO SEE THE NEXT SHIFT ARRIVING. YOU WON'T BELIEVE HOW BUSY I'VE BEEN!
OH? BUSIER THAN USUAL?
YOU BET!
WE'VE HAD ALL THESE HOME DIALYSIS PATIENTS COMING IN IN VERY POOR SHAPE! THEIR CONDITION HAD JUST SUDDENLY DETERIORATED. THE WHOLE EMERGENCY DEPARTMENT IS IN MAYHEM!
WOW. THAT'S... WEIRD.
YEAH! I'VE NEVER SEEN SOMETHING LIKE THIS BEFORE!


LATER
THANK YOU FOR COMING AT SUCH A SHORT NOTICE. THIS NEED FOR AN EXTRA MEETING CAME UP QUITE SUDDENLY...
SINCE YESTERDAY EVENING, KIDNEY DISEASE PATIENTS HAVE BEEN TURNING UP TO THE EMERGENCY DEPARTMENT WITH PULMONARY EDEMA AND ARRHYTHMIA, AND THEIR LAB RESULTS HAVE BEEN ABNORMAL. AT THE SAME TIME, THOUGH, THE LOG DATA RECEIVED FROM THE HOME DIALYSIS MACHINES HAVE BEEN COMPLETELY NORMAL.
AHEM, THE SAME THING IS HAPPENING IN SWEDEN! I WAS JUST TALKING TO A COLLEAGUE THIS MORNING, AND WE WERE EQUALLY CONFUSED.
HOW'S OUR STAFF COPING WITH THE INCREASED WORKLOAD? WE ALSO HAVE A SKILLS SHORTAGE BECAUSE DIALYSIS PATIENTS ARE TREATED AT HOME NOWADAYS.
HMM.
THE LATEST UPDATE WAS INSTALLED ON THE MACHINES TWO DAYS AGO WITHOUT ISSUES. TAIYANG HASN'T INFORMED US OF ANY PROBLEMS.
TAIYANG WON THE CONTRACT WITH US NOT ONLY FOR ITS COST-EFFECTIVENESS BUT ALSO FOR ITS STRONG CYBERSECURITY EXPERTISE. EACH DEVICE IS CONNECTED TO A SECURED NETWORK. IT'S HARD TO BELIEVE THE PROBLEM WOULD BE IN THE DEVICES. IN ANY CASE, I'LL DISCUSS THIS WITH TAIYANG'S IT CONTACT PERSON AS SOON AS POSSIBLE.
PULMONARY EDEMA CAN BE CAUSED BY MANY OTHER FACTORS... WE'LL INVESTIGATE THE MATTER.


IN THE MORNING
HI MIKA! FEELING TIRED?
URRRGH... WELCOME TO THE BATTLE ZONE, TIITU! LEENA AND I HAVE DONE A DOUBLE SHIFT IN EMERGENCY AND TRANSFERRED MULTIPLE KIDNEY PATIENTS TO THE WARD. WE'VE BEEN RUSHED OFF OUR FEET ALL NIGHT!
HAVE YOU HEARD ANYTHING FROM THE MANAGEMENT?
THEY'RE SUSPECTING THAT THE PROBLEM IS IN THE HOME DIALYSIS MACHINES. THEY MAY HAVE BEEN SENDING INCORRECT VALUES TO US. AND HERE WE'VE THOUGHT THE TREATMENTS HAVE BEEN GOING FINE AS USUAL!
IN THE MEANTIME
SO... IT SEEMS THAT HOME DIALYSIS MACHINES CAN BE MANIPULATED TO TRANSMIT FALSE DATA. I'M SUSPECTING THAT MIGHT BE THE CASE HERE, BUT TAIYANG DENIES THAT THERE IS ANY PROBLEM WITH THEIR MACHINES.


I'VE SAID THIS BEFORE: CHINESE COMPANIES ARE A RISK. CORRUPTION, LACK OF TRANSPARENCY, CRACKDOWNS ON BIG COMPANIES...
BUT YOU YOURSELF ARGUED THAT CHINA PRODUCES HIGH-QUALITY HEALTHCARE TECHNOLOGY MORE COST-EFFECTIVELY THAN OTHERS. THERE WAS A CLEAR CHANGE IN THE LATE 2020S WHEN CHINA SHIFTED FROM A BULK COMMODITY EXPORTER TO A HIGH-TECHNOLOGY PRODUCER.
INDEED, BACK IN 2027, THERE WAS ALSO AN INCIDENT IN FRANCE WHERE THE OXYGÈNE HOME-USE VENTILATORS WERE COMPROMISED. THE RISKS ARE ALWAYS PRESENT.
BLAH BLAH BLAH COST-EFFECTIVENESS...
BLAH BLAH BLAH THE TRANSITION WAS SPEEDED UP BECAUSE OF THE NURSE SHORTAGES...
BLAH BLAH BLAH PUBLIC TENDERING RULES!
HEY! THE PARAMEDICS JUST BROUGHT IN ANOTHER BLUE-LIPPED PATIENT.
I GUESS THAT'S THE END OF OUR BREAK. BACK TO WORK THEN!


I JUST GOT NEWS.
A SOUTH ASIAN HACKER GROUP IS BEHIND THIS. IT'S BLACKMAILING TAIYANG. THEY INJECTED MALWARE INTO THE UPDATE, AND IT WILL DISRUPT THE MACHINE'S FUNCTIONS UNTIL THE COMPANY PAYS A RANSOM.
I WONDER HOW WE'LL MANAGE TO FIND ENOUGH DIALYSIS MACHINES FOR ALL THE PATIENTS.
OR ENOUGH PERSONNEL!
HAS THE RANSOM BEEN PAID?
WHAT KIND OF POVERTY, GREED OR WICKEDNESS DRIVES PEOPLE TO DO SOMETHING SO UNETHICAL!?
AND WHAT KIND OF COMPANY TRIES TO HIDE SUCH A THING?
AND HOW ON EARTH COULD THIS SITUATION HAVE BEEN AVOIDED?

The scenario sparked numerous suggestions and comments to other panellists' views. It was considered plausible – no expert argued otherwise – but the experts were divided in whether they perceived China as a particular risk. While a few panellists viewed Chinese corporate culture as particularly vulnerable to cyberattacks, a larger group of experts explicitly emphasized that all companies – regardless of their owners' nationality – could be targeted by hacker groups from third countries, as suggested in the scenario. However, many of them added that authoritarian states are a particular risk when it comes to cyberattacks made by state-supported hackers. The desire to underline the universal nature of cyberattacks might have been partly influenced by the recent revelation of an "all-Finnish" data breach incident at the psychotherapy service provider Vastaamo (Oct 2020), which was also frequently referred to in the comments. At least one of the responses also explicitly underlined the dangers of riskifying China: "I wouldn't arouse excessive suspicion of China because it may also create self-fulfilling prophecies and strengthen unwanted scenarios. What I mean is that perhaps an aspiration for collaboration and a mutually beneficial relationship is better than suspicion and isolation."

Only a few panellists expressed reservations regarding the likelihood of the scenario. One expert considered healthcare a highly unlikely target due to the immoral nature of such attacks, but another panellist contested the view: "cyberattacks on healthcare do take place at the moment, although not in Finland (apart from the Vastaamo case). Healthcare is a good target because much harm can be caused (people may die), which makes people pay the attackers." Another expert stressed that great power rivalry is likely to increase the state-led weaponization of common data networks because they constitute grey-zone confrontations, not acts of war. Moreover, one expert underlined that an attack on dialysers would yield even more dramatic consequences if it took place in a situation in which hospitals were already strained.

## Expert suggestions

*Regulation and tendering*

According to multiple panellists, the existing tendering rules should be reformed to mitigate supplier risk. First, quality considerations should take precedence over price considerations. More specifically, a more complex tendering system with sustainability, responsibility and data protection criteria should be developed – instead of simply selecting bids that promise certain services at the lowest cost. Moreover, related risk analyses should form an integral part of the tendering process.

These changes were seen to be linked to the need to reform the EU rules of competition.

Second, critical and non-critical purchases should be separated in tendering. This would enable having different rules for specific industries and allow more expensive procurements in the critical ones. Yet this would also call for a broader debate on the meaning and aims of supply security: Which devices are considered critical? Are maintenance and the ability to repair critical medical devices – with the right spare parts – included in the national supply security calculus? Who is responsible for these duties – the importers or hospitals' technical experts? One way to tackle some aspects of this problem would be to include bids only from those companies whose products could be updated through a subsidiary with local staff in either Finland or the EU. Data transfers from the devices should be strictly limited (e.g., to local health centres). However, this idea would be problematic from the perspective of research and development; the anonymisation of data might be sufficient to mitigate the security risks and yet gain benefits from research, as one panellist argued.

Third, tendering processes should consider country-specific risks. One panellist went as far as limiting Chinese bids, whereas another expert suggested dividing the responsibility of producing different critical devices and applications among the EU countries. Other panellists proposed that bids should only be accepted from allies and partners or those countries that have a data security treaty with Finland. When defining the criteria for a country-specific risk analysis, consideration should be given to the supplier's available toolkit in the event of a cyberattack. As one panellist proposed, Western producers may have substantially more diverse toolkits than Chinese companies: Western companies can react immediately and appeal to national courts, whereas Chinese producers' possibilities are limited in this regard. As a consequence, the only option for a Finnish company would be to "bin the Chinese product" if a breach took place.

Fourth, tendering rules should be changed to avoid an excessive concentration of providers. In practice, it would be necessary to define a statutory maximum number of critical health technology devices, applications and patient information systems that could be obtained from one supplier. Yet this strategy could only be successful if other measures were taken: devices should be made compatible with each other. Here the European standardization efforts would play a key role.

In addition, two experts proposed tightening the existing EU-level MD regulation with regard to data security. New mechanisms to protect sensitive data and interface traffic should also be established in Europe. The small number of such comments is unsurprising given that the field is already heavily regulated.

*Cybersecurity practices*

Several panellists underlined the role of cybersecurity not only in preventing attacks but also in reacting to them: the assumption should be that the attacker *does* find the gaps. Moreover, "the real issue is bad recovery, not the attack itself", as one panellist argued. In addition to adhering to the current practices and making system updates, the most vulnerable aspects of digital healthcare should be defined and backup systems developed for critical software. Given that interfaces are often the weak link in the IoMT, their security must be enhanced; most importantly, life-supporting devices should not be linked to interfaces that can be accessed from outside. Yet it is not easy to define which "things" should be shielded: surprising elements may be critical to life since – as one panellist illustratively underlined – a frosted car window can be fatal in bad weather. Devices' main operating functions could also be separated from those services that can be accessed remotely. This would mean that treatments could be controlled, but the devices' parameters could not be changed remotely.

Manufacturers should not have access to individual devices, and software updates should be made under expert surveillance. Domestic data security providers could be prioritized, and data management units should be kept smaller. Moreover, as human beings are prone to make errors, personnel training is essential. Overall, it is important to reduce the enablers of attacks – be they human factors or weak systems. Often the factors that help prevent hazards are "well known like a healthy diet, dental hygiene and safe driving", but committing people to such practices may call for better sticks and carrots – and these should be further developed.

*Investments in healthcare*

The scenario also sparked a few suggestions to develop the overall operating conditions of the Finnish healthcare system. Most notably, the panellists emphasized that hospital districts must be allocated sufficient resources to be able to bounce back after crises – which themselves are unavoidable. The same applies to the staff: not only doctors but also other personnel must be adequately compensated for their work. Moreover, public funding is needed to develop the Finnish health technology industry, which can then spawn domestic innovations.

## 4.3. SUPPLY OF CHEMICALS FOR ADVANCED RESEARCH AND DEVELOPMENT ACTIVITIES: HELIUM

Helium is applied for multiple purposes, including quantum computing, space technologies, medical imaging, semiconductor production and welding.[161] As technologies develop and the green transition advances, helium might turn into an even more critical material.

Helium-4 (He-4) is the "ordinary" form of helium used by industries and research institutions. It is produced mainly in natural gas facilities by capturing helium,[162] and most of its reserves are located in the US. However, Algeria and Russia also have significant deposits.[163] Helium-3 (He-3), in turn, is a rare form that has been regarded as an ideal fuel for fusion reactors.[164] So far, progress in fusion energy has been slow, but in December 2022, a group of scientists performed a fusion energy experiment which created more energy than what was needed to start it.[165] Unfortunately, the earth has limited resources of He-3. Its main source has been the nuclear industry, but commercial production has also taken off in recent years.[166] The current reserves of He-3 are very small, and the US emergency stockpile includes only 25 kilograms of it.[167]

The moon and Jupiter have large reserves of He-3. It has been estimated that the He-3 reserves on the moon amount to around one million tons, and 100 to 200 tons would cover the world's annual electricity consumption.[168] It is at least theoretically possible to mine He-3 from space.[169] China's space programme, for example, has investigated the possibility to extract He-3 from the moon[170] as China wishes to decrease its dependence on the US helium sources.[171]

Nobel laureate, helium researcher Robert Richardson has estimated that there will be a global helium shortage by 2040.[172] Several temporary supply disruptions have occurred in the 2000s. As helium production

161 US Geological Survey 2023.

162 S&P Global Commodity Insights 2022.

163 Statista 2023.

164 Dobransky 2013.

165 Chang 2022.

166 Air Liquide 2021.

167 De Temmermann 2021.

168 Simko and Gray 2014.

169 European Space Agency 2023.

170 Fan 2023.

171 Chen 2020.

172 Edwards 2010.

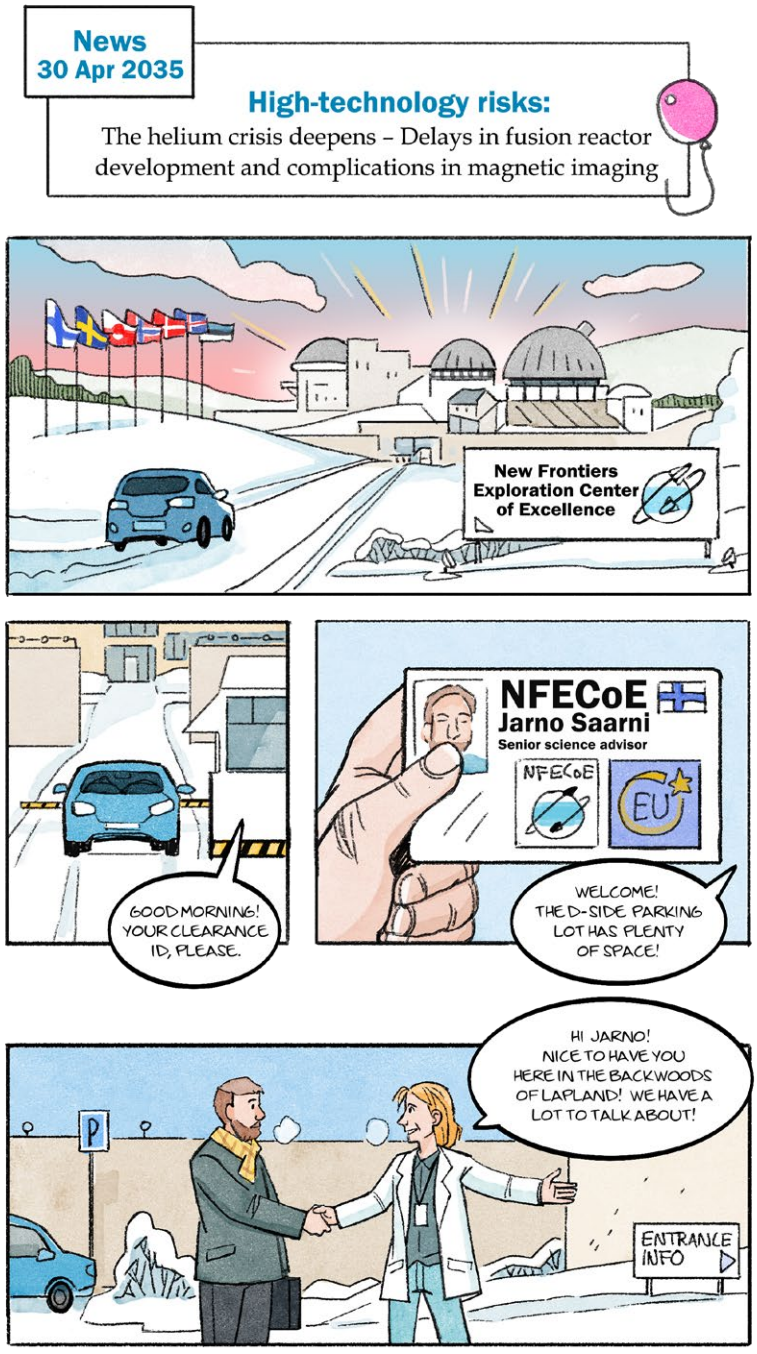
is very centralized, any logistics issues can complicate its distribution. Helium is transported in cryocontainers, whose limited availability may also destabilize the supply chains.[173] Despite these risks – and the overall importance of helium – the US and China have not listed it as a critical mineral.[174] In the EU, helium was considered a critical mineral in 2017 and 2023,[175] but it was not included in the 2020 listing, which was the most recent available at the time of running this expert panel.[176]

173 S&P Global Commodity Insights 2022.

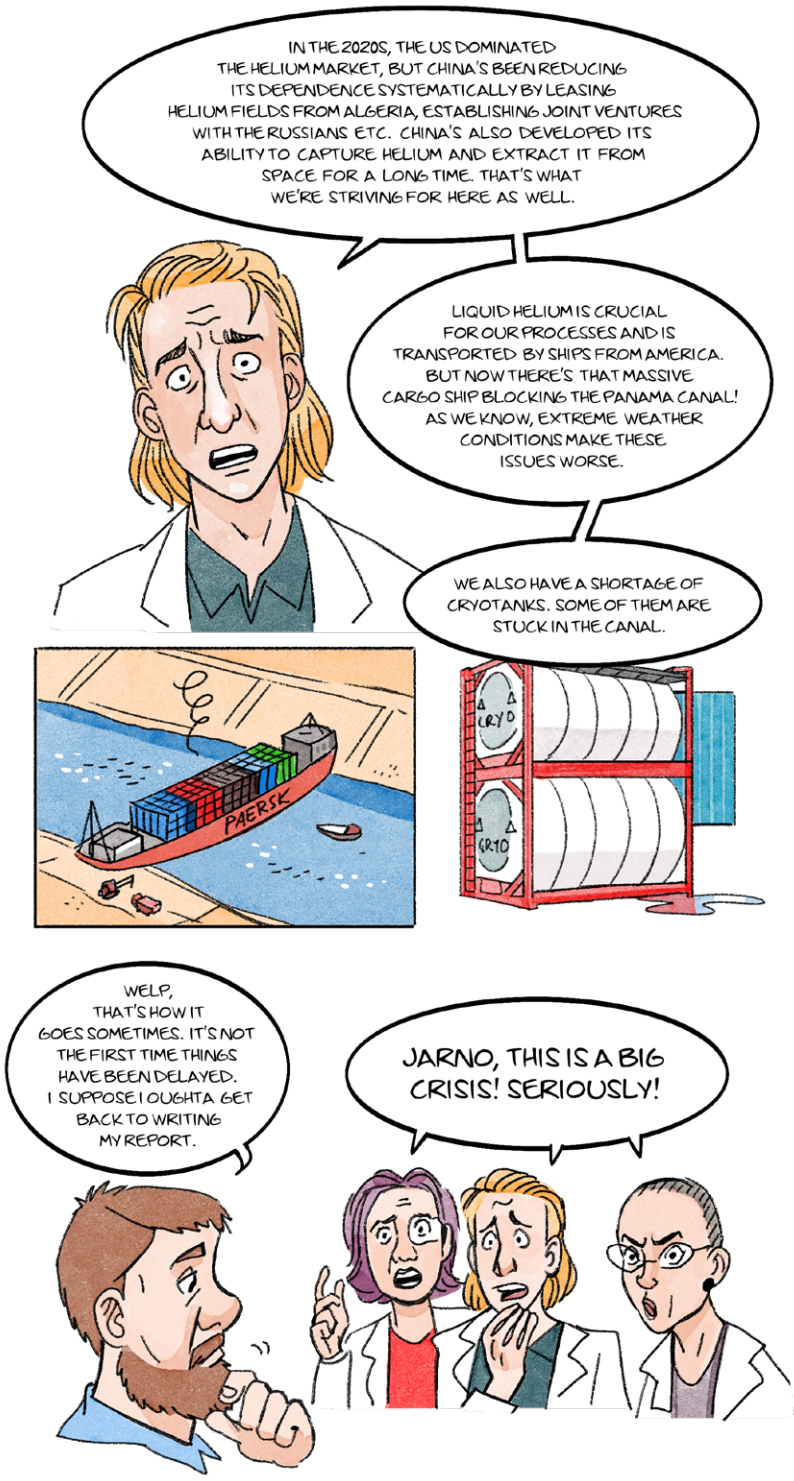
174 US Geological Survey 2022; Chinese Ministry of Natural Resources 2016.

