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Dynamics of De-Risking

Towards resilient supply chains for antibiotics, drones and the electricity grid in the Netherlands

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Executive Summary

The European Union (EU) and its member states face increasing risks due to economic dependencies on China in sectors of vital importance: health, defence, and energy. Economic statecraft, or the use of economic tools to influence another state's behaviour, has been employed at different times throughout history. Reversing a prolonged period of relatively liberalised global trade, these tools have seen a resurgence in the last decade. While Europe and China have been historically tied by stable commercial links, increasing international tensions have marred this relationship. China's increasing usage of economic statecraft has the potential to threaten the security of these vitally important European sectors.

The EU's response to China's economic statecraft toolbox is the so-called 'de-risking' agenda, which provides an avenue for member states like the Netherlands to increase their resilience and supply chain security. While de-risking lacks a universal policy or scholarly definition, for the purpose of this study it is defined as an effort to reduce vulnerability to other states' involvement in areas of vital importance to the European economy and society, in line with the Union's Economic Security Strategy.

This report unpacks the dynamics of de-risking vital sectors from China by (1) creating a taxonomy of Europe's de-risking interventions; (2) developing a typology of China's possible responses to such interventions; (3) identifying vulnerabilities in the antibiotics, drones, and electricity grid supply chains; and (4) conducting a multidimensional assessment of interventions that the Netherlands and Europe more broadly could use to pursue derisking. This leads to tailored recommendations for action in each of the three sectors, combined with three overall recommendations for the de-risking agenda moving forward.

As the EU's economy remains heavily dependent on open trade, the aim is not to disrupt global markets through heavy state intervention, but to ensure that those sectors of vital importance are resilient. The EU has been taking steps toward de-risking over the last years, though lacking a comprehensive cross-sectoral approach. Efforts so far have been fragmented as they address individual sectors (critical raw materials, chips, net zero industry) or instruments (anti-coercion, foreign direct investment screening). It is thus essential for the EU's de-risking efforts to be implemented in a comprehensive way that accounts for cross-sectoral synergies and risks.

Beijing has not shied away from employing economic statecraft tools against countries that they perceive as threatening to the achievement of Chinese foreign policy objectives. Based on official Chinese statements, there seems to be a growing perception by Chinese officials that the EU's de-risking actions are hostile and counterproductive to their mutual interests. While China's usage of economic statecraft for both reward and punishment make it difficult to predict when a type of measure will be employed, intensified trade disputes and political tensions point to the growing risk that its economic statecraft toolbox will be deployed against the EU and member states across different sectors, including health, defence, and energy.

This report analyses three case studies – antibiotics, drones, and the electricity grid – to offer a deep-dive into existing strategic dependencies between the Netherlands and China and ways to mitigate them. Each case study outlines the supply chain structure and market dynamics specific to the Netherlands; individuates supply chain risks; and evaluates a set of de-risking options that the Dutch government, the EU, and industry could undertake to effectively reduce exposure to China. The interventions are evaluated based on two criteria: effort, defined as the resource intensity – both financial and time – required to successfully implement the intervention; and effectiveness, referring to (1) the extent to which the intervention directly contributes to de-risking goals, as opposed to indirectly creating conditions that would still need additional interventions to achieve de-risking, (2) the responsible actor's ability to sustain it in the long term, which tends to decrease the higher the required effort, and (3) the ability to mitigate associated risks, including unintended market effects and the likelihood of retaliation from China. The methodology is explained in Annex 1, while the full assessment of each intervention is included in Annex 2.

The following three paragraphs summarize the case studies' main findings and recommendations for de-risking.

Antibiotics

When it comes to generic antibiotics, the focus of this case study, dependencies on China are mostly upstream in the supply chain. The global market suffers from a lack of suppliers of primary manufacturing stages. Amongst policymakers, the awareness of the resulting risks is spreading, as the pending reform of the EU pharmaceutical legislation illustrates. Still, healthcare remains partly a sovereign competency, so EU reforms can only have limited impact without significant national reform in the Netherlands. Moreover, translating policy goals into concrete action by the private sector will come at substantial costs and require commitment over a prolonged period. Dialogue is needed on the national and EU levels about how a resilient antibiotic manufacturing process can be incentivised. The central question is how much the Netherlands and the EU are willing to pay for a sovereign pharmaceutical industry, and who is going to absorb the costs. Reconciling the affordability of critical medicines with reducing their vulnerability to disruption will be a major challenge for policymakers in the coming years. **Table** 1 includes an overview of the proposed interventions for the antibiotics sector and their evaluation.

Table 1: Proposed interventions to de-risk antibiotic supply chains in the Netherlands and their evaluation

Intervention	Actor	Effort		Effectiveness			Effort x Effectiveness
		Cost	Time	Contribution to de-risking	Ability to sustain long-term	Ability to mitigate associated risks	
Interventions to de-risk generic antibiotic supply chains in the Netherlands							
1. Priority sectors in Europe *Develop sector-specific industrial policy to enhance the competitiveness of priority sectors and increase global market share, including the implementation of financial aid, permitting, administrative reform and other necessary conditions.*	European Commission & Dutch government	**High**	**High**	**High**	**Medium**	**High**	High investment, high reward
2. Direct subsidies *Provide direct subsidies, e.g., through state aid, boosting the production capacities within the EU and the NL to enhance autonomy.*	European Commission & Dutch government	**High**	**Low**	**High**	**Low**	**Medium**	Moderate gains
3. Procurement requirements *Require insurance companies to incorporate criteria other than price into tendering process to improve resilience, i.e. parallel sourcing or sourcing from European suppliers.*	Dutch government	**Medium**	**Medium**	**High**	**High**	**Medium**	Low hanging fruit
4. Supply chain monitoring, stress testing and contingency planning *Monitor supply chain risks, conduct stress tests and develop contingency plans with suppliers along the supply chain to increase resilience to potential disruptions.*	Dutch industry	**Medium**	**Medium**	**Medium**	**High**	**Medium**	Low hanging fruit

Drones

Dependencies on China run deep along the entire supply chain of both military and civil unmanned aerial vehicles (UAVs). While military drones used by Dutch armed forces are mainly sourced from Western countries, these platforms still make use of materials and components produced in China. For civil drones the dependence is even more significant, with the Netherlands importing most of these platforms directly from China. To secure the drone supply chain it is vital to take a comprehensive approach to de-risking, which includes boosting domestic production while tackling existing vulnerabilities. This requires enhanced supply chain mapping, supplier diversification, and stockpiling of essential materials and components. Additionally, fostering domestic production through R&D investments, subsidies, and industrial policies will be vital for long-term resilience. **Table 2** includes an overview of the proposed interventions for the drone sector and their evaluation.

Table 2: Proposed interventions to de-risk drone supply chains in the Netherlands

Intervention	Actor	Effort		Effectiveness			Effort X Effectiveness
		Costs	Time	Contribution to de-risking	Ability to sustain long-term	Ability to mitigate associated risks	
Interventions to de-risk drone supply chains in the Netherlands							
1. Supply chain monitoring, stress testing and contingency planning *Monitor supply chain risks, conduct stress tests and develop contingency plans with suppliers along the supply chain to increase resilience to potential disruptions.*	Dutch industry	**Medium**	**Medium**	**Medium**	**High**	**Medium**	Low hanging fruit
2. Stockpiling *Create stockpiles of critical materials, components, assemblies and super assemblies to overcome short-term supply disruptions.*	Dutch government & Dutch industry	**Medium**	**Low**	**Medium**	**Medium**	**Medium**	Moderate gains
3. Diversification of suppliers *Ensure a diversified supplier base (both in terms of geographical location and corporate ownership) along the supply chain to increase resilience to potential disruptions.*	Dutch industry	**High**	**High**	**High**	**High**	**Medium**	High investment, high reward
4. Subsidies *Offer tax breaks, operational or capital expenditure support to increase the competitiveness of domestic civil drones and components industry.*	European Commission & Dutch government	**High**	**Low**	**High**	**Low**	**Medium**	Moderate gains
5. Priority sectors in Europe *Develop sector-specific industrial policy to enhance the competitiveness of priority sectors and increase global market share, including the implementation of financial aid, permitting and administrative reform, and other necessary conditions.*	European Commission & Dutch government	**High**	**Medium**	**High**	**Medium**	**High**	High investment, high reward
6. R&D investments for substitution *Invest in research and development (R&D) programmes that investigate the substitution of materials or components to decrease unwanted dependencies.*	Dutch industry	**High**	**High**	**Medium**	**Medium**	**High**	High investment, high reward

The electricity grid

When it comes to the electricity grid, operators in the Netherlands have been taking good first steps to mitigate their vulnerabilities, which lie particularly at the level of raw and processed materials. Apart from grain oriented electrical steel (GOES), a specific material used in grid components, most of the other materials do not pose sector-specific risks given that they are used across different economic areas. As such, grid operators should focus on strengthening their ability to respond and bounce back after short-term disruptions that cannot be prevented by their sector alone. Secondly, preventing GOES availability from becoming an issue in the long-term through procurement requirements should be a priority, and so should standardization and R&D to compensate for some of the remaining unwanted dependencies in the long term. **Table 3** includes an overview of the proposed interventions for de-risking grid component supply chains and their evaluation.

Table 3: Proposed interventions to de-risk the supply chains of grid components in the Netherlands and their evaluation

Intervention	Actor	Effort		Effectiveness			Effort X Effectiveness
		Costs	Time	Contribution to de-risking	Ability to sustain long-term	Ability to mitigate associated risks	
Interventions to de-risk the supply chains of grid components in the Netherlands							
1. Stockpiling *Create stockpiles of critical materials or components to overcome short-term supply disruptions.*	Dutch government & Dutch industry	**Medium**	**Low**	**Medium**	**High**	**Medium**	Low hanging fruit
2. Procurement requirements for GOES *Impose procurement requirements for minimum local content of GOES to increase the market share of domestic industry or industry in partner countries.*	Dutch government	**Medium**	**Medium**	**High**	**High**	**Low**	High investment, high reward
3. Standard setting *Develop and uphold technical and/or environmental standards that align with domestic industries to expand global market share.*	European Commission & Dutch government	**Medium**	**Medium**	**High**	**High**	**High**	Low hanging fruit
4. R&D investments for substitution *Invest in research and development (R&D) programmes that investigate the substitution of materials or components to decrease unwanted dependencies.*	Dutch industry	**High**	**High**	**Medium**	**Medium**	**High**	High investment, high reward

Overarching conclusions and recommendations

In addition to sector-specific interventions for realising de-risking, three overarching conclusions and associated recommendations can be drawn from the comparative case studies.

1. **Define specific de-risking goals at the European level for each sector**. The effectiveness of de-risking depends on clear sector-specific goals, but the fuzziness of the definition and level of ambition is hampering its success. To this end, Dutch and European policymakers should develop sector-specific targets and action guidelines in close collaboration with industry.
2. **Adopt a cross-sectoral approach to support synergies and prevent unintended consequences.** De-risking in one sector cannot be done in isolation from the others, given that actions in one area may cause retaliation from the Chinese government in a seemingly unrelated one. What is more, policies developed without a cross-sectoral approach have the potential of causing significant unintended consequences. To this end, Dutch and European policymakers should engage a wide range of stakeholders across sectors to ensure effective de-risking approaches.
3. **Anticipate Chinese retaliation by preparing risk mitigation strategies**. While the form and timing of Chinese retaliation to de-risking will be difficult to predict, the Chinese economic statecraft toolbox is relatively well understood. It is likely that European countries will continue facing Chinese economic statecraft. Dutch and European policymakers should jointly prepare for the risk of retaliation.

The tense geopolitical environment and the Netherlands and Europe's vulnerable position in the supply chains of vital sectors point to an urgent need to derisk. The likelihood of geopolitically motivated disruptions is on the rise. Dutch and European policymakers should take a comprehensive approach to reduce supply chain vulnerabilities that includes investment in domestic capacities, private-public partnerships, and cross-sectoral dialogue.

1. Introduction

In 2017, a factory explosion in China led to a global supply chain disruption of the antibiotic piperacillin/tazobactam, used to battle lung, bladder and skin bacterial infections. The factory in question was one of the few locations where the Active Pharmaceutical Ingredient (API) for the drug was produced, leaving pharmacies across the world scrambling to secure enough supplies for their patients.[1]

The concentration and fragility of antibiotic supply chains have become major vulnerabilities for the Netherlands and the European Union (EU). For years, companies have been outsourcing production to a few highly specialized manufacturing sites in China or India. As a result, the Dutch and European industrial base lost its ability to fulfil citizens' basic medical needs. Governments have been primarily interested in keeping costs down, which the move toward Asia very successfully achieved. Security of supply, however, suffered at the expense of extreme efficiency.

Antibiotics are not the only sector where Europe has significant import dependencies. Sectors such as drones and electricity grids are also vulnerable. Both the commercial and military drone market are highly reliant on China. Since September 1, 2024, China has adjusted drone export standards in order to increase their control over the supply chain.[2] According to the Ukrainian military, China's restrictions on drone exports could seriously impact its operations.[3] Europe is also dependent on China for the supply of raw materials like copper and aluminium, which are indispensable to the electricity grid expansion required by the energy transition.[4]

In a world characterised by increasing geopolitical tensions and tit-for-tat confrontations between great powers, Europe's significant import dependencies have turned into risks. When weaponised against the EU, dependencies can delay important policy goals like the energy transition, affect military readiness and negatively impact the health of Dutch and European citizens. The Chinese government is known to utilise a powerful toolbox of economic means to reach its foreign policy goals. This capability is supported by globally clustered supply chains of strategic importance on the Chinese territory or in the hands of Chinese companies.[5] The likelihood that the Chinese government will use economic statecraft in the energy, defence and health sectors to coerce the EU is on the rise.

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[1] Belma Skender and Mingyuan Zhang, 'From Local Issue to Global Challenge: A Brief Overview of Antibiotic Shortages since the 1970s', *Humanities and Social Sciences Communications* 11, no. 1 (18 September 2024): 1–6, https://doi.org/10.1057/s41599-024-03759-y.

[2] Global Times, 'China Optimizes Export Control Measures for Drones, Bans Export Intended for Military Purposes - Global Times', 31 July 2024, https://www.globaltimes.cn/page/202407/1317107.shtml.
Miriam McNabb, 'China Amends Drone Export Controls Amid Rising Scrutiny', Dronelife, 5 August 2024, https://dronelife.com/2024/08/05/china-amends-drone-export-controls-amid-rising-scrutiny/.

[3] Aosheng Pusztaszeri, 'Why China's UAV Supply Chain Restrictions Weaken Ukraine's Negotiating Power', 16 December 2024, https://www.csis.org/analysis/why-chinas-uav-supply-chain-restrictions-weaken-ukraines-negotiating-power.

[4] United States Geological Survey, 'Mineral Commodity Summaries 2024: Aluminum', 2024, https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-aluminum.pdf. United States Geological Survey, 'Mineral Commodity Summaries 2024: Copper', 2024, https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-copper.pdf.

[5] 'Joint Communication To The European Parliament, The European Council And The Council On "European Economic Security Strategy"' (2023), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52023JC0020.

The EU's response to China's economic statecraft toolbox is the so-called 'de-risking' agenda, which provides an avenue to member states like the Netherlands to increase their resilience and supply chain security.[6] To help understand the Dutch perspective on efforts to de-risk from China, this report (1) creates a taxonomy for Europe's de-risking interventions; (2) develops a typology of China's likely responses; and (3) identifies vulnerabilities in three critical sectors, antibiotics, drones, and the electricity grid, chosen in cooperation with the Dutch Ministries of Health, Welfare and Sport; Defence; and Economic Affairs; and (4) conducts a multidimensional assessment of interventions for the Netherlands and for Europe. This leads to tailored recommendations for action in each of the three sectors combined with three overall recommendations for the de-risking agenda going forward.

The research relies on primary sources including seven interviews with actors in the antibiotics industries of the Netherlands, Germany and Sweden conducted in the second half of 2024; a workshop with the three Dutch distribution grid operators' procurement departments that took place in October 2024; two interviews with stakeholders in the Dutch and British drone sectors; and an analysis of Chinese governmental communications and speeches. Moreover, significant desk research was conducted analysing reports from EU and US-based institutions, think tanks and companies in the three sectors.

This report proceeds as follows. Chapter two outlines the basics of de-risking at the European level: what it is, how it can be achieved, and what kind of Chinese responses could be expected. Chapter three zooms in on the Netherlands by presenting three case studies. It analyses each sector's key supply chain dependencies and risks in detail and offers recommendations for de-risking, which are evaluated based on required effort and expected effectiveness. Chapter four offers a set of three policy recommendations to Dutch and European policymakers for the de-risking agenda moving forward.

[6] Ursula von der Leyen, 'Europe's Choice: Political Guidelines for the Next European Commission 2024–2029', 2024, https://commission.europa.eu/document/download/e6cd4328-673c-4e7a-8683-f63ffb2cf648_en?filename=Political%20Guidelines%202024-2029_EN.pdf.

2. The dynamics of European de-risking from China

2.1 De-risking: A response to economic statecraft

De-risking has emerged since 2022-2023 as a European strategy to minimize vulnerabilities arising from the intensified use of economic statecraft, notably by China. As David Baldwin puts it, economic statecraft can be understood as "the usage of economic policy tools to influence the behaviour of foreign actors."[7] For an action to be considered economic statecraft (1) the tool of use must be economic, (2) the target of the action must be a foreign actor and (3) the aim of the action must be to influence said actor(s).[8] Common examples of economic statecraft include foreign policies on lending, sanctions, and trade agreements.[9]

The use of economic statecraft varies between states and has evolved over time. During the large globalisation and liberalisation wave of the mid-to-late 19th century the degree of state intervention in international markets was comparatively low. From the early-to-mid 20th century, economic statecraft saw a marked increase due to the First and Second World Wars.[10] European governments and the US used economic statecraft to gain leverage over their opponents. An example is the steel embargo imposed by the US against Japan in 1917-1918. Since steel was an essential component for shipbuilding, the embargo was an attempt to frustrate Japan's maritime production in wartime.[11]

In the postwar period, economic statecraft in the West gradually declined as a result of the effort to stimulate free trade. In a policy agenda shaped by the Allied powers, a compromise was struck between international trade promotion and domestic stability considerations, generally referred to as 'embedded liberalism'.[12] The goal of this compromise was to prevent the destructive external consequences' of the economic statecraft that had prevailed during the interwar period.[13] Free trade would be facilitated through international forums such as the OECD (formerly OEEC) and the General Agreement on Tariffs and Trade (GATT).[14] Domestic stability would be provided by building up social welfare states through government intervention.

In the 1970s and 1980s, domestic regulation of the economy was partially abandoned in favour of market-based solutions.[15] Instruments like free floating exchange rates, deregulation and

[7] David Baldwin, *Economic Statecraft* (Princeton University Press, 2020). Matt Ferchen, 'Does China's Coercive Economic Statecraft Actually Work?', United States Institute of Peace, 2023, https://www.usip.org/publications/2023/03/does-chinas-coercive-economic-statecraft-actually-work.
[8] Baldwin, *Economic Statecraft*.
[9] Council on Foreign Relations, 'What Is Economic Statecraft?', CFR Education from the Council on Foreign Relations, 12 May 2023, https://education.cfr.org/learn/reading/what-economic-statecraft.
[10] Antoni Estevadeordal, Brian Frantz, and Alan M. Taylor, 'The Rise and Fall of World Trade, 1870-1939', *The Quarterly Journal of Economics* 118, no. 2 (2003): 359–407.
[11] Jeffrey J. Safford, 'Experiment in Containment: The United States Steel Embargo and Japan, 1917-1918', *Pacific Historical Review* 39, no. 4 (1970): 439–51, https://doi.org/10.2307/3637781.
[12] John Gerard Ruggie, 'International Regimes, Transactions, and Change: Embedded Liberalism in the Postwar Economic Order.', *International Organization* 36, no. 2 (1982): 379–415.
[13] Ruggie.
[14] WTO, 'Agreement on Tariffs and Trade (GATT 1947)', WTO, N.D., https://www.wto.org/english/docs_e/legal_e/gatt47_e.htm.
[15] The Belfer Center for Science and International Affairs, 'Fifty Years of Floating', The Belfer Center for Science and International Affairs, 26 March 2023, https://www.belfercenter.org/publication/fifty-years-floating.
Christoph Hermann, 'Neoliberalism in the European Union', *Studies in Political Economy* 79, no. 1 (6 March 2016): 61–90.

relaxing of capital controls took prominence as a way to liberalize the global economy.[16] This *laissez faire*-thinking reached its apex in the US and Europe just before the financial crisis of 2007.[17] In response to the crisis, government intervention in the economy became more accepted as a means to provide socio-economic stability. Large stimulus packages and new banking regulations were introduced in Europe and the US.[18]

Parallel to these developments, the rise of China as a global manufacturing powerhouse and the subsequent Sino-American competition for technological dominance put pressure on the liberal trade regime. In a renewed context of great power competition, economic statecraft made a comeback as a highly appealing foreign policy tool. After a year of investigations into Chinese economic practices, US President Donald Trump placed in 2018 import tariffs on steel and aluminium from a variety of countries but targeted mainly at China, on the grounds of national security concerns.[19] This marked the beginning of bilateral trade tensions and saw a notable increase in the usage of economic statecraft tools. The tensions escalated in final years of President Trump's first mandate, as China retaliated with tariffs on agricultural products from the US.[20] A bilateral Phase One Trade Deal was reached in 2020, ensuring a temporary reduction of these tariffs.[21] The Biden Administration further consolidated this resurgence of economic statecraft, especially in the high-tech industry. In October 2022, Washington imposed sanctions and restrictions on the export of advanced chips components and machinery to China. This prompted China to retaliate by restricting US access to gallium and germanium, critical raw materials (CRM) needed for the production of semiconductors. A more comprehensive restriction of CRM exports followed, including graphite, rare earths and antimony. The trade relations have been put under even more pressure in the first months of Trump's second presidential mandate, reaching 15-20% tariffs on both sides in sectors like energy, raw materials and agrifood.[22]

Lastly, the aftermath of the 2022 Russian invasion of Ukraine became a prime example of states' renewed willingness to use economic statecraft in international relations. As Russia weaponised its gas supplies, the G7 and EU imposed economic sanctions on Moscow to hamper its ability of continuing fighting the war.[23] Sanctions became one of the main tools used by the EU against Russia and opened the door to the increasing usage of economic statecraft instruments moving forward.

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[16] Ruggie, 'International Regimes, Transactions, and Change: Embedded Liberalism in the Postwar Economic Order.'
[17] Shale Horowitz, 'Restarting Globalization after World War II: Structure, Coalitions, and the Cold War', *Comparative Political Studies* 2, no. 37 (2004), https://journals.sagepub.com/doi/abs/10.1177/0010414003260980.
[18] Robert E. Krainer, 'Regulating Wall Street: The Dodd–Frank Act and the New Architecture of Global Finance, a Review', *Journal of Financial Stability* 8, no. 2 (1 April 2012): 121–33, https://doi.org/10.1016/j.jfs.2011.05.001.
[19] Yong-Shik Lee, 'Three Wrongs Do Not Make a Right: The Conundrum of the US Steel and Aluminum Tariffs', *World Trade Review* 18, no. 3 (July 2019): 481–501, https://doi.org/10.1017/S147474561900020X.
[20] Simina Mistreanu, 'Timeline of U.S.-China Tariffs', TIME, 11 February 2025, https://time.com/7216481/us-china-tariffs-trade-war-trump-timeline/.
[21] Mistreanu, 'Timeline of U.S.-China Tariffs'.
[22] Wyatte Grantham-Philips, 'Trump Has Begun Another Trade War. Here's a Timeline of How We Got Here', AP News, 10 March 2025, https://apnews.com/article/trump-tariffs-mexico-china-canada-trade-cfe1fa82a47f1bca21a82f4b504486c8.
[23] Alex Lawson, '"Gas Blackmail": How Putin's Weaponised Energy Supplies Are Hurting Europe', *The Guardian*, 15 July 2022, sec. World news, https://www.theguardian.com/world/2022/jul/15/gas-blackmail-how-putins-weaponised-energy-supplies-are-hurting-europe.
Global Trade Alert, 'Economic Sanctions Related to the Russian Invasion of Ukraine', Global Trade Alert, n.d., accessed 19 January 2025.

The resurgence of economic statecraft, combined with the unprecedented interconnectedness of supply chains resulting from hyperglobalisation, has highlighted the urgent need to address supply chain vulnerabilities. Two lenses dominate the global discourse: decoupling and derisking. Decoupling refers to an attempt to radically cut off risks in certain sectors. This has already been demonstrated by the US ban on the export of certain semiconductor machinery and the 100% import tariff on Chinese electric vehicles.[24] Derisking has been introduced by European Commission President Von der Leyen as a more balanced approach to "resilience, long-term prosperity and security" without severing economic interdependencies.[25]

At the policy level, de-risking is often operationalised in a broad sense. For instance, the EU's 2023 *Economic Security Strategy,* lays out a broad country-agnostic framework to enhance the EU's economic resilience.[26] The Strategy identifies the balancing the benefits of an open economy and the necessities of economic security as a major challenge. The Department of State of the US defines de-risking instead as "terminating or restricting business relationships with clients or categories of clients to avoid, rather than manage, risk."[27]

Scholarly attempts to define de-risking resulted in a variety of interpretations. Cerdeiro et al. define de-risking as "countries changing how they source goods and services" by bringing back domestic production capacity ('reshoring') or moving production capacity to 'friendly' states.[28] Others, meanwhile, attempt to clarify the concept by contrasting it to de-coupling. According to Farrell and Newman (2023), for instance, de-risking refers to "managing the risks of continued interdependence."[29] De Quant et al. (2024) point out the vagueness of de-risking, as de-risking could mean anything between maintaining the status quo or striving for full autarky in critical areas.[30] De Quant et al. argue that a definition of de-risking would require one to quantify not only the risks but also the amount of risk that is acceptable.[31]

While de-risking clearly lacks a universal policy and scholarly definition, for the purpose of this study it is defined as an effort to reduce vulnerability to other states' involvement in economic areas of vital importance to the European economy and society. Sectors of vital importance

[24] Jeremy Mark and Dexter Tiff Roberts, 'United States–China Semiconductor Standoff: A Supply Chain under Stress - Atlantic Council', Atlantic Council, 23 February 2023, https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/united-states-china-semiconductor-standoff-a-supply-chain-under-stress/.
The White House, 'FACT SHEET: President Biden Takes Action to Protect American Workers and Businesses from China's Unfair Trade Practices', The White House, 14 May 2024, https://www.whitehouse.gov/briefing-room/statements-releases/2024/05/14/fact-sheet-president-biden-takes-action-to-protect-american-workers-and-businesses-from-chinas-unfair-trade-practices/.
[25] 'Speech by the President on EU-China relations', European Commission, 30 March 2023, https://ec.europa.eu/commission/presscorner/detail/en/speech_23_2063.
[26] 'Joint Communication To The European Parliament, The European Council And The Council On "European Economic Security Strategy"' (2023), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52023JC0020.
[27] 'De-Risking', *United States Department of State* (blog), 2025, https://www.state.gov/de-risking/.
[28] Diego A. Cerdeiro Muir Parisa Kamali,Siddharth Kothari,Dirk V., 'The Price of De-Risking Reshoring, Friend-Shoring, and Quality Downgrading', IMF, 21 June 2024, https://www.imf.org/en/Publications/WP/Issues/2024/06/20/The-Price-of-De-Risking-Reshoring-Friend-Shoring-and-Quality-Downgrading-545774.
[29] Henry Farrell and Abraham Newman, 'The New Economic Security State', Foreign Affairs, 19 October 2023, https://www.foreignaffairs.com/united-states/economic-security-state-farrell-newman.
[30] Sebastian de Quant, Sander Tordoir, and Shahin Vallée, 'Caught in Geopolitical Fragmentation: How to De-Risk Germany's Economic Model', Working Paper (Working Papers, 2024), 9, https://www.econstor.eu/handle/10419/281432.
[31] Sebastian de Quant, Sander Tordoir, and Shahin Vallée, 'Caught in Geopolitical Fragmentation: How to De-Risk Germany's Economic Model', Working Paper (Working Papers, 2024), 8, https://www.econstor.eu/handle/10419/281432.

include health, clean tech, defence, raw materials and dual-use technologies such as quantum computing, AI and biotechnology. This definition is based on the above-mentioned historical legacy of economic statecraft, the scholarly and political debate, as well as the EU's 2023 *Economic Security Strategy*, given the European focus of the present research.

2.2 European de-risking: How to achieve it?

In order to reduce risks, they must first be identified. To this purpose, the *EU's 2023 Economic Security Strategy* (henceforth: the Strategy) provides useful input.[32] Although the Strategy is country-agnostic, for the purpose of this study it is applied to the case of de-risking from China. With this in mind, the strategy highlights the following main risk categories:

1. **Risks to the resilience of supply chains, including energy security:** A high dependence on China for raw materials and manufacturing capacity can lead to potential supply chain disruptions in the form of price volatility or supply scarcity, as a result of geopolitical tensions, natural disasters, pandemics, or vulnerable trade routes.
2. **Risks to physical and cyber security of critical infrastructure:** Recent experience strongly suggests that dependencies in critical sectors can be exploited to achieve political purposes, as became apparent during the Nord Stream sabotage in 2022 or the underwater cable sabotage in the Baltics.[33] Other examples include 5G networks, the electricity grid, offshore wind and healthcare. The penetration of Chinese technology within European critical infrastructure brings additional concerns for physical and cyber security.
3. **Risks related to technology security and technology leakage:** The technology leakage of dual-use technologies, such as quantum computing, advanced semiconductors, and artificial intelligence has the potential to enhance the military and intelligence capabilities of Chinese actors who may exploit them to undermine global peace and security.
4. **Risks of weaponisation of economic dependencies or economic coercion:** The risk of weaponisation of economic dependencies arises from the potential for Chinese actors to target EU governments or businesses through trade or investment-related measures. Such actions aim to influence policy changes within the EU's legitimate policymaking domain, thereby challenging the autonomy and resilience of the Union's economic and political frameworks.

Efforts to address some of these risks have been ongoing at the European level in different sectors. For instance, the EU Cybersecurity Act adopted in 2019 focuses safeguarding digital

[32] Joint Communication To The European Parliament, The European Council And The Council On "European Economic Security Strategy".
[33] Karoline Rosenkrantz Paasch, 'New Underwater Footage Raise Sabotage Suspicions against Yi Peng 3', Scandasia, 18 December 2024, https://scandasia.com/new-underwater-footage-raise-sabotage-suspicions-against-yi-peng-3/.

services, supply chains and critical infrastructure.[34] The Foreign Direct Investment Screening Regulation to help scrutinize investments from foreign actors in vital sectors.[35] The EU Chips Act was introduced in 2022 to support European digital and economic security in response to global semiconductor supply chain disruptions during the Covid-19 pandemic.[36] The Critical Raw Materials Act (CRMA) aims to increase domestic mining, processing and recycling capacity and diversify the EU's CRM supplier base.[37] The Net-Zero Industry Act (NZIA) was introduced to "avoid dependencies" for the supply of clean energy technologies.[38] In 2023, the 'anti-coercion instrument' was introduced to protect the EU members states from economic coercion by third countries.[39]

The October 2024 countervailing duties on Chinese EV imports marked a new step in the implementation of the de-risking agenda.[40] It was the first piece of economic de-risking legislation in which China was explicitly singled out as the country to which the duties would be applied.
In addition to EU-led interventions, member states are also increasingly deploying de-risking measures. According to the European Think-tank Network on China, countries like France, Lithuania, Italy and the Czech Republic have been early adopters of de-risking measures.[41] Lithuania started taking measures in 2022 when it withdrew from the "16+1 initiative" and blocked Chinese investments in its critical infrastructure.[42] France has been an early advocate of strategic autonomy and de-risking, manifested primarily in their push for the development of EU-wide policies like the anti-coercion instrument.[43] In Austria, pharmaceutical company Sandoz has received significant state support to open a significant production plant.[44] The Dutch government developed an industrial policy for its maritime industry in order to ensure its competitiveness and strategic autonomy moving forward.[45]

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[34] 'Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA (the European Union Agency for Cybersecurity) and on Information and Communications Technology Cybersecurity Certification and Repealing Regulation (EU) No 526/2013 (Cybersecurity Act) (Text with EEA Relevance)' (2019), http://data.europa.eu/eli/reg/2019/881/oj/eng.
[35] 'Regulation (EU) 2019/452 of the European Parliament and of the Council of 19 March 2019 Establishing a Framework for the Screening of Foreign Direct Investments into the Union' (2021), http://data.europa.eu/eli/reg/2019/452/2021-12-23/eng.
[36] 'Regulation (EU) 2023/1781 of the European Parliament and of the Council of 13 September 2023 Establishing a Framework of Measures for Strengthening Europe's Semiconductor Ecosystem and Amending Regulation (EU) 2021/694 (Chips Act) (Text with EEA Relevance)' (2023), http://data.europa.eu/eli/reg/2023/1781/oj/eng.
[37] 'Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 Establishing a Framework for Ensuring a Secure and Sustainable Supply of Critical Raw Materials and Amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020 (Text with EEA Relevance)' (2024), http://data.europa.eu/eli/reg/2024/1252/oj/eng.
[38] 'Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on Establishing a Framework of Measures for Strengthening Europe's Net-Zero Technology Manufacturing Ecosystem and Amending Regulation (EU) 2018/1724 (Text with EEA Relevance)' (2024), http://data.europa.eu/eli/reg/2024/1735/oj/eng.
[39] 'Regulation (EU) 2023/2675 of the European Parliament and of the Council of 22 November 2023 on the Protection of the Union and Its Member States from Economic Coercion by Third Countries', accessed 21 January 2025, https://eur-lex.europa.eu/eli/reg/2023/2675/oj/eng.
[40] 'Regulation (EU) 2024/2754 of the Commission of 29 October 2024 Imposing a Definitive Countervailing Duty on Imports of New Battery Electric Vehicles Designed for the Transport of Persons Originating in the People's Republic of China', accessed 21 January 2025, https://eur-lex.europa.eu/eli/reg_impl/2024/2754/oj/eng.
[41] 'National Perspectives on Europe's De-Risking from China' (European Think-tank Network on China, 2024), https://www.clingendael.org/sites/default/files/2024-07/ETNC2024_National_Perspectives_on_Europes_De-risking_from_China.pdf.
[42] 'National Perspectives on Europe's De-Risking from China'.
[43] 'National Perspectives on Europe's De-Risking from China'.
[44] 'Sandoz Opens New Antibiotic Production Facility in Austria, to Significantly Increase Capacity for Life-Saving Medicines', 2024, https://www.sandoz.com/sandoz-opens-new-antibiotic-production-facility-austria-significantly-increase-capacity-life-saving/.
[45] 'No Guts, No Hollands Glorie! Sectoragenda Maritieme Maakindustrie', 2023. https://www.rijksoverheid.nl/documenten/rapporten/2023/10/26/sectoragenda-mmi

While these efforts are a good starting point, they tend to be fragmented as they address individual sectors (critical raw materials, chips, net zero industry) or instruments (anti-coercion, foreign direct investment screening) without a cross-sectoral lens. It is thus essential for the EU's de-risking efforts, implemented through the Economic Security Strategy, to gain a comprehensive approach that accounts for cross-sectoral synergies and risks.

As the EU's economy remains heavily dependent on open trade, the aim is not to disrupt global markets through heavy state intervention by the EU, but to ensure that those sectors of vital importance for the European society are secure and resilient.

Keeping this in mind, Table 4 includes a selection of public and private interventions that – applied in effective combinations, with a cross-sectoral lens – can support European de-risking goals more broadly. The interventions are categorised depending on their primary aim and the primary actor that should be responsible for their implementation. The first group of interventions aims to strengthen resilience within the Netherlands and the EU by supporting industries and protecting them from unfair competition. The second group is focused on international cooperation aimed at increasing the security of vital supply chains. Given the focus on de-risking Dutch supply chains, the key actors considered are the European Commission as the Union's main executive body, the Dutch government, and Dutch industry, although most often a whole-of-society approach is needed to ensure the success of the intervention.

These interventions are perceived in the literature and by industry stakeholders interviewed in the context of this study as good practices, though their effectiveness heavily depends on the sectoral context. The case studies in section three include a selection of the interventions in **Table 4** as well as an assessment of their perceived effectiveness in each specific context.

Table 4: A taxonomy of de-risking intervention options. Note: The list is not comprehensive but includes the most effective interventions that governments and industry can implement to achieve de-risked supply chains

Intervention	Description	Responsible Actor
Aim 1: Domestic economic resilience		
Import controls	Imposing tariffs, quotas or licenses to protect domestic industries and expand global market share.	European Commission
Priority sectors in Europe	Developing sector-specific industrial policy to enhance the competitiveness of priority sectors and increase global market share, including the implementation of financial aid, permitting administrative reform and other necessary conditions.	European Commission & Dutch government
Direct subsidies	Offering tax breaks, operational, or capital expenditure support to increase the competitiveness of domestic industries.	European Commission & Dutch government
Inbound investment screening	Screening inbound investments to prevent foreign ownership in strategic sectors.	European Commission & Dutch government

Intellectual property	Enhancing research security to prevent technology leakage in strategic sectors.	European Commission & Dutch government
Standard setting	Developing and upholding technical and/or environmental standards that align with domestic industries to expand global market share.	European Commission & Dutch government
Procurement requirements	Imposing procurement requirements for responsible sourcing, minimum local content, country of origin, in order to increase the market share of domestic industry or industry in partner countries.	Dutch government
Educational programmes	Developing educational programmes to enhance required skill-sets required for enhancing domestic industrial capabilities, including in the mining or refining sector; manufacturing; automation; cybersecurity etc.	Dutch government
Stockpiling	Creating stockpiles of critical materials or components to overcome short-term supply disruptions.	Dutch government & Dutch industry
R&D investments for substitution	Investing in research and development (R&D) programmes that investigate the substitution of materials or components to decrease unwanted dependencies.	Dutch industry
Vertical integration	Acquiring full or partial ownership of other production facilities along the supply chain to decrease the likelihood of supply disruptions.	Dutch industry
Aim 2: Secure global supply chains		
Export controls	Imposing tariffs, quotas or licenses to protect domestic industries and expand global market share.	European Commission
Trade and investment agreements	Developing favourable trade and investment agreements to improve trade terms for domestic industry.	European Commission
Diplomatic agreements	Developing favourable diplomatic agreements to increase domestic industry's access to critical materials or components.	European Commission & Dutch government
Asymmetrical strategic dependencies	Developing and using asymmetrical strategic dependencies as leverage to further foreign policy goals.	European Commission & Dutch government
Outbound investment screening	Screening outbound investments to prevent technology leakage in strategic sectors.	European Commission & Dutch government
Diversification of suppliers	Ensuring a diversified supplier base (both in terms of geographical location and corporate ownership) along the supply chain to increase resilience to potential disruptions.	Dutch industry
Divestment from high-risk locations	Divesting from high-risk locations in terms of political instability, technical challenges or geopolitical risk to decrease the likelihood of supply disruptions.	Dutch industry
Supply chain monitoring, stress testing and contingency planning	Monitoring supply chain risks, conducting stress tests and developing contingency plans with suppliers along the supply chain to increase resilience to potential disruptions.	Dutch industry

2.3 Chinese responses to European de-risking

China possesses an expansive economic statecraft toolkit, supported by its rapid economic growth over the last few decades. Beijing has not shied away from employing these tools against countries that they perceive as threatening the achievement of Chinese foreign policy objectives.