175 European Commission 2017; 2023.

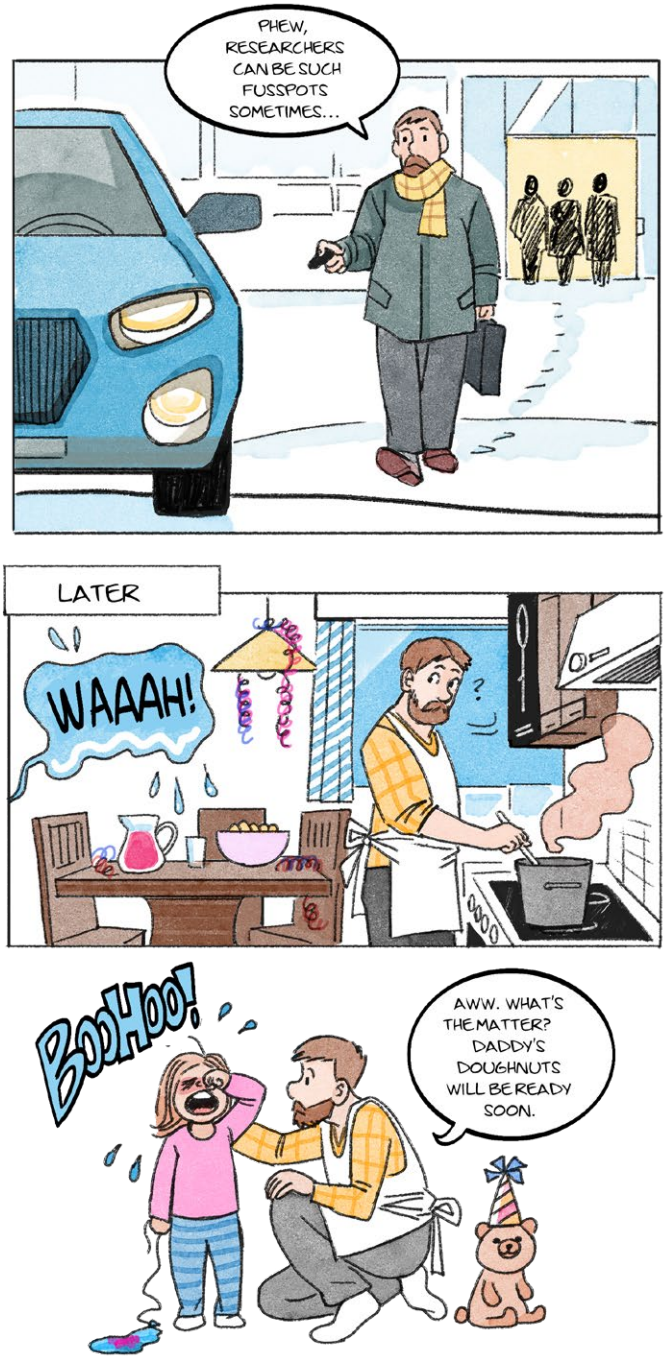
176 European Commission 2020c.


News
30 Apr 2035
High-technology risks:
The helium crisis deepens – Delays in fusion reactor development and complications in magnetic imaging
New Frontiers Exploration Center of Excellence
GOOD MORNING! YOUR CLEARANCE ID, PLEASE.
NFECoE
Jarno Saarni
Senior science advisor
NFECoE
EU
WELCOME! THE D-SIDE PARKING LOT HAS PLENTY OF SPACE!
HI JARNO! NICE TO HAVE YOU HERE IN THE BACKWOODS OF LAPLAND! WE HAVE A LOT TO TALK ABOUT!
P
ENTRANCE INFO


SO HERE YOU GUYS DEVELOP TECHNOLOGY THAT ENABLES EUROPEANS TO MINE MINERALS IN THE POLAR REGIONS AND OUTER SPACE...
AND THIS HE3EU SCIENCE PROGRAMME, WHICH FOCUSES ON EXTRACTING A RARE FORM OF HELIUM FROM THE MOON...
...HAS BEEN DELAYED, YES!
AT THE MOMENT, OUR MOST URGENT CONCERN IS THE AVAILABILITY OF HELIUM. NOT ONLY IS OUR SCIENCE PROGRAMME AIMED AT EXTRACTING HELIUM FROM THE MOON, BUT WE ALSO NEED IT FOR THE RESEARCH PROCESS ITSELF! THERE HAVE BEEN LONG-STANDING SUPPLY ISSUES, AND OUR RESEARCH HAS NOT PROGRESSED.
MMMYEAH... I GATHERED AS MUCH FROM OUR EMAILS, THAT THINGS ARE AT A STANDSTILL... NOT A BIGGIE, BUT THERE'S THE MEETING OF NORDIC FOREIGN MINISTERS ON MINERAL AND ENERGY SECURITY NEXT WEEK. SO I'M SUPPOSED TO COME UP WITH A LINE OR TWO ABOUT THIS DELAY.
JARNO, THIS IS NOT ONLY OUR PROBLEM! THE GLOBAL HELIUM RESERVES ARE ALREADY LIMITED AND MAINLY CONTROLLED BY CHINA AND THE US!


IN THE 2020S, THE US DOMINATED THE HELIUM MARKET, BUT CHINA'S BEEN REDUCING ITS DEPENDENCE SYSTEMATICALLY BY LEASING HELIUM FIELDS FROM ALGERIA, ESTABLISHING JOINT VENTURES WITH THE RUSSIANS ETC. CHINA'S ALSO DEVELOPED ITS ABILITY TO CAPTURE HELIUM AND EXTRACT IT FROM SPACE FOR A LONG TIME. THAT'S WHAT WE'RE STRIVING FOR HERE AS WELL.
LIQUID HELIUM IS CRUCIAL FOR OUR PROCESSES AND IS TRANSPORTED BY SHIPS FROM AMERICA. BUT NOW THERE'S THAT MASSIVE CARGO SHIP BLOCKING THE PANAMA CANAL! AS WE KNOW, EXTREME WEATHER CONDITIONS MAKE THESE ISSUES WORSE.
WE ALSO HAVE A SHORTAGE OF CRYOTANKS. SOME OF THEM ARE STUCK IN THE CANAL.
MAERSK
CRYO
CRYO
WELP, THAT'S HOW IT GOES SOMETIMES. IT'S NOT THE FIRST TIME THINGS HAVE BEEN DELAYED. I SUPPOSE I OUGHTA GET BACK TO WRITING MY REPORT.
JARNO, THIS IS A BIG CRISIS! SERIOUSLY!


WE'RE NOT GETTING BETTER AT EXTRACTING CRITICAL MINERALS FROM SPACE, AND EUROPE IS, ONCE AGAIN, FALLING BEHIND IN FUSION ENERGY RESEARCH!
HELIUM-3 IS AN IDEAL FUEL FOR FUSION REACTORS! AND THE SITUATION IS CATASTROPHIC IN TERMS OF CLIMATE CHANGE!
AND WHAT ABOUT MY PHD THESIS…? SHOULD I JUST SIT ON MY HANDS AND WAIT FOR A MIRACLE?
AND WHAT ABOUT THE SITUATION IN HEALTHCARE? MRI MACHINES WON'T FUNCTION WITHOUT HELIUM BECAUSE IT'S NEEDED IN HUGE AMOUNTS TO COOL DOWN THE MAGNETS! JARNO, I HOPE YOU UNDERSTAND THAT PEOPLE'S STROKES AND CANCERS MAY GO UNDIAGNOSED BECAUSE OF THE HELIUM SHORTAGE!
…THOSE THINGS FALL UNDER THE RESPONSIBILITY OF THE MINISTRY OF HEALTH …


PHEW, RESEARCHERS CAN BE SUCH FUSSPOTS SOMETIMES...
LATER
WAAAH!
BOOHOO!
AWW. WHAT'S THE MATTER? DADDY'S DOUGHNUTS WILL BE READY SOON.


MY MAY DAY BALLOON DOESN'T HAVE ENOUGH HELIUM IN IT! IS IT SO LOUSY BECAUSE IT WAS TENDERED?
OH DEAR!
DADDY, HOW THIS COULD HAVE BEEN AVOIDED?
HMM.

The key elements of the scenario divided the experts' opinions. Some contested the usability and feasibility of He-3 in fusion reactors either completely or by 2035: in addition to the skyrocketing price of He-3 (up to 3000 USD/l), another type of nuclear fusion – deuterium-tritium fusion – was considered more advantageous. Moreover, it was considered unlikely that fusion fuels would ever be obtained from space due to the paradoxical nature of the idea: fusion energy loses its climate benefits if it necessitates environmentally costly space travel. For these reasons, one panellist considered this element of the scenario to be "from sci-fi – not from the real world". A few panellists also anticipated that less He-4 would be needed in MRI by 2035 since the latest device models are already based on closed-cycle technology: the helium is reused over the lifespan of the machine. However, multiple experts underlined the criticality of both He-4 and He-3 to quantum technology: a mixture of He-3 and He-4 can reach the lowest temperatures. He-3 is also critical in specific medical examinations and neuron detectors used in nuclear physics, as well as in the production of liquefied hydrogen.

## Expert suggestions

*R&D solutions*

Multiple panellists proposed improving recycling and recovery as a technical solution to a potential helium shortage. Recycling can be improved at hospitals, and further investments in closed-cycle technologies will reduce the total amount of helium required for MRI devices. The same applies to quantum technology: currently, a set of cooling solutions, for example, need to be maintained so that the necessary functions can be performed. In MRI, it may be possible to replace the helium in the magnets by developing other materials that equally exhibit superconductivity, that is, the ability to conduct a direct electric current without resistance. This would make it possible to use liquefied nitrogen to cool the magnets – supposing that helium would no longer be needed to produce liquefied nitrogen. The transportation of helium could also benefit from technological advancement as the currently used cryocontainers could be cooled with larger liquid nitrogen tanks or replaced with larger high-pressure cryocontainers, which already exist. They would facilitate transportation over longer distances and hence change the nature of the market. Yet one panellist contested this idea by questioning whether producers would have any initiative to further develop such containers as the existing ones meet the current demand very well.

Research and development are not only important in reducing the need for helium, but also in preparing for a future with limited helium

resources. For this reason, investments in domestic and European R&D capabilities – especially in the most critical fields – are necessary. Yet, when making investment decisions, it is crucial not to hype any one technology or technology problem, be it fusion energy, hydrogen production or finding replacement options for helium. Sometimes it is necessary to opt not to fund something for strategic reasons.

*Partnerships*

Multiple panellists suggested that partnerships should be maintained and initiated to ensure access to helium resources. Some panellists stressed the role of the EU and its member states as Finland's key partners, and, in line with this, individual experts argued that both Finland and the EU as a whole should enhance the recycling and liquefaction of "ordinary" He-4. Only one panellist explicitly underlined the role of stockpiling in this equation. Moreover, European He-4 production could be initiated in collaboration with such natural gas producing countries as Norway and the UK. Given the extremely limited production of He-3 on a global level, one panellist argued that it is necessary to increase its production in Europe. Since it is typically produced from the decay of tritium, a starting point could be to study whether European nuclear reactors could produce tritium.

Partnerships should also be formed with non-European helium producers. The EU should be Finland's reference group, and Finland should adopt an active role. A few panellists singled out Qatar and the US, whereas one expert mentioned Russia as a potential partner. A concrete solution would be to form the mineral partnership with the US that is currently being negotiated.[177] Yet, as one expert underlined, the US is a reliable partner only as long as it has the needed helium resources and is willing to export them to Europe. One expert took a more general approach and argued that Finland should participate actively in all multilateral collaboration and seek deeper bilateral partnerships, while another panellist argued for opting for reliable and politically stable countries.

In addition to helium production, it is also important to establish partnerships that allow Finland and the EU to conduct experimental space research – possibly to extract He-3 resources, as the scenario proposed. One expert highlighted the need to turn to such private market leaders as Space X since they possess the ability to reuse carrier rockets. That would not only make space exploration less costly, but also reduce the need for the helium used in rocket technology.

177 See https://ec.europa.eu/commission/presscorner/detail/en/statement_23_1613.

*Risk assessment and foresight*

Several suggestions were made to conduct risk assessments and practise foresight. In addition to mapping the existing and potential helium resources and reserves, potential transportation routes and uses of helium should be studied. Attention should be paid to potential causes of supply disruptions, including events related to climate change and global technology competition. While it is difficult to diversify suppliers due to the concentration of helium production, the likely fluctuations in its global availability should be anticipated carefully. Notably, these may result from changes in the demand for other natural resources. For one, less natural gas will be extracted in the future due to its climate effects. This may mean that significantly smaller amounts of "ordinary" helium – He-4 – will also be captured because it is a side product of natural gas. Moreover, as helium is used to produce liquefied hydrogen, its demand may be increasing in an era of hydrogen economy. This may also increase the likelihood of container shortages: the same containers are used for liquefied helium and hydrogen, and there are only few producers in the whole industry. Another challenge is to ponder which emerging technologies will need helium in the future. This question boils down to whether it is – and will be – a *critical* material, and more foresight studies should hence be conducted.

*Behavioural and policy changes*

Some panellists proposed broader behavioural and policy changes. For one, mineral dependencies should be reduced in general. One expert proposed guiding people away from products whose manufacturing relies on minerals and ores, and which also have a short useful life and cannot be recycled reliably. Such "conspicuous consumption" should be punished by levying heavy pollution taxes in support of climate efforts and environmental protection. Similar criteria should be applied to construction and community planning.

Communication should be improved among state officials and between different stakeholder groups to avoid bureaucratic silos and tackle the impacts of potential mineral shortages on various sectors of society. Here it would be possible to start with pragmatic solutions:

> *A home-spun solution would be to create flexible remits for ministries. When the walls around officials fall down, their desks turn into football fields. It is harder to find solutions to new technological problems in the Ministry of Health, for example, if the problem also concerns the Ministry of the Interior and the Ministry of Defence. Furthermore, someone might have*

*already found a solution, but information about it is blocked. We should place all reliable officials in an open office space with a shared intranet.*

Finland and the EU should also adopt a holistic approach to international collaboration on mineral extraction and research. The key is not to focus on one's own needs only but to consider the international society as a whole. This calls for a better understanding of other countries' viewpoints and positions, and the ways in which they can benefit from partnerships.

## 4.4. DISCUSSION

The scenarios on high-technology dependencies offered few low-hanging fruits in terms of policy suggestions, but our expert participants managed to list a laudable number of solutions, nevertheless. Two themes were common to all the expert discussions concerning the three cases. First, the panellists believed in further technological development in mitigating some of the risks of high-tech dependencies. Second, the increase of neither domestic nor European self-reliance was generally strongly advocated. Here international partnerships and diplomacy came to the rescue. The suggestions with strong cooperative elements included explaining the importance of Finnish national defence to US policymakers, accepting bids only from those countries that have a data security treaty with Finland and forming partnerships with helium producing countries.

The rest of the means were diverse in content but could be loosely placed under the umbrella of decreasing Finland's weaknesses. The respondents identified improvements to regulations and tendering rules, suggested investing in underinvested areas in healthcare and the national defence industry and recommended further preparing for potential dangers with risk assessment and foresight. A better organization of relevant government bodies was also seen as helpful.

The level of risk awareness varied across cases, and the experts sometimes contested the risks presented in the scenarios. Such a polarization of views was to be expected as the themes were controversial and entailed elements that triggered strong political opinions. Furthermore, the helium scenario was almost sci-fi-like in some of its elements. The proposed risks are also not widely discussed in the Finnish media, and the generalist panellists were therefore less familiar with these themes. The public debate on the procurement of the F-35 stealth fighters concentrated on their price rather than their technical maintenance or the ability of the fighter programme to meet its production targets. While the Vastaamo

psychotherapy case brought our dialysis scenario closer to the present day, risks associated with the IoMT are rarely covered in the media. The most futuristic scenario – the implications of helium scarcity – is discussed in international media, but in Finland the theme is not widely covered. In other words, all the cases were somewhat challenging for panellists who were not sectoral experts of the particular case. The risk assessments concerning the F-35 jets were divided as some almost denied that there was any risk associated with the procurement, while others found multiple problem zones. The same applied to the helium scenario in which the criticality of helium divided opinions, whereas the risks proposed in the home dialysis narrative were hardly contested.

## Managing critical technology dependencies: Key takeaways

### Increasing self-reliance in maintenance of high technology

**Enhancing domestic and EU capacity, reserves and knowledge**

- recycling and stockpiling critical components and spare parts
- creating a backup reserve of older technology (e.g., the Hornets)
- finding a niche for Finland in global production and partnerships
- educating domestic high-tech maintenance personnel

### Regulation and tendering

**Developing existing tendering rules to mitigate supplier risk**

- covering sustainability, responsibility, data protection, compatibility and geopolitical risk criteria
- separating critical and non-critical purchases
- imposing country- and company-specific limitations to bids in critical industries by including only
  - countries with a data security treaty with Finland
  - companies whose products can be updated through a subsidiary with local staff in either Finland or the EU
- defining a statutory maximum number of critical devices, applications and information systems obtained from one supplier

### Diplomatic means and partnerships

**Developing European partnerships by**

- recycling, liquefaction and production of "ordinary" He-4 and He-3
  - studying prospects for producing tritium in European nuclear reactors
- establishing experimental space research schemes

**Developing non-European partnerships by**

- producing helium with Qatar and the US
- formulating a mineral deal with the US
- turning to space industry's private market leaders, including Space X
- creating military-industry partnerships with the "big players"
- dividing the production of different critical devices and applications

### Cybersecurity practices

**Defining the most vulnerable aspects of devices and applications**
**Separating devices' main operating functions from services that can be accessed remotely**
**Limiting manufacturers' access to individual devices**
**Making software updates under expert surveillance**

### R&D solutions

**Developing recycling, recovery, transportation and saving of helium**

- exploring larger high-pressure or cooling cryocontainers with larger liquid nitrogen tanks
- investing in closed-cycle technologies
- exploring alternative materials (exhibiting superconductivity)

**Risk assessment and foresight**

**Mapping the existing and potential helium resources and reserves, transportation routes and uses of helium**

- anticipating likely fluctuations in the global availability

**Behavioural and policy changes**

**Levying pollution taxes on products whose manufacturing relies on minerals**

**Enhancing communication between different stakeholder groups**

- creating flexible remits for ministries
- placing relevant officials in an open office space with a shared intranet

/5

# 5. ENHANCING SWEDEN'S NATIONAL PREPAREDNESS UP TO 2030

**Björn Cappelin, Liisa Kauppila and Ines Söderström**

Swedish attitudes to economic interdependence have changed fundamentally in the past few years. Since the late 2010s, European discussion on strategic company acquisitions, the Covid-19 pandemic and Russia's massive-scale attack on Ukraine have made Swedes acutely aware of the risks of foreign investments and overdependence on foreign suppliers of critical goods. Given China's distinctive investment practice and strong role in global supply chains, it is unsurprising that especially Chinese FDI and China dependencies have become perceived as security risks.[178] Moreover, although most China-related dangers and harms are looming possibilities that may – or may not – affect Swedish society in the future, the Swedish views have also been shaped by some realized deals in the country's strategic industries, including electronics and steel production. In the local media, these acquisitions have been connected to transferring sensitive knowledge and products with dual-use potential to the Chinese state.[179]

To respond to changing national threat perceptions, the Swedish government is increasingly seeking to tackle risks *before* they materialize as dangers. In essence, it is acting on the basis of a possible future in which economic interaction – especially with China – may threaten Sweden's national security and supply of critical goods. Most notably, it has adopted a national FDI control mechanism, *a screening system for foreign*

178 Bohman and Nymalm 2020; Mattlin and Rajavuori 2023.

179 See, e.g., Forsberg 2018.

*investments to protect Swedish security interests*[180], which will constitute one of the EU's most extensive investment screening mechanisms when it comes into effect in December 2023.[181] Given that for decades, Sweden upheld an open economy and had no mechanism to regulate foreign investments, this marks a clear shift in its national strategy. Due to the fast-paced nature of such changes, it is necessary to engage the whole of society in a critical debate on the preferable means to practise the "politics of preemption"[182] – not least because this process also contributes to shaping Sweden's identity in the future.

In this chapter, we seek to contribute to Sweden's national debate by providing tangible expert insights into mitigating China-related risks in Sweden's energy industry and digital economy. The views were gathered in an on-site Delphi workshop in Stockholm in October 2022. As a joint Swedish-Finnish activity, the workshop built on the ForAc project's Finnish Delphi exercise and the local knowledge and networks of the Swedish National China Centre of the Swedish Institute for International Affairs. As such, the workshop sought to raise awareness and discussion on short- to mid-term risks among a panel of 16 experts from Swedish ministries, government agencies, academic institutions and business associations.[183] The Swedish case also diversified the overall theme of small state preparedness by providing views from another Nordic small open economy that shares evident similarities with Finland but also differs from it in some crucial respects. Most notably, Sweden's "activist" foreign policy culture and declarative discourse differs from Finland's pragmatic tradition.[184] Sweden's supply security governance is also distinctly different, albeit Sweden is currently rebuilding its approach – a process in which Finland's network-based model serves as an inspiration.[185]

This chapter will begin with a brief overview of the workshop process. We will go on to analyse Swedish expert views on managing China-related supply disruptions in the wind power industry. We will then proceed to their suggestions on tackling national security risks related to the digital economy. We will conclude the chapter by situating the views expressed in the workshop within larger trends in Swedish foreign policy culture and discussing the limitations of its findings.

180 Lagrådsremiss: Ett granskningssystem för utländska direktinvesteringar till skydd för svenska säkerhetsintressen [Referral to the Council on Legislation: A Screening System for Foreign Direct Investments to Protect Swedish Security Interests].

181 Cf. Kauppila and Cappelin 2023.

182 De Goede 2008.

183 See the Appendix for a more detailed description of the selection and composition of the panel.

184 Dahl 2006; Tiilikainen 2006; Mattlin 2020.

185 Wigell et al. 2022b.

### The Swedish Delphi workshop

Over a period of three hours, the Swedish experts were presented with two comic strip–format threat scenarios. These scenarios were adjusted from the Finnish exercise to suit the Swedish context. The workshop was divided into two structurally similar sessions, both of which began with a brief oral introduction. After that, the experts entered the eDelphi online platform with their own devices to read the comics and anonymously propose[186] means to prevent the depicted developments from unfolding. The views they shared appeared on-screen in real time. An open discussion then followed, and, finally, the experts edited and complemented their original answers.

The unconventional workshop format allowed the panellists to express their views both orally and anonymously in written form. The initial round of online answers gave the experts the opportunity to consider and structure their views. The oral discussion then opened the floor for more interaction and elaboration of the themes taken up online. There was room for spontaneous reactions, and some completely new themes were also raised. In editing their original answers after the oral part, most experts either complemented their views or added new perspectives. Some initial ideas were also deleted from the platform.

## 5.1. SANCTIONS ON MATERIALS, COMPONENTS AND MINERALS NECESSARY FOR THE GREEN TRANSITION: WIND ENERGY IN 2030

The first scenario highlights the much-debated issue of European dependency on Chinese materials, components and minerals for the green transition. By focusing on Sweden's wind power industry, the scenario elaborates on what the consequences to Swedish society may be if Sino-EU relations take a deep downturn, and China weaponizes its dominant position in the global production chain of wind power turbines.

Currently, approximately 19% of Sweden's electricity production is generated by wind power. By 2025, its share is expected to rise to 26%.[187] After that, the expansion of capacity is expected to flatline, meaning that it will likely remain at that level in the run-up to 2030, the year of the scenario.

186 In practice, the platform enabled the panellists to type in their answers without revealing their identity. In this way, it was impossible for others in the room (including the facilitators) to know which answers belonged to whom.