It is often difficult to directly pinpoint the link between the Chinese exercise of economic statecraft and a triggering event, as Beijing justifies policy interventions in an intentionally vague way. However, the targeted country and timing are good indicators of the political goals that underlie China's exercise of economic statecraft. It has become clear over the last few years that attempts at de-risking (or de-coupling in the case of the US) are a key instigator of such Chinese measures. While this is mostly true in the US (e.g., gallium and germanium restrictions as a response to the American ban on chip-making technology), European states have not been spared similar retaliatory attempts at economic coercion. Examples include the Chinese probe of pork imports from Europe in mid-June 2024, curtailing European access to the Chinese market. While Beijing framed this measure as an 'anti-dumping investigation', the timing and contextual cues rather indicate a policy responding to the European electric vehicle (EV) tariffs put in place a couple of weeks earlier.[46] In the same context, China has directly targeted France by imposing restrictions on imports of French cognac.[47] Chinese response to EV tariffs also exposed the ability of the Chinese government to leverage its domestic industries for foreign policy goals, with Beijing telling its domestic carmakers to halt expansion in European countries that backed the EV tariffs.[48]

China's use of economic statecraft as a response to de-risking is however not only a retaliatory show of force. The use of economic incentives is also part of Beijing's proactive toolkit. The case of Hungary is exemplary, with economic ties between the two countries increasingly tightening. By increasing cooperation between Beijing and Budapest, China hopes to sell a success story to other European countries, fostering fragmentation at the EU level and signalling that de-risking is not necessary for economic prosperity.[49]

To shed some light on what can be expected in the coming years, policy documents, speeches, and official statements of the Chinese Ministry of Foreign Affairs, overseas embassies, state-linked media and Chinese overseas business associations from 2023 and 2024 have been analysed in the original Chinese-language text. They reveal that China has been using a mixture of rhetorical devices to deter European policy interventions that could pose a threat to the current Chinese economic model.

1. **Dissuading the EU from ending the "mutually beneficial cooperation"**

[46] Reuters, 'China Singles out Danish, Dutch, Spanish Firms in Anti-Dumping Probe into EU Pork', Reuters, 14 July 2024, https://www.reuters.com/markets/commodities/china-singles-out-danish-dutch-spanish-firms-anti-dumping-probe-into-eu-pork-2024-07-18/.
[47] He, 'Beijing Steps up Probe into EU Brandy Imports as Trade Tensions Deepen after Tariffs on Chinese EVs'.
[48] Reuters, 'Exclusive: China Tells Carmakers to Pause Investment in EU Countries Backing EV Tariffs, Sources Say'.
[49] Ministry of Foreign Affairs of the People's Republic of China, 24 September 2024, https://www.mfa.gov.cn/web/wjbz_673089/xghd_673097/202409/t20240924_11495637.shtml.

China has condemned the EU's approach to de-risking, calling it "decoupling from opportunities, cooperation, stability and development" in a statement by the Permanent Mission of China to the UN.[50] Chinese statements in public speeches or bilateral meetings greatly emphasise that 'derisking means to reduce collaboration and opportunity.[51] They regularly highlight the positive effects of trade cooperation. The Chinese Minister of Foreign Affairs Wang Yi stresses the benefits of an open market and the progress brought by large cross-border interactions between people, and trade of goods, technology, and data.[52] Based on this statement, Beijing seems to promote the deepening of trade and investment ties with the EU. They also suggest China and the EU could cooperate more within the structure of existing international organisations.[53]

2. Warning the EU against the fragmentation of the global liberal trade order

Foreign Minister Wang Yi suggested that the EU should avoid damaging the global trade order and invited the EU to fight against the "fragmentation of the world economy, protectionist tendencies, and deglobalisation".[54] Chinese officials argue that the real risk comes from the great power competition between China and the US, leading to supply chain disruption, trade unilateralism and anti-globalisation. For instance, in the context of the CRMA, a key European de-risking policy, Chinese officials urged the EU not to "disrupt global critical raw materials supply chains and value chains through non-market measures".[55]

3. Suggesting that the EU should differentiate itself from US policy

China frequently blames US-China competition for the fragmentation in the global economic order. Statements from Chinese ambassadors in Europe blame the US hegemony that actively promotes the confrontation between China and the western countries.[56] From the Chinese point of view the EU should not let 'external actors' (read: the US) influence its decision-making and instead chart its own course. For example, Fu Cong, Head of the Chinese Mission to the European Union mentioned that 'There is no reason to be a "vassal" of any other country,' when referring to the diplomatic relations of the EU.[57] For China a more independent Europe would increase the multipolarity of the international order, thereby preventing a potential escalation with the West.

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[50] Permanent Mission of the People's Republic of China to the UN, 'Qin Gang: De-Sinicization in the Name of "De-Risking" Is Decoupling from Opportunities, Cooperation, Stability and Development', Permanent Mission of the People's Republic of China to the UN, accessed 8 January 2025, http://geneva.china-mission.gov.cn/eng/zgyw/202305/t20230511_11075089.htm.

[51] Mr PENG Gang, 'The Essence of China-EU Trade and Economic Relations Is Mutual Benefit and Win-Win', Euractiv, 8 April 2024, https://www.euractiv.com/section/global-europe/opinion/the-essence-of-china-eu-trade-and-economic-relations-is-mutual-benefit-and-win-win/. Ministry of Foreign Affairs of the People's Republic of China, 23 May 2023, https://www.mfa.gov.cn/web/wjbz_673089/xghd_673097/202305/t20230509_11074124.shtml.

[52] Ministry of Foreign Affairs of the People's Republic of China, 1 April 2024, https://www.mfa.gov.cn/wjbzhd/202404/t20240401_11274315.shtml.

[53] Ministry of Foreign Affairs of the People's Republic of China, 21 February 2024, https://www.mfa.gov.cn/wjbzhd/202402/t20240221_11248118.shtml.

[54] Ministry of Foreign Affairs of the People's Republic of China, 21 February 2024, https://www.mfa.gov.cn/wjbzhd/202402/t20240221_11248118.shtml.

[55] MINEX Forum, 'The China Chamber of Commerce Response to the Approval of the Critical Raw Materials Act (CRMA)', MINEX Forum, 20 August 2024, https://minexforum.com/2024/03/20/the-china-chamber-of-commerce-response-to-the-approval-of-the-critical-raw-materials-act-crma/.

[56] Ambassade de la Republique Populaire de Chine en Republique Francaise, 6 June 2023, http://fr.china-embassy.gov.cn/chn/ttxw/202306/t20230606_11090678.htm. Ministry of Foreign Affairs of the People's Republic of China, 20 May 2024, https://www.fmprc.gov.cn/web/zwbd_673032/wjzs/202405/t20240522_11309663.shtml.

[57] Ministry of Foreign Affairs of the People's Republic of China, 26 September 2024, https://www.mfa.gov.cn/web/wjbz_673089/xghd_673097/202409/t20240926_11497357.shtml. Mission of the People's Republic of China to the European Union, 28 May 2023, http://eu.china-mission.gov.cn/dshd/202305/t20230528_11084824.htm.

4. Framing the EU as a protectionist disruptor of the Chinese economic ascent

Chinese officials suggested that EU de-risking efforts are an attempt to disrupt the Chinese technical and economic development.[58] Beijing sees EU de-risking as a means to exclude China from global supply chains, particularly in key areas and critical technologies. The Embassy of China in UK also noted that the EU de-risking efforts were "doomed to failure".[59]

5. Establishing China's export policies as a favour to EU's climate ambitions

Chinese government statements towards the MFAs of Germany, Spain and Denmark contain efforts to cast the current EU-China trade relations in clean technologies as a joint effort to implement the global climate transition in a win-win fashion.[60] The Chinese Embassy in Paris for example claims that its electric vehicle production overcapacity and the subsequent export to Europe is beneficial for global climate goals.[61] This framing by Chinese officials could reflect the desire to retain the current trade dynamics of Chinese production and European consumption which is a centrepiece of the Chinese economic system of export-led growth.[62]

Intensified trade disputes and political tensions point to the growing risk that its economic statecraft toolbox will be deployed against the EU, even though China's usage of economic statecraft for both reward and punishment make it difficult to predict when a type of measure will be employed. As such, a good understanding of China's diplomatic rhetoric and economic statecraft tools is essential for European and Dutch policymakers to successfully navigate and implement de-risking measures. To this end, **Table 5** summarises the Chinese economic statecraft toolbox based on past examples targeting the US, EU member states, Australia, Korea.[63]

Table 5: China's economic statecraft tactics

Economic statecraft tools	Description
Import inspections/ audits/ restrictions	China routinely performs inspections or audits on foreign products or foreign companies in order to have legal justifications to selectively disrupt their economic activities. For instance, after South Korea and the US announced in 2016 their decision to install a Terminal High Altitude Area Defense (THAAD) missile system in Korea, the Chinese government decided to close almost all

[58] Embassy of the People's Republic of China in the United Kingdom of Great Britain and Northern Ireland, 9 June 2023, http://gb.china-embassy.gov.cn/dshd/202306/t20230609_11094440.htm. Mission of the People's Republic of China to the European Union, 28 May 2023, http://eu.china-mission.gov.cn/dshd/202305/t20230528_11084824.htm.
[59] Embassy of the People's Republic of China in the United Kingdom of Great Britain and Northern Ireland.
[60] Ministry of Foreign Affairs of the People's Republic of China, 27 September 2024, https://www.mfa.gov.cn/web/wjbz_673089/xghd_673097/202409/t20240927_11498608.shtml. Ministry of Foreign Affairs of the People's Republic of China, 27 September 2024, https://www.mfa.gov.cn/web/wjbz_673089/xghd_673097/202409/t20240927_11498601.shtml. Ambassade de la Republique Populaire de Chine en Republique Francaise, 7 June 2024, http://fr.china-embassy.gov.cn/ttxw/202406/t20240607_11410602.htm. Ministry of Foreign Affairs of the People's Republic of China, 23 February 2024, https://www.mfa.gov.cn/web/wjbz_673089/xghd_673097/202402/t20240223_11249092.shtml. Ministry of Foreign Affairs of the People's Republic of China, 19 February 2024, https://www.mfa.gov.cn/web/wjbz_673089/xghd_673097/202402/t20240219_11246749.shtml.
[61] Ambassade de la Republique Populaire de Chine en Republique Francaise.
[62] Zongyuan Zoe Liu, 'China's Real Economic Crisis: Why Beijing Won't Give Up on a Failing Model', Foreign Affairs, 6 August 2024, https://www.foreignaffairs.com/china/chinas-real-economic-crisis-zongyuan-liu.
[63] Logan Wright et al., 'Retaliation and Resistance: China's Economic Statecraft in a Taiwan Crisis', Atlantic Council, 1 April 2024, https://www.atlanticcouncil.org/in-depth-research-reports/report/retaliation-and-resilience-chinas-economic-statecraft-in-a-taiwan-crisis/. Matthew Reynolds and Matthew P. Goodman, 'Deny, Deflect, Deter: Countering China's Economic Coercion', *Center for Strategic and International Studies*, 21 March 2023, https://www.csis.org/analysis/deny-deflect-deter-countering-chinas-economic-coercion.

	Lotte stores (Korean conglomerate) in China due to fire code violations. More recent examples include the Chinese probe into French brandy and European pork in the aftermath of the EU's EV tariffs, with the aim of inflicting economic damage to the exporting country. [64]
Export restrictions	China wields its leading position in the supply chains of critical raw materials and other components to destabilize markets and prevent the export of critical technologies. The most recent examples of Chinese export restrictions are the bans on the export of Gallium, Germanium and Antimony to the United States.[65] These minerals are critical to the development of semiconductors, solar panels and defence applications.
Foreign company restrictions	China uses tariff or non-tariff barriers to restrict entry for foreign companies to certain markets. The goal of these efforts is to protect domestic companies from being competed out of their home market. In a survey, two-thirds of German companies argued that their access to the Chinese market was diminished due to 'unfair competition'.[66]
Outbound Investment restrictions	More recently, China has been leveraging the outward investment potential of its domestic companies as a tool to induce states to comply with Chinese interests. For example, in October 2024 the Chinese government told its domestic carmakers not to invest in European countries that voted in favour of the Chinese EV-tariffs.[67]
Travel/visa restrictions	China has used the ability to travel to and from China as a tool to influence individuals or states. An example of this is the travel warning issued for the US by the Chinese government warning for 'unexpected situations' in the United States.[68]More recently, China instated additional requirements for visa-free travel from Japan: in contrast to other countries that unilaterally received access to visa-free travel.[69]
Popular media boycotts	China uses media to instigate popular movements against products, companies or countries. In the period of 2016-2021 these boycotts were mainly aimed at products from North America, Europe, Japan or South Korea. A high profile example of this strategy was the state-sponsored boycott of Swedish fashion brand H&M.[70]
Diplomatic-economic disruption	China uses diplomatic tools to coerce states into more cooperative behaviour regarding what China considers its core interests. An example of this is the suspension of economic dialogue between China and Australia in 2020 after a call by the Australian prime minister to start an inquiry on the origins of the COVID-19 virus.[71] Another example was the Chinese threatening to close its borders with Mongolia after the latter country welcomed the Dalai Lama into their country.[72]

[64] Laura He, 'Beijing Steps up Probe into EU Brandy Imports as Trade Tensions Deepen after Tariffs on Chinese EVs', CNN Business, 8 July 2024, https://edition.cnn.com/2024/07/08/business/china-eu-brandy-import-probe-intl-hnk/index.html.
Alistair Driver, 'China Names Three European Pork Producers as Focus of Anti-Dumping Probe', Pig World, 24 July 2024, https://www.pig-world.co.uk/news/china-names-three-european-pork-producers-as-focus-of-anti-dumping-probe.html.
[65] The Guardian, 'China Bans Exports of Key Microchip Elements to US as Trade Tensions Escalate', *The Guardian*, 4 December 2024, sec. World news, https://www.theguardian.com/world/2024/dec/04/us-china-microchips-export-bans-gallium-germanium.
[66] Reuters, 'Majority of German Firms Feel Unfair Competition in China, Commerce Chamber Says', *Reuters*, 10 April 2024, sec. Business, https://www.reuters.com/business/majority-german-firms-feel-unfair-competition-china-commerce-chamber-says-2024-04-10/.
[67] Reuters, 'Exclusive: China Tells Carmakers to Pause Investment in EU Countries Backing EV Tariffs, Sources Say', Reuters, 31 October 2024, https://www.reuters.com/business/autos-transportation/china-tells-carmakers-pause-investment-eu-countries-backing-ev-tariffs-sources-2024-10-30/. Reuters.
[68] TTG Asia, 'China Issues Travel Warning for the US', 1 April 2024, https://www.ttgasia.com/2024/04/01/china-issues-travel-warning-for-the-us/.
[69] Kawashima Shin, 'The China-Japan Travel Visa Spat', The Diplomat, 13 November 2024, https://thediplomat.com/2024/11/the-china-japan-travel-visa-spat/.
[70] Swedish National China Centre, 'Chinese Consumer Boycotts of Foreign Companies, 2008–2021', Swedish National China Centre, 11 July 2022, https://kinacentrum.se/en/publications/chinese-consumer-boycotts-of-foreign-companies/.
[71] BBC, 'China "indefinitely" Suspends Key Economic Dialogue with Australia', BBC, 6 May 2021, https://www.bbc.com/news/business-57004797.
[72] AsiaNews.it, 'Beijing Cancels Bilateral Meetings with Mongolia Following Dalai Lama Visit', AsiaNews.it, AsiaNews.it, 26 November 2016, https://www.asianews.it/news-en/Beijing-cancels-bilateral-meetings-with-Mongolia-following-Dalai-Lama-visit-39251.html.

International arbitration	China activated the dispute mechanism of the World Trade Organisation (WTO) in October 2024 as a response to the EU tariffs on EVs.[73] Earlier, in 2022 it initiated the same mechanism against US semiconductor chip trade measures.[74]

At the same time, Europe should also be alert to non-economic measures employed by Beijing to reach its economic and foreign policy goals. Chinese actions outside the realm of economic coercion, such as cyberoperations, military exercises, or incidents like the 2024 destruction of the Baltic undersea cable by the Chinese ship Yi Peng 3, reflect its willingness to pursue a variety of methods to achieve political and economic objectives.[75] While not strictly economic in nature, such measures could play a more prominent role if European-Chinese tensions continue to escalate, underscoring the multifaceted risks in the evolving relationship.

[73] Investment Monitor, 'China Files WTO Complaint over EU's EV Tariffs', Investment Monitor, 5 November 2024, https://www.investmentmonitor.ai/news/china-files-wto-complaint-over-eus-ev-tariffs/.
[74] World Trade Organisation, 'China Initiates WTO Dispute Complaint Targeting US Semiconductor Chip Measures', accessed 8 January 2025, https://www.wto.org/english/news_e/news22_e/ds615rfc_15dec22_e.htm.
[75] Bojan Pancevski, 'Exclusive | Chinese Ship's Crew Suspected of Deliberately Dragging Anchor for 100 Miles to Cut Baltic Cables', WSJ, 29 November 2024, https://www.wsj.com/world/europe/chinese-ship-suspected-of-deliberately-dragging-anchor-for-100-miles-to-cut-baltic-cables-395f65d1.

3. De-risking Dutch vital sectors: Antibiotics, drones, the electricity grid

As de-risking takes central stage in Brussels, the Netherlands is also closely involved in efforts to reduce the vulnerability of key supply chains to Chinese economic statecraft. The three case studies in this section -antibiotics, drones, and the electricity grid- offer a deep-dive into existing strategic dependencies between the Netherlands and China. Throughout the report, we refer to them as 'vital sectors' because they are of vital importance to the European economy and society. As heavy dependencies on China are present across these three sectors, it is essential to investigate risks and possible options to address them. The three sectors are also strategically important to China, meaning that future European and/or Dutch de-risking interventions could be challenging to achieve and even cause retaliation, as explained below.
The case studies have been chosen in cooperation with the Dutch Ministries of Health, Wellbeing and Sport; Defence; and Economic Affairs. They rely on interviews with industry actors and researchers; desk research of policy documents, individual company websites and strategies; and previous research conducted by universities, think tanks, and international institutions. They follow a similar structure to allow for comparison and to draw cross-sectoral conclusions that are relevant for the Dutch government, industry, and the EU.

First, each case study outlines the supply chain structure and market dynamics specific to the Netherlands. All three case studies split the relevant supply chains into three parts: Upstream, where the raw materials are extracted and processed into refined forms; Midstream, where components or intermediate products are manufactured; and Downstream, where the end-product is developed and assembled.

Second, threats to secure supply chains are individuated. To assess the supply chain risk, the dependency on Chinese resources and manufacturing is analysed alongside the potential for diversification outside of China. A higher dependency on China in combination with a lack of existing alternatives either within the EU or in third countries is considered a higher risk.

Third, each case study recommends and evaluates a set of de-risking options that the Dutch government, the EU, and industry could undertake ameliorate dependency on China. Depending on the risks and vulnerabilities identified in each sector, relevant de-risking intervention options are selected from the Taxonomy in section 2.1.2. The selection is based on interviews and on the analysis of existing (best) practices in countries outside of the Netherlands. They are evaluated according to two criteria: effort and effectiveness. Effort refers to the resource intensity – both financial and time – required to successfully implement the intervention. Effectiveness refers to (1) the extent to which the intervention directly contributes to de-risking goals, as opposed to indirectly creating conditions that would still need additional interventions to achieve de-risking, (2) the responsible actor's ability to sustain it in the long term, which tends to decrease the higher the required effort, and (3) the ability to mitigate associated risks, including unintended market effects and the likelihood of retaliation from China. Overall, the assessment results in three

categories defined in **Table 6** below. For more information about the methodology and the evaluation calculations see Annex 1 and Annex 2.