187 Energimyndigheten 2023.

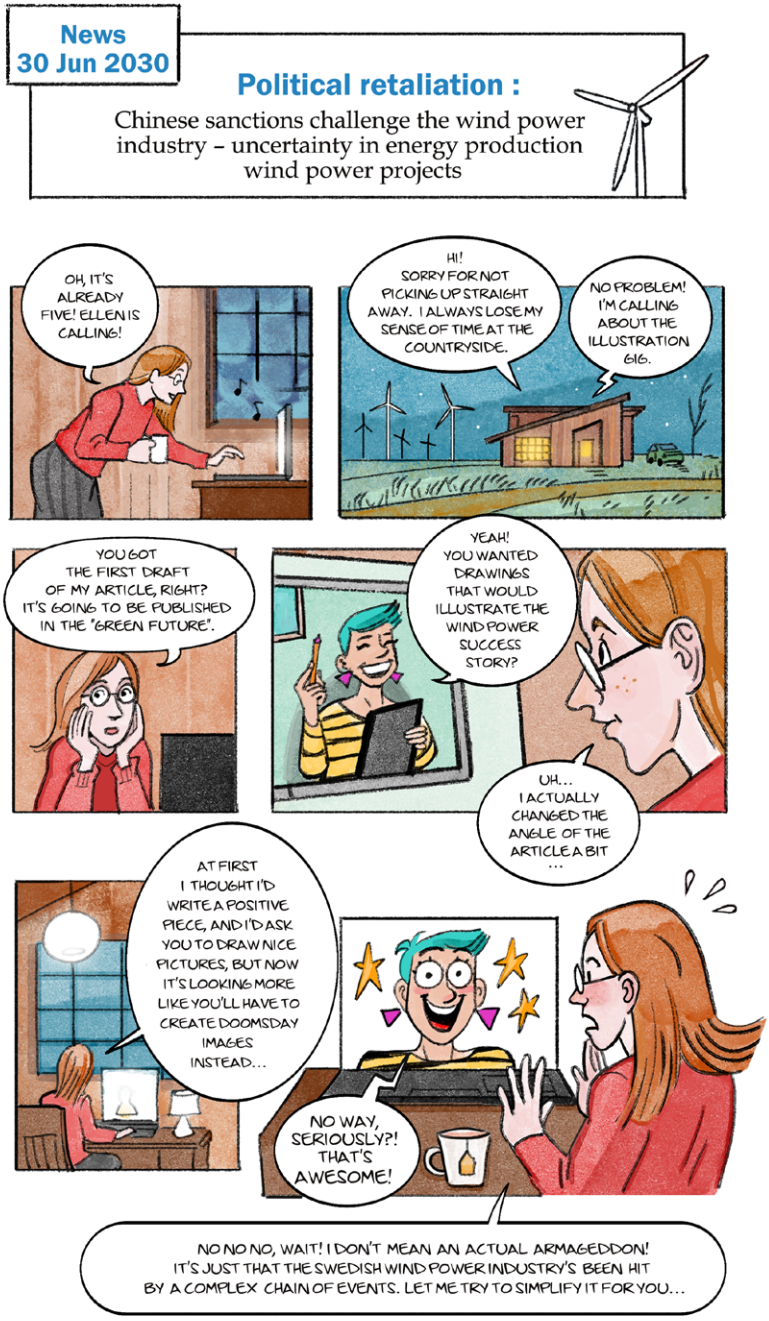
The companies that dominate Sweden's electricity production are both domestic and foreign domiciled, with Vattenfall and Skellefteå Kraft (Sweden), Fortum (Finland), Uniper (Finland/Germany) and Statkraft (Norway) being the dominant actors.[188] In contrast to Finland, however, foreign companies own the majority of Sweden's wind power parks. By 2024, approximately 65% of total wind energy production in Sweden is projected to be owned by foreign companies, with 6.6% being owned by a Chinese state-owned company, China General Nuclear Power Group (CGN).[189]

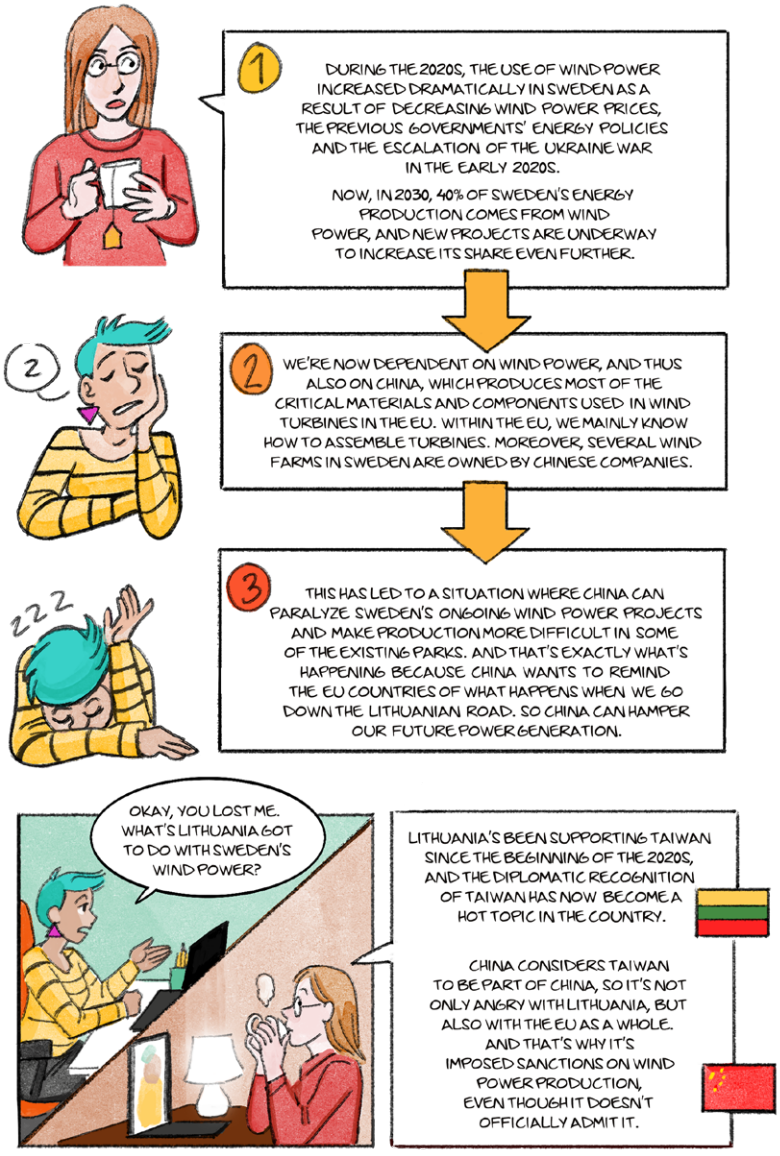
Despite the relatively small percentage share of China's ownership in Sweden's overall energy infrastructure, its clear foothold in Sweden's wind power industry has led to heated debates. Concerns have been raised about potential dependencies and supply chain bottlenecks that could impact Sweden and Europe's green transition, given China's advanced capabilities in green technologies.[190]

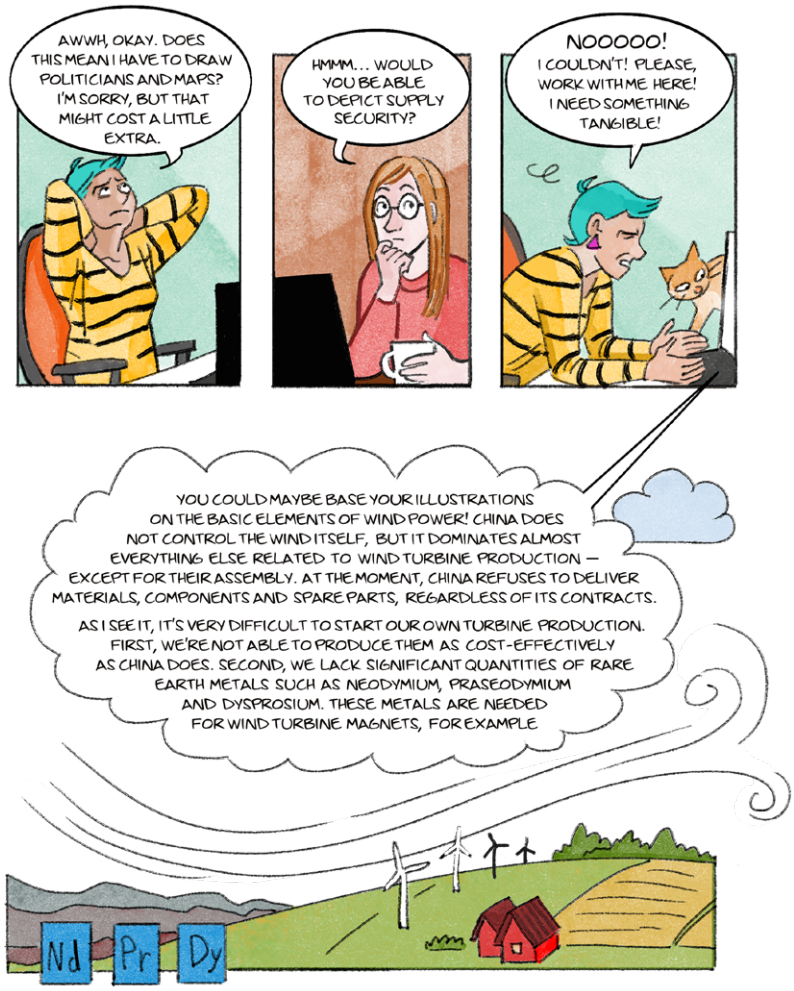
188 Energiföretagen 2023.

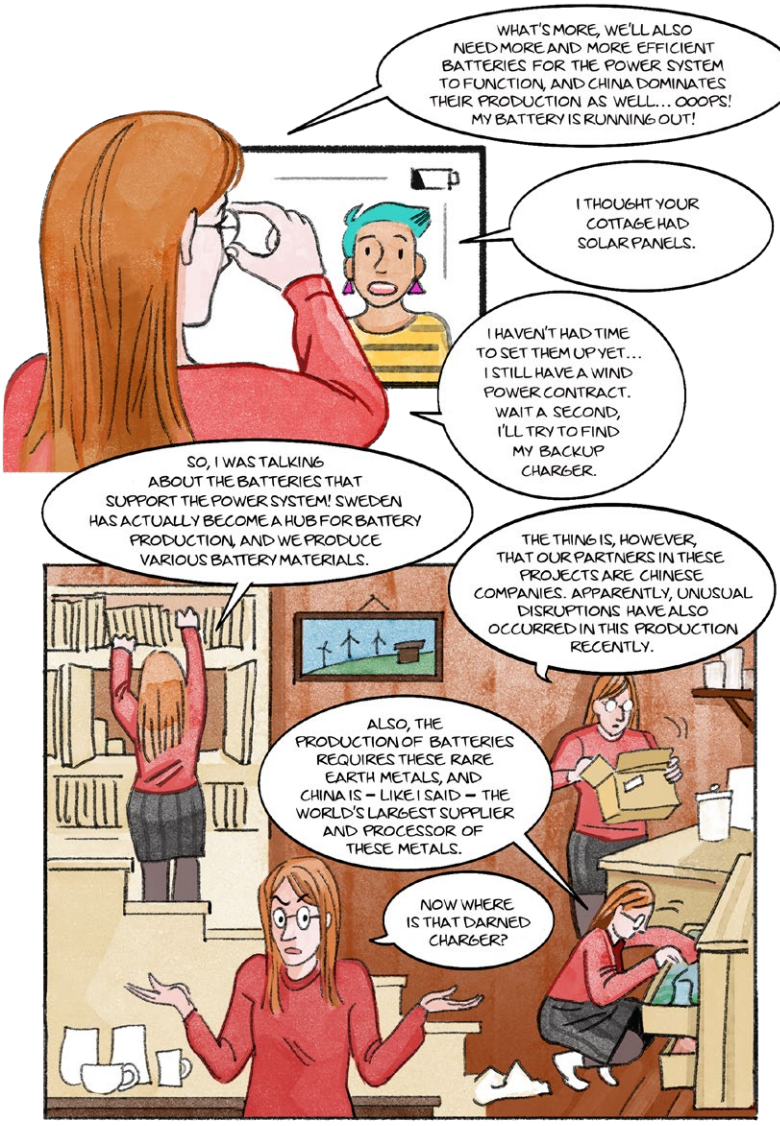
189 Svensk Vindenergi 2022.

190 See, e.g., Sundqvist and Lindberg 2022, 27; Wiechel 2021; Fagerström 2022; Cirkulation 2022. For a more detailed discussion on China's role in the global wind power industry, see Chapter 3 in this report.


News
30 Jun 2030
Political retaliation :
Chinese sanctions challenge the wind power industry – uncertainty in energy production wind power projects
OH, IT'S ALREADY FIVE! ELLEN IS CALLING!
HI! SORRY FOR NOT PICKING UP STRAIGHT AWAY. I ALWAYS LOSE MY SENSE OF TIME AT THE COUNTRYSIDE.
NO PROBLEM! I'M CALLING ABOUT THE ILLUSTRATION 616.
YOU GOT THE FIRST DRAFT OF MY ARTICLE, RIGHT? IT'S GOING TO BE PUBLISHED IN THE "GREEN FUTURE".
YEAH! YOU WANTED DRAWINGS THAT WOULD ILLUSTRATE THE WIND POWER SUCCESS STORY?
UH... I ACTUALLY CHANGED THE ANGLE OF THE ARTICLE A BIT ...
AT FIRST I THOUGHT I'D WRITE A POSITIVE PIECE, AND I'D ASK YOU TO DRAW NICE PICTURES, BUT NOW IT'S LOOKING MORE LIKE YOU'LL HAVE TO CREATE DOOMSDAY IMAGES INSTEAD...
NO WAY, SERIOUSLY?! THAT'S AWESOME!
NO NO NO, WAIT! I DON'T MEAN AN ACTUAL ARMAGEDDON! IT'S JUST THAT THE SWEDISH WIND POWER INDUSTRY'S BEEN HIT BY A COMPLEX CHAIN OF EVENTS. LET ME TRY TO SIMPLIFY IT FOR YOU...


1
DURING THE 2020S, THE USE OF WIND POWER INCREASED DRAMATICALLY IN SWEDEN AS A RESULT OF DECREASING WIND POWER PRICES, THE PREVIOUS GOVERNMENTS' ENERGY POLICIES AND THE ESCALATION OF THE UKRAINE WAR IN THE EARLY 2020S.
NOW, IN 2030, 40% OF SWEDEN'S ENERGY PRODUCTION COMES FROM WIND POWER, AND NEW PROJECTS ARE UNDERWAY TO INCREASE ITS SHARE EVEN FURTHER.
2
2
WE'RE NOW DEPENDENT ON WIND POWER, AND THUS ALSO ON CHINA, WHICH PRODUCES MOST OF THE CRITICAL MATERIALS AND COMPONENTS USED IN WIND TURBINES IN THE EU. WITHIN THE EU, WE MAINLY KNOW HOW TO ASSEMBLE TURBINES. MOREOVER, SEVERAL WIND FARMS IN SWEDEN ARE OWNED BY CHINESE COMPANIES.
zzz
3
THIS HAS LED TO A SITUATION WHERE CHINA CAN PARALYZE SWEDEN'S ONGOING WIND POWER PROJECTS AND MAKE PRODUCTION MORE DIFFICULT IN SOME OF THE EXISTING PARKS. AND THAT'S EXACTLY WHAT'S HAPPENING BECAUSE CHINA WANTS TO REMIND THE EU COUNTRIES OF WHAT HAPPENS WHEN WE GO DOWN THE LITHUANIAN ROAD. SO CHINA CAN HAMPER OUR FUTURE POWER GENERATION.
OKAY, YOU LOST ME. WHAT'S LITHUANIA GOT TO DO WITH SWEDEN'S WIND POWER?
LITHUANIA'S BEEN SUPPORTING TAIWAN SINCE THE BEGINNING OF THE 2020S, AND THE DIPLOMATIC RECOGNITION OF TAIWAN HAS NOW BECOME A HOT TOPIC IN THE COUNTRY.
CHINA CONSIDERS TAIWAN TO BE PART OF CHINA, SO IT'S NOT ONLY ANGRY WITH LITHUANIA, BUT ALSO WITH THE EU AS A WHOLE. AND THAT'S WHY IT'S IMPOSED SANCTIONS ON WIND POWER PRODUCTION, EVEN THOUGH IT DOESN'T OFFICIALLY ADMIT IT.


AWWH, OKAY. DOES THIS MEAN I HAVE TO DRAW POLITICIANS AND MAPS? I'M SORRY, BUT THAT MIGHT COST A LITTLE EXTRA.
HMMM... WOULD YOU BE ABLE TO DEPICT SUPPLY SECURITY?
NOOOOO! I COULDN'T! PLEASE, WORK WITH ME HERE! I NEED SOMETHING TANGIBLE!
YOU COULD MAYBE BASE YOUR ILLUSTRATIONS ON THE BASIC ELEMENTS OF WIND POWER! CHINA DOES NOT CONTROL THE WIND ITSELF, BUT IT DOMINATES ALMOST EVERYTHING ELSE RELATED TO WIND TURBINE PRODUCTION — EXCEPT FOR THEIR ASSEMBLY. AT THE MOMENT, CHINA REFUSES TO DELIVER MATERIALS, COMPONENTS AND SPARE PARTS, REGARDLESS OF ITS CONTRACTS.
AS I SEE IT, IT'S VERY DIFFICULT TO START OUR OWN TURBINE PRODUCTION. FIRST, WE'RE NOT ABLE TO PRODUCE THEM AS COST-EFFECTIVELY AS CHINA DOES. SECOND, WE LACK SIGNIFICANT QUANTITIES OF RARE EARTH METALS SUCH AS NEODYMIUM, PRASEODYMIUM AND DYSPROSIUM. THESE METALS ARE NEEDED FOR WIND TURBINE MAGNETS, FOR EXAMPLE
Nd
Pr
Dy


WHAT'S MORE, WE'LL ALSO NEED MORE AND MORE EFFICIENT BATTERIES FOR THE POWER SYSTEM TO FUNCTION, AND CHINA DOMINATES THEIR PRODUCTION AS WELL... OOOPS! MY BATTERY IS RUNNING OUT!
I THOUGHT YOUR COTTAGE HAD SOLAR PANELS.
I HAVEN'T HAD TIME TO SET THEM UP YET... I STILL HAVE A WIND POWER CONTRACT. WAIT A SECOND, I'LL TRY TO FIND MY BACKUP CHARGER.
SO, I WAS TALKING ABOUT THE BATTERIES THAT SUPPORT THE POWER SYSTEM! SWEDEN HAS ACTUALLY BECOME A HUB FOR BATTERY PRODUCTION, AND WE PRODUCE VARIOUS BATTERY MATERIALS.
THE THING IS, HOWEVER, THAT OUR PARTNERS IN THESE PROJECTS ARE CHINESE COMPANIES. APPARENTLY, UNUSUAL DISRUPTIONS HAVE ALSO OCCURRED IN THIS PRODUCTION RECENTLY.
ALSO, THE PRODUCTION OF BATTERIES REQUIRES THESE RARE EARTH METALS, AND CHINA IS – LIKE I SAID – THE WORLD'S LARGEST SUPPLIER AND PROCESSOR OF THESE METALS.
NOW WHERE IS THAT DARNED CHARGER?


THE DRAFT YOU SENT ME MENTIONED SWEDISH LITHIUM AND VANADIUM MINES, THE STORAGE POTENTIAL OF HYDROPOWER PLANTS AND THE POSSIBILITIES OF NUCLEAR POWER. WHY WON'T THESE SOLVE THE PROBLEM?
YOU KNOW, IT'S REALLY HARD FOR ME TO BELIEVE THAT A HIGH-TECH COUNTRY LIKE SWEDEN IS UNABLE TO PRODUCE THESE THINGS ITSELF!
YEAH, THE LEVEL OF DEPENDENCE IS QUITE UNBELIEVABLE...
KIRSI? YOUR VOICE IS BREAKING UP ...
HEY, MAYBE I COULD HAVE CONTACTED AN EXPERT FOR THIS ARTICLE...
...AND ASKED THEM HOW THIS COULD HAVE BEEN AVOIDED?
HELLOOO? DID YOU RUN OUT OF POWER? A FORETASTE OF THINGS TO COME?
Hyden23

The scenario sparked several comments online and was actively commented on in the open discussion. In addition to proposing concrete means to reduce dependencies, the panellists also emphasized broader issues that Sweden is faced with in managing these risks. In essence, the scenario was seen to highlight an intricate governance problem that points to a difficult balancing of priorities: climate targets cannot be compromised, recent developments call for enhanced national security capabilities, and electricity consumption is increasing even if there is a supply crisis in the energy market – as was the case at the time of running the workshop. In a similar vein, the scenario sparked broader thoughts about the future of collaboration with China. Intriguingly, in this regard, the issues raised by the panellists ranged from the need to advance democratization in China to what was called the "unmentionable alternative": lying flat, respecting China's interests and thereby keeping China happy.

## Expert suggestions

*Diversification of sources and increasing self-reliance*

The majority of experts underlined the need to enhance the control of critical supply chains through diversification and increasing self-reliance – in the spirit of better strategic autonomy for Sweden, as one panellist conceptualized. In this way, the risks of relying on one dominant supplier country of critical materials or goods could be mitigated, authoritarian states being particular cases in point. Yet, given that the diversification of sources of origin may be difficult and take time to achieve, a short-term response could be to carefully manage the relations with dominant suppliers. In practice, this would mean managing the relations with China to avoid situations in which supply chain vulnerabilities could be weaponized.

The domestic supply of critical raw materials was viewed as a way to increase Sweden's self-reliance, and several experts pointed out that Sweden and Finland have a unique access to minerals and raw materials (iron ore, gold, rare earths, nickel, cobalt etc.), which makes it possible to reduce dependencies on China – especially since the two countries are among the few in the EU to actually encourage mining. The panellists also argued that Sweden should improve its capacity to recycle rare earths, invest in research to initiate technological innovations and hence reduce the demand for certain rare earths. In allocating these resources, it was seen crucial to note that politicians often have a hard time anticipating the technologies of the future; however, this risk should be lower with raw materials than with industrial policy, for example.