Table 6: Evaluation of interventions

Effort x Effectiveness	Definition
High investment, high reward	Significant effort required to implement a highly effective intervention.
Low hanging fruit	Limited effort required to implement a highly effective intervention.
Moderate gains	Limited effort required to implement a moderately effective intervention.

3.1 Antibiotics

Key takeaways: How can antibiotic supply chains be de-risked?
This case study shows that the dependencies on China in the production of generic antibiotics are mostly upstream in the supply chain, and that the market suffers from a lack of suppliers and producers. Amongst policymakers, the awareness of the resulting risks is spreading, as the pending reform of the EU pharmaceutical legislation illustrates. Still, healthcare remains largely a sovereign competency, so EU reforms can only have limited impact without significant national reform in the Netherlands. Moreover, translating the high-level policy goals into concrete action by the private sector will come at substantial costs and require prolonged commitment. Dialogue is needed on the national and EU level about how a resilient antibiotics manufacturing process can be incentivized. The central questions are how much are the Netherlands and the EU are willing to pay for a sovereign pharmaceutical industry, and who is going to absorb the cost? Reconciling the affordability of critical medicines with reducing their vulnerability to supply disruption will be a major challenge for policymakers in the coming years.

After having revolutionised modern medicine for more than a hundred years and extended the average human life span by 23 years, the generics antibiotics market finds itself in a precarious situation.[76] Highly concentrated and fragile supply chains drive antibiotic shortages in the Netherlands and the EU, which in turn, heightens the risk of antimicrobial resistance.[77] Lockdowns and export restrictions during the Covid-19 pandemic exposed the risks of these dependencies, which are particularly worrying in view of the fragile geopolitical environment.[78] Concerns amongst policymakers that essential medicines may become a 'weapon in geopolitical games' are growing and fostering calls to de-risk the supply chains of pharmaceutical products.[79]

To contribute to this end, this case study assesses the supply chain risks of four antibiotics: Amoxicillin, Amoxicillin/Clavulanic Acid, Cotrimoxazole, and Azithromycin. The first two are combined in the case study because both of them use of Amoxicillin, leading to significant overlap in their supply chain analysis. These were selected in collaboration with the Ministry of

[76] Matthew I Hutchings, Andrew W Truman, and Barrie Wilkinson, 'Antibiotics: Past, Present and Future', *Current Opinion in Microbiology*, Antimicrobials, 51 (1 October 2019): 72–80, https://doi.org/10.1016/j.mib.2019.10.008.
[77] Avaneesh Kumar Pandey et al., 'A Systematic Review of Antibiotic Drug Shortages and the Strategies Employed for Managing These Shortages', *Clinical Microbiology and Infection*, 26 September 2024, https://doi.org/10.1016/j.cmi.2024.09.023.
[78] Suzannah Chapman, Guillaume Dedet, and Ruth Lopert, 'Shortages of Medicines in OECD Countries' (Paris: OECD, 24 March 2022), https://doi.org/10.1787/b5d9e15d-en.
[79] Lech Pilawski and Thomas Student, 'Securing Europe's Medicine Supply: Envisioning a Critical Medicines Act' (EESC, 27 January 2023), 1, https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/securing-europes-medicine-supply-envisioning-critical-medicines-act.

Health, Welfare and Sport of the Netherlands based on two considerations. First, the antibiotics belong to three different drug classes and are being utilised across different lines of treatments, making them suitable proxies to depict the antibiotics landscape. Second, all four antibiotics have been suffered numerous shortages on a European and national level in recent years. For their main uses, see **Table 7**.

All four antibiotics are part of the generic medicines list, which are "developed to be the same as a medicine that has already been authorised".[80] In other words, after the patent of the original medicine, known as reference medicine, has expired, generics can be manufactured and marketed by any company that fulfils the same quality standards and uses the same active substance.[81] Reference medicines include innovative medicines, which are newly developed brand-name medicines where the initial company has a patent and is the only player that can sell it. This case study is only focused on the generic medicines sector.

After providing a high-level overview of the antibiotic production landscape, the section proceeds to analyse supply chain risks and propose a set of interventions to enhance the de-risking of pharmaceutical supply chains.

Table 7: Main uses of the considered antibiotics

Antibiotic	Amoxicillin/Clavulanic Acid	Azithromycin	Cotrimoxazole
Drug class	Aminopenicillin antibiotic	Macrolides antibiotic	Sulfonamides antibiotic
Fields of application	Middle ear infections, bronchitis, pneumonia, urinary tract infections, skin infections	Respiratory infections, urogenital infections, dermal infections, STDs	Chronic bronchitis, pneumonitis, urinary tract infections, therapy of HIV-related infections

3.1.1 Understanding the antibiotic sector

The production of antibiotics is a highly globalised process, fragmented across countries and companies and, in the case of generic antibiotics, dominated by India and China. A simplified overview of the antibiotics supply chain is shown in **Figure 1**. The primary manufacturing steps include key starting materials (KSM), intermediates and active pharmaceutical ingredients (API). In the case of both innovative and generic antibiotics, these steps are dominated by China. As of 2022, China accounted for 71% of the global inter-region export volume of antibiotic API, including both innovative and generic antibiotics.[82] While India is also a major API producer, its industry heavily relies on imports of KSM and intermediates from China. Secondary

[80] 'Generic and Hybrid Medicines', European Medicines Agency (EMA), accessed 11 March 2025, https://www.ema.europa.eu/en/human-regulatory-overview/marketing-authorisation/generic-hybrid-medicines.
[81] 'Generic and Hybrid Medicines'.
[82] Boston Consulting Group and Wellcome, 'Understanding the Antibiotic Manufacturing Ecosystem: A View of Global Supply Chains, Pressure Points, and Implications for Antimicrobial Resistance Response', 2022, https://cms.wellcome.org/sites/default/files/2022-04/understanding-the-antibiotic-manufacturing-ecosystem-2022.pdf.

manufacturing steps, including drug formulation, packaging and distribution, tend to be less geographically concentrated, though it depends on each medicine, as seen in the next sections.

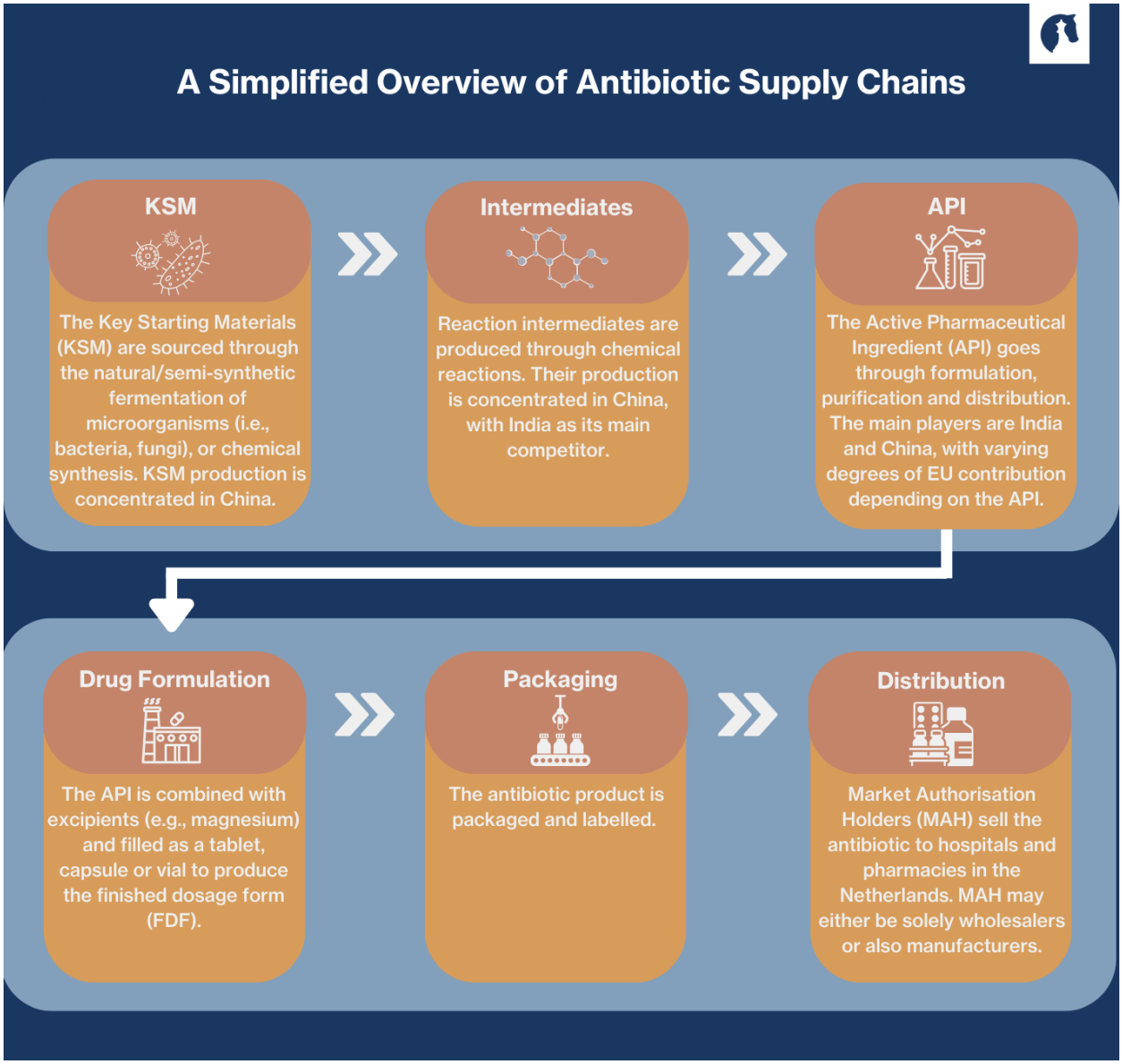

Figure 1: A simplified overview of antibiotic supply chains

China and India's dominance in global supply chains for generic medicines are a result of purposeful industrial policy implemented by the Chinese and Indian governments as well as broader trends of economic globalisation in Europe.[83] Both of these are explained below.

The creation of an independent generic medicines industry in India and China was an integral governmental development goal of both states in the late 20th century.[84] Both countries have strategically attracted pharmaceutical manufacturers and boosted local production capacities. In China, policies to accelerate the growth of this industry include but are not limited to: investments in education programs, the facilitation of Research & Development Parks, the establishment of 'special economic zones' (SEZs), which offer infrastructural benefit such as

[83] Zhang and Bjerke, 'Antibiotics "Dumped"'.
[84] Zhang and Bjerke, 'Antibiotics "Dumped"'.

lower prices for land purchase; discount on energy or water, support with waste disposal, benefits for employees, the exemption from import duties, lower tax rates, and other forms of subsidies.[85]

Especially in view of the low profit margins in the antibiotic market, these subsidies are of crucial importance. In 2021, the Chinese pharma companies Guobang, HEC Pharm and Shanghai Shyndec received subsidies amounting to roughly 3%, 9% and 2% of their annual turnover, respectively.[86] Guobang and HEC Pharm are amongst the major global manufacturers of the azithromycin API (see next section).

In the Netherlands, two factors have led to the reduction of domestic production capacity and its relocation to Asia. First, the labour-intensive and environmentally costly manufacturing process is a major obstacle for companies to operate in Europe in general and in the Netherlands in particular.

Moreover, the costs of compliance with EU social and environmental regulatory requirements for API production are estimated to represent up to 30% of expenditure, which are often not present in other countries.[87] Examples include regulations for environmental and health safety when it comes to chemical testing, waste management regulations for hazardous waste disposal and reduction, and the 2024 Urban Wastewater Directive. Second, the price and procurement policies of countries with high purchasing power at a global level have induced a race to the bottom, driving down antibiotics prices and making it more difficult for companies in Europe to compete on the global market.[88] In the Netherlands, profit margins in the manufacturing and sale of generic antibiotics are chronically thin and opportunity costs high, leading to industrial facilities shutting down or companies withdrawing their products from the market.[89] This is primarily linked to the low prices of antibiotics, controlled by governmental instruments and health insurance companies' practices. A governmentally mandated reimbursement limit incentivizes suppliers to lower prices given that the patient is obliged to pay the difference when a product exceeds the set limit. At the same time, maximum allowable prices are calculated for each medicine, based on the average unit prices of comparable medicines in a group of reference countries. Adding to these two measures, health insurance companies widely deploy a 'preferential policy' for outpatient medicines, whereby only one product within a therapeutic class is reimbursed. This results in a highly competitive tendering process, where suppliers compete for the lowest possible price, making it difficult for companies that did not win the tender to remain active in the market.[90]

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[85] 'China Policies to Promote Local Production of Pharmaceutical Products and Protect Public Health' (World Health Organisation, 2017), 2, https://iris.who.int/bitstream/handle/10665/336684/9789241512176-eng.pdf.
[86] Sébastien Miroudot et al., 'Securing Supply Chains' (Paris: OECD, 23 February 2023), https://doi.org/10.1787/c21c5c9b-en.
[87] Medicines for Europe and European Fine Chemicals Group, 'A Strong European API Industry Can Achieve Strategic Autonomy of the EU Health System', November 2022, 1, https://www.medicinesforeurope.com/wp-content/uploads/2022/11/A-Strong-European-API-Industry-Can-Achieve-Strategic-Autonomy-of-the-EU-Health-System-1.pdf.
[88] Cogan, Deirdre; Karrar, Karrar; Iyer, Jayasree K., 'Shortages, Stockouts and Scarcity' (Access to Medicine Foundation, 2018), https://cdn.who.int/media/docs/default-source/searo/amr/white-paper-antibiotic-shortages-stockouts-and-scarcity-2018.pdf?sfvrsn=b75e416d_2.
[89] Cogan, Deirdre; Karrar, Karrar; Iyer, Jayasree K.
[90] Steven Marinus, 'Price-Control and Availability of Antibiotics: A Balancing Act' (Master Thesis, Utrecht University, 2023), https://studenttheses.uu.nl/handle/20.500.12932/44582.

Box: Chinese perspectives on antibiotics and implications for de-risking in the Netherlands
Since World War II, the Chinese government has viewed the domestic production of pharmaceuticals as an integral part of the nation-building process. Parallel to the economic opening, the government has attracted pharma producers with investments in special economic zones (SEZ) and research and development (R&D) parks, heavy subsidies and high-level university programs. The *Made in China 2025* strategy identifies the pharmaceutical sector as a high-tech industry of geopolitical importance. Moreover, to achieve self-sufficiency in this sector, the *Guidelines for planning the development of the pharmaceutical industry* outline a coordinated approach involving the targeted use of foreign resources. The guide encourages Chinese pharmaceutical companies to use the channels opened by the Belt & Road initiative to attract technology and talent. It also suggests promoting international cooperation in the use of production facilities and recommends mergers and investments to gain access to foreign pharmaceutical technologies. Lastly, the guide commits to maintaining generous subsidies to consolidate China's leading position in pharmaceutical production.

What does this mean for Dutch de-risking? The top-down long-lasting Chinese industrial policy for pharmaceuticals shows that de-risking cannot simply be supported by market forces, as companies are facing fierce state-sponsored competition from China. The most profitable choice for Dutch and European companies seems to be the divestment from Europe and reliance on imported materials given high costs, low profit margins and high barriers to entry in the precursory and generic pharmaceutical industries. As such, to ensure minimal production capacity of antibiotics and ensure resilience in times of (health) crises, the government has a major role to play in restructuring the Dutch market to support the competitiveness of local manufacturing.
Text box sources: Honcharenko (2020); WHO (2017).[91]

3.1.2 Supply chain risks

Key risk factors

Although there has been no known purposeful weaponisation of supply chain dependencies in antibiotic production, existing dependencies feed into three major risks.

First, supply chain dependencies are a systemic driver of medicine shortages. The prevalence of which have increased significantly across Europe.[92] Amoxicillin, which is the most frequently prescribed antibiotic in the Netherlands, has been subject to numerous global shortages.[93] Survey data from hospitals in 36 European countries suggest that more than half of all cases of medicine shortage reported involve antibacterial drugs, with amoxicillin and amoxicillin/clavulanic acid causing "particular alarm".[94] Most recently, the European Medicines

[91] Daria Honcharenko, 'Pharmaceutical Industry Development: Key Policy Instruments in China', 31 July 2020, https://papers.ssrn.com/abstract=3749118. China Policies to Promote Local Production of Pharmaceutical Products and Protect Public Health' (World Health Organisation, 2017), 2, https://iris.who.int/bitstream/handle/10665/336684/9789241512176-eng.pdf
[92] Nenad Miljković et al., 'Results of EAHP's 2018 Survey on Medicines Shortages', *European Journal of Hospital Pharmacy* 26, no. 2 (1 March 2019): 60–65, https://doi.org/10.1136/ejhpharm-2018-001835. Directorate-General for Health and Food Safety et al., 'Future-Proofing Pharmaceutical Legislation: Study on Medicine Shortages : Final Report' (Publications Office of the European Union, 2021), 4, https://data.europa.eu/doi/10.2875/211485.
[93] Matej Mikulic, 'Netherlands: Medicines with the Highest Usage 2023', Statista, 12 September 2024, https://www.statista.com/statistics/708125/leading-medicines-with-the-highest-usage-in-the-netherlands/.
[94] Robert Cohen et al., 'The Shortage of Amoxicillin: An Escalating Public Health Crisis in Pediatrics Faced by Several Western Countries', *The Journal of Pediatrics* 257 (1 June 2023): 1, https://doi.org/10.1016/j.jpeds.2023.01.001.

Agency (EMA) noted a long-lasting shortage of amoxicillin starting in October 2022.[95] Shortages in the Netherlands in 2024 mainly concerned amoxicillin in liquid form, typically used for the treatment of children.[96] Fragile supply chains, stemming from the dependencies on China and India in the primary manufacturing steps, are a major structural factor behind such shortages.[97]

Second, external shocks can impact the availability of antibiotics in the short term, as the case of Covid-19 illustrated. Especially in the initial phase of the pandemic, the demand for medicines for intensive care, including antibiotics, experienced a surge. Simultaneously, lockdowns affected transport and logistics processes, disrupting international trade.[98] In the Chinese region of Hubei, for instance, the spread of the virus in 2020 temporarily halted production, causing bottlenecks in the production of major pharmaceutical precursors.[99] Moreover, a wide range of countries enacted export rules for critical medical goods during the pandemic. In March 2020, India imposed restrictions on the export of erythromycin salts (relevant for the azithromycin production),[100] while the UK prohibited the export of amoxicillin.[101] Overall, a total of 17 countries restricted the export of azithromycin during the second quarter of 2020.[102]

Third, trade disputes between China and India concerning antibiotic products could impact the EU's access to medicine due to dependencies on both countries. Though their pharmaceutical sectors are closely intertwined, competition for the pole position in the global production has been stiff.[103] India regularly accuses China of unlawful dumping practices, which have contributed to India's dependence on China for precursors and intermediates. As part of the resulting disputes, India even interrupted imports of penicillin G, the major precursor for amoxicillin, in 2004. Trade complaints have also concerned the intermediate (2011) and the active substance (2021) used for the production of amoxicillin.[104]

In view of these risk factors, the supply chains of the three antibiotics are analysed below.

[95] European Medicines Agency (EMA), 'Shortage of Amoxicillin and Amoxicillin/Clavulanic Acid', 2 September 2024, https://www.ema.europa.eu/en/documents/shortage/amoxicillin-amoxicillin-clavulanic-acid-supply-shortage_en.pdf.
[96] Pia Dijkstra, 'Netherlands Still Struggling with Shortage of Antibiotics for Children', *NL Times*, 13 March 2024, https://nltimes.nl/2024/03/13/netherlands-still-struggling-shortage-antibiotics-children.
[97] See Nusrat Shafiq et al., 'Shortage of Essential Antimicrobials: A Major Challenge to Global Health Security', *BMJ Global Health* 6, no. 11 (1 November 2021): e006961, https://doi.org/10.1136/bmjgh-2021-006961., Cogan, Deirdre; Karrar, Karrar; Iyer, Jayasree K., 'Shortages, Stockouts and Scarcity'. and Mingyuan Zhang, 'In Shortage: Understanding Global Antibiotic Supply Chains Through Pharmaceutical Trade Fairs', *Anthropologica* 65, no. 1 (2023): 1–16, https://doi.org/10.18357/anthropologica65120232605.
[98] Chapman, Dedet, and Lopert, 'Shortages of Medicines in OECD Countries'.
[99] Hosseini, Morris, Supply bottlenecks for antibiotics due to corona pandemic: crisis with announcement, Roland Berger, 2020, https://www.rolandberger.com/en/Insights/Publications/Supply-bottlenecks-for-antibiotics-due-to-corona-pandemic-crisis-with.html.
[100] India Ministry of Commerce & Industry, 'Notification No. 50 / 2015-2020, New Delhi Dated 3 March 2020, Amendment in Export Policy of APIs', n.d., https://www.macmap.org/OfflineDocument/Covid19/COVID_IND_2.pdf.
[101] Directorate-General for Health and Food Safety et al., 'Future-Proofing Pharmaceutical Legislation'.
[102] Miroudot et al., 'Securing Supply Chains'.
[103] Jerin Jose Cherian et al., 'India's Road to Independence in Manufacturing Active Pharmaceutical Ingredients: Focus on Essential Medicines', *Economies* 9, no. 2 (June 2021): 71, https://doi.org/10.3390/economies9020071.
[104] Zhang and Bjerke, 'Antibiotics "Dumped"'.

Amoxicillin/Clavulanic Acid

Discovered and developed in the 1960s and early 1970s, the broad-spectrum antibiotic amoxicillin is one of the most used anti-bacterial drugs in the world.[105] Amoxicillin has been shown to be effective against a variety of infections and diseases like infections of the middle ear, the throat, bronchitis, pneumonia and urinary tract and skin infections.[106] The addition of clavulanic acid makes amoxicillin effective against several bacterial strains possessing antibiotic resistance, enhancing the anti-bacterial spectrum of amoxicillin.[107] As the primary manufacturing steps of amoxicillin and amoxicillin/clavulanic acid are very similar as they rely on the same anti-bacterial agent, their supply chains will be analysed jointly, as shown in **Figure 2**.

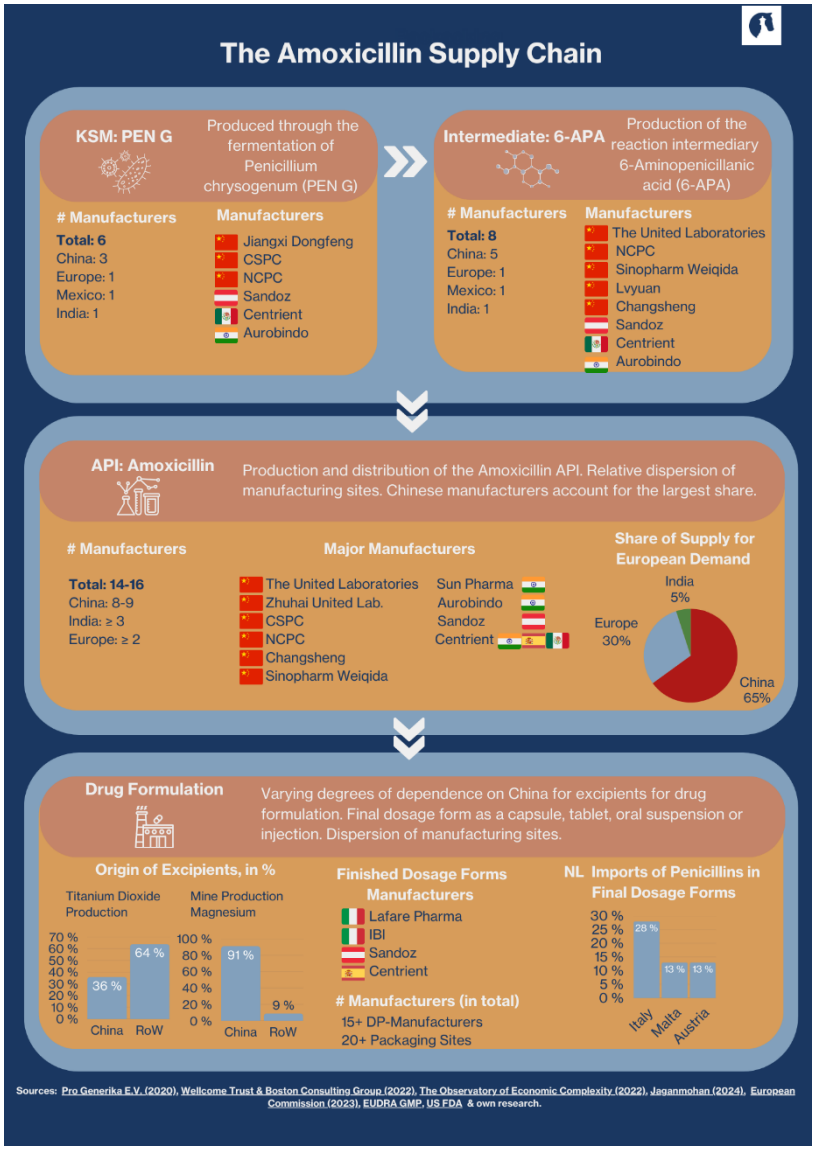

Figure 2: The amoxicillin supply chain

[105] Paddy S Gibson and Jan-Willem Veening, 'Gaps in the Wall: Understanding Cell Wall Biology to Tackle Amoxicillin Resistance in *Streptococcus Pneumoniae*', *Current Opinion in Microbiology* 72 (1 April 2023): 102261, https://doi.org/10.1016/j.mib.2022.102261.
[106] Simar Preet Kaur, Rekha Rao, and Sanju Nanda, 'Amoxicillin: A Broad Spectrum Antibiotic', *International Journal of Pharmacy and Pharmaceutical Sciences* 3, no. 3 (2011): 30–37.
[107] Alasdair M. Geddes, Keith P. Klugman, and George N. Rolinson, 'Introduction: Historical Perspective and Development of Amoxicillin/Clavulanate', *International Journal of Antimicrobial Agents*, Augmentin Supplement, 30 (1 December 2007): 109–12, https://doi.org/10.1016/j.ijantimicag.2007.07.015.

Dependencies on China in the supply chain of amoxicillin are particularly significant in the production of the intermediate 6-Aminopenicillanic Acid (6-APA) and its major precursor Penicillin G (PEN G). The manufacturing of the latter is nearly exclusively clustered in China and undertaken by a handful of companies. Studies link the low number of PEN G manufacturers to the global penicillin shortage since 2015.[108]

The supply base is becoming more diversified as the Indian pharma company Aurobindo opened a new PEN G and 6-APA plant in 2024.[109] Previously, China had accounted for 100% of India's 6-APA imports.[110] Outside of Asia, the only major producers of the key starting material and intermediate for amoxicillin are the European companies Sandoz and Centrient. While Centrient produces in Mexico, Sandoz owns the last production facility of 6-APA in Europe. Located in Kundl, Austria, the site takes up a vital role for Europe's strategic autonomy in pharmaceutical supplies. Therefore, the Austrian government supports the modernisation efforts of Sandoz with state grants amounting to EUR 28 million.[111]

Meanwhile, the production of the amoxicillin API is characterised by a larger number of relatively dispersed manufacturers. While China accounts for two thirds of the amoxicillin API supply to the EU, 30% is produced within Europe, suggesting a moderate supply risk.[112] The European share could further increase due to the expected expansion of the production capacities of Sandoz in Kundl.

Finally, while drug formulation sites may be spread across the globe, excipients must still often be imported from China. In the case of amoxicillin, the formulation may involve the usage of excipients such as magnesium (classified as critical raw material by the EU), titanium (usually in the form of titanium dioxide) and iron.[113] In 2023, China accounted for 91% of the global mine production of magnesium and 97% of all EU magnesium imports.[114]

Azithromycin

Azithromycin is a broad-spectrum antibiotic of the macrolides class. Its areas of application include the treatment of respiratory, urogenital and dermal infections, and azithromycin is often prescribed to treat sexually transmitted diseases.[115] Due to temporary hopes that azithromycin

[108] Shafiq et al., 'Shortage of Essential Antimicrobials'.
[109] Swati Bharadwaj, 'Aurobindo Pharma Commissions Pen-G Facility, Three Other Plants', *The Times of India*, 2 April 2024, https://timesofindia.indiatimes.com/city/hyderabad/aurobindo-pharma-commissions-pen-g-facility-three-other-plants/articleshow/108956116.cms.
[110] Cherian et al., 'India's Road to Independence in Manufacturing Active Pharmaceutical Ingredients'.
[111] Official Journal of the European Union, 'Authorisation for State Aid Pursuant to Articles 107 and 108 of the Treaty on the Functioning of the European Union – Cases Where the Commission Raises No Objections – SA.62915', 28 October 2024, https://eur-lex.europa.eu/eli/C/2024/6477/oj. European Commission, 'State Aid SA.62915 (2022/N) – Austria – Aid for Maintaining Sandoz Penicillin Production in Kundl (Tyrol)', 27 July 2023, https://ec.europa.eu/competition/state_aid/cases1/202428/SA_62915_87.pdf.
[112] Pro Generika E.V., 'Where Do Our Active Pharmaceutical Ingredients Come From? – A World Map of API Production', accessed 25 September 2024, https://progenerika.de/app/uploads/2020/11/API-Study_long-version_EN.pdf.
[113] United Nations Economic Commission for Europe (UNECE), 'Securing Critical Raw Materials Supply Is Key to the Response to COVID-19', 16 April 2020, https://unece.org/media/press/1490.
[114] Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (European Commission), Milan Grohol, and Constanze Veeh, 'Study on the Critical Raw Materials for the EU 2023: Final Report' (Publications Office of the European Union, 2023), https://data.europa.eu/doi/10.2873/725585.
[115] Michael J. Parnham et al., 'Azithromycin: Mechanisms of Action and Their Relevance for Clinical Applications', *Pharmacology & Therapeutics* 143, no. 2 (1 August 2014): 225–45, https://doi.org/10.1016/j.pharmthera.2014.03.003.

could also be used in the treatment of Covid, the macrolide experienced an abrupt spike in demand in Spring 2020.[116] Recently, persistent supply chain issues and rising demand have increased global azithromycin prices and induced shortages.[117]

The supply chain of azithromycin follows a structure similar to amoxicillin (**Figure 3**). The manufacturing of the major precursor erythromycin is dominated by China-based companies. Despite the existence of active manufacturers outside of China, a study by OECD notes that "only China currently has the capacity to produce erythromycin on a large scale".[118] This is reflected in trade statistics, according to which China accounted for 78% of Indian Erythromycin imports in 2017.[119]

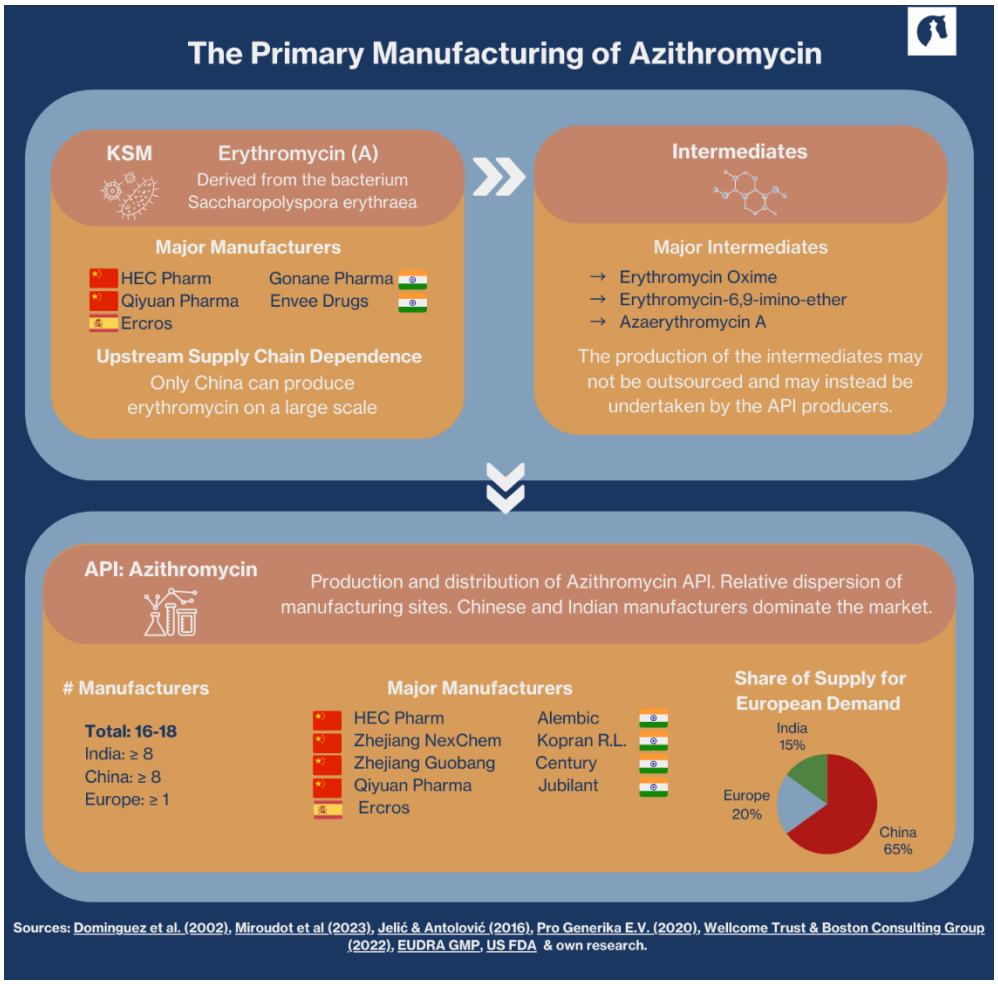

Figure 3: The primary manufacturing of azithromycin

While the data suggests that there is no substantial risk resulting from an insufficient number of azithromycin producers, the existing supply chain remains fragile. The geographical

[116] Daniel Martingano et al., 'Clarithromycin Use for Adjunct Surgical Prophylaxis before Non-Elective Cesarean Deliveries to Adapt to Azithromycin Shortages in COVID-19 Pandemic', *PLOS ONE* 15, no. 12 (21 December 2020): e0244266, https://doi.org/10.1371/journal.pone.0244266.
[117] Tomethee Greene, 'Global Azithromycin Prices Set to Climb in October Amid Rising Demand and Supply Chain Challenges', *ChemAnalyst*, 16 October 2024, https://www.chemanalyst.com/NewsAndDeals/NewsDetails/azithromycin-prices-set-to-climb-in-october-amid-rising-demand-and-supply-chain-30791.
[118] Miroudot et al., 'Securing Supply Chains'.
[119] Cherian et al., 'India's Road to Independence in Manufacturing Active Pharmaceutical Ingredients'.

concentration of API producers in China and India and the global dependence on Chinese erythromycin indicate that the supply chain is vulnerable to geopolitical shocks. In this context, the API import dependence ratio of 80% highlights that Europe lacks autonomy in the production of azithromycin.[120] The Spain-based Ercros is the only European company that plays a major role throughout the entire primary manufacturing process.

Cotrimoxazole

Cotrimoxazole is a broad-spectrum combination antibiotic consisting of trimethoprim (TMP) and sulfamethoxazole (SMX). It is widely used as a preventive therapy of HIV-related infections and it is effective against chronic bronchitis, pneumonitis and urinary tract infections.[121] Since the start of the amoxicillin shortage in October 2022, a cascade effect resulting from the forced substitution of substances has increased the shortage notifications for cotrimoxazole in Europe.[122]

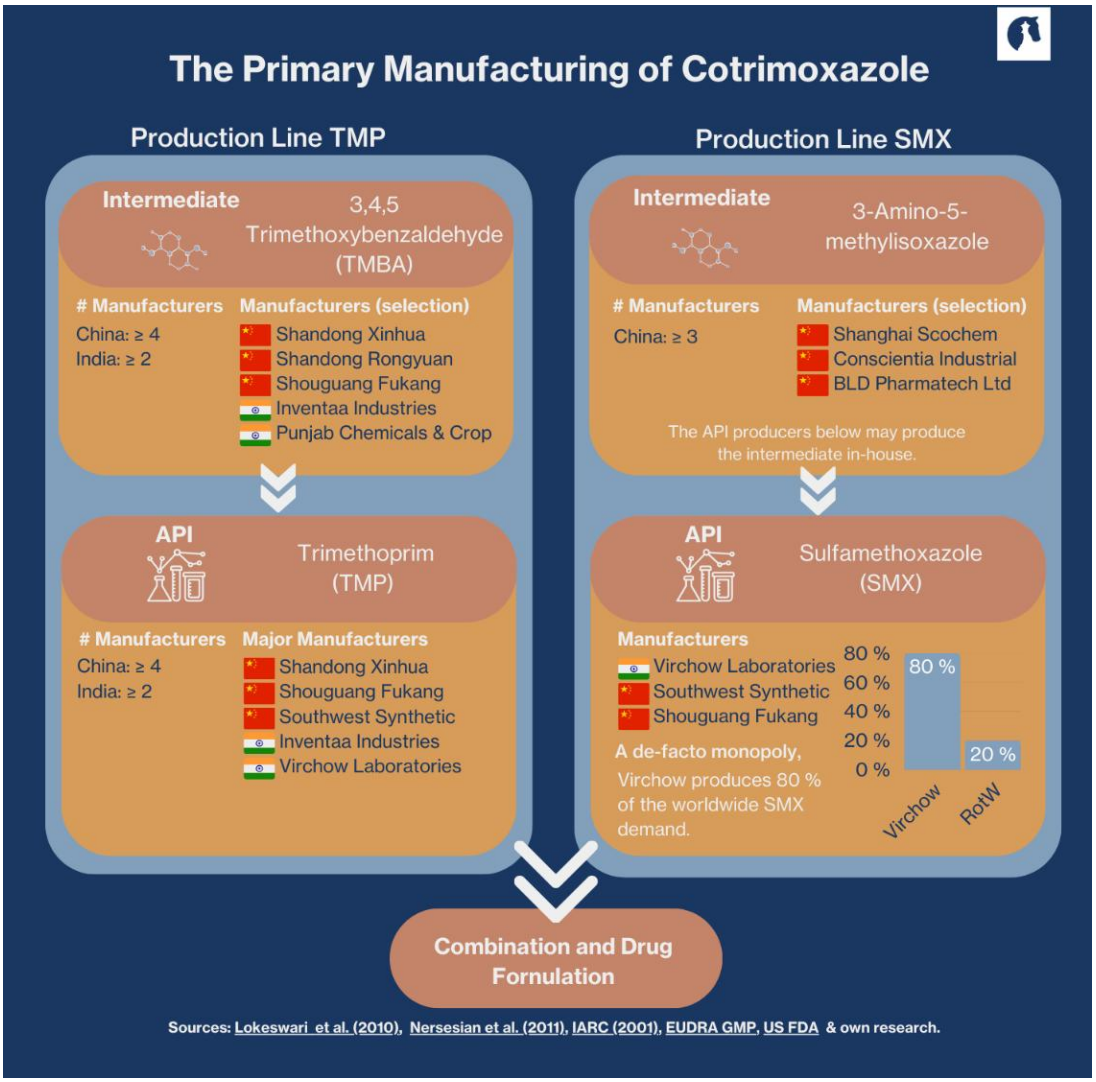

Figure 4: The primary manufacturing of cotrimoxazole

[120] Pro Generika E.V., 'Where Do Our Active Pharmaceutical Ingredients Come From? – A World Map of API Producton'.
[121] National Center for Biotechnology Information, 'PubChem Compound Summary for CID 358641, Sulfamethoxazole; Trimethoprim', 2024, https://pubchem.ncbi.nlm.nih.gov/compound/358641.
[122] European Public Health Alliance, 'Joint Letter: The Shortage of Antibiotics Should Be Considered a "major Event"', 25 January 2023, https://epha.org/joint-letter-the-shortage-of-antibiotics-should-be-considered-a-major-event/.