The diversification of Sweden's energy portfolio was also highlighted, and some participants saw the current energy crisis as an opportunity to accelerate it. Moreover, nuclear power generating capacity could be expanded, and EU-level coordination could be enhanced through such measures as a common energy strategy, legislation and energy supply, as a few experts proposed.

*Legislative and regulatory changes*

Several experts underlined that Sweden needs legislative and regulatory changes to mitigate the risks stemming from foreign dominance of key supply chains and ownership of wind power parks. For one, the need for the upcoming legislation for screening FDI was underlined. It should, as will be the case, include acquisitions and investments in the energy sector. The legislation should also cover concentration of ownership to avoid situations in which a specific country ends up dominating an industry or a sector. One expert also highlighted that municipal and county-level decisions on investments should be subject to national security analysis. This is because local decision makers may lack the "big picture", and hence they need guidance from competent authorities.

Another proposal made by multiple experts was the reform of mining-related permit processes and environmental legislation. It was argued that the current legislation protects people and nature but does not capture supply security considerations. Changes would be needed to make it more attractive to invest in the Swedish energy industry. Yet, it was acknowledged that these measures would not offer instant returns: it takes 10 to 20 years from the initiation of permit reforms to large-scale extraction and refining. Therefore, such changes should always be complemented with other means.

*Awareness raising and foresight*

Awareness raising and foresight activities were also proposed as means to manage the risks depicted in the scenario. Some experts argued that Sweden lacks a commonly shared view of critical and strategic dependencies, which should be grounded in a clear understanding of what Sweden's needs are. Once such an understanding was established, it would be possible to know which materials are critical in different sectors. As the experts argued, this analysis should be made by the state, but in dialogue with the private sector. Here the National Emergency Supply Agency of Finland was proposed to be viewed as a source of inspiration.[191]

191 The National Emergency Supply Agency (NESA) is a central government organization operating under the Ministry of Economic Affairs and Employment of Finland. It is tasked with carrying out planning and operations related to the maintenance and development of Finland's security of supply.

The importance of national unity – across the political spectrum and between the public and private spheres – was also emphasized in broader risk assessments, which should focus not only on dependencies but also on geopolitical risks and the origins of capital. As one expert proposed, one way to reach out to a wide range of actors would be to contact industry associations. Some experts also argued that Sweden should explore institutional arrangements that facilitate long-term thinking and decision-making, such as the Swedish Defence Commission.[192] Among other things, this would contribute to the long-term development of Sweden's mining industry especially if the above-mentioned legislative changes were made. On a more general level, such institutions would alleviate a weakness characteristic of democratic systems: the lack of long-term vision beyond each election cycle.

Moreover, it was argued that in awareness raising and policymaking, critical dependencies should be separated from less critical ones; yet it was not specified how such decisions should be made and by whom. One panellist, for example, held the view that the proposed problems with the deliveries of Chinese-owned wind power parks would be smaller because the parks could be nationalized or foreign owners "forced" out if need be. From his point of view, a more acute problem was Sweden's dependency on China's critical inputs in the supply chain.

Finally, it was emphasized that awareness should also be raised more generally on China's behaviour. For example, the actual efficacy of China's economic coercion should be analysed. Moreover, given that China uses economic coercion in ways that affect trade, such as in the Lithuanian case, it was suggested that the West should be familiar with China's "red lines" – and, at the same time, be aware that they cannot always be trusted to be consistent.

*Shaping market conditions*

Making changes in market conditions – the economic environment for business – could also contribute to reducing over-reliance on foreign suppliers. A few experts underlined that the new FDI controls may result in a loss of FDI inflow, and the legislative reforms should hence be complemented with changes that facilitate access to alternative sources of capital. This would be crucial in keeping up a balance between the mitigation of security risks and a healthy economic environment for businesses. As one expert put it: "if foreign ownership is limited, new sources of financing must be identified to find the necessary capital. Nothing is for free!"

192 The Swedish Defence Commission (Försvarsberedningen) is an advisory body consisting of all political parties. It is tasked with long-term defence policy planning and meant to ensure some continuity over election cycles. See https://www.regeringen.se/regeringens-politik/forsvarsberedningen/ (in Swedish).

Although it is the companies themselves that should be concerned with the origin of capital and seek alternative investors besides China, sometimes state intervention is needed to break market dominance and reduce dependencies on one foreign actor. This is especially the case if the risks of concentration are major, which was emphasized by one expert: "state measures need to be taken to increase diversification where political risk cannot be priced at company level, and where the risks at a societal level are too great". As an extension of this argument, it was also pointed out that certain parts of the economy may even need to be re-regulated if market actors cannot be trusted or expected to make the necessary decisions. It was added that such a line of action would need to be supported by a thorough economic analysis.

*Trade policy*

Some experts argued that it is necessary to push politically – both bilaterally against China and in multilateral trade fora – for a level playing field and reciprocity in trade and market access. In the absence of this, punitive tariffs should be considered on state-subsidized imports from China.

Generally, it was argued that subsidized production in China is the basic problem – and that it may not be reasonable to aim at beating China at its own game. Instead, the West should focus on its advantages and strengths. This is because, as one expert put it, "rare earths are not so rare. But it's not possible to extract them everywhere in the world at prices that can compete with China". According to one panellist, Western countries themselves are partly to blame here: they have not been tough enough in their negotiations with China on production-related environmental degradation, for example. Yet, as a counterargument, some experts also emphasized that it would be too risky to wait until China dominates the market in existing and prospective technologies such as batteries. Consequently, some form of state intervention may also be needed in Western countries.

Intriguingly, trade policy was also viewed as a means to coexist with a more authoritarian China. Given that trade between countries creates economic interdependence, policies that encourage mutual trade relations may help in avoiding conflicts; yet the most sensitive sectors – whatever they are at any given time – could be ruled out from this. More still, in the spirit of the "change through trade" paradigm[193], this comment was extended by suggesting that we should not stop thinking that we can affect democratization in China – although we should also be prepared for the opposite.

193 The concept of "change through trade" (*Wandel durch Handel* in German) maintains that trade and commercial relations with authoritarian states such as China will eventually lead to their democratization. See, e.g., Barkin 2020.

## 5.2. ACQUISITIONS OF COMPANIES THAT GATHER PERSONAL DATA: MOBILE GAME COMPANY IN 2027

The second scenario brings under scrutiny another major debate in Sino-Western relations: the potential mis- and dual-use of foreign-owned products, devices, data and real estate obtained through acquisitions. It focuses on the potential misuse of data gathered by the online applications of a Chinese-owned mobile game company, whose hit product was developed by the company's previous Swedish owners. As such, the scenario elaborates on the particular risks associated with authoritarian states' close state-business relations and the fuzzy ownership arrangements that characterize the global economy.

The digital economy has gained prominent ground in the daily lives of Swedes. Yet the increasing awareness of risks associated with data transfer through technologies such as gaming and entertainment apps is fuelling domestic debates. According to the upcoming national FDI screening legislation, investments in operations that involve the processing of sensitive personal or localization data will be subject to screening in Sweden.[194] However, the precise scope and extent of the review process, including whether it would include mobile applications and games, remains uncertain.

Chinese companies have emerged as strong players in various domains of the digital economy, including telecommunication infrastructure, digital consumer products manufacturing and digital platform development. The country's prominence in the digital economy is attributed in part to its sizable domestic market in terms of users and data generation. Notably, in April 2020, the Chinese government officially recognized data as a distinct factor of production alongside land, labour, capital and technology.[195] In 2021, the Swedish gaming industry consisted of 785 companies that generated over 5 billion euros in revenue.[196] Additionally, based on a 2023 mapping by the Swedish Defence Research Agency FOI, six gaming companies in Sweden have been acquired by Chinese entities since 2002.[197] Moreover, it is clear that there is potential for significant large-scale buyouts to be made in the future, as Tencent's 8.4 billion euro acquisition of the Finnish Supercell in 2016 gives grounds to anticipate.

194 Lagrådsremiss: Ett granskningssystem för utländska direktinvesteringar till skydd för svenska säkerhetsintressen [Referral to the Council on Legislation: A Screening System for Foreign Direct Investments to Protect Swedish Security Interests].

195 National Development and Reform Commission of the PRC 2020.

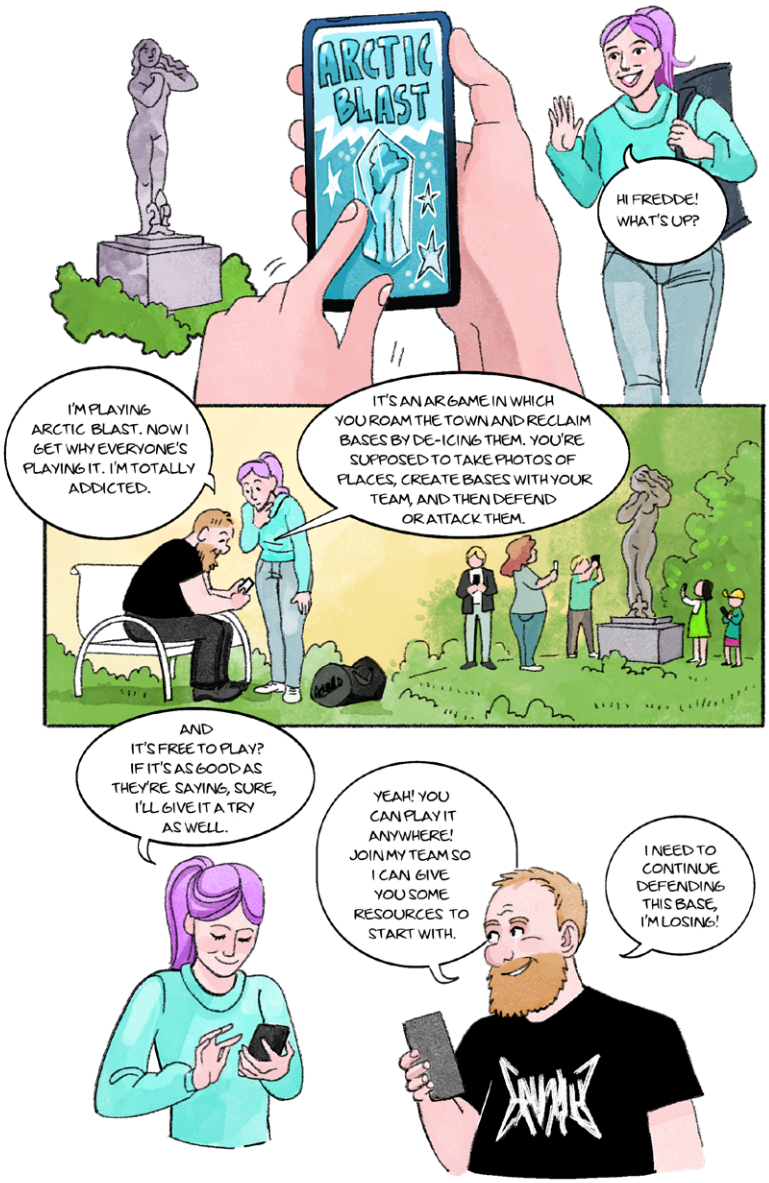
196 Swedish Games Industry 2023.

197 Almén 2023; Hellström et. al 2019.

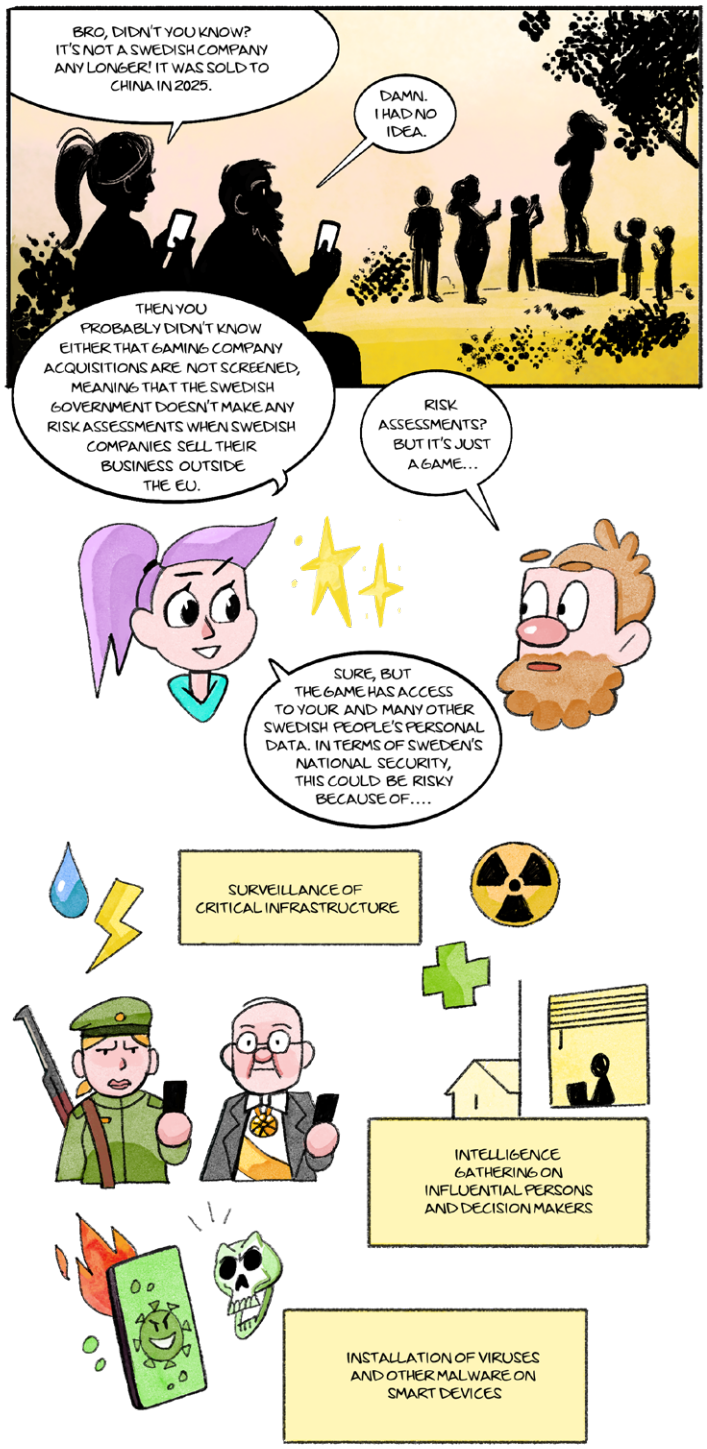
**News**
**31 May 2027**

## Company acquisitions:

Chinese gaming company enables the Chinese government's access to Swedes' private data




OH, THE APP IS ASKING FOR A LOT OF PERMISSIONS. HAVE YOU READ THE TERMS AND CONDITIONS?
DUDE, NO ONE EVER READS THEM. BUT THE COMPANY IS SWEDISH. IT WAS FOUNDED BY LOVISA NYLUND. SHE HAS A STRONG TRACK RECORD OF EXPORTING SWEDISH GAMES.
ONE COOL THING INGMAR GAMES DOES IS TO ALWAYS INCLUDE SOME REFERENCES TO SWEDEN IN ITS GAMES.
INGMAR GAMES


BRO, DIDN'T YOU KNOW? IT'S NOT A SWEDISH COMPANY ANY LONGER! IT WAS SOLD TO CHINA IN 2025.
DAMN. I HAD NO IDEA.
THEN YOU PROBABLY DIDN'T KNOW EITHER THAT GAMING COMPANY ACQUISITIONS ARE NOT SCREENED, MEANING THAT THE SWEDISH GOVERNMENT DOESN'T MAKE ANY RISK ASSESSMENTS WHEN SWEDISH COMPANIES SELL THEIR BUSINESS OUTSIDE THE EU.
RISK ASSESSMENTS? BUT IT'S JUST A GAME...
SURE, BUT THE GAME HAS ACCESS TO YOUR AND MANY OTHER SWEDISH PEOPLE'S PERSONAL DATA. IN TERMS OF SWEDEN'S NATIONAL SECURITY, THIS COULD BE RISKY BECAUSE OF....
SURVEILLANCE OF CRITICAL INFRASTRUCTURE
INTELLIGENCE GATHERING ON INFLUENTIAL PERSONS AND DECISION MAKERS
INSTALLATION OF VIRUSES AND OTHER MALWARE ON SMART DEVICES

MONITORING OF CROWD FLOWS

AND OTHER POSSIBLE UNPLEASANT SURPRISES THAT WE HAVEN'T EVEN THOUGHT OF!

The scenario generated many replies online and was actively commented on in the open discussion. Multiple experts highlighted the gaming industry's economic weight, and that foreign online applications and platforms have been underestimated as an arena for political influence attempts. It was also underlined that gaming often comes with communication options between players, which adds to the layers of information that can be extracted from these platforms. Moreover, it was pointed out that more extensive investments in foreign gaming companies would increase China's international reach greatly since Chinese social media itself has very limited global popularity outside the Chinese diaspora. At the same time, it was questioned whether Chinese companies would be allowed to hold on to their stakes in foreign companies under Xi Jinping's policies directed at technology companies and the private sector.

## Expert suggestions

*Legislative changes and regulatory efforts*

According to multiple panellists, the gaming industry has not received enough regulatory and legislative attention in comparison with other digital economy domains. Generally, the General Data Protection Regulation (GDPR) was seen as an indication that the EU regulatory landscape is moving in the right direction. Yet, the GDPR should be enforced by tougher sanctions to protect personal data and deter state-backed actors from misusing it. As one panellist proposed, a fine of four per cent of the annual turnover could be imposed. Some panellists also questioned whether the GDPR is, after all, a sufficient means to deter this kind of behaviour: Chinese companies could follow the rules but still have a back door open for the Chinese government. Moreover, it was underlined that the GDPR only deals with personal data, and non-personal sensitive data such as data emanating from connected devices (IoT) in cars, watches, aeroplanes and so on should be taken into account when seeking means to protect data from misuse.

On a more general level, several suggestions were made to improve EU-level regulation. One expert proposed the development of a common EU regulatory effort to facilitate better risk assessment of foreign, particularly Chinese, applications and online services. Moreover, multiple panellists argued that when it comes to *using* the data, further EU-level regulation of online activity would be necessary. For one, stricter data localization requirements should be in place to limit data access outside of the EU, regardless of who owns the application. Geo-localisation could only be allowed when an app is being used. Legal standards should also be set to make terms and conditions more accessible so that people

understand what they agree to when they share their personal data. Moreover, in the future, data could potentially be seen as a dual-use product, which would thus change the way in which the field is regulated.

Some experts also argued for developing the upcoming national FDI screening mechanism to include investments in all companies that possess large amounts of data. However, others pondered whether the issues of data breaches and the use of geo-localisation data near sensitive installations should be tackled through security policy rather than investment screening tools. Overall, it was pointed out that re-establishing sovereignty in this area is difficult, and the creation of data spaces with more control over secondary use will be necessary.

In many expert contributions, China was seen to constitute a particular motivation for legislative and regulatory efforts. It was highlighted that Sweden is very interwoven with China in data flows, and China is a special case with its technological capabilities and capital reserves. These factors were seen to make the issue of Chinese actors' intent especially relevant. In this context, it was also highlighted that Finland's and Sweden's NATO memberships are likely to add to the pressure from the US to see China as a threat. Yet some experts also emphasized that foreign ownership always carries the kinds of risks depicted in the scenario – and that Swedish ownership does not guarantee a "safe" space either. With Swedish-controlled applications, however, they proposed developing cybersecurity practices as the major way to tackle the risks.

Finally, in contrast to all the suggestions on addressing the China threat through stricter legislation, one expert asked thought-provokingly what such changes would do to Western societies themselves: "Open market economies have probably gained the most from globalization, but how do we deal with our own openness? It is constitutionally guaranteed!"

*Awareness raising and behavioural changes*

The consensus among the experts was that enhancing awareness of data collection and usage is crucial, and such efforts should be targeted at the demand side rather than the supply side because it will – most likely – be the consumer who bears the risks. According to some experts, public awareness campaigns about data security and usage could be effective. For instance, the public could be educated about "free" applications that actually profit by collecting data from the user.

On a general level, the target audience for awareness raising should be both individuals and companies. At the same time, behavioural changes should be enacted – although some experts acknowledged the difficulty of adopting them. Intriguingly, one panellist also held the view that raising awareness of Chinese ownership might result in users' losing confidence

in apps and platforms, which, in turn, could potentially have devastating consequences for these businesses. Finally, it was emphasized that awareness raising should not focus too much on ownership structures because it might cause other ways of data tapping to be neglected.

*R&D solutions*

Some panellists proposed technological solutions to help prevent or hamper the misuse of sensitive personal data. On a general level, innovations were called for to tackle issues regarding data protection and safety. More specific suggestions included technological solutions to allow geo-localisation only when apps are used and to restrict access to augmented reality (AR) games when playing near critical infrastructure. Further anonymization of sensitive data was also considered as a means to mitigate the risk of misuse.

*Shaping market conditions*

Some experts also suggested the shaping of market conditions to make the use of data-gathering applications safer without extensively restricting the operations of companies. This was seen as a more realistic solution than awareness raising because gaming companies are often start-ups in need of capital, which makes them neglect the risks of acquisitions.

According to one expert, the gaming market may, in any case, become more fragmented due to current political trajectories in China and the US, Chinese efforts to regulate the digital economy, and requirements to localize data. This, in turn, may weaken the power of large platform companies and hence allow for new actors to emerge.

Some experts also argued that market conditions could be shaped by influencing the way China behaves in the gaming market. One panellist underlined the importance of communicating to China that its aggressive corporate practices and political control of enterprises are harmful to China's own economic development. Therefore, he went on to argue, China should reduce the level of state involvement in private business practice.

## 5.3. DISCUSSION

The Swedish Delphi exercise focused on two threat scenarios built around the concerns that China will have the ability and the desire to weaponize critical dependencies and create security risks through its FDI practice in the future. Generally, most participants suggested an active approach to tackling these issues through legislative changes, awareness raising, domestic market reforms and international diplomacy, especially in the

field of trade. Notably, several panellists expressed a sense of agency vis-à-vis China by making suggestions that implied confidence in negotiating with, influencing and even pressuring the country – to the extent that taking these actions would induce changes in Chinese practices and Chinese society. Although such views may reflect Sweden's activist and declarative foreign policy discourse and identity as a "moral superpower"[198], they may also have been shaped by the composition of the panel and the workshop's way of posing problems. Since the majority of the participants were state officials, they might have been inclined to envision broader – diplomatic and social – risk mitigation means, instead of more sector-specific or company-level methods. The same applies to the intriguing suggestion of lying flat and avoiding antagonizing China: it was probably raised more for the sake of argument or even as an expression of frustration in the face of the difficult situation presented in the scenario.