Despite data availability issues for the cotrimoxazole supply chain, several observations on the concentration of its production can be drawn (**Figure 4**). The production of the major TMP intermediate is clustered in India and China and carried out by only a few companies. The same holds for the intermediate production of SMX. Concerning the API production, at least six active TMP producers exist globally. These are evenly dispersed between China and India. Contrarily, China does not play a substantial role in the production of SMX, where the Indian company Virchow Laboratories holds a de-facto monopoly. As estimated in 2011, Virchow satisfies around 80% of the global SMX demand.[123]

The supply chains of TMP and particularly SMX, which only has one producer, are vulnerable to disruptions mainly due to the low number of active producers.

3.1.3 Realising de-risking

To mitigate the risks arising from the Netherlands' antibiotics import dependency, interventions should aim to (1) address structural market dynamics, covered by the first three interventions; and (2) increase the resilience of existing supply chains through increased insights and stress testing, as proposed by the fourth intervention. There is a wide range of available public and private policy tools to work towards this goal based on the taxonomy in chapter 2 and shown in **Table 8** below. Some of them are already under discussion in the European Commission as well as the Dutch government, but they either have not yet been implemented or their implementation has not yielded the desired results according to the interviews conducted for this study. The EU's 2025 Critical Medicines Act could provide the necessary support to implement these interventions in the Netherlands. The full assessment of each intervention is included in Annex 2.

Table 8: Proposed interventions to de-risk antibiotic supply chains in the Netherlands and their evaluation

Intervention	Actor	Effort		Effectiveness			Effort x Effectiveness
		Cost	Time	Contribution to de-risking	Ability to sustain long-term	Ability to mitigate associated risks	
1. Priority sectors in Europe *Develop sector-specific industrial policy to enhance the competitiveness of priority sectors and increase global market share, including the implementation of financial aid, permitting and administrative reform, and other necessary conditions.*	European Commission & Dutch government	**High**	**High**	**High**	**Medium**	**High**	High investment, high reward
2. Direct subsidies *Provide direct subsidies, e.g., through state aid, boosting the production*	European Commission & Dutch government	**High**	**Low**	**High**	**Low**	**Medium**	Moderate gains

[123] Paula Nersesian, Andrew Fullem, and Melissa Sharer, 'Co-Trimoxazole Management and Availability: Logistics and Supply Chain Experience in 15 U.S. President's Emergency Plan for AIDS Relief Countries.' (Arlington, VA: AIDS Support and Technical Assistance Resources (AIDSTAR-One), 2011), https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=11324&lid=3.

capacities within the EU and the NL to enhance autonomy.							
3. Procurement requirements *Require insurance companies to incorporate criteria other than price into tendering process to improve resilience, i.e. parallel sourcing or sourcing from European suppliers.*	Dutch government	**Medium**	**Medium**	**High**	**High**	**Medium**	Low hanging fruit
4. Supply chain monitoring, stress testing and contingency planning *Monitor supply chain risks, conduct stress tests and develop contingency plans with suppliers along the supply chain to increase resilience to potential disruptions.*	Dutch industry	**Medium**	**Medium**	**Medium**	**High**	**Medium**	Low hanging fruit

Priority sectors in Europe and **direct subsidies** play a crucial role in addressing market challenges**.** The market structure for antibiotics is characterized by low margins and high opportunity costs. This is one of the major root causes of existing overdependencies (see above). To facilitate de-risking in the long-run, strengthening the domestic industrial base should be a priority. As various reports and expert interviews confirm, the Netherlands possesses the relevant technical know-how and skilled labour force to enhance the production of primary manufacturing stages. The most strategic of these would be API given that it can be used directly by the existing industry in the second manufacturing stages.[124] Producing KSM or intermediates without API capacities would mean that these primary products will be sent to China or India to be transformed into API before being sent back for the secondary steps, thus not being an effective de-risking measure to reduce unwanted dependencies.

While the intervention will require significant financial, time and human resources, it is also likely the most effective intervention. The industry is also generally willing to invest into the local production of APIs and medicines in Europe. However, this is only under the precondition of addressing administrative and regulatory issues that hamper industrial competitiveness. In addition to direct subsidies, state support could also be provided through the creation of 'Special Economic Zones', with designated areas offering infrastructural benefits, tax incentives or other direct subsidies to attract manufacturers.

A **reform of the procurement system** emerges from interviews as a widely supported policy option.[125] Through the incorporation of criteria other than price into the tendering process, such as environmental or social factors, a 'race to the bottom' can be prevented and resilient supply

[124] European Parliament: Directorate-General for Internal Policies of the Union (European Parliament) et al., *Potential Measures to Facilitate the Productions of Active Pharmaceutical Ingredients (APIs)* (European Parliament, 2023), https://data.europa.eu/doi/10.2861/27104.
[125] Enrico Baraldi and Sofia Wagrell, 'Policy Options for Nordic Collaboration to Improve Access to Antibiotics', Report Commissioned by the Public Health Agency of Sweden (Uppsala University, 17 June 2024), https://uu.diva-portal.org/smash/get/diva2:1871987/FULLTEXT01.pdf.

chains rewarded. This is to some degree already practiced, e.g. in Norway[126], though their public procurement approach differs from the privatised system in the Netherlands. While the reform of procurement systems is likely to increase the price of antibiotics, this increase can prove crucial to enhance supply chain resilience. Thus, policymakers must carefully balance the trade-off between the affordability and availability of critical medicines.

Finally, enhancing **supply chain risk monitoring and contingency planning** is crucial. While the effort initially required is relatively high, as starting such an effort from scratch is time intensive, maintaining the system once it is in place is less difficult. At the same time, the fully privatised healthcare system means that companies have quite a good overview of their supply chains compared to other sectors, so the required time is less than in the case of drones. Such an intervention is likely to yield valuable results when done in a public-private setting, as it not only creates a shared understanding of issues but also encourages joint problem-solving. A good example is Swedish platform PLATINEA, which regularly conducts needs inventories and studies on selected antibiotics to inform healthcare authorities.[127] At the same time, the European Health Emergency Preparedness and Response Authority's (HERA) 'Critical Medicines List' introduces additional requirements for medicines, such as mandatory contingency plans and enhanced stockpiling obligations for APIs.[128] However, in absence of measures that support market reform (see below), industry is ringing alarm bells that these measures may unintendedly lead to more market withdrawals. As such, public-private dialogue is essential in the development of effective interventions.

3.2 Drones

Key takeaways: How can drone supply chains be de-risked?
Dependencies on China run deep along the entire supply chain of both military and civil UAVs. While military drones used by Dutch armed forces are mainly sourced from Western countries, these platforms still make use of materials and components coming from China. For civil drones, the dependence is even more significant, with the Netherlands importing most of these platforms directly from China. To secure the drones' supply chain it is hence vital to take a comprehensive approach to de-risking, which includes boosting domestic production while tackling existing vulnerabilities. This requires enhanced supply chain mapping, supplier diversification, and stockpiling of essential materials and components. Additionally, fostering domestic production through R&D investments, subsidies, and industrial policies will be vital for long-term resilience.

Unmanned aircraft or aerial vehicles (UAV), remotely piloted aircraft systems (RPAS) and unmanned aircraft systems (UAS) are all ways to refer to what are commonly known as drones. These are aircrafts that have no human operator onboard, use aerodynamic forces to provide

[126] Baraldi and Wagrell.
[127] 'Platinea - About Us', Platinea, 4 March 2024, https://www.platinea.se/w/pl/en/about-us.
[128] European Commission, Directorate-General for Health and Food Safety, 'Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL Laying down Union Procedures for the Authorisation and Supervision of Medicinal Products for Human Use and Establishing Rules Governing the European Medicines Agency, Amending Regulation (EC) No 1394/2007 and Regulation (EU) No 536/2014 and Repealing Regulation (EC) No 726/2004, Regulation (EC) No 141/2000 and Regulation (EC) No 1901/2006', 26 April 2023, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52023PC0193.

vehicle lift and can either be expendable or recoverable.[129] While this technology has been in use for decades, recent technological advancements have made it an increasingly fundamental asset for warfighting capabilities. In the past twenty years, drones have become a crucial tool for militaries globally, performing roles that range from targeting insurgents in war zones to providing surveillance support for disaster relief efforts. Beyond military use, the civilian industry has also adopted drone technology for tasks like capturing aerial images, monitoring crops, and inspecting infrastructure.[130] Many drones today are considered dual-use, meaning they can perform both military and civilian/commercial functions.

This case study focuses on drones (UAVs) in the military domain, including both high-end military drones and dual-use (civilian) technologies. Drones are a priority domain for the Netherlands, and the Ministry of Defence is looking at ways to position the Netherlands as a key player in the emerging European supply chains for military and dual-use drones. Military and civilian technologies have overlapping supply chains, which also determines the type of interventions that public and private actors need to consider in order to increase open strategic autonomy. The case study will investigate the types of interventions that the Dutch ministries as well as the EU can take to support the development and de-risk this vital industry.

3.2.1 Understanding the drone sector

Drones come in different shapes and sizes, ranging from insect-sized ones weighing several tons and serving a variety of civil, military, and dual-use applications. Civil and military drones differ from one another in several technical aspects. Civil drones are usually smaller, with rotary wings and payload capacities rarely exceeding a few kilograms, and operate at altitudes below 500 feet. Military drones, on the other hand, are often fixed wing vehicles that weigh over 150 kilograms and are equipped with sophisticated command-and-control systems enabling operations at altitudes up to 65,000 feet.[131] **Table 9** below summarizes the technical differences between civil and military drones.

Table 9: Technical differences between civil and military drones

Characteristics	Civil	Military
Size & weight	• Small to medium sized drones of <150 kg	• Medium to large drones of >150 kg
Wing-type	• Rotary wing or fixed wing with wing spans of > 50 cm and < 2 m	• Fixed wing with wing spans ≥5 m
Altitude	• Altitude of maximum 500 feet	• Medium Altitude Long Endurance (MALE): altitudes of ≤ 45,000 feet (13,7 km) • High Altitude Long Endurance (HALE): altitude of ≤ 65,000 feet (19,8 km)

[129] Bobba et al., 'Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study' (Luxembourg: European Commission, 2020), 47.
[130] Harry Du, 'Is China at the Forefront of Drone Technology?', *ChinaPower Project* (blog), 29 May 2018, https://chinapower.csis.org/china-drones-unmanned-technology/.
[131] M. Hassanalian and A. Abdelkefi, 'Classifications, Applications, and Design Challenges of Drones: A Review', *Progress in Aerospace Sciences* 91 (1 May 2017): 99–131, https://doi.org/10.1016/j.paerosci.2017.04.003. Tania Lațici, 'Civil and Military Drones: Navigating a Disruptive and Dynamic Technological Ecosystem' (European Parliamentary Research Service, October 2019), https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2019)642230; Paul van Hooft and Lotjie Boswinkel, 'Surviving the Deadly Skies: Integrated Air and Missile Defence 2021-2035' (The Hague Centre for Strategic Stuides, 1 December 2021), https://hcss.nl/report/surviving-the-deadly-skies/.

Power source, range and flight endurance	• Fly at close to short range: 10 km≤R≤250 km • Close range (50km) lasts 1-6 hours • Use lithium batteries	• Fly at short, mid- and long range: 70 km≤R≤1500 km • Short range (up to 150km) lasts 8-12 hours • Mid-range and long-range (600km or more) last at least 24 hours • Fuel powered
Type of payload	• Light payloads up to 2kg	• Designed to carry weapons or IRS equipment, can carry heavy payloads of more than 1000 kgs
Take-off	• Catapult or hand-launched	• Catapult, hand-launched, and the heavier ones require a runway

Civil and military drones are also used to different ends. Civil drones primarily serve sectors like agriculture, hobby videomaking, manufacturing, and logistics. These systems are typically lightweight, battery-powered, and designed for short-range, low-altitude operations. In contrast, military drones are purpose-built for demanding environments, with capabilities such as long-endurance flight, advanced surveillance, and payload delivery.[132]

Some drones can however have both civil and military applications, and they are thus named dual-use. These UAVs straddle the two categories, employing civil platforms for military-grade performance, for instance for intelligence, surveillance, and reconnaissance (ISR) purposes, as summarized **Figure 5**. Dual-use drones, while leveraging commercial manufacturing efficiencies, incorporate military-specific enhancements such as anti-jamming devices, GPS systems, and hardened airframes.[133] The war in Ukraine has shown how smaller, civil drones can be used on the battlefield to enhance battlespace awareness and transparency, as well as offer cost-effective options to strike fixed targets.[134] The growing use of civil drones for military purposes (dual-use) makes them an important asset for defence ministries, which increasingly include such assets in their arsenals.

[132] Tania Latici, 'Civil and Military Drones' (European Parliamentary Research Service, October 2019); S. Bobba et al., 'Critical Raw Materials in Technologies and Sectors: A Foresight Study' (European Commission, 2020).
[133] Latici, 'Civil and Military Drones'; Bobba et al., 'Critical Raw Materials in Technologies and Sectors: A Foresight Study'.
[134] Kristen D. Thompson, 'How the Drone War in Ukraine Is Transforming Conflict | Council on Foreign Relations' (Council on Foreign Relations, 16 January 2024), https://www.cfr.org/article/how-drone-war-ukraine-transforming-conflict.

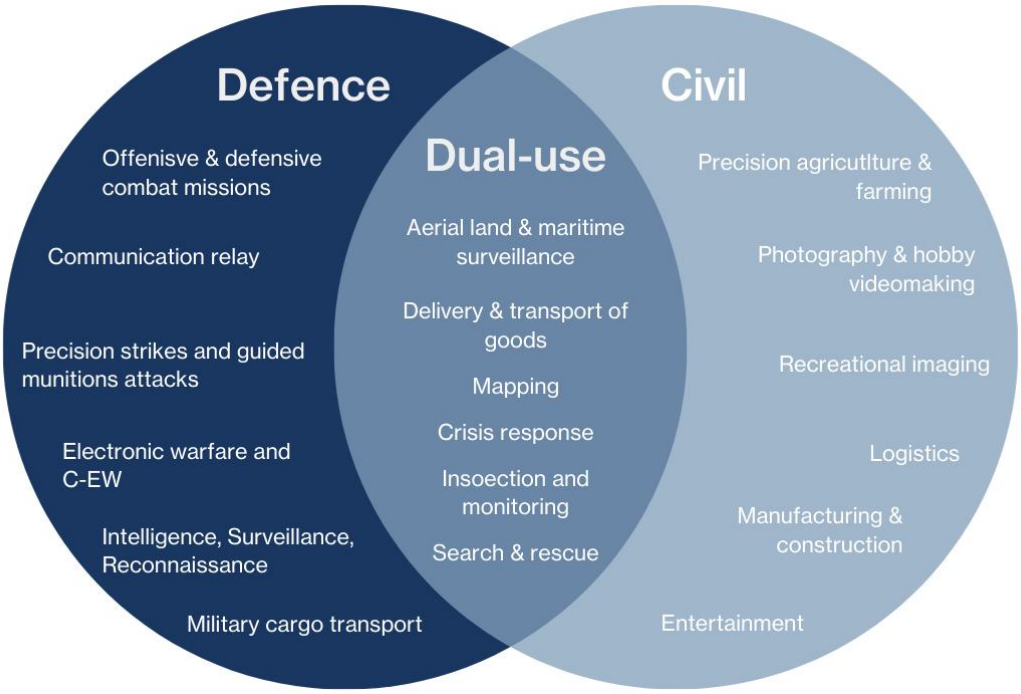

Figure 5: Employment differences between civil and military drones

Despite differences in technical aspects and employment, there is "significant overlap between the supply chains of UAVs for civil and military applications".[135] The supply chain of both civil and military drones entails five main steps: (1) raw materials; (2) processed materials; (3) components; (4) assemblies; and (5) super-assemblies.[136] **Figure 6** below summarizes and simplifies the elements composing the five stages of the supply chains of drones (see Annex 3 for the complete breakdown).

Upstream, at the level of raw and processed materials, the similarities between the two types of drones are more evident.[137] Both types of drone make use of around 50 raw materials, 34 of which are deemed critical for the EU, including gallium, germanium, cobalt, lithium, hafnium, and silicon.[138] These materials are then refined and processed into the second stage of the supply chain. Downstream, from the third step onwards, supply chains vary considerably between military and civil applications.[139] The supply chain of military drones is more heavily reliant on high-performance components such as stealth technologies and advanced electronic systems. Moreover, large UAV capabilities are also more advanced, including carrying heavier payloads,

[135] Darina Blagoeva, 'Material Dependenices for Dual Use Technologies Relevant to Europe's Defence Sector' (European Commission Joint Research Centre, 2019), 56.
[136] Samuel Carrara et al., 'Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study' (JRC, European Commission, 16 March 2023), https://doi.org/10.2760/386650.
[137] Darina Blagoeva, 'Material Dependenices for Dual Use Technologies Relevant to Europe's Defence Sector' (European Commission Joint Research Centre, 2019); Bobba et al., 'Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study'; Samuel Carrara et al., 'Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study.'
[138] Carrara et al., 'Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study', 16 March 2023.
[139] Blagoeva, 'Material Dependenices for Dual Use Technologies Relevant to Europe's Defence Sector', 56.

ISR capabilities, combat, or logistics, and employ degrees of autonomous software, and thus require increasingly sophisticated components and assemblies.[140]

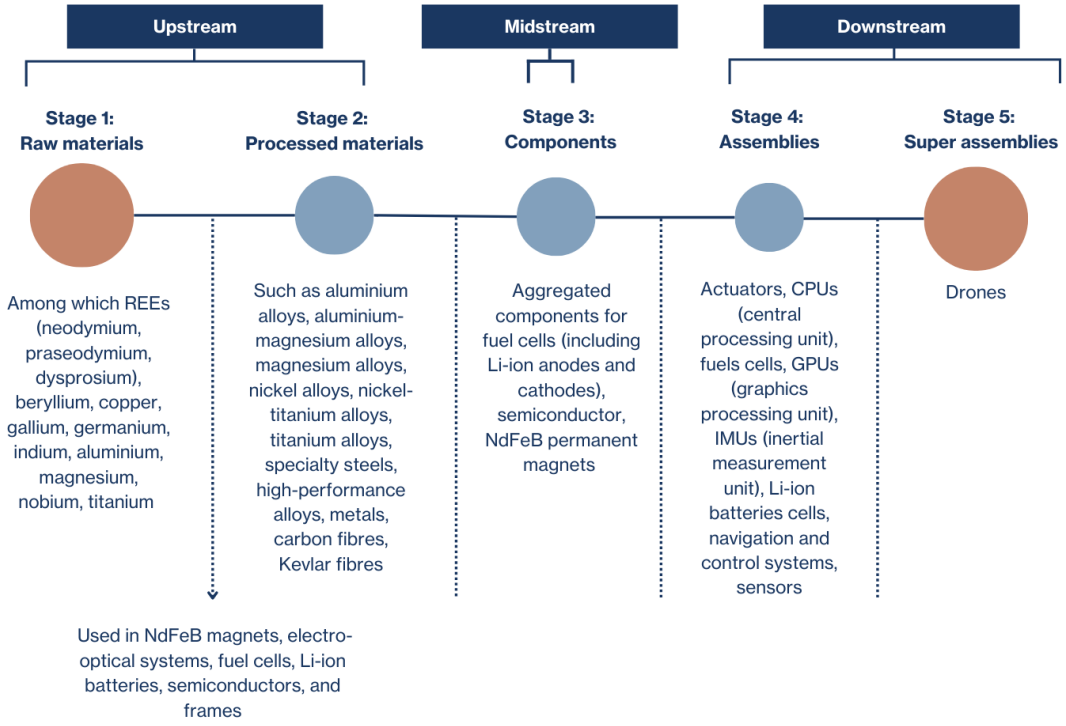

Figure 6: Simplified breakdown of drone supply chains

3.2.2 Supply chain risks

When it comes to the supply chain of drones used by the Dutch armed forces, the supply risks vary between military and civil drones adapted for dual-use.