In many responses, China was viewed as a particular threat or at least a special challenge. Only a few panellists explicitly underlined the broader nature of the risks depicted in the scenarios. This is in line with Sweden's increasingly wary and negative China perceptions, but also indicative of the composition of the panel. For state officials, conflicts are often considered to be built in the relations between actors, and, therefore, the nature of the partner is a key variable. Such a way of thinking differs clearly from the views of sectoral experts and entrepreneurs, who may define the problem in a more country-neutral and issue-specific manner by emphasizing the technical vulnerabilities of online applications, for example. For these reasons, it is important to further underline the most important limitation of Delphi exercises: the results only represent the views of the panel at hand and can never be generalized.

In the face of increasingly negative China threat perceptions – which this exercise may not only have revealed but also unintentionally strengthened – it is also essential to stress that the making of Sweden's national strategy of preparedness is not only indicative of its identity; it also shapes what Sweden will be like in the future. Therefore, and although the security risks are actual and real, caution should be exercised when seeking to tackle China-related risks by all means necessary, even in ways that compromise the foundational values of Western democracies – as one of the participating experts pointed out at the workshop. The key to succeeding in this task lies in one of the most viable features of Swedish culture: continuous discussion and debate.

198 Dahl 2006.

## Enhancing Sweden's national preparedness: Key takeaways

### Diversification of sources and increasing self-reliance

**Encouraging domestic mining**
**Investing in recycling of rare earths and developing alternatives for them**
**Diversifying Sweden's energy portfolio**
- Expanding nuclear power generating capacity

**Enhancing EU-level coordination on energy issues**
- Developing a common energy strategy, regulatory framework and supply

### Legislative and regulatory changes

**Developing national FDI controls**
- Screening cumulative effects of investments
- Including investments in companies that possess large amounts of data
- Defining data as a dual-use product

**Initiating national security analyses on municipal-level decisions on investments**
**Reforming national mining permit processes and environmental legislation**
**Developing the EU's regulatory framework**
- Enforcing General Data Protection Regulation (GDPR) with tougher sanctions
  - imposing a fine of four per cent of the annual turnover
- Regulating non-personal sensitive data, including data emanating from connected devices (IoT)
- Setting standards to make terms and conditions more accessible

### Awareness raising, foresight and behavioural changes

**Enhancing public risk awareness**
- With a focus on
  - public awareness campaigns about data security and usage
  - forming national unity in broader risk assessments
  - enhancing understanding on China's actual behaviour and practices

**Mapping critical and strategic dependencies and technologies**
- Defining which materials are critical in different sectors
- Using the National Emergency Supply Agency of Finland as a source of inspiration

**Initiating institutional arrangements facilitating long-term decision-making**

### Shaping market conditions

**Incentivising alternative forms of investments**
**Encouraging state intervention and re-regulation of parts of the economy**
**Influencing China's behaviour**
- Emphasising the risks of China's practices to its own economy

### Trade policy

**Pushing politically for reciprocity in trade and market access**
**Initiating punitive tariffs on state-subsidized imports**
**Using trade policy as way to coexist with China**

### R&D solutions

**Developing geofencing solutions**

# POLICY IMPLICATIONS AND CONCLUSIONS

**Mikael Mattlin, Shaun Breslin, Elina Sinkkonen, Liisa Kauppila and Matt Ferchen**

Globalization ushered in a golden age for interdependence and belief in the ability of cross-border capital flows and relatively free markets to deliver prosperity and indirectly reduce conflicts. Enterprises took full advantage of the opportunities they were offered. The grand-old lady of International Political Economy (IPE) Susan Strange[199] asserted that transnational corporations (TNCs) were key actors in the promotion of globalized production. She argued:

> *[T]his has not happened entirely by accident. The shift from state authority to market authority has been in large part the result of state policies. It was not that the TNCs stole or purloined power from the government of states. It was handed to them on a plate – and, moreover, for "reasons of state".*

Strange went on to argue that even the US government could not contain the forces it had unleashed, and that even the world's most powerful government found its options constrained by the actions of TNCs. But this should not obscure the fact that the original liberalization of the economic structure was based on political choice and government decisions that served the interests of a subset of national actors.

In recent years, scepticism with regard to the advantages of interdependence has grown. Rather than promoting security, interdependence has come to be seen as a cause of insecurity and an element in conflicts. Consequently, governments have shown an increasing willingness to claw

199 Strange 1996, 44–45.

back power from enterprises, in the process attempting to reduce risks in globalized supply chains.[200]

In an environment characterized by a lack of trust in the motives of key global actors, especially small states are vulnerable to the vicissitudes of major powers' geoeconomic competition. As established in the introduction, small states are less able to dictate the global structure in which economic interactions take place and are more often system takers than system shapers. How, then, can small states shield themselves from adverse consequences and enhance their preparedness?

This report has taken a deep dive into a bundle of issues related to small state preparedness. The Finnish and Swedish backcasting exercises discussed in the previous chapters brought together 113 notable sectoral experts and generalists to immerse themselves into a set of imaginary future situations manifesting small state vulnerabilities. By raising risk awareness through comic-format scenarios and discussing alternative ways to respond to the challenges described in them, the exercises sought to contribute to Finland's and Sweden's national debates on their leeway, role and available coping strategies in the new cold war. Given the crossroads at which both countries currently stand, facilitating such an iterative process was of crucial value in itself in both countries. Yet the findings of the panels also raise some final thoughts on the broader phenomenon of small state preparedness. In this conclusion, we focus on these general observations and also discuss some methodological lessons learned.

Overall, the empirical cases presented in this report showcase that small state preparedness is a two-way street: the quality of one's own policies, practices and behaviour shape one's readiness to act and contribute to defining the space in which risks are both constructed and materialize. Yet, at the same time, the specific variables of a given external risk environment do define – and limit – the leeway that a small country has in responding to potential threats. While our limited set of scenarios – nine in Finland and two in Sweden – could not possibly cover the entire nexus of internal and external environments exhaustively, they nevertheless help to draw a broader picture of the relevant phenomena. In other words, this report contributes to understanding small state preparedness by

200 For its part, China has consistently maintained state ownership and control over what it considers the "commanding heights" of the economy in key sectors. Despite the widely shared view that the party-state role in the economy has grown under Xi Jinping (see, e.g., Pearson et al. 2022), other scholarship highlights the consistent role of industrial planning and state-owned enterprises as part of that planning (see Leutert and Eaton 2021).

1. grouping perceived risks under thematic categories and
2. providing an ordinal scale of the leeway a small country has when faced with different types of risks

The thematic groupings highlight the different sectoral environments small states are faced with. Generally, based on the variety of the responses given by our panellists to our three bundles of risk scenarios, small states seem to have the smallest leeway in navigating risk environments created by technological dependencies, whereas the toolkits to tackle the potential dangers of foreign ownership and supply disruptions are more extensive. There may also be other significant categories of risks that can be placed on this ordinal scale.[201]

As all our cases indicate, small countries *do* have means to act although the proposed solutions may be partly in contradiction with each other. No single clear preferred direction of travel emerged, while a few suggestions were widely supported. Different issues and insecurities require different bespoke solutions, and what might work in one area is not necessarily a solution to other problems. What we have is a set of issue-specific recommendations. These observations point to the need for fine-grained and nuanced functional analyses of different types of insecurities rather than a one-size-fits-all response that works across the board. Given the expertise and experience of our panellists, we were also somewhat wary of being seen to "out-expert the experts" in some way. Instead, we chose to present individual policy recommendations at the end of each substantive chapter (as key takeaways).

Nevertheless, three main approaches towards enhancing small state preparedness emerged from our data: protectionism (or interventionism), liberalism and technological optimism. We emphasize that these approaches are not only of heuristic nature but also contextual, that is, they are tightly linked to the small state perspective. In other words, someone who has here suggested solutions labelled as protectionist (or more positively, interventionist) might well support economic openness in principle but may, at the same time, feel that small countries cannot but follow the lead of great powers in their urge to impose tariffs and de-riskify supply chains. Moreover, given the relatively liberal nature of our empirical settings – the Finnish and Swedish economies – basically any novel regulatory effort could be viewed as a shift towards protectionism.

***Protectionist/interventionist solutions*** would impose stricter legislation on foreign ownership. Real estate acquisitions of all or certain foreign nationalities would be banned, or their screening would cover a

201 Rühlig 2023.

wide range of countries of origin. As for FDI, not only acquisitions but also greenfield investments would be screened in Finland as well (in Sweden, the soon-to-take-effect mechanism will already cover them). Venture capital investments would be brought under systematic scrutiny. Moreover, international trade would be restricted, tariffs increased and support provided for domestic or EU-level production through such means as subsidies and active industrial policies. Legislative changes would also be needed for the state to be able to intervene in business and, at the extreme, even take over the means of production if foreign ownership became an issue.

The United States has adopted a similar strategy in its relationship with China (with major policy initiatives such as the Inflation Reduction Act and the Chips Act) and promoted this approach towards the EU countries as well, as a means of reducing China-related risks and insecurities. Interestingly, in high-tech issues, increasing neither domestic nor European self-reliance was generally strongly advocated. It is also worth noting that despite a growing concern about Chinese economic coercion, including at the formal G7 level, it is the United States that is increasingly acknowledged as having the most capacity, and willingness, to "weaponize interdependence" in the technology sphere.[202]

Expanding the scope of supply stockpiling would also be a protectionist solution. Preparing for supply disruptions requires funds for stocks and their supervision. Furthermore, not all risks can be prepared for at the same time.[203] There is always the possibility of "black swans" emerging that few saw coming.

There needs to be an awareness and acceptance that putting more emphasis on national preparedness and reducing interdependencies will not be cheap either. How do you persuade commercial actors to think beyond profit motives in making their sourcing and production decisions? How do you get them to put a price on long-term national security considerations? Such considerations are particularly difficult if competitors are not thinking and acting in the same way and thus potentially gain commercial advantage, at least in the short term. Some combination of carrots (financial incentives to move production processes and/or supplies) and sticks (legislative action to force them to move) is needed to influence corporate calculations. Still, this is likely to result in significant costs, at least in the short run, to both governments (economic incentives and subsidies) and consumers (increased prices and taxes).

202 See Farrell and Newman forthcoming.

203 Wigell et al. 2022b.

If governments turn towards protectionist solutions, they will need to do some calculations first. How much will it cost to make a difference, and how much of an economic price are they prepared to pay (again, in the short term at least) for longer-term economic security? They will also need to hope that their electorates have done the same sort of implicit calculation and come to the same conclusion – especially as in the case of providing incentives, it will be public money that will be used to ensure private commercial profits.

Conversely, those in favour of upholding a more ***liberal approach*** towards national preparedness attempted to solve the issues primarily by raising awareness of the risks of foreign ownership and changing people's behaviour. For example, instead of limiting entrepreneurial freedom to decide where to sell one's company, value-based considerations could be initiated to guide individuals' choices when accepting investments and offers. A national innovation strategy could boost domestic companies' operating conditions. Moreover, instead of banning certain foreign-owned applications, people should be taught to be "technology literate" to be able to use them wisely. Rather than tightening laws on foreign real estate acquisitions, it would suffice that the original inhabitants – such as the Indigenous peoples – were granted broader rights to govern their land.

The liberal solutions offered by the panellists also included diversifying the sources of goods rather than outright blocking exports from certain countries. Adaptability and awareness of risks, rather than drastic changes in supply chains, were seen as the key. Instead of erecting direct trade barriers, market functioning could be improved. For example, the EU's single market could be deepened so that it would offer genuine scalability opportunities for start-ups in the member states because currently start-up companies are often bought out early and often by enterprises from outside of the EU.

These solutions are thematically related to the high-tech scenarios as regional resilience would be improved if the technology sector could be strengthened in Europe (which would reduce dependencies on both China and the US). This has been a problem especially in Finland, where typically promising medium-sized enterprises are sold to foreign buyers just before entering the business phase in which economies of scale kick in, and the company's full market potential is realized. For example, a large number of the most important Finnish gaming and security software companies, as well as many companies operating in biomedicine, have been acquired by foreign companies over the past decade. A liberal solution would be to provide a supportive operating environment and realistic options for rapid business scaling by improving the single market and

capital market support.[204] More difficult to change are the serious labour and skills shortages currently affecting both Finland and many other EU member states, including Germany, that may hamper growth potential, as well as socio-cultural traits that favour "cashing in" relatively early rather than continuing to expand and develop the company.

The third, more ***technologically oriented approach*** was to try to solve the issues with new innovations or technical solutions such as replacing antibiotics with new medicines, not buying Chinese rare earths but rather producing energy with SMRs, producing water purification membranes with 3D printing or searching for alternative materials to replace helium. Geofencing and coding could be used to prevent the risks created by foreign-owned applications and technologies that gather and transmit data. While much innovation comes from private sector funding, it is likely, as with protectionist measures, that future-proofing security-based innovation will have at least some financial implications for governments and/or consumers.

When analysed in the context of the three risk categories of foreign ownership, supply chain resilience and technological dependencies, the broader positions of protectionism, liberalism and techno-optimism naturally face contradictions. Still, there were a few issues that were supported by many or even the majority of our respondents. Regarding the external environment, diversification was widely supported. In more concrete terms, diversification could be achieved with the help of improved tendering rules that would better mitigate supply security risks by placing quality over price, taking geopolitical risks into account and allowing multiple winners in contrast to the currently dominant winner-takes-it-all logic, which leads to overly concentrated supply chains. As for the internal context, a well-educated population and sufficient research funding will ensure that there is domestic expertise to tackle new technological and/or great power rivalry related challenges. Some legislative changes were also widely encouraged to be made, and especially real estate acquisitions made by nationals of authoritarian states were proposed to be banned. Any regulatory and legislative efforts were also proposed to be complemented with balancing acts such as long-term leases and incentives to develop and acquire domestic products and companies.

As should be clear by now, there are no right or wrong ways to enhance small state preparedness. Instead, there are different policy options whose desirability and feasibility divide the views of experts. Yet, judging from the public debate, it often appears that the only option left is to opt for a security-oriented and highly protectionist approach – especially because

204 In this respect, Finland's situation has improved in recent years, especially with regard to start-up financing. On a per capita basis, Finland's venture capital financing is now one of the highest in Europe.

even the supposedly liberal United States is currently in the process of remaking itself as an increasingly protectionist country with activist industrial policies.[205] Similar policy ideas are also currently in vogue in several larger EU member states.

Australia, however, offers a different approach. While the government has been seeking to mend fences with China through diplomatic means, Australian companies have actively sought to diversify their international relationships by finding new sources of supplies and markets. In fact, the Australian case is one example of a relatively small state that opted for a largely liberal, and ultimately successful, response in the face of increasing trade pressure generated by a broader diplomatic and political dispute with China. Australia's successful "resilience" when faced with such commercial pressure was largely a factor of China's continued need for imports of key Australian commodities and Australian businesses' ability to adapt and find alternative markets.[206]

China itself has increasingly veered in a more protectionist direction in recent years, the highly security-focused 20th Party Congress work report from October 2022 being a case in point. This reminds us that changing production, trade and investment relationships is not the monopoly of Western governments and companies; decisions made in China will be a crucial determinant too, and at the very least, they may bring forward the time scale for action. Indeed, it is not impossible that thinking of China in a certain way might become a self-fulfilling prophecy. If China is thought of as being potentially antagonistic in the future, and a large set of actions are preventively taken to change, restrict or stop investment and trade relations with China, this might well create the antagonism that was originally feared (or at least accelerate a vicious spiral of deteriorating relations),[207] or a form of *economic security dilemma.*[208]

It is also possible to reflect on the differences between the views expressed in the Finnish and Swedish panels and the methodological lessons learned from them. At the risk of oversimplifying, it can be argued that the sense of agency to influence China's future behaviour was stronger in the Swedish panel than in the Finnish exercise. More specifically, more than a few Swedish experts underlined the ability to negotiate with China and

205 *Financial Times*, 5 June 2023.

206 See McGregor 2022. It is worth noting that the concept of "resilience" also features prominently in US discussions of supply chain recalibrations as part of enhanced competition with China. In contrast to Australia, however, the Biden administration has emphasized that American resilience is intimately connected to a more muscular industrial policy necessary to outcompete China, including the reshoring or "friendshoring" of semiconductor supply chains. For example, China appears 458 times in the Biden administration's 2021 report "Building Resilient Supply Chains".

207 See Mattlin and Rajavuori 2023 on causal narratives related to perceived China risks.

208 Bulman 2021; Moraes and Wigell 2022.

even to change Chinese practices. Such views were rarely expressed in the Finnish data. There may be various reasons for this. For one, the Swedish panel consisted mainly of state officials – practitioners of diplomacy and professional negotiators – whereas the Finnish panel was more diverse and often dominated by the views of sectoral experts. For the same reason, the Finnish exercise also sparked more detailed suggestions. However, it is also possible that the Swedish on-site setting inspired the panellists to come up with such bold views since they were "compelled" to propose something. A third option is that the views might truly reflect the different foreign policy traditions of Sweden and Finland: the sense of agency to influence China might have been a manifestation of Sweden's declarative and bold foreign policy discourse, which is different from Finland's traditionally more pragmatic and cautious approach.

Due to the large number of sectoral experts, the technologically oriented approach was more prevalent in the Finnish than the Swedish panel. Protectionism/interventionism and liberalism were equally present in both panels, although the most extreme views were expressed in the Swedish exercise – possibly due to the above-mentioned methodological reasons. Generally, it is intriguing that relatively little criticism was expressed about Sweden's upcoming FDI screening mechanism, which can be interpreted as a major shift towards protectionism in one of the "bastions" of an open economy; some panellists even underlined the need to tighten its scope. In Finland, on the other hand, the opinions were often rather divided on whether the country's relatively liberal legislation on foreign ownership should be tightened. Clearly, this discussion must be continued in Finnish society.

Given the focus on Sino-US rivalry and China-related risks in particular, it is unsurprising that the responses of the panellists often underlined risks related to China. This is not to be taken as an indication of particularly strong China threat perceptions among our panellists but as something that follows from the research design and case selection. Nevertheless, it should be noted that the Russian full-scale invasion of Ukraine most likely triggered some of the panellists to "roll up their sleeves" and envision drastic means to tackle China-related risks. This was most likely – and, on a few occasions, reportedly – motivated by the fact that, in essence, the China threat presented them with a danger that had not yet materialized and, in their view, could therefore be avoided with pre-emptive means. As such, the timing of the exercises enabled the panellists to make the most out of the empowering function of dystopian backcasting: the ability to use the approach to practise unwanted future situations and ways to avoid them. Yet, adopting dystopian backcasting also meant that the exercises might have strengthened China-related risk perceptions – to a degree

that was not intended. To that criticism, we respond by underlining the need to enhance what could be coined as "risk literacy": the ability to detect, assess and question which of the constructed potential dangers and harms around us are possible, plausible and likely.

Overall, according to the general standards of Delphi studies, both the Finnish and the Swedish exercises were successful. In Finland, the research team was able to secure a versatile, sizable and balanced panel of renowned experts. Notably, almost half of the sectoral experts were highly surprised when invited by phone to join the panel since they did not consider their expertise to be sufficient to assess risks related to Sino-US rivalry or China. Yet a vast majority of these experts participated actively and shared valuable sectoral insights. Generally, the panellists were highly engaged with the discussion, and many of them explicitly commented on the effectiveness of the comic strips to convey complex issues in an approachable manner. Simply put, the aim of the iteration was achieved, and we received a multitude of concrete suggestions on how to avoid the dystopian scenarios. Some of the scenarios also evoked emotional responses among the panellists (as they self-reported), which increases the likelihood of remembering the exercise later. Although the Swedish panel was smaller and its composition was more homogenous, all the above-mentioned qualities were present as well. The unconventional online/on-site hybrid used in Sweden resulted in a particularly lively discussion, and such an application of the Delphi method could well be further developed in the future as it enables one of the key features of the Delphi method – the anonymity of responses – to be secured in on-site exercises.

Finally, identifying potential ways of providing greater security in the future is merely a starting point. We have already pointed to the potential economic costs that some of these solutions will likely entail and the decisions that will need to be made on what prices are worth paying. But there are also potential political costs to consider: what type of state and/or economy do Finland, Sweden and others (including some not-so-small countries) wish to be? Are the measures that seem most likely to succeed in line with a preference for openness and internationalism, for example? In keeping with our definition of small states, it is tempting to suggest that there might not be much of a choice to make: is it even possible to retain a commitment to liberal principles of openness when other more powerful global actors do not share that commitment? Several of the recommendations in this report do indeed have a relatively strong protectionist tinge. But not all of them. There are choices to be made, and in democracies, it is essential that decisions as big as these have legitimacy and a necessary degree of popular support and buy-in. Reports such as

this can thus form part of a very necessary process of expanding public awareness and knowledge, establishing a foundation for comprehensive stakeholder cooperation and dialogue between a range of different actors. Which options are likely to be politically the most acceptable, supportable and legitimate?

# APPENDIX: THE DELPHI PROCESS IN FINLAND AND SWEDEN

**Liisa Kauppila and Elina Sinkkonen**

This appendix presents the methodological choices made in our Finnish and Swedish Delphi exercises in more detail. We elaborate on the specific considerations of each step of the process.

## STEP ONE: SCANNING THE RISK ENVIRONMENT AMIDST CHANGING SECURITY SITUATIONS

In exploring the risk environment, we conducted a forecasting exercise. On the one hand, we anticipated "risks", that is, potentially dangerous future situations or developments faced by Finland and Sweden in a world of Sino-US strategic competition. On the other hand, we identified "triggers", meaning factors or events that initiate sequences of events that may result in (potentially) dangerous outcomes. We forecasted both short- and longer-term risks: developments that could realistically unfold either within the next five to seven years – from 2027 to 2030 – or significantly later, up to 2035. Naturally, anticipating longer-term risks was more difficult: the further in time we go, the more difficult it is to imagine potential dangers whose materialization is both possible and realistic.

In practice, we organized two internal on-site and six online workshops to bring together the findings of individual team members and benefit from group synergies. Our data and sources of inspiration included Nordic, Chinese and Western international media, official documents and websites, reports, academic literature and expert interviews conducted

earlier to serve the broader aims of the ForAc project.[209] Many of these sources are referred to in the context of each mini scenario. The initial risk scan was also complemented with ideas shared by our panellists during the first two questionnaire rounds.

Although we conducted our scan without any pre-existing categories in mind, we examined the work of various institutions to ensure a comprehensive take on risks. For example, we found it useful to consider the Finnish National Emergency Supply Agency's list of seven sectors critical to the functioning of Finnish society: energy, food security, finance, logistics, industry, healthcare, and information society.[210]

The external security environment of Finland and Sweden changed radically during our risk scan as Russia launched a massive attack on Ukraine in February 2022. Although the most significant changes took place in Finland's and Sweden's relations to Russia and attitudes towards the North Atlantic Treaty Organization (NATO), the war also had an impact on their threat perceptions related to China – not least due to China's partnership with Russia. While the immediate reaction of European countries was to minimize their economic ties with Russia, the public and policy discussion soon expanded to dependencies related to China and the country's potential to "weaponize"[211] those dependencies. This debate intensified considerably in August 2022 when Sino-US relations worsened as a result of US House of Representatives Speaker Nancy Pelosi's visit to Taiwan.

While these developments in great power relations motivated our stakeholders to participate in the project's expert interviews and the actual Delphi exercises reported here, they also shaped our own risk perceptions: the potential dangers related to dependencies on China and Chinese investments were emphasized. At times, our take on China-related risks was also directly inspired by Russia's actions (e.g., real estate acquisitions). As we focused more on the dependencies and risks related to China, there was consequently less space to analyse those related to the US.

The short-term risks identified during the scan ranged from dependence on the supply of Chinese pharmaceuticals, rare-earth elements and critical green transition materials to foreign ownership of real estate with dual-use potential and Sino-American dominance in the manufacture of industrial components. The longer-term risks included dependence on US-produced military technology and Chinese and American advanced

209 14 interviewees were specifically asked to identify risks faced by Finland and/or Sweden for the Delphi process.

210 National Emergency Supply Agency (of Finland) 2023. Since the exercise was designed, the agency has added the private security service sector as an eight category.

211 Farrell and Newman 2019.

health technology. The triggers, in turn, included such developments as sanctions, extreme weather events and unforeseen incidents in third countries.

Some of the identified risks were ones that have been known for a long time, yet this knowledge has led to very little action (e.g., dependence on imported antibiotics), whereas others were potential dangers that small states may face only in the long term (dependence on Chinese advanced health technology). In other words, some risks were ones in plain sight, while others were of a more surprising nature. This variation highlights the general tendency of groups to be better at reacting to acute and intense threats than to gradually emerging threats[212] – even when the feared end result of the latter would be as bad or worse than that of the former (i.e., the "boiling frog syndrome").

## STEP TWO: STRUCTURING THE DELPHI PROCESS

To structure the Delphi process, we formulated the framework presented in the introduction (Figure 1) and chose the empirical cases to be developed into mini scenarios. As for the framework, we clustered the anticipated risks – the results of our scan in Step One – into groups of similar types of small state vulnerabilities. After that, we identified those great power competences that contribute to their development. In this way, we created three (pairs of) categories that formed the basis of our analysis and the structure of our Delphi questionnaires.

Most of the short-term risks identified in our scan fell into the first two categories, whereas the longer-term risks revolved mainly around technological dependencies. For this reason, it was clear that our scenarios would need to have at least two target years. However, given that navigating between short- and longer-term futures within the same questionnaire would be a great cognitive challenge, we decided to add a mid-term target year to make "mental time travel"[213] smoother. In that way, each of the above-mentioned three categories was connected to one target year only, which also added clarity to the exercise.

Since security risks created by great powers' investment leverage were a highly topical issue of debate in both Finland and Sweden already at the time of starting the Delphi process, we chose the shortest time span for the related mini scenarios: 2027. In that way, the proposals of our panellists

212 Epp and Herschel 2022.

213 Cuhls 2017.

could also contribute to the ongoing reforms in Finland's and Sweden's approach to screening foreign investments and real estate ownership.[214]

Although many of the identified supply disruptions could take place immediately, the triggers with the ability to make these disturbances far greater are likely to emerge closer to 2030. For example, global heating-related extreme weather events will be more common then,[215] and, presumably, the weaponization of choke points and hubs will most likely increase by the end of the decade as great power competition will further polarize the world. More specifically, the Taiwan issue is likely to become an even hotter topic in Sino-Western relations by the end of the decade. Given that China is currently undergoing a transformation from being the world's factory to being a high-tech superpower, and that many of the technological developments identified in our scan have long lead times, 2035 was a sufficiently distant target year for facilitating a nuanced analysis of small state vulnerabilities in the face of great powers' core technology control.

Having three mini-scenarios per questionnaire was considered to be a manageable task: we wanted to avoid "Delphi fatigue" resulting from too arduous and time-consuming processes. At the same time, we thought that the total of nine scenarios would provide a sufficient overview of different types of small state vulnerabilities for the panellists to consider. More specifically, the total of nine cases allowed us to present the panellists with a wide variety of sectoral risks: our mini scenarios dealt with all but one of the sectors listed by the Finnish National Emergency Supply Agency as critical for the functioning of society (see Step One). Moreover, presenting the panellists with multiple scenarios in each broad category gave enough space for iteration: the panellists could build on the answers of the previous questionnaire rounds.

## STEP THREE: DEVELOPING QUESTIONNAIRES WITH DYSTOPIAN COMICS

In Step Three, we constructed the mini scenarios in two phases. First, we researched the issue areas of the scenarios and brainstormed their core elements:

214 In Finland, the Act on the Screening of Foreign Corporate Acquisitions was amended in 2020, whereas the Act on Transfers of Real Estate Requiring Special Permission came into effect in the same year. Sweden's FDI Act *Lag om anmälan och granskning av utländska direktinvesteringar* is estimated to come into effect in December 2023. Yet, there is pressure for further reforms as neither of the two countries screen venture capital investments, and Finland does not screen greenfield investments. Moreover, there is no legislation restricting foreign real estate acquisitions in Sweden, although a preliminary proposal has been submitted.

215 IPCC 2021.

1. the end-point, that is, the nature of the crisis or threatening situation faced by Finland/Sweden;
2. key variables, especially the role of China and/or the United States;
3. core trigger(s), meaning events or factors that initiate sequences of events that result in the crisis; and
4. other key events that build the pathway from the future to the present.

Since we asked our stakeholders to backcast from illustrated dystopias constructed by us, and thus "forced" them to consider very strong mental images, it was crucial to ensure that our scenarios were sufficiently plausible and convincing. Otherwise, the experts might have focused on arguing against or improving the image of the future itself[216] – although the point of backcasting is to propose means to ends. We also explored preliminary means to avoid the depicted crises and added them to the scenario storylines; this strategy further stimulated the panellists to focus on their primary task.

Second, we designed the actual storylines and plots of the scenarios with a comic artist. The artist started from the premise that all the dystopian futures should be brought onto the level of ordinary people and universal human emotions. In that way, the comics would be well-equipped to immerse all kinds of panellists in the future – be they businesspeople, state officials or researchers. From a survey research perspective, successful immersion was important for validity: facilitating mental time travel allowed the experts to practise unconstrained futures thinking, consider the correct dimension of time and thus truly digest the puzzle they were presented with.[217] Notably, we received plenty of positive comments about this: many experts felt that the scenarios "got under their skin" and made them think long term. In the actual questionnaire, the panellists were presented with both the comic format and a one-page backgrounder that summarized the research conducted on the issue area of the scenario. This enabled us to provide the most interested experts with additional knowledge in a more traditional manner.

The overall comic art format was also chosen to tackle survey and Delphi fatigue: a loss of interest in participating in yet another (Delphi) survey. Delphi processes are notoriously arduous, and it was likely that our panellists did not have only positive experiences of them. By presenting the scenarios in a comic format and starting the process with a

216 See, e.g., Zimmermann et al. 2011.

217 Kauppila 2018.

teaser promising "something different" (Figure 3), we sought to engage the panellists and attract their curiosity.

The actual questionnaires – and their instructions – were formulated with a heavy emphasis on the need to backcast. In other words, we used various methods to communicate that we were seeking to gain efficient means to avoid the dystopias – not estimations of the likelihood of the proposed scenarios. In addition to the above-mentioned stimulants in the storylines of the scenarios, we underlined that proposing means to avoid the dystopias did not indicate that the panellists agreed with their content. We also provided an open slot at the end of each scenario section to allow the panellists to argue against the dystopia itself, if necessary. In this way, the panellists were able to engage in backcasting and yet rest assured that their possible doubts about the image of the future itself were being heard.

In addition to the research team members, six persons tested the questionnaires for clarity and functionality. Most of the test panellists had experience of conducting either Delphi exercises or other types of survey studies. Their expertise also covered information technology and art meets science projects, which meant that the questionnaires were evaluated from diverse viewpoints. Overall, minor changes were made based on the test panellists' comments.

## STEP FOUR: FORMULATING THE PANELS

The panels of experts were selected using an expertise matrix, a much-utilized method for ensuring that relevant stakeholder groups and necessary types of knowledge are covered in a Delphi process (See Tables 2 and 3 in the Appendix).[218] In addition, we considered Kuusi's qualities of ideal Delphi panellists: interest in thinking beyond one's own field of knowledge and national context, ability to make local-global and past-present-future connections and, perhaps most importantly, willingness to analyse trends from an unconventional perspective.[219] Moreover, we paid attention to equal representation (gender balance) and, given that the exercise was performed in a comic art format, considered potential panellists' reactions to such an exercise.

218 Kuusi et al. 2006.

219 Kuusi 1999.

## STEP FIVE: RUNNING THE PANELS

In Finland, the experts conducted the entire exercise on a Finnish open-source online platform specifically designed for the Delphi method (https://www.edelphi.org/). Each questionnaire round had two phases. During the first phase (eight days), the panellists entered the platform, read the comic scenarios and shared their initial answers. Since the exercise was run in real time (answers appeared on the platform as they were written), most panellists had the chance to build their first suggestions on the arguments of others. In the second phase (seven days), the panellists were given the opportunity to read all the answers of the first phase, comment on them and then, if need be, change their original answers. Overall, this two-phased real-time format was chosen to maximize the level of iteration, which is a key feature and a goal of any Delphi process. As for anonymity, the identity of the experts was not revealed at any point of the study. However, we – the facilitators – knew which answer belonged to whom.

The response rates for the questionnaire rounds were high for Delphi processes (based on logging onto the eDelphi platform: 92%, 78% and 87%. Most likely, the telephone invitations, the repeated reminders and the comic art format enhanced the level of the panellists' engagement.

For our Delphi exercises, six broad categories of stakeholders were identified (horizontal row in Table 2): research, business, independent/civic sector, public sector, political decision-making, and citizens. As for decision makers, each round included stakeholders on a rough left-right spectrum. Although "citizens" may strike as a deviant category, it is typical to include "user" perspectives in Delphi exercises. These individuals are often innovative persons that cannot be placed in other slots.

As for the types of knowledge on the vertical row, we utilized the six themes of our broad framework. In addition, to reflect the empirical content of the mini scenarios, we added three distinct types of knowledge to each questionnaire round. (Table 2)

| | | Research | Business | Civic sector | Public sector | Decision-making | Citizens |
|---|---|---|---|---|---|---|---|
| Competences of great powers | Supply chain dominance | 6 | 2 | 2 | 6 | 2 | 1 |
| | Core tech control | 8 | 6 | 4 | 5 | 3 | 1 |
| | Investment leverage | 7 | 4 | 2 | 8 | 2 | 1 |
| Vulnerabilities of Finland | Supply disruptions | 6 | 3 | 3 | 4 | 2 | 1 |
| | Critical tech dependencies | 6 | 6 | 4 | 4 | 4 | 1 |
| | Security risks | 5 | 5 | 3 | 7 | 2 | 1 |
| 1st questionnaire | Pharmaceutical industry | 2 | 2 | 1 | 1 | 1 | 1 |
| | Game industry | 1 | 3 | 1 | 1 | 1 | 1 |
| | Defence industry | 3 | 3 | 2 | 4 | 2 | 1 |
| 2nd questionnaire | Real-estate industry | 2 | 1 | 1 | 1 | 5 | 2 |
| | Wind power industry | 2 | 3 | 1 | 3 | 2 | 1 |
| | Health technology industry | 2 | 2 | 2 | 2 | 1 | 2 |
| 3rd questionnaire | Quantum computing industry | 4 | 2 | 3 | 2 | 1 | 1 |
| | Water management industry | 2 | 2 | 1 | 1 | 3 | 1 |
| | Research and technology industry | 9 | 1 | 3 | 2 | 2 | 1 |

Table 2. Expertise matrix / Finnish Delphi exercise

Two kinds of panellists were identified: generalists and sectoral experts. The generalists included individuals with a high level of understanding of at least one of the aspects of small state vulnerabilities or great power competencies. The sectoral experts, in turn, were stakeholders that had deeper and more industry-specific understanding of the issue areas of the nine mini-scenarios. In this way, the chosen panel would, as a whole, be capable of understanding our scenarios both through the small state-great power lens and the perspectives of the included industries.

Some of the experts could have been placed in more than one stakeholder category of the horizontal row. In those cases, we made the choice based on the expert profile instead of affiliation; the panellists were instructed to answer the questionnaires as individual professionals, not as representatives of their institutions. Moreover, since our experts typically possessed more than one type of knowledge, most panellists were placed in various slots of the vertical row.

The generalists participated in all the questionnaire rounds, whereas a new group of sectoral experts was selected to answer each of the three questionnaires. In questionnaires one, two and three, 48, 63 and 67 panellists were invited to participate in the exercise.

According to the general practice of running a Delphi panel, most panellists were first contacted either by phone or in face-to-face encounters and only then sent an official and personalized invitation email. These measures are widely considered to reduce drop-out rates and enhance the panellists' level of commitment.[220] It also gives potential panellists the chance to refuse the invitation, which allows the research team to find replacements before the actual process begins.

In Sweden, the Finnish expertise matrix was used as a heuristic. In other words, it was ensured that the panel would consist of different types of stakeholders who would analyse the chosen scenarios with different skill sets (Table 3). However, since the exercise was conducted as an on-site workshop, practical constraints – the specified time and place, no funding allocated to experts' travel costs – played a part in selecting the experts. This also explains why equal representation was harder to reach, and why there were considerably more state officials than representatives of other stakeholder groups. The invitations were only sent out by email.

220 E.g., Varho and Tapio 2013, 614.

| | | Research | Business | Public sector |
|---|---|---|---|---|
| Competences of great powers | Supply chain dominance | 1 | 1 | 1 |
| | Investment leverage | 0 | 3 | 3 |
| Vulnerabilities of Sweden | Supply disruptions | 1 | 1 | 1 |
| | Security risks | 2 | 1 | 5 |
| Issue areas | Energy industry | 1 | 0 | 1 |
| | Digital economy | 0 | 0 | 2 |

Table 3. Expertise matrix / Swedish Delphi exercise

In Sweden, an on-site workshop was organized at the Swedish Institute of International Affairs in Stockholm. The session was divided into two slots, one for each mini scenario. The panellists were first given a brief five-minute oral presentation (an equivalent of the Finnish one-page backgrounders), then asked to read the actual mini-scenario and anonymously share their initial proposals by using the eDelphi platform. The experts' answers appeared on the screen in real time, allowing everyone to see the variety of arguments immediately. An oral discussion followed, and at the end of the session, the panellists had the chance to re-enter the platform and modify their original answers. Due to the nature of the exercise, it was possible that the panellists were aware of the identity of the other experts (although no rounds of introduction were held in the room), but the anonymity of the answers was guaranteed. In Sweden, this also extended to the facilitators.

## STEP SIX: ANALYSING THE ANSWERS AND THEIR POLICY IMPLICATIONS

As the last step, we analysed the content of the answers. Although the tangible means and measures naturally differed in each case, similar broad themes were found in the answers of all the scenarios of the same category. Based on the analysis, we identified points of development for Finland and Sweden and drew broader implications concerning the enhancement of the preparedness of small states in a world of great power competition.

# BIBLIOGRAPHY


Aaltola, M., J. Käpylä, H. Mikkola and T. Behr (2013) Towards the geopolitics of flows.Implications for Finland. *FIIA Report 40*, September 2014. https://www.fiia.fi/en/publication/towards-the-geopolitics-of-flows.

Access to Medicine Foundation (2018) Shortages, stockouts and scarcity. The issues facing the security of antibiotic supply and the role of pharmaceutical companies. *White paper*, 31 May 2018, https://accesstomedicinefoundation.org/resource/shortages-stockouts-and-scarcity-the-issues-facing-the-security-of-antibiotic-supply-and-the-role-for-pharmaceutical-companies.

AFRY (2020) "Kemiallisen saostuksen huoltovarmuuden parantaminen" [Improving the maintenance readiness of chemical precipitation], https://www.vvy.fi/site/assets/files/3226/kemiallisen_saostuksen_huoltovarmuuden_ parantaminen.pdf. National Supply Emergency Organization.

Air Liquide (2021) "Air Liquide enters a long-term partnership to secure its supply of helium-3", 7 December 2021, https://www.airliquide.com/group/press-releases-news/2021-12-07/air-liquide-enters-long-term-partnership-secure-its-supply-helium-3.

Allison, G., K. Klyman, K. Barbesino and H. Yen (2021) "The great tech rivalry: China vs. the US. Cambridge: Belfer Center for Science and the International Relations, https://www.belfercenter.org/sites/default/files/GreatTechRivalry_ChinavsUS_211207.pdf.

Almén, O. (2023) Kinesiska investeringar i Sverige: en kartläggning [Mapping Chinese investments in Sweden]. *FOI Report* FOI-R--5474--SE, 12 June 2023, https://www.foi.se/report-summary?reportNo=FOI-R--5474--SE.

Anderson, B. (2010) "Preemption, precaution, preparedness: Anticipatory action and future geographies". *Progress in Human Geography* 34 (6): 777–798.

Babić, M. and A. D. Dixon (2022) "Is the China effect real? Ideational change and the political contestation of Chinese state-led investment in Europe". *The Chinese Journal of International Politics* 15 (2): 111–139.

Baldwin, D. A. (2020) *Economic Statecraft*. New Edition. Princeton: Princeton University Press.

Barkin, N. (2020) "Germany's strategic grey zone with China". Carnegie Endowment for International Peace, https://carnegieendowment.org/2020/03/25/germany-s-strategic-gray-zone-with-china-pub-81360.

Bereiter, C. (2002) *Education and Mind in the Knowledge Age*. Mahwah: Lawrence Erlbaum Associates Publishers.

Birtles, B. (2019) "Gay dating app Grindr caught up in US-China tech rivalry". *Australian Broadcasting Corporation*, 27 March 2019, https://www.abc.net.au/news/2019-03-28/gay-dating-app-grindr-targeted-by-us-over-spying-fears/10947092.

Bjurström, E. (2019) ”Suomalaisten varusmiesten hulvaton Disney-teemainen TikTok-video naurattaa ympäri maailmaa – miehet tanssivat tutun lastenohjelman tunnarin tahtiin” [Hilarious Disney-themed TikTok video of Finnish conscripts makes people around the world laugh – the men dance to the rhythm of a familiar children's show's theme song]. *Yle*, 20 November 2019, https://yle.fi/uutiset/3-11077860.

Bloomberg (2023) “Germany, Intel agree €10 billion subsidy package for chip plant, https://www.bloomberg.com/news/articles/2023-06-19/germany-intel-agree-subsidies-for-chip-plant-worth-10-billion?leadSource=uverify%20wall

Bochner, S. and A. Simmermann (2016) “The venture capital board member's survival guide: Handling conflicts effectively while wearing two hats”. *Delaware Journal of Corporate Law* 41 (1): 1–27.

Bohman, V. and N. Nymalm (2020) “Kinesiska investeringar i Sverige: från framgång till fara?”. [*Chinese investments in Sweden: From success to danger?*]. *Internasjonal politikk* 78 (1): 93–105.

Bulman, D. J. (2021) “The economic security dilemma in US-China relations”, *Asian Perspective* 45 (1): 49–73.

Business Finland (2023) “China FDI”.

Bøje Forsby, A. and B. Sverdrup-Thygeson (2022) China's coercive diplomacy: Why it's on the rise and what it means for Scandinavia. *NUPI Policy Brief* 6. The Norwegian Institute of International Affairs, https://www.nupi.no/en/publications/cristin-pub/china-s-coercive-diplomacy-why-it-s-on-the-rise-and-what-it-means-for-scandinavia.

Campbell, K. M. and E. Ratner (2018) “The China reckoning: How Beijing defied American expectations”. *Foreign Affairs* 97: 60.

CGTN (2019) “Chinese firm to set up dialysis centers in West Africa”, 19 February 2019, https://newsaf.cgtn.com/news/3d3d774d33557a6333566d54/index.html.

Chang, K. (2022) “Scientists achieve nuclear fusion breakthrough with blast of 192 lasers”. *New York Times*, 13 December 2022, https://www.nytimes.com/2022/12/13/science/nuclear-fusion-energy-breakthrough.html.

Chen, S. (2020) “China opens first large-scale helium plant as it tries to reduce reliance on US imports”. *South China Morning Post*, 28 July 2020, https://www.scmp.com/news/china/science/article/3094905/china-opens-first-large-scale-helium-plant-it-tries-reduce.

Chinese Ministry of Natural Resources (2016) 全国矿产资源规划（2016–2020年) [National mineral resources plan 2016–2020], https://www.mnr.gov.cn/gk/ghjh/201811/t20181101_2324927.html.

Choer Moraes, H. and M. Wigell (2022) “Balancing dependence: The quest for autonomy and the rise of corporate geoeconomics”, in M. Babic, A. M. Dixon and I. T. Liu (eds) *The Political Economy of Geoeconomics: Europe in a Changing World*. London: Palgrave Macmillan, 29–55.

Christopher, M. and L. Ryals (2014) “The supply chain becomes the demand chain”. *Journal of Business Logistics* 35 (1): 29–35.