As mentioned in the previous section, both military and civil drones make use of a handful of raw and processed materials, for which dependence on China is considerable. For instance, rare earth elements (REEs), such as neodymium, are a critical upstream component for drones. These elements are used in permanent magnets for motors and sensors, and China's near-monopoly in REEs production exposes the drones' supply chain to disruptions. Beijing is also a leader in the processing of materials indispensable to drones, such as ferroniobium, Pt-Ru alloys, and several processed materials for lithium-ion (li-ion) batteries.[141] In 2023, 50% of raw materials relevant for UAVs were supplied by China, and 34% of processed ones.[142] Both military and civil drones used in the Netherlands also depend on China for many of their components. China dominates the production of NdFeB permanent magnets, which are indispensable for the functioning of drones' motors. The production of semiconductors, which are essential for drones' navigation and

[140] Blagoeva, 56.
[141] Carrara et al., 'Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study', 16 March 2023.
[142] Carrara et al., 124.

communication systems, also remains concentrated in a few places, many of which are linked to China.[143]

Box: Chinese perspectives on military self-sufficiency and implications for de-risking in the Netherlands

Reducing the dependence on foreign supply to achieve self-sufficiency for the military sector remains a geopolitical priority for China. That is reflected in the *Military-Civil Fusion (MCF) Strategy*, developed in 2017 following the establishment of the *Central Commission for Integrated Military and Civilian Development* . At its core, the strategy blurs the line between civilian innovations and military modernisation. The aim is to exploit the dual-use potential of cutting-edge technologies such as AI, quantum, big data, semiconductors or aerospace to achieve global economic and military leadership by mid-century. As Can and Vieira (2022) summarise, this requires nothing less than the "full integration of the civilian industrial base into the People's Liberation Army's (PLA) supply chain". Drones, and in particular the dual-use potential of civil ones, are an integral part of China's strategy for military self-sufficiency. Drones are seen as an instrument to bolster China's military flexibility and adaptability while enhancing its surveillance, reconnaissance, and strike capabilities. China's dominance in the production of critical materials and components like rare earth elements, semiconductors, and li-ion batteries underpins its ability to manufacture advanced drones domestically. Beijing's continuous investment in domestic production capabilities for both military and commercial drones reduce its reliance on foreign suppliers and secures the country's strategic autonomy. At the same time, the Chinese government views these investments as facilitating rapid technological advancements and cost efficiencies, reinforcing its position in asymmetric warfare.

What does this mean for Dutch and European de-risking? China's prominent role in the drones supply chain considerably exposes Dutch and European procurement to risks of economic coercion and supply disruptions. To overcome this, the Netherlands must prioritize diversifying suppliers, boosting domestic production, and improving supply chain transparency. Focusing on reducing reliance on Chinese materials, components, and platforms is crucial. Ultimately, de-risking requires a concerted effort involving government, industry, and European partners to build a resilient domestic ecosystem.

Text box sources: **Can & Vieira (2022); Bitzinger (2021); Central Committee of the Chinese Communist Party (2020)[144]**

At the assembly level, 75% of li-ion battery cells and 66% of fuel cells used to power drones are supplied by China.[145] Several foreign manufacturers of assemblies are also present in China, contributing to the exposure of supply chains to dependence-related risks. For example, American company Honeywell Aerospace Technologies manufactures the Honeywell TPE331-10 Turboprop engine, a type of engine used in the MQ-9 Reaper, a drone used by the Dutch armed forces. Honeywell has two factories in Tianjin, China that manufacture this specific engine.[146]

[143] Carrara et al., 'Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study', 16 March 2023.

[144] Can, Muhammed, and Alena Vieira. 'The Chinese Military-Civil Fusion Strategy: A State Action Theory Perspective'. *The International Spectator* 57, no. 3 (3 July 2022): 85–102. https://doi.org/10.1080/03932729.2022.2080262.; Bitzinger, Richard A. 'China's Shift from Civil-Military Integration to Military-Civil Fusion'. *Asia Policy* 16, no. 1 (2021): 5–24. ; Central Committee of the Chinese Communist Party. 'Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035'. Center for Security and Emerging Technology, 2020. https://cset.georgetown.edu/wp-content/uploads/t0284_14th_Five_Year_Plan_EN.pdf.

[145] Margaret Mann, Vicky Putsche, and Benjamin Shrager, 'Grid Energy Storage: Supply Chain Deep Dive Assessment', 24 February 2022.

[146] 'Engines Manufacted by Honeywell in China', honeywell.com.cn, accessed 23 July 2024, https://www.honeywell.com.cn/cn/zh/aero/learn/products/engines.

The largest difference between military and civil drones lies is at the super assemblies level. The Netherlands primarily sources its military drones from the US, Canada, or other European countries.[147] This means that, while the supply chain is still exposed to upstream risk, the procurement of finished platforms is rather secure. However, the story changes drastically for civil drones that have dual-use potential, as the Netherlands mainly imports this type of drones largely from China, as showed by the second table of Annex 3. **Figure 7** summarizes the vulnerability of drone supply chains.

	Provenance of the super assembly	Supply chain risks	Threats to a secure supply chain
Military drones 	Mainly US and other European countries	**Upstream** • Raw materials • Processed materials • Components **Downstream** • Assemblies	• Raw and processed materials bans/export controls • Restrictions on components, e.g., semiconductors and batteries • Export controls/bans on assemblies
Dual-use drones 	Mainly China (>80%)	**Upstream** • Raw materials • Processed materials • Components **Downstream** • Assemblies • Super assemblies	• Raw and processed materials bans/export controls • Restrictions on components, e.g., semiconductors and batteries • Export controls/bans of super assemblies

Figure 7: Vulnerabilities in the supply chains of drones

Chinese company DJI commands 90% of the global civil drone market, creating significant downstream reliance on Chinese-made platforms. These drones, widely used in agriculture, infrastructure monitoring, and logistics, are also adaptable for dual-use purposes.[148] The high quality and affordability of these platforms made their use widespread in the Ukrainian battlefield, where they have been used mainly for ISR duties and bombing.[149] Notably, as a consequence of the widespread use of DJI drones in Ukraine, China restricted the exports of these super assemblies to both Moscow and Kyiv.[150] This market dominance poses risks for countries like the Netherlands, which import substantial numbers of commercial drones from China. While the Dutch Defence Ministry declared that they "do[n't] use DJI drones for

[147] 'Vliegtuigen en helikopters', onderwerp, Ministerie van Defensie (Ministerie van Defensie, 14 May 2020), https://www.defensie.nl/onderwerpen/materieel/vliegtuigen-en-helikopters.
[148] Zeyi Yang, 'Why China's Dominance in Commercial Drones Has Become a Global Security Matter', MIT Technology Review, 26 June 2024, https://www.technologyreview.com/2024/06/26/1094249/china-commercial-drone-dji-security/.
[149] Falne Greenwood, 'The Ukraine-Russia Drone War Is Crowdsourced and Made in China', Foreign Policy, 16 February 2023, https://foreignpolicy.com/2023/02/16/ukraine-russia-war-drone-warfare-china/; Philip Ross, 'Budget Drones in Ukraine Are Redefining Warfare', IEEE Spectrum, 17 May 2023, https://spectrum.ieee.org/drone-warfare-ukraine.
[150] Joe McDonald, 'China Restricts Civilian Drone Exports, Citing Ukraine and Concern about Military Use | AP News', AP News, 1 August 2023, https://apnews.com/article/china-ukraine-russia-drone-export-dji-e6694b3209b4d8a93fd76cf29bd8a056.

operational use,"[151] the Dutch police together with NS and ProRail and other government-related agencies were found to be using DJI drones in an Investico investigation in 2021.[152]

China's extensive role in drone supply chains -spanning all stages of production- poses distinct risks to the secure procurement of both military and civil drones for the Netherlands. China's influence on the supply chains of these platform makes the Netherlands vulnerable to economic coercion measures taken by Beijing. Chinese-led bans or export controls on raw and processed materials, as well as restrictions on components such as semiconductors and batteries, or assemblies like Li-ion batteries and fuel cells have the potential to disrupt the production of drones globally, limiting the availability of these platforms to the Dutch market. The potential for disruption goes even further when it comes to civil drones with dual-use capacity, as China's market dominance of the finished product makes the Netherlands' supply highly vulnerable to export controls/bans of super assemblies.

3.2.3 Realising de-risking

Given the extensive Chinese involvement along the whole supply chains of both military and dual-use drones, Dutch and European public and private actors need to take concerted steps to mitigate risks stemming from dependencies on China. The complex supply chain of drones implies a multi-layered approach to de-risking that combines (1) mitigating unavoidable risks, as supported by the first three interventions; as well as (2) boosting domestic industry for long-term gains, as proposed by the last three measures. The interventions are based on the taxonomy in chapter 2 and summarised in **Table 10** below. The full assessment of each intervention is included in Annex 2.

Table 10: Proposed interventions to de-risk drone supply chains in the Netherlands and their evaluation

Intervention	Actor	Effort		Effectiveness			Effort x Effectiveness
		Costs	Time	Contribution to de-risking	Ability to sustain long-term	Ability to mitigate associated risks	
1. Supply chain monitoring, stress testing and contingency planning *Monitor supply chain risks, conduct stress tests and develop contingency plans with suppliers along the supply chain to increase resilience to potential disruptions.*	Dutch industry	**Medium**	**Medium**	**Medium**	**High**	**Medium**	Low hanging fruit
2. Stockpiling *Create stockpiles of critical materials, components,*	Dutch government	**Medium**	**Low**	**Medium**	**Medium**	**Medium**	Moderate gains

[151] 'Kijkt China Met Ons Mee? Grote Zorgen over Massaal Gebruik Chinese Drones Door Politie En Rijkswaterstaat', EenVandaag, 30 September 2021, https://eenvandaag.avrotros.nl/item/kijkt-china-met-ons-mee-grote-zorgen-over-massaal-gebruik-chinese-drones-door-politie-en-rijkswaterstaat/.
[152] 'Data Voor China', Investico onderzoeksjournalisten, accessed 6 November 2024, https://www.platform-investico.nl/onderzoeken/data-voor-china.

assemblies and super assemblies to overcome short-term supply disruptions.	& Dutch industry						
3. Diversification of suppliers *Ensure a diversified supplier base (both in terms of geographical location and corporate ownership) along the supply chain to increase resilience to potential disruptions.*	Dutch industry	**High**	**High**	**High**	**High**	**Medium**	High investment, high reward
4. Subsidies *Offer tax breaks, operational or capital expenditure support to increase the competitiveness of domestic industry of civil drones and components.*	European Commission & Dutch government	**High**	**Low**	**High**	**Low**	**Medium**	Moderate gains
5. Priority sectors in Europe *Develop sector-specific industrial policy to enhance the competitiveness of priority sectors and increase global market share, including the implementation of financial aid, permitting, administrative reform and other necessary conditions.*	European Commission & Dutch government	**High**	**Medium**	**High**	**Medium**	**High**	High investment, high reward
6. R&D investments for substitution *Invest in research and development (R&D) programmes that investigate the substitution of materials or components to decrease unwanted dependencies.*	Dutch industry	**High**	**High**	**Medium**	**Medium**	**High**	High investment, high reward

Some dependencies are inherently difficult to eliminate, underscoring the need for comprehensive supply chain monitoring, stress testing, and contingency planning. These are mainly at the raw and processed materials level as well as at the component stage of the supply chains. The availability of raw materials in a state's territory is something that can hardly be changed by the Netherlands, though European efforts under the Critical Raw Materials Act will likely bring more supply online in the coming 5-10 years. Moreover, the production of semiconductors is also centralised in Asia and very much reliant on Taiwan, whose relations with China are a source of great potential instability. Still, measures can be taken to mitigate this kind of risks.

Supply chain monitoring, stress testing and contingency planning is a necessary first step in de-risking the drones sector**.** While China is the main producer of many materials generically used in drones, there is still little clarity as to which components used in the Netherlands actually contain materials sourced in China and which ones sourced elsewhere. This lack of supply chain transparency hampers the effectiveness of risk mitigation measures. The first step to realise de-risking hence entails enhancing efforts to better map supply chains for each specific model of drone employed by the Dutch defence sector. The Smart Industry Program is an example of a good practice, which leverages digital tools to create more transparent and resilient supply

chains by supporting the creation of regional networks.[153] Still, the initiative does not directly address foreign ownership or explicitly include mapping efforts. Other countries, such as the US, have already put forward more specific, defence-related commitments. This includes for instance American pledges to identify Foreign Ownership, Control, or Influence (FOCI) under the Department of Defence's 2022 *Securing Defense-Critical Supply Chains*' action plan.[154]

Stockpiling critical materials can prove effective in ensuring drones' supply chains continuity, addressing vulnerabilities related to the presence of raw materials in a state's territory. Stockpiling materials such as cobalt and lithium, essential for drone batteries, would offer a buffer against disruptions. Yet stockpiling only makes sense if sufficient production capabilities for components, assemblies, and super assemblies are also present.[155]

Diversification of suppliers is another crucial step. The Netherlands has begun fostering supplier relationships outside of China. For instance, Dutch firms in the semiconductor industry, like ASML, have expanded sourcing from nations like South Korea and Japan, offering a model for diversification that allows for diversification in the supply chain of critical drones' components.[156] To achieve greater resilience, the Netherlands can boost domestic production and develop indigenous capabilities. China's extensive production capabilities, particularly in the supply of commercial drones, place the Netherlands at a strategic disadvantage. While it may be challenging to compete with Chinese giants like DJI in the short term, investing in domestic capabilities promises substantial long-term benefits. Priority should be given to the production of civil dual-use drones for several reasons. First, dependence on China is most pronounced for these platforms at the level of super assemblies. Second, civil drones are relatively easier and cheaper to produce than complex military systems, thus setting up a domestic ecosystem would be more feasible. Nonetheless, the Dutch government should also focus on supporting the military drones' industry, possibly in cooperation with other European states, such as France, Italy, and the UK that already manufacture this type of equipment. Additionally, support for the industry should not only be at the super assemblies level, but also regard other stages of the supply chain, such as components and assemblies.

Providing subsidies to stimulate local industry, identifying priority sectors within Europe, and targeted investments in research and development are key measures to support the expansion of the Dutch domestic drone industry. Although limitations to such measures exist in the short term, including lengthy bureaucratic processes, regulatory constraints, and budgetary

[153] 'Smart Industry programma leidt tot regionale kennis- en testcentra met honderden bedrijven', nieuwsbericht, Ministerie van Economische Zaken (Ministerie van Algemene Zaken, 22 April 2021), https://www.rijksoverheid.nl/actueel/nieuws/2021/04/22/smart-industry-programma-leidt-tot-regionale-kennis--en-testcentra-met-honderden-bedrijven.
[154] 'Securing Defense-Critical Supply Chains' (Department of Defense (DoD), February 2022), https://media.defense.gov/2022/Feb/24/2002944158/-1/-1/1/DOD-EO-14017-REPORT-SECURING-DEFENSE-CRITICAL-SUPPLY-CHAINS.PDF.
[155] Jeff Amrish Ritoe, 'Een studie naar de haalbaarheid van een nationaal programma voor de opslag van kritieke grondstoffen ter versterking van Europese waardeketens', rapport (Ministerie van Economische Zaken en Klimaat, 28 October 2024), https://doi.org/10/28/bijlage-number-three-en-tno-haalbaarheidsstudie-naar-nationaal-programma-voor-opslag-kritieke-grondstoffen-rapport.
[156] Cagan Koc, 'ASML, Samsung to Spend 1 Trillion Won to Build South Korean Research Plant', Bloomberg, 12 December 2023, https://www.bloomberg.com/news/articles/2023-12-12/asml-samsung-to-invest-760-million-research-plant-in-korea.

restrictions, these steps will eventually allow the Netherlands to achieve a more secure position in global markets. Investing in R&D allows for expanding the domestic market, leading to the creation of a national ecosystem. This goes hand in hand with the provision of subsidies, funds, and tax incentives for industrial development: making the ecosystem attractive for investment is fundamental in order to compete with cheap and effective Chinese platforms. Lastly, the development of sector-specific industrial policy at the EU level would contribute to enhancing the competitiveness of the drone sector and increase global market share.

A certain degree of awareness regarding the importance of boosting domestic drone production is highlighted by some initiatives already undertaken not only at the Dutch level, but also internationally. Project Beethoven, a €2.5 billion initiative centred around Eindhoven's chip sector, focuses on talent development and improving regional infrastructure, tackling component-level supply chain bottlenecks.[157] Complementing this, the Dutch Defence White Paper (September 2024) introduced the Security Fund (SecFund), designed to support innovative start-ups and SMEs in the defence market through subsidies totalling €100million, enabling them to scale rapidly and align their growth with the Ministry of Defence's strategic needs. This also includes drone start-ups.[158] Other existing subsidies include the European Defence Fund allocation of €100 million in 2024 for R&D in dual-use drone technologies, including the Eurodrone program for European MALE drones.[159]

Despite ongoing efforts, achieving an ecosystem able to sustain itself over the long run requires significantly more structured investments and concerted efforts from government, industry, and international organizations. While the financial cost would be significant, the long-term payoff of developing a solid Dutch drone industry would allow to considerably reduce dependency from China.

3.3 The electricity grid

Key takeaways: How can the electricity grid supply chains be de-risked?
The case study shows that grid operators in the Netherlands have been taking good first steps to mitigate their vulnerabilities, which lie particularly at the raw and processed materials levels. Apart from grain oriented electrical steel (GOES), a specific material used in grids, most of the other materials used in the electrical grid do not pose sector-specific risks given that they are used across different economic areas. As such, grid operators should focus on strengthening their ability to respond and bounce back after short-term disruptions that cannot be prevented by their sector alone. Secondly, preventing GOES availability from becoming an issue in the long-term through procurement requirements should be a priority, and so are standardization and R&D to build out some of the remaining unwanted dependencies in the long term.

[157] Ministerie van Algemene Zaken, 'Nederland investeert € 2,5 miljard in sterk ondernemingsklimaat voor microchipsector Brainport Eindhoven - Nieuwsbericht - Rijksoverheid.nl', nieuwsbericht (Ministerie van Algemene Zaken, 28 March 2024), https://www.rijksoverheid.nl/actueel/nieuws/2024/03/28/nederland-investeert-25-miljard-euro-in-sterk-ondernemingsklimaat-voor-microchipsector-brainport-eindhoven.
[158] 'Staatssecretaris Tuinman: "Kracht van innovatie sleutel tot succes in gevecht"', nieuwsbericht, Ministerie van Defensie (Ministerie van Defensie, 16 October 2024), https://doi.org/10/16/staatssecretaris-tuinman-kracht-van-innovatie-sleutel-tot-succes-in-gevecht.
[159] Elisabeth Gosselin-Malo, 'Eurodrone Program Bags Fresh Round of EU Subsidies', Defense News, 25 March 2024, https://www.defensenews.com/global/europe/2024/03/25/eurodrone-program-bags-fresh-round-of-eu-subsidies/.