Cirkulation (2022) “Kinesiskt ägande väcker frågor” [Chinese ownership raises questions]. *Cirkulation* 1/22, https://www.cirkulation.se/artiklar-och-notiser/kinesiskt-aegande-vaecker-fraagor/.

Congressional Research Service (2022) F-35 Joint Strike Fighter (JSF) Program, https://sgp.fas.org/crs/weapons/RL30563.pdf.

Covers, O. and M. Doeland (2020). “How the financial sector can anticipate the threats of quantum computing to keep payments safe and secure”. *Journal of Payments Strategy & Systems* 14 (2): 147–156.

Cuhls, K. (2017) “Mental time travel in foresight processes – Cases and applications”. *Futures* 86: 118–35.

Cyranoski, D. (2018) “Chinese firms enter the battle for AI talent”. *Nature*, 553 (7688): 260–261.

Dahl, A. S. (2006) “Sweden: Once a moral superpower, always a moral superpower?”. *International Journal* 61 (4): 895–908.

Dalkney, N. and O. Helmer (1962) An Experimental application of the Delphi method to the use of the experts. *RAND Memorandum* RM-727/1-Abridged, Santa Monica, https://www.rand.org/content/dam/rand/pubs/research_memoranda/2009/RM727.1.pdf.

Dataspelsbranschen [Swedish Games Industry] (2023) Game Developer Index 2022. Third edition, April 2023, https://dataspelsbranschen.se/game-developer-index.

Davis, N. (2017) “Antibiotic shortage puts patients at risk, doctors fear”. *The Guardian*, 1 July 2017, https://www.theguardian.com/society/2017/jul/01/antibiotic-shortage-puts-patients-at-risk.

De Goede, M. (2008) “The politics of preemption and the war on terror in Europe”. *European Journal of International Relations* 14 (1): 161–85.

De la Bruyère, E. and N. Picarsic (2022) *The Weaponization of Capital. Strategic Implications of China's Private Equity/Venture Capital Playbook*. Foundation for Defence of Democracies, 15 September 2022.

De Temmermann, G. (2021) "The helium bubble: Prospects for 3He-fuelled nuclear fusion". *Joule* 5 (6): 1312–1315.

Dobransky, S. (2013) "Helium-3: The future of energy security". *International Journal on World Peace* 30 (1): 61–88.

Drezner, D. (2019) "Technological change and international relations". *International Relations* 33 (2): 286–303.

Drinhausen, K. and H. Legarda (2022) "'Comprehensive national security' unleashed. How Xi's approach shapes China's policies at home and aboad". *MERICS China Monitor*, 15 September 2013, https://merics.org/sites/default/files/2022-09/Merics%20China%20Monitor%2075%20National%20Security_final.pdf.

Edwards, L. (2010) "The world is running out of helium: Nobel prize winner". *Phys.org*, 24 August 2010, Https://phys.org/news/2010-08-world-helium-nobel-prize-winner.html.

Eilu, P., T. Bjerkgård, H. Franzson, H. Gautneb, T. Häkkinen, E. Jonsson, J. K. Keiding, J. Pokki, A. Raaness, H. Reginiussen, B. G. Róbertsdóttir, D. Rosa, M. Sadeghi, J. S. Sandstad, H. Stendal, E. R. Þórhallsson and T. Törmänen (2021) The Nordic supply potential of critical metals and minerals for a Green Energy Transition. *Nordic Innovation Report* 6, https://www.nordicinnovation.org/2021/nordic-supply-potential-critical-metals-and-minerals-green-energy-transition.

Elgabry, M., D. Nesbeth and S. Johnson (2022) "The future of biotechnology crime: A parallel Delphi study with non-traditional experts". *Futures* 141, https://doi.org/10.1016/j.futures.2022.102970.

Energiföretagen [Swedenergy] (2023) "Vem äger elproduktionen?" [Who owns the energy production?], https://www.energiforetagen.se/energifakta/elsystemet/produktion/vem-ager-elproduktionen/.

Energimyndigheten [Swedish Energy Agency] (2023) "Fortsatt snabb utbyggnad av vindkraften krävs för omställning" [Continued rapid expansion of wind power is needed for transition], https://www.energimyndigheten.se/nyhetsarkiv/2023/fortsatt-snabb-utbyggnad-av-vindkraften--kravs-for-omstallning/.

Epp, D. A. and T. F. Herschel (2023) "When bad news becomes routine: Slowly-developing problems moderate government responsiveness". *Political Research Quarterly* 76 (1): 3–13.

EU Chamber of Commerce in China (2020) European Business in China Position Paper 2022/2023. *European Chamber Publications*, 21 September 2022, www.europeanchamber.com.cn/en/publications-position-paper.

European Commission (2017) The 2017 list of Critical Raw Materials for the EU. COM (2017) 490 final, 13 September 2017, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017DC0490.

European Commission (2019) Screening of foreign direct investment – An EU framework. Regulation 2019/452, 19 March 2019, Brussels, https://eur-lex.europa.eu/EN/legal-content/summary/screening-framework-for-foreign-direct-investments.html.

European Commission (2020a) Critical raw materials resilience: Charting a path towards greater security and sustainability. COM (2020) 474 final, 3 September 2020, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0474.

European Commission (2020b) Critical raw materials for strategic technologies and sectors in the EU: A foresight study, https://rmis.jrc.ec.europa.eu/uploads/CRMs_for_Strategic_Technologies_and_Sectors_in_the_EU_2020.pdf.

European Commission (2020c) Study on the EU's list of critical raw materials (2020). Final Report, https://rmis.jrc.ec.europa.eu/uploads/CRM_2020_Report_Final.pdf.

European Commission (2021) Future-proofing pharmaceutical legislation – study on medicine shortages. Final report (revised), https://op.europa.eu/en/publication-detail/-/publication/1f8185d5-5325-11ec-91ac-01aa75ed71a1/language-en/format-PDF/source-245338952.

European Commission (2023a) A secure and sustainable supply of critical raw materials in support of the twin transition. COM (2023) 165 final, 16 March 2023, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52023DC0165.

European Commission (2023b) Proposal for establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending regulations. COM (2023) 160 final, 16 March 2023, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0160.

European Parliament and the Council of the European Union (2017) Regulation on medical devices (EU 2017/745), 5 May 2017, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0745.

European Parliament and the Council of the European Union (2019) Regulation EU 2019/452 establishing a framework for the screening of foreign direct investments into the Union, 19 March 2019, Brussels, https://eur-lex.europa.eu.

European Space Agency (2023) "Helium-3 mining on the lunar surface", https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Space_for_Earth/Energy/Helium-3_mining_on_the_lunar_surface.

Fagerström, J. (2022) "Regeringen pressas om stort kinesisk ägande i svensk vindkraft". [The Government being pressured on large Chinese ownership in Swedish wind power]. *Aktuell hållbarhet*, 27 May 2022, https://www.aktuellhallbarhet.se/miljo/energi/regeringen-pressas-om-stort-kinesisk-agande-i-svensk-vindkraft/.

Fan, A. (2023) "China determines over 40 elements in Chang'e-5 lunar samples, 'significant for Moon formation studies'". *Global Times*, 27 March 2023, https://www.globaltimes.cn/page/202203/1256907.shtml.

Farrell, H. and A. L. Newman (2019) "Weaponized interdependence. How global economic networks shape state coercion". *International Security* 44 (1): 42–79.

Farrell, H. and A. L. Newman (forthcoming, 2023). *Underground Empire: How America Weaponized the World Economy*. Henry Holt and Co.

Federal Office for Civil Protection (2017) Nationale Strategie zum Schutz kritischer Infrastrukturen 2018–2022 [National Critical Infrastructure Protection Strategy 2018–2022], https://www.babs.admin.ch/de/aufgabenbabs/ski/nationalestrategie.html.

Federal Office for National Economic Supply (2023) Minimum ICT Standard 2018, https://www.bwl.admin.ch/bwl/en/home/themen/ikt/ikt_minimalstandard.html.

Ferchen, M. and M. Mattlin (2023) "Five modes of China's economic influence: Rethinking Chinese economic statecraft". *The Pacific Review*, https://doi.org/10.1080/09512748.2023.2200029.

Financial Times (2020) "Vestager urges stakebuilding to block Chinese takeovers", 12 April 2020, https://www.ft.com/content/e14f24c7-e47a-4c22-8cf3-f629da62b0a7.

Financial Times (2022) "Ursula von der Leyen promises EU help for companies lured by US green subsidies", 4 December 2022, https://www.ft.com/content/19a28687-0172-445a-829d-a8fd08592197.

Financial Times (2023) "How America is reshaping the global economy", 5 June 2023, https://www.ft.com/content/c73fd7bc-b06f-42a9-bce1-040890566e73.

Finnish Air Defence (2021) "Lockheed Martin F-35A Lightning II on Suomen seuraava monitoimihävittäjä" [Lockheed Martin F-35A Lightning II will be Finland's next multirole combat aircraft], 10 December 2021, https://ilmavoimat.fi/-/lockheed-martin-f-35a-lightning-ii-on-suomen-seuraava-monitoimihavittaja.

Finnish Government (2020) "Suomen ensimmäisen kvanttitietokoneen rakentaminen alkaa – VTT:n kumppanina suomalainen IQM" [The construction of Finland's first quantum computer begins – Finnish IQM will be VTT's partner], 16 November 2020, https://valtioneuvosto.fi/-//1410877/suomen-ensimmaisen-kvanttitietokoneen-rakentaminen-alkaa-vtt-n-kumppanina-suomalainen-iqm.

Finnish Government (2023) Suomen kaupallisista riippuvuuksista Kiinaan [Finland's commercial dependencies on China]. *Valtioneuvoston julkaisuja* 2023:10, 3 March 2023, https://julkaisut.valtioneuvosto.fi/handle/10024/164691.

Finnish Ministry of Economic Affairs and Employment (2021) National battery strategy 2025: Executive summary. *MEAE Sector Reports* 2021: 6, https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162685/TEM_2021_6.pdf?sequence=1&isAllowed=y.

Finnish Society of Nephrology (2021) Vaikean kroonisen munuaistaudin hoidon ohjaus: Suomen strategia [Management of severe chronic kidney disease: Finland's strategy], https://www.e-julkaisu.fi/sny/ckd-strategia/pdf/1_SNY_-CKD-strategia.pdf.

Flood, S., F. Rogan, A. Revez, C. McGookin, B. O'Dwyer, C. Harris, N. Dunphy, E. Byrne, B. Ó. Gallachóir, P. Bolger and E. Boyle (2023) "Imagining climate resilient futures: A layered Delphi panel approach". *Futures* 147, https://doi.org/10.1016/j.futures.2023.103100.

ForAc project homepage (2023) University of Turku, https://sites.utu.fi/forac/en/.

ForAc report background page (2023) University of Turku, https://sites.utu.fi/forac/fi/raportti/

Forsberg, B. (2018) "Staten sålde spjutspetsbolag till Kina – under radarn" [The state sold flagship company to China – under radar], *SvD Näringsliv*, 18 December 2018, https://www.svd.se/a/21Od8R/staten-salde-spjutspetsbolag-till-kina-under-radarn#:~:text=Trots%20milit%C3%A4ra%20kopplingar%20har%20tre,spjutspetsbolagen%20ligger%20den%20svenska%20staten.

Future Market Insights (2022) "Membrane filtration systems market", July 2022, https://www.futuremarketinsights.com/reports/membrane-filtration-market.

García Herrero, A. (2021) "What is behind China's dual circulation strategy". *China Leadership Monitor*, https://www.prcleader.org/herrero.

Gilli, A. and M. Gilli (2019) "Why China has not caught up yet: Military-technological superiority and the limits of imitation, reverse engineering, and cyber espionage". *International Security* 43 (3): 141–189.

Government of the People's Republic of China (2020) 中共中央 国务院关于构建更加完善的要素市场化配置体制机制的意见 [Opinions of the Central Committee of the Communist Party of China and the State Council on Constructing a More Complete System and Mechanism for the Market-Oriented Allocation of Factors], 9 April 2020, http://www.gov.cn/zhengce/2020-04/09/content_5500622.htm.

Guanyan baogaowang (2021) 中国血液透析行业现状深度研究与投资趋势预测报告 (2022–2029 年) [In-depth research on the status quo of China's hemodialysis industry and forecast report on investment trends (2022–2029)].

Hanemann, T. and M. Huotari (2018) *EU–China FDI: Working towards reciprocity in investment relations*. Berlin: Rhodium Group & MERICS.

Hayakawa, S. I. (1939/1978) *Language in Thought and Action*. San Diego: Harcourt Brace Jovanovich. Originally published as *Language in Action*.

Healthtech Finland (2022a) "MD-asetus" [MD regulation]. Updated 19 May 2022, https://healthtech.teknologiateollisuus.fi/fi/terveysteknologia/saadokset/md-asetus.

Healthtech Finland (2022b) "Terveysteknologia osana terveysalaa" [Health technology as part of the healthcare sector]. Updated 27 June 2022, https://healthtech.teknologiateollisuus.fi/fi/terveysteknologia-osana-terveysalaa.

Hellström, J., O. Almén and J. Englund (2019) Kinesiska bolagsförvärv i Sverige: en kartläggning [Chinese company acquistions in Sweden: a survey]. *FOI Memo* 6903, https://www.foi.se/rapportsammanfattning?reportNo=FOI%20Memo%206903.

Helmer, O. and T. J. Gordon (1964) "Report on a long-range forecasting study." The RAND Corporation, Santa Monica, http://www.rand.org/content/dam/rand/pubs/papers/2005/P2982.pdf.

Helmer, O. and N. Rescher (1958) "On the epistemology of the inexact sciences". The RAND Corporation P-1513, Santa Monica, https://www.rand.org/content/dam/rand/pubs/papers/2005/P1513.pdf.

Herrala, O. (2017) "Kiina ostaa kiinteistöjä Suomesta – "Tuotto on Helsingissä korkeampi kuin Tukholmassa"" [*China buying properties in Finland – "Profits higher in Helsinki than in Stockholm"*]. *Kauppalehti*, 5 September 2017. https://www.kauppalehti.fi/uutiset/kiina-ostaa-kiinteistoja-suomesta-tuotto-on-helsingissa-korkeampi-kuin-tukholmassa/d114aac0-62e3-31ea-8fc3-913b6e47a115.

Hiilamo, E.-A. (2021) "Lääkkeen pitkä tie" [The long road of a medicine]. *Yle*, 28 December 2021, https://yle.fi/a/3-12186304.

Howell, S. (2023) "The China-US quantum race". *The Diplomat*, 13 January 2023, https://thediplomat.com/2023/01/the-china-us-quantum-race/.

Hsiung, J. C. (2009) "The age of geoeconomics, China's global role, and prospects of cross-strait integration". *Journal of Chinese Political Science* 14: 113–133.

Huld, A. (2022) "China's lithium-ion battery industry – Overcoming supply chain challenges". *China Briefing*, 30 November 2022, https://www.china-briefing.com/news/chinas-lithium-ion-battery-industry-overcoming-supply-chain-challenges/.

Hyyppä, E., S. Kundu, C. F. Chan, A. Gunyhó, J. Hotari, D. Janzso, K. Juliusson, O. Kiuru, J. Kotilahti, A. Landra and W. Liu (2022) "Unimon qubit". *Nature Communications*, 13 (1): 6895.

IEA (2022) The role of critical minerals in clean energy transitions (revised version). *Flagship report*, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions.

Insinna, V. (2020) "The inside story of two supersonic flights that changed how America operates the F-35". *DefenseNews*, 22 May 2020, https://www.defensenews.com/smr/hidden-troubles-f35/2020/05/22/the-inside-story-of-two-supersonic-flights-that-changed-how-america-operates-the-f-35/.

IPCC (2021) *Climate Change 2021: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, https://report.ipcc.ch/ar6/wg1/IPCC_AR6_WGI_FullReport.pdf.

IQM (2020) "Finnish quantum computing firm IQM raises $46 million", 10 November 2020, https://meetiqm.com/articles/news/finnish-quantum-computing-firm-iqm-raises-46-million/.

Kaaresvirta, J., E. Kerola and R. Nuutilainen (2023) "Suomen ja EU:n Kiina-tuontiriippuvuuden tarkastelua", *BOFIT Policy Brief*, No. 4, 38 p, https://urn.fi/URN:NBN:fi-fe2023022828915.

Katada, S. N., J. H. Lim and M. Wan (2023) "Reshoring from China: Comparing the economic statecraft of Japan and South Korea". *The Pacific Review*. https://doi.org/10.1080/09512748.2023.2200025

Katzenstein, P. J. (1985). *Small States in World Markets: Industrial Policy in Europe*. Ithaca: Cornell University Press.

Kauppila, L. (2018) "Participatory backcasting from value principles – Three approaches to futures of mobility in Finland up to 2025". Master's thesis. Turku School of Economics.

Kauppila L. and B. Cappelin (2023) The China dilemma in foreign direct investment screening: Comparing the Finnish and Swedish approaches. *NKK Report*, 20 June 2023, https://kinacentrum.se/en/publications/the-china-dilemma-in-foreign-direct-investment-screening-comparing-the-finnish-and-swedish-approaches/.

Keohane, R.O. and J. S. Nye (2012) *Power and Interdependence*. 4th edition. Boston: Longman.

Korpela, H. (2022) "Haminan akkumateriaalitehdasta varten on perustettu yhteisyritys – omistuksesta yli puolet kiinalaisyrityksellä" [A joint venture has been established for the Hamina battery material factory – over half of the ownership is held by a Chinese company]. *Yle*, 5 May 2022, https://yle.fi/uutiset/3-12431472.

Kratz, A., M. J. Zenglein, G. Sebastian and M. Witzke (2022) Chinese FDI in Europe. 2021 Update. *Merics Report*, April 2022, https://rhg.com/wp-content/uploads/2022/04/MERICS-Rhodium-Group-COFDI-Update-2022-2.pdf.

Kratz, A., Zenglein, M.J., Sebastian, G., & Witzke, M. (2023) EV battery investments cushion drop to decade low. Chinese FDI in Europe: 2022 update, *Merics Report*, May 2023, https://merics.org/sites/default/files/2023-05/merics-rhodium-group-chinese-fdi-in-europe-2022%20%281%29.pdf.

Kuusi, O. (1999) "Delfoi-metodi" [The Delphi method]. *Metodix.fi*, https://metodix.fi/2014/05/19/kuusi-delfoi-metodi/.

Kuusi, O., O.-P. Ryynänen, J. Kinnunen, M. Myllykangas and J. Lammintakanen (2006) Terveydenhuollon tulevaisuus: Tulevaisuusvaliokunnan kannanotto vuoden 2015 terveydenhuoltoon [The future of healthcare: Statement by the Future Committee on the healthcare system in 2015]. *Publications of the Secretariat of the Finnish Parliament* 3/2006, https://www.eduskunta.fi/FI/naineduskuntatoimii/julkaisut/Documents/ekj_3+2006.pdf.

Laakkonen, T., A. Haapea and M. Kuosmanen (2023) "Suomen kaupallisista riippuvuuksista Kiinaan". *Valtioneuvoston julkaisuja* 2023:10, 30 p, http://urn.fi/URN:ISBN:978-952-383-934-2.

Lagrådsremiss: Ett granskningssystem för utländska direktinvesteringar till skydd för svenska säkerhetsintressen. [Referral to the Council on Legislation: A Screening System for Foreign Direct Investments to Protect Swedish Security Interests]. 13 March 2023, https://www.regeringen.se/contentassets/ab453b2fde624fe9ae9caed6cddd5956/ett-granskningssystem-for-utlandska-direktinvesteringar-till-skydd-for-svenska-sakerhetsintressen.pdf.

Laki eräiden kiinteistöhankintojen luvanvaraisuudesta (470/2019) [Act on Transfers of Real Estate Requiring Special Permission (470/2019)], 29 March 2019, Helsinki, https://www.finlex.fi/fi/laki/alkup/2019/20190470.

Laki eräiden kiinteistönhankintojen luvanvaraisuudesta annetun lain muuttamisesta (1098/2022) [Law amending the Act on Transfers of Real Estate Requiring Special Permission (1098/2022)], 20 December 2022, Helsinki, https://www.finlex.fi/fi/laki/alkup/2022/20221098.

Laki ulkomaalaisten yritysostojen seurannasta (2012/172) [Act on the Screening of Foreign Corporate Acquisitions (2012/172)], 13 April 2012, Helsinki, https://finlex.fi/fi/laki/ajantasa/2012/20120172.

Laki valtion etuosto-oikeudesta eräillä alueilla (469/2019) [Act on the State's right of pre-emption in certain areas (469/2019)], 29 March 2019, Helsinki, https://www.finlex.fi/fi/laki/alkup/2019/20190469. An official but non-binding English translation can be accessed at https://www.finlex.fi/en/laki/kaannokset/2019/en20190470.pdf.

Laki valtion etuosto-oikeudesta eräillä alueilla annetun lain muuttamisesta (1099/2022) [*Law amending the Act on the State's Right of Pre-emption in Certain Areas (1098/2022)*]. 20 December 2022, Helsinki. https://www.finlex.fi/fi/laki/alkup/2022/20221099.

Lentoposti (2019) "Ilmavoimien Hornet-hävittäjien seuraajien määrästä kiistellään – mutta mistä tuli luku 64 konetta" [Disputes about the number of successors to the Air Force's Hornets – but where did the figure of 64 aircraft come from?],10 February 2019, http://www.lentoposti.fi/artikkelit/ilmavoimien_hornet_h_vitt_jien_seuraajien_m_r_st_kiistell_n_mutta_mist_tuli_luku_64_konetta.

Leutert, W. and S. Eaton (2021). "Deepening not departure: Xi Jinping's governance of China's state-owned economy", *The China Quarterly*, 248: 200–221.

Li, S. (2022) "China's health-technology industry update". *Edustojen raportit*, 13 July 2022, https://um.fi/edustustojen-raportit/-/asset_publisher/W41AhLdTjdag/content/china-s-health-technology-industry-update/384951.

Linstone, H. A. and M. Turoff (eds.) (2002/1975) *The Delphi Method*. Reading, MA: Addison-Wesley.

Liu, W. and X. Liu (2021) "Sociological analysis of Chinese sports viewers with differences in social capital". *Complexity* 2021: 1–7.

Losey, S. (2022) "Full weapons tester report highlights F-35 availability, software problems". *DefenseNews*, 16 March 2022, https://www.defensenews.com/air/2022/03/16/full-weapons-tester-report-highlights-f-35-availability-software-problems/.

Lundborg Regnér, A. (2022) Screening foreign direct investment: As important as it is challenging. *UI Brief* No. 9, June 2022. https://www.ui.se/globalassets/ui.se-eng/publications/ui-publications/2022/ui-brief-no.-9-2022.pdf.

Matikainen, J. and M. Tolsa (2023) "Vaarallinen suhde" [*A dangerous relationship*]. *Yle*, 3 March 2023, https://yle.fi/a/74-20014599.

Mattlin, M. (2020) "Kanariefågeln som tystnade. Finlands *Gestalt shift* om kinesiska investeringar" [The canary that fell silent. Finland's gestalt shift on Chinese investments]. *Internasjonal Politikk* 78 (1): 54–67.

Mattlin, M. (2021) "Normative economic statecraft: China's quest to shape the world in its image". In C. C. Shei and W. Wei (eds) *The Routledge Handbook of Chinese Studies*. London and New York: Taylor & Francis, 24–40.

Mattlin, M. and M. Nojonen (2015) "Conditionality and path dependence in Chinese lending". *Journal of Contemporary China* 24 (94): 701–720.

Mattlin, M. and M. Rajavuori (2023) "Changing causal narratives and risk perceptions on foreign investment: The riskification of Chinese investments in the Nordic region". *East Asia*, https://doi.org/10.1007/s12140-023-09397-6.

Mattlin, M. and M. Wigell (2016) "Geo-economics in the context of restive regional powers". *Asia Europe Journal* 14 (2): 125–134.

McGregor, R. (2022). "Chinese coercion, Australian resilience," Lowy Institute, https://www.lowyinstitute.org/publications/chinese-coercion-australian-resilience.

Miglierini, G. (2023) "HERA reports on stockpiling of antimicrobials". European Industrial Pharmacist Group, 24 February 2023, https://eipg.eu/hera-reports-on-stockpiling-of-antimicrobials/.

Ministry of Defence of Finland 2022. Statistics of permits to non-EU and non-EEA buyers to buy real estate in Finland. Personal communication by the research team.

Ministry of Economic Affairs and Employment (2020) "Työ- ja elinkeinoministeriö seuraa ulkomaalaisia yrityskauppoja ja toimii EU:n seuranta-asetuksen kansallisena yhteyspisteenä" [Ministry of Economic Affairs and Employment monitors foreign corporate acquisitions and serves as national contact point for the EU screening regulation], https://tem.fi/yritysostot.

Ministry of Foreign Affairs of Finland (2022) "China's winter sports industry update", 17 June 2022, https://um.fi/edustustojen-raportit/-/asset_publisher/W41AhLdTjdag/content/china-s-winter-sports-industry-update/384951.

National Development and Reform Commission (2020) 关于扩大大战略性新兴产业投资培育壮大大新增长长点增 长长极的指导意见见(发改高高技 (2020) [Expanding investment in strategic emerging industries and cultivating and strengthening new growth points and growth poles 2020], 8 September 2020, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202009/t20200925_1239582.html.

National Emergency Supply Agency (2023) "Toimialat" [Sectors], https://www.huoltovarmuuskeskus.fi/toimialat.

National People's Congress (2017) 中华人民共和国国家情报法 [National Intelligence Law of the People's Republic of China]. Adopted 27 June 2017, http://www.npc.gov.cn/npc/c30834/201806/483221713dac4f31bda7f9d951108912.shtml.

Norris, W. J. (2018) *Chinese Economic Statecraft, Commercial Actors, Grand Strategy, and State Control*. Ithaca: Cornell University Press.

Nylund, P. and P. Ruokoniemi (2018) "Tunne terveysteknologia – käyttöönotto vaatii valvontaa" [Understanding health technology – Implementation requires supervision]. *Sic! Lääketietoa Fimeasta* 3/2018, https://urn.fi/URN:NBN:fi-fe2018091835975.

O'Donnell, C., L. B. Baker and E. Wang (2019) "Exclusive: Told U.S. security at risk, Chinese firm seeks to sell Grindr dating app". *Reuters*, 27 March 2019, https://www.reuters.com/article/us-grindr-m-a-exclusive/exclusive-us-pushes-chinese-owner-of-grindr-to-divest-the-dating-app-sources-idUSKCN1R809L.

Pearson, M., M. Rithmire and K. S. Tsai (2022) "China's party-state capitalism and international backlash". *International Security* 47 (2): 135–176.

Poutala, T., E. Sinkkonen and M. Mattlin (2022) "EU strategic autonomy and the perceived challenge of China: Can critical hubs be de-weaponised?" *European Foreign Affairs Review* 27: 79–98.

Pääomasijoittajat ry (2018) "Näin haet pääomasijoitusta – opas yrittäjälle" [Applying for venture capital – Guide for entrepreneurs], 6–9, https://paaomasijoittajat.fi/wp-content/uploads/2018/02/Nain-haet-paaomasijoitusta-opas-yrittajalle.pdf.

Rajavuori, M. (2019) "Ulkomaisten yritysostojen seuranta – paluu tulevaisuuteen?" [Monitoring foreign company acquisitions – Back to the future?]. *Defensor Legis 2*: 113–130.

Review on Antimicrobial Resistance (2014) "Antimicrobial resistance: Tackling a crisis for the health and wealth of nations", https://wellcomecollection.org/works/rdpck35v.

Reynolds, M. and M. P. Goodman (2023). "Deny, deflect, deter: Countering China's economic coercion". Center for Strategic and International Studies (CSIS), https://www.csis.org/analysis/deny-deflect-deter-countering-chinas-economic-coercion.

Robinson, J. B. (1988) "Unlearning and backcasting – Rethinking some of the questions we ask about the future". *Technological Forecasting & Social Change* 33: 325–338.

Robinson, J. B. (1990) "Futures under glass: A recipe for people who hate to predict". *Futures* 22: 820–842.

Robinson, J. B. (2003) "Future subjunctive: Backcasting as social learning". *Futures* 35: 839–856.

Rosner, M., S. Lew, P. Conway, J. Ehrlich, R. Jarrin, U. Patel, K. Rheuban, B. Robey, N. Sikka, E. Wallace, P. Brophy and J. Sloand (2017) "Perspectives from the kidney health initiative on advancing technologies to facilitate remote monitoring of patient self-care in RRT". *Clinical Journal of the American Society of Nephrology* 12 (11): 1900–1909.

Rühlig, T. (ed.) (2023) Europe's strategic technology autonomy from China: Assessing foundational and emerging technologies. German council on foreign relations, January 2023, https://dgap.org/en/research/publications/europes-strategic-technology-autonomy-china.

Salidjanova, N., R. Lietzow and D. Rosen (2023) "China Pathfinder: Q1 2023 Update". Rhodium Group, 4 May 2023, https://rhg.com/research/china-pathfinder-q1-2023-update/.

Sanger, D. (2019) "Grindr is owned by a Chinese firm, and the U.S. is trying to force it to sell". *New York Times*, 28 March 2019, https://www.nytimes.com/2019/03/28/us/politics/grindr-china-national-security.html.

Simko, T. and M. Gray (2014) "Lunar helium-3 fuel for nuclear fusion". *World Future Review* 6 (2):158–171.

Smith-Goodson, P. and P. Moorhead (2019) "Quantum USA vs. quantum China: The world's most important technology race", 28 October 2019, https://moorinsightsstrategy.com/quantum-usa-vs-quantum-china-the-worlds-most-important-technology-race/.

S&P Global Commodity Insights (2022) "Helium". *Chemical Economics Handbook*, April 2022, https://www.spglobal.com/commodityinsights/en/ci/products/helium-chemical-economics-handbook.html.

State Council of the PRC (2015) 国务院关于印发《中国制造2025》的通知 [Announcement on the publication of the "Made in China 2025" report], 8 May 2015, http://www.gov.cn/zhengce/content/2015-05/19/content_9784.htm.

Statista (2016) "Distribution of Pokémon GO users in the United States as of July 2016, by age group", https://www.statista.com/statistics/589197/pokemon-go-players-us-age/.

Statista (2022) "Number of daily active users (DAU) of Pokémon Go via iPhone in selected countries in February 2022", https://www.statista.com/statistics/604551/pokemon-go-daily-active-users-in-europe.

Statista (2023) "Reserves of helium worldwide in 2022, by country", https://www.statista.com/statistics/925805/helium-reserves-worldwide-by-country/.

Steinert, M. (2009) "A dissensus based online Delphi approach: An explorative research tool". *Technological Forecasting and Social Change* 76 (3): 291–300.
Strange, S. (1996) *The Retreat of the State*. Cambridge: Cambridge University Press.
Strange, S. (1998) *States and Markets*. London: Pinter.
Sundqvist, G. and F. Lindberg (2022) Statliga kinesiska påverkansoperationer mot demokratin i svenska kommuner [Chinese state influence operations against democracy in Swedish municipalities]. *MDU and NKK report*, https://kinacentrum.se/publikationer/statliga-kinesiska-paverkansoperationer-mot-demokratin-i-svenska-kommuner/.
Svensk Vindenergi. [Swedish Wind Energy Association] (2022) "Över 117 miljarder i vindkraftsinvesteringar 2017–2024". [Over 117 billion in wind power investments in 2017–2024], https://svenskvindenergi.org/komm-fran-oss/over-117-miljarder-i-vindkraftsinvesteringar-2017-2024.
The Finnish Broadcasting Company (2019) "Kuinka paljon tuulivoimaa tarvitaan lisää? Näin puolueet vastasivat Ylen kyselyssä" [How much more wind power do we need? Here's how the parties responded in Yle's survey], 5 February 2019, https://yle.fi/uutiset/3-10630608.
The Office of the Director, Operational Test and Evaluation DOT&E (2021) FY 2021 Annual Report: F-35 Joint Strike Fighter (JSF), https://www.dote.osd.mil/Portals/97/pub/reports/FY2021/dod/2021f35jsf.pdf?ver=Kt7vc6iG3F2MCJCScIttIw%3d%3d.
The White House (2021) Building resilient supply chains, revitalizing American manufacturing, and fostering broad-based growth. *Executive Order 14017 report*, June 2021, https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf.
Tiilikainen, T. (2006) "Finland – An EU member with a small state identity". *Journal of European Integration* 28 (1): 73–87.
Tillman P. and N. Maunula (2015) "Hemodialyysikäynteihin liittyvät sairausvakuutuksen matkakorvaukset 13 miljoonaa euroa vuonna 2012" [*Travel reimbursements related to haemodialysis visits amounted to 13 million euros in 2012 under the sick insurance*]. *Työpapereita* 73/2015, Kela Research Department, https://helda.helsinki.fi/bitstream/handle/10138/155346/Tyopapereita73.pdf?sequence=1&isAllowed=y.
Traficom (2021) "Viestintäpalvelujen kuluttajatutkimus" [Consumer survey on communication services], 15 June 2021, https://www.traficom.fi/fi/julkaisut/viestintapalvelujen-kuluttajatutkimus-2021.
Tuominen, A., P. Tapio, V. Varho, T. Järvi and D. Banister (2014) "Pluralistic backcasting: Integrating multiple visions with policy packages for transport climate policy". *Futures* 60: 41–59.
Tuominen, T. (2022) "Vahdinvaihto Suomen taivaalla – F-35 esittelyssä" [Guard change in the Finnish skies – Introduction of the F-35]. *Reserviläinen*, 21 February 2022, https://www.reservilainen.fi/uutiset/vahdinvaihto_suomen_taivaalla_-_f-35_esittelyssa.
Turoff, M. and H. A. Linstone (2002) *The Delphi method-techniques and applications*. Boston: Addison-Wesley Publishing Company.
Uggla, S. (2022) "Avtal tyder på kinesisk polis i Stockholm" [Contract suggests Chinese police presence in Sweden]. *Svenska Dagbladet*, 27 October 2022, https://www.svd.se/a/763na9/avtal-tyder-pa-kinesisk-polis-i-stockholm.
UK government (2022) "Acquisition of Newport wafer fab by Nexperia BV: Notice of final order". Cabinet Office, Department for Business, Energy & Industrial Strategy, and the Rt Hon Grant Shapps MP, 16 November 2022, https://www.gov.uk/government/publications/acquisition-of-newport-wafer-fab-by-nexperia-bv-notice-of-final-order.
UNCTAD (2023) "Global foreign direct investment flows over the last 30 years", 9 June 2022, https://unctad.org/data-visualization/global-foreign-direct-investment-flows-over-last-30-years.
US Geological Survey (2022) 2022 final list of critical minerals. Department of the interior notice, https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/media/files/2022%20Final%20List%20of%20Critical%20Minerals%20Federal%20Register%20Notice_2222022-F.pdf.
US Geological Survey (2023) "Helium". *Mineral Commodity Summaries*, https://pubs.usgs.gov/periodicals/mcs2023/mcs2023-helium.pdf.
Van de Linde, E. and P. van de Duin (2011) "The Delphi method as early warning: Linking global societal trends to future radicalization and terrorism in The Netherlands". *Technological Forecasting and Social Change* 78 (9): 1557–1564.

Varho, V. and P. Tapio (2013) "Combining the qualitative and quantitative with the Q2 scenario technique – The case of transport and climate". *Technological Forecasting & Social Change* 80 (4): 611–630.

Viljanen, M. (2020) "Suurvallat ja -yritykset syytävät nyt miljardeja teknologiaan, jonka ennustetaan mullistavan maailman – Voisiko pienen budjetin Suomi ollakin kisan yllättäjä?" [Great powers and corporations are now pouring billions into technology that is predicted to revolutionize the world – Could budget-conscious Finland be the surprise contender in the race?]. *Helsingin Sanomat*, 25 June 2020, https://www.hs.fi/talous/art-2000006551169.html.

Volza Grow Global (2023) "Water filtration membrane exports from China", https://www.volza.com/p/water-filtration-membrane/export/export-from-china/.

Wang, E. and D. Shepardson (2023) "TikTok says US threatens ban if Chinese owners don't sell stakes". *Reuters*, 16 March 2023, https://www.reuters.com/technology/us-threatens-tiktok-ban-if-chinese-owners-dont-sell-stake-wsj-2023-03-15/.

Wang, L. and X.-L. Wang (2019) "Research and Development of Membrane Technology in China", *Membrane* 44 (4): 187–191.

Wiechel, M. (2022) "Kinesiskt ägande av vindkraft" [Chinese ownership of wind power]. Written parliamentary question by Marcus Wiechel (SD) (2021/22:1556), 9 May 2022, https://www.riksdagen.se/sv/dokument-lagar/dokument/skriftlig-fraga/kinesiskt-agande-av-vindkraft_H9111556.

Wigell, M., M. Deschryvere, C. Fjäder, N. Helwig, V. Kaitila, J. Seilonen and A. Suominen (2022a) "Europe facing geoeconomics: Assessing Finland's and the EU's options in the technological rivalry", Publications of the Government´s analysis, assessment and research activities 2022:12. Helsinki: Prime Minister's Office.

Wigell, M., M. Hägglund, C. Fjäder, E. Hakala, J. Ketola and H. Mikkola (2022b) Nordic resilience: Strengthening cooperation on security of supply and crisis preparedness. *FIIA Report* 70, September 2022, https://www.fiia.fi/wp-content/uploads/2022/09/report70_nordic-resilience_strengthening-cooperation-on-security-of-supply-and-crisis-preparedness.pdf.

Wigell, M. and A. Soliz Landivar (2018) "China's economic statecraft in Latin America: Geostrategic implications for the United States", in M. Wigell and S. Scholvin (eds) Geo-economics and Power Politics in the 21st Century. London: Routledge, 164–181.

Wigell, M. and A. Vihma (2016) "Geopolitics versus geoeconomics: The case of Russia's geostrategy and its effects on the EU", *International Affairs* 92 (3): 605–627.

WIPO (2022) Global Innovation Index 2021. *Tracking innovation through the Covid-19 crisis*, 14th edition, https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021.pdf.

Wrath, J., H. A. von der Gracht and I.-L. Darkow (2013) "A dissent-based approach for multi-stakeholder scenario development – the future of electric drive vehicles". *Technological Forecasting and Social Change* 80 (4): 566–583.

Yang, Y. and J. Fontanella-Kahn (2020) "Grindr sold by Chinese owner after US national security concerns". *Financial Times*, 7 March 2020, https://www.ft.com/content/a32a740a-5fb3-11ea-8033-fa40a0d65a98.

Yin, J., Li, YH., Liao, SK. *et al.* (2020) Entanglement-based secure quantum cryptography over 1,120 kilometres, *Nature* 582, 501–505, https://doi.org/10.1038/s41586-020-2401-y.

Yle News (2018) "Monday's papers: A closer look at Airiston Helmi's land grab and speeding penalty changes", 24 September 2018, https://yle.fi/a/3-10419525.

Yunakovsky, S. E., M. Kot, N. Pozhar, D. Nabokov, M. Kudinov, A. Guglya, E. Kiktenko, E. Kolycheva, A. Borisov and A. K. Fedorov (2021) "Towards security recommendations for public-key infrastructures for production environments in the post-quantum era". *EPJ Quantum Technology* 8 (1): 14.

Zimmermann, M., I.-L. Darkow and H. A. von der Gracht (2012) "Integrating Delphi and Participatory Backcasting in Pursuit of Trustworthiness – The Case of Electric Mobility in Germany". *Technological Forecasting and Social Change* 79 (9): 1605–1621.

# CONTRIBUTORS

**Prof. Mikael Mattlin** is a Research Professor at the Finnish Institute of International Affairs. He heads the Center on Global Orders and China (CORD). Earlier he has been Professor of Chinese Studies (University of Helsinki) and Professor of Political Science in the University of Turku, where he leads the Academy of Finland-funded ForAc-research project and also holds the Title of Docent. Mattlin has published extensively in leading academic journals, e.g., in *The China Quarterly*, *Journal of Contemporary China*, *Information, Communication & Society*, *Cooperation and Conflict* and *The Pacific Review*. In 2022, he published the first comprehensive Finnish-language research-based book on the Chinese political system (Vastapaino), together with two other leading Finnish China experts.

**Prof. Shaun Breslin** is Professor of Politics and International Studies at the University of Warwick in the UK, and co-editor of *The Pacific Review*. His research focuses on the political economy and international relations of contemporary China with a side interest in comparative approaches to studying regions. His latest book, *China Risen: Studying China's Global Power*, was published by Bristol University Press in 2021.

**Dr Elina Sinkkonen** is Senior Research Fellow at the Finnish Institute of International Affairs. She holds the Title of Docent in East Asian Studies, specifically in East Asian Politics at the University of Turku. In addition to the ForAc-project, her recent research has examined authoritarian resilience, autocratization and China-Russia relations. Sinkkonen's work has been published in *Political Psychology*, *Democratization*, *The China Quarterly*, *The Pacific Review*, *European Review of International Studies* and *European Foreign Affairs Review*, among others.

**MSocSci, MPhil Liisa Kauppila** is a futurist and Senior Researcher at the University of Turku. Her research has focused on spatial aspects of China's global economic outreach, Chinese FDI in Finland and Sweden, Arctic politics and the futures research approach of backcasting. She has published peer-reviewed articles, book chapters and policy-oriented reports and facilitated three major Delphi studies at the intersection of social science and art.

**MA Björn Cappelin** is deputy director of the Swedish National China Centre at the Swedish Institute of International Affairs. In this capacity he is also team leader for the Centre's analysis work in the areas of economy, research, and technology. His previous work as an analyst at the Centre has covered Chinese industrial policy and foreign investment activities, as well as Chinese Covid-19 policy. Before joining the Centre in 2021, Björn worked in the Swedish government offices and in capacities abroad, including in China in 2007–2010. He holds an M.A. in Asian studies from Stockholm university and has studied at Beijing Language and Culture University.

**BSc Ines Söderström** is the ForAc project's Research Assistant and a MSc student in East Asian Studies at the University of Turku. Ines holds a BSc degree in International Relations from the London School of Economics and Political Science.

**Dr Matt Ferchen** is a Senior Fellow in the Paul Tsai China Center at Yale University Law School and a Senior Research Scholar at Yale Law School. His research focuses on Chinese economic statecraft and economic influence, including China's relations with developing countries in Asia and Latin America. Ferchen previously was an Associate Professor in the Department of International Relations at Tsinghua University and a resident scholar at the Carnegie-Tsinghua Center for Global Policy, both in Beijing. More recently he has been a lecturer in Chinese political economy at Leiden University and a Senior Fellow at the LeidenAsiaCentre.

**MPhil Tuuli Hypén** is a Turku-based illustrator and comic book artist with an academic background in cultural history. Hypén's comics have been featured in several Finnish newspapers, including Helsingin Sanomat and Turun Sanomat. Their first comic book album Nanna (2010) was a nominee for the Finlandia comic book award.

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## RISKS OF FOREIGN OWNERSHIP, SUPPLY DISRUPTIONS AND TECHNOLOGICAL DEPENDENCIES

The post-Cold War liberalist view, according to which interdependences supported a virtuous cycle of mutual gains, has given way to a realist-tinged view that regards economic interdependence as bringing various risks.

In this new environment of increasing great power competition, economic warfare and technological decoupling, all states are not created equal. Major states such as the United States and China can be system shapers, whereas small states tend to be system takers. Major states have a greater ability to use their investment leverage, supply chain dominance and control of core technology. For smaller states with open economies, such as Finland and Sweden, these create vulnerabilities in the form of security risks, supply disruptions and critical technological dependencies.

The report explores how small open economies can mitigate such risks. A series of innovative Delphi backcasting exercises in Finland and Sweden brought together sectoral experts and generalists to ponder ways to prevent dystopian future scenarios from unfolding. The scenarios, presented in the form of comic art, ranged from acquisitions of mobile gaming companies and curtailing access to water treatment components to the cybersecurity of home dialysis machines.

Small states have the least leeway in navigating the risk environments created by technological dependencies, whereas the toolkits to tackle the potential dangers of foreign ownership and supply disruptions are more extensive. However, different issues and insecurities require different bespoke solutions. Three main approaches emerged: protectionist (interventionist), liberal and technologically oriented. Ultimately, the issue involves a broader political question: what type of state and economy do states wish to be?

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