The electricity grid is the backbone of the Dutch and European electricity system but it risks becoming a bottleneck in the energy transition. Electricity needs are growing rapidly as more and more societal and economic functions – like transport – are electrified as a way to reduce emissions, and digitalized as a way to increase efficiency. At the same time, the electricity sector is transitioning from fossil fuels to renewables, which have different characteristics that the grid must accommodate – they are dependent on weather patterns, they can be produced both at scale and at home, and they are both on land and offshore. Net congestion is already an issue for households and industries not just in the Netherlands but across the world. Without an adequate expansion of the grid, the energy transition could be delayed.

Apart from challenges like permitting and funding, the grids are also dependent on fragile supply chains at risk of disruption. To explore the dynamics and dilemmas of EU de-risking, this case study gives insights into the set-up and characteristics of the sector and its supply chains in the Netherlands, then explores the associated vulnerabilities and proposes de-risking strategies.

3.3.1 Understanding the electricity grid sector

The grid fulfils two broad functions, the transmission of electricity from power sources and the distribution of electricity to the consumer. Transmission refers to electricity transported through high-voltage lines over long distances, as in the case of electricity produced by offshore wind turbines, which is brought to regional sub-stations. There, high-voltage electricity is converted to lower voltages through a transformer and distributed over smaller distances to residential and commercial users. Both transmission and distribution of electricity require similar components, including cables, power transformers, electrical switchgears and grid automation systems (see **Figure 8**).

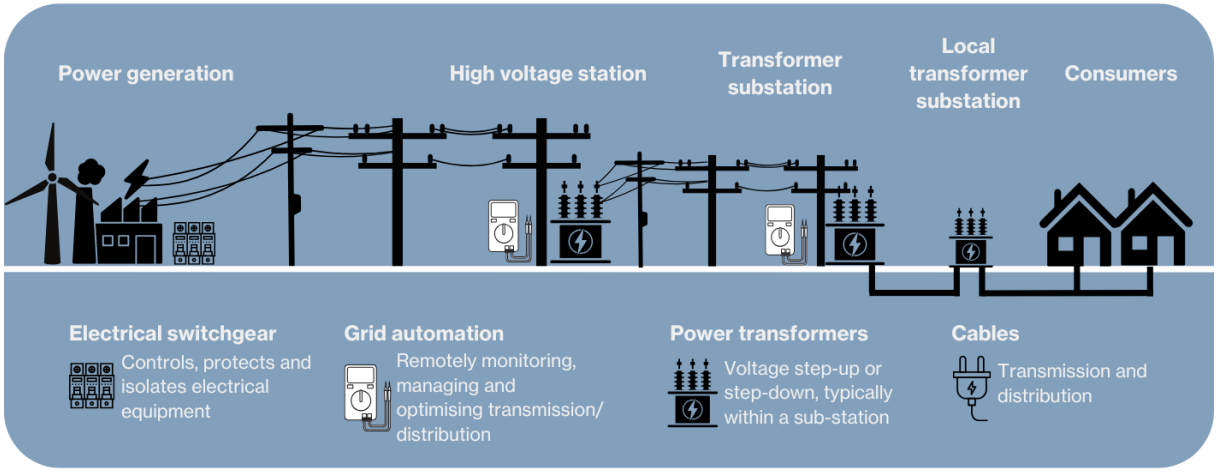

Figure 8: Simplified overview of an electricity grid, including power generation and consumption

The grid is a building block of the Dutch and European energy systems, but its transmission and distribution capacity has not expanded in tandem with renewable capacity additions, causing significant interruptions, blackouts and negative energy prices. This creates issues for

households and companies that are currently connected to the grid but have unstable electricity supply and for the thousands of users queueing for new grid connections. In 2024, 10,000 new users had been queueing.[160] At the same time, it makes it difficult for new producers to feed renewable electricity in the grid, as 3.54 GW of capacity is waiting to be connected to the grid.[161] Altogether, apart from the logistical issues experienced by those on waiting lists, it also discourages future investments in the renewable energy system in the Netherlands.

To address these issues, significant capacity additions are planned. The International Energy Agency estimates that over 80 million kilometres of grids must be added or refurbished globally by 2040. In the Netherlands, TenneT aims to construct 2,500 kilometers of high-voltage grid by 2045.[162] According to TenneT's 2024 investment plan, over EUR 22 billion will be spent until 2033 to expand this high-voltage grid on land, and EUR 36 billion for the grid on sea.[163] In addition, low-voltage grid operators like Stedin, Alliander and Enexis are also expanding capacity. Stedin, the operator providing electricity to the provinces of Utrecht, Zuid-Holland and Zeeland among others and the industrial cluster in the Port of Rotterdam, requires EUR 657 million in investment for grid expansion between 2024-2026.[164]

3.3.2 Supply chain risks

Table 11 includes an overview of some key components of electricity grids, their functions, the degree of market diversification, and the main materials used in these.

Table 11: Key products used in electricity grids, their functions and key required raw materials, based on IEA 2023 and on HCSS research. Note: The list of suppliers is not comprehensive but aims to offer an idea of the market structure and main players.

Product	Function	Supply base	Required materials
Cables	Transmission or distribution of electricity	Diversified, with the largest producers in Europe (Südkabel, Nexans, NKT, Prysmian/Draka), US (General Cable, Belden, Okonite), China (NBO, ZTT), Japan (Sumitomo Electric Industries), Korea (LS Cable), Middle East (Dubai Cable Company Pvt Ltd)	Aluminium, copper, insulation materials
Power transformers	Voltage step-up or step-down to facilitate switch between transmission and distribution, typically within a sub-station	Concentrated, with the largest producers in Europe (Hitachi Energy, Siemens Energy), Japan (Mitsubishi Electric, Toshiba), US (General Electric, Westinghouse),	Carbon steel (98% iron, 2% carbon), stainless steel (88% iron, 10% chromium, 1% carbon), grain oriented electrical steel (94% iron, 6% silicon metal), aluminium,

[160] Door Jeroen Kraan, 'Wachtlijst voor overvol stroomnet beter in kaart: tien keer Eindhoven in de rij', *NU*, 11 June 2024, https://www.nu.nl/klimaat/6316400/wachtlijst-voor-overvol-stroomnet-beter-in-kaart-tien-keer-eindhoven-in-de-rij.html.
[161] Moutaz Altaghlibi, 'ESG Economist - Dutch Grid Delays 9 Sept 24', *ABN AMRO Bank*, 9 September 2024, https://www.abnamro.com/research/en/our-research/esg-economist-dutch-grid-delays-cost-up-to-eur-376-million-every-year.
[162] 'TenneT Invests 30% More in Grid Expansions', *Transformers Magazine*, 29 July 2024, https://transformers-magazine.com/tm-news/tennet-invests-30-more-in-grid-expansions/.
[163] Tennet, 'Investeringsplan Net op land 2024-2033', 2024, 14–15.
[164] 'Investeringsplan 2024 Stedin', Stedin, 1 November 2023, https://www.stedin.net/over-stedin/pers-en-media/persberichten/investeringsplan-2024-stedin.

		Korea (Hyunday Heavy Industries), China (Chint, China XD Electric), India (Compton Greaves)	copper, gallium, germanium, silicon, brass alloys (copper, zinc)
Grid automation	Monitor, manage and optimize distribution or transmission remotely through advanced technologies	Diversified, with large producers in Europe (ABB, Schneider Electric, Siemens Electric, Eaton), US (General Electric, Belden), Japan (Hitachi Energy), China (CHINT Group)	Carbon steel (iron, carbon), stainless steel (iron, carbon, chromium), gallium, germanium, silicon
Electrical switchgear	Control, protect and isolate electrical equipment before maintenance or to limit damage in case of electrical faults	Diversified, with large producers in Europe (ABB, Schneider Electric, Siemens Electric, Eaton), Japan (Hitachi Energy, Mitsubishi Electric), US (General Electric), India (Havells)	Carbon steel (iron, carbon), stainless steel (iron, carbon, chromium), aluminium, copper, silver, zinc, tin

At the manufacturing stage, Europe and the Netherlands do not face particular supply risks nor dependencies on China. Europe has a notable industrial base in this sector, including Siemens in Germany, Schneider Electric in France, ABB in Switzerland and NKT in Denmark. The Netherlands has cable manufacturing capabilities through Prysmian, the Italian multinational that purchased Dutch group Draka in the early 2010s.[165] Moreover, other countries with whom the EU has good diplomatic, economic and military relations with like the US, Japan and Korea also have leading market positions.

Looking further upstream, electricity grids are dependent on three key materials in large quantities: aluminium, copper and steel (**Table 11).** Aluminium and copper are conductor metals, essential to transmit and distribute electricity. For this reason they are the main materials used in cables as well as in other products that support this functionality. As such, power transformers and electrical switchgear also require aluminium and copper. Still, the material used in the largest quantity in these two products is steel. It comes in various alloys: carbon steel, stainless steel, and grain oriented electrical steel.

The exact quantity of aluminium and copper in cables and transformers is dependent on the types of product. Transmission lines have a higher voltage than distribution cables, therefore requiring a lower amount of conductor metals like aluminium and copper to transmit the same amount of power as a distribution line. Given that they run on longer distances, however, more kilometres of transmission cables are likely to be needed compared to distribution lines.

The other materials are primarily used in smaller quantities, either on their own (silver, tin), in an alloy with steel (chromium, silicon), or specifically in semiconductors used in automation devices, transformers and electrical switchgear (gallium, germanium, silicon).

[165] Lisa Jucca and Greg Roumeliotis, 'Prysmian Clinches Draka Bid to Form Cable Leader', *Reuters*, 4 February 2011, https://www.reuters.com/article/business/prysmian-clinches-draka-bid-to-form-cable-leader-idUSTRE7131H7/.

The extraction of all these materials is relatively diversified across countries, which does not pose significant supply risks for Dutch grids (see Annex 4). While the Netherlands is dependent on external suppliers, these dependencies do not pose notable risks. Only in one case does the top supplier have more than 50% of production capacity, namely South Africa which possesses a leading position in chromium production, though the second and third ranked producers also have a significant market share.

The highest dependency on China and therefore the highest risk for European and Dutch electricity grids is on processed materials. China is the largest producer of almost every material included in **Table 11Error! Reference source not found.**, except for chromium where its role is l ess important. For aluminium and steel, two of the three most important materials for grids, China controls more than 50% of global processing capacity. This is especially striking considering that its role in extraction is low, with 21% for bauxite and 15% for iron. China also has the largest processing capacity for copper, the third most important material for grids, though the supply base for copper is diversified. Moreover, notable new investments in processing capacity in Latin America point to a continuation of a diversified copper supply.

Due to its massive steel production capacity, China is also a leading global producer of alloys like stainless steel, carbon steel and grain oriented electrical steel (GOES). The latter is primarily used to produce power transformers and demand has been rapidly growing over the last years. Chinese manufacturers have struggled to perfect the advanced technology required for GOES production. GOES production is concentrated in several countries including China as well as Japan, South Korea and the EU. As China uses most of its GOES production for its domestic market, which is the largest in the world, Japan and Korea are bigger exporters.[166]

Box: Chinese perspectives on the EU's critical raw materials policy and implications for de-risking in the Netherlands

The export controls imposed by the Chinese government since 2022 on gallium, germanium, graphite, antimony and rare earths demonstrate that China is aware of its position in key global supply chains and resulting political leverage. Apart from this, China itself also needs massive amounts of metals for the expansion of its own electricity grid. China is the largest investor in grid expansion as the government announced more than $800 billion in investment over six years (2024-2030). In 2024, the Chinese investments are estimated at over $100 billion, while US and Europe at about $70-75 billion each.

What does this mean for Dutch de-risking? When trying to reduce dependencies on Chinese raw materials, two factors come into play. On the one hand, China has the upper hand in the production of aluminium, copper, and steel, and has shown in the trade tensions around semiconductors that this advantageous position can be leveraged for geopolitical goals. On the other hand, China is in need of the same materials for its grid, and even if it does not dominate the market like in the case of gallium, germanium or rare earths, it will compete with Europe for the same materials sourced in third countries.

[166] 'Powering the Energy Transition: Supply Shortage of Electrical Steel Could Crimp Energy Transition Movement', *Fastmarkets*, 7 August 2024, https://www.fastmarkets.com/insights/powering-the-energy-transition-supply-shortage-of-electrical-steel-could-crimp-energy-transition-movement/; International Energy Agency, 'Electricity Grids and Secure EnergyTransitions' (Paris: International Energy Agency, 2 October 2023), https://iea.blob.core.windows.net/assets/ea2ff609-8180-4312-8de9-494bcf21696d/ElectricityGridsandSecureEnergyTransitions.pdf.

This means that de-risking efforts should account both for geopolitical issues but also price increases and potential supply shortages.

Text box source: Financial Times, 2024.[167]

In 2021, Chinese companies accused Japanese, Korean and European manufacturers of dumping GOES in the Chinese market, hampering their own competitive position.[168]

Finally, China controls the supply of gallium, germanium and silicon, which are essential materials for semiconductors used in automation devices, electrical switchgears and electronic systems used in power transformers. The semiconductors used in electricity grids are less technologically advanced than those used in high-tech products as they prioritise durability, cost-effectiveness and thermal management, while miniaturisation and computational power are less relevant for this sector. Yet gallium, germanium and silicon remain essential materials. Export controls for gallium and germanium have been in place since August 2023.

3.3.3 Realising de-risking

In the Netherlands electricity grid operators are state-owned, meaning that de-risking this sector can only be done in close coordination with the government. At the same time, grid operators are much more aware of their current and potential supply chain risks when compared to other sectors. They have not only entered into dialogues with their own suppliers about mitigating risks but also collaborated at the national level to find common and effective solutions. This means that efforts to map and address existing vulnerabilities are already in motion. The interventions recommended in this section refer on the one hand to mitigating existing and unavoidable vulnerabilities, as outlined by the first two measures; and to boost the domestic production of processed materials and components, as proposed by the last two. The interventions are based on the taxonomy in chapter 2 and summarised in **Table 12** below. The full assessment of each intervention is included in Annex 2.

Table 12: Proposed interventions to de-risk the supply chains of grid components in the Netherlands and their evaluation

Intervention	Actor	Effort		Effectiveness			Effort x Effectiveness
		Costs	Time	Contribution to de-risking	Ability to sustain long-term	Ability to mitigate associated risks	
1. Stockpiling *Create stockpiles of critical materials or components to overcome short-term supply disruptions.*	Dutch government & Dutch industry	**Medium**	**Low**	**Medium**	**High**	**Medium**	Low hanging fruit
2. Procurement requirements for GOES	Dutch government	**Medium**	**Medium**	**High**	**High**	**Low**	High investment, high reward

[167] Edward White, 'Gridlock in China: Huge Spending on Network in Shift to Green Energy', Financial Times, 9 July 2024, https://www.ft.com/content/2c0fa0d1-2902-440e-8677-d9f087c2e943.

[168] https://images.mofcom.gov.cn/trb/202107/20210723084832649.pdf

Impose procurement requirements for minimum local content of GOES to increase the market share of domestic industry or industry in partner countries.							
3. Standard setting *Develop and uphold technical and/or environmental standards that align with domestic industries to expand global market share.*	European Commission & Dutch government	**Medium**	**Medium**	**High**	**High**	**High**	Low hanging fruit
4. R&D investments for substitution *Invest in research and development (R&D) programmes that investigate the substitution of materials or components to decrease unwanted dependencies.*	Dutch industry	**High**	**High**	**Medium**	**Medium**	**High**	High investment, high reward

Stockpiling ensures that the supply chain can bounce back with minimal damage to the operations of grid companies in the Netherlands in case of a disruption. As mentioned above, distribution grid operators have been active in mapping their supply chains and getting a better understanding of their vulnerabilities, meaning that targeted and effective interventions are already possible. Still, while stockpiling components can be an effective strategy, this only functions if suppliers can increase their production capacity without negatively affecting the market. Due to the global increase in demand for grid components, this can be tricky as suppliers are struggling to meet immediate orders and have little or no excess capacity.

The main risk when it comes to material dependency on China for electricity grids is the availability of GOES. Still, the situation is not entirely dire, as companies in the EU, Japan and Korea are major global producers. Within Europe, ArcelorMittal and Thyssenkrupp in Germany produce electrical steel in France and Germany.[169] Supporting and expanding this existing industrial base through the establishment of **procurement requirements** is a key avenue for de-risking electricity grid supply chains. The Netherlands has significant steel production capacity, which could be leveraged to expand GOES production as well.

Standard setting for cables or transformers is essential for grid operators in the Netherlands, as they still use different technical standards for these products. Using the same type of products would increase interoperability and enhance the ability of grid operators to share inventories in times of disruption.

Finally, **coordinating R&D programmes between grid operators in Europe and exchanging knowledge to substitute at-risk products** and improve product design by, for instance, incorporating circularity principles, would enhance the chances of de-risking success. It would

[169] 'ArcelorMittal's Electrical Steels', ArcelorMittal, accessed 8 January 2025, https://europe.arcelormittal.com/marketsegmentseurope/electrical-steels; 'The Tension Is Rising: How Electrical Steel Is Driving the Energy and Mobility Revolution', Thyssenkrupp, accessed 8 January 2025, https://www.thyssenkrupp-steel.com/en/newsroom/highlights/electrical-steel-for-the-energy-and-mobility-transition.html.

introduce new types of products where supply security considerations could be integrated from the very beginning, while removing the products with high supply security risks.

4. Overarching conclusions and recommendations

This report was a first step towards unpacking the dilemmas of de-risking. It did so by first highlighting the complexities of China's economic statecraft and the challenges of achieving European de-risking across different sectors. It then looked specifically into the application of de-risking to three different sectors – antibiotics, drones and the electricity grid – in order to support effective interventions by Dutch and European policymakers and industry. On top of the sector-specific interventions for realising de-risking proposed in section 3, three overarching conclusions and associated recommendations can be drawn from the comparative case studies.

First, the effectiveness of de-risking depends on clear sector-specific goals, but the fuzziness of the definition and level of ambition is hampering its success. Overall, de-risking efforts suffer from unspecified objectives and a lack of joint coordination and commitment between public and private actors at the national and European level. Each sector requires different interventions and approaches to achieve de-risking. For instance, boosting antibiotics production in Europe is a matter of improving competitiveness, while fostering a drone ecosystem faces technical and manufacturing challenges. At the same time, while end-users of civil drones in the Netherlands have little information about what their supply chains look like, grid operators have a clearer picture of vulnerabilities. Therefore, it is essential to arrive at a common European understanding of what de-risking entails, when de-risking in a sector has been successful, and what level of risk is acceptable. **To this end, Dutch policymakers should work together with European counterparts to develop sector-specific targets and action guidelines in close collaboration with industry.**

Second, while examples of effective de-risking best practices are difficult to come across as the effects of policies are often yet to be seen, it is clear that successful de-risking requires a cross-sectoral approach. Although the examined sectors face common risks, the root causes of their import dependencies as well as the applicability of de-risking policies differ fundamentally. This brings challenges to policymakers. On the one hand, de-risking requires tailor made and targeted interventions for each sector. On the other hand, de-risking in one sector cannot be done in isolation from the others, given that actions in one area may cause retaliation from the Chinese government in another seemingly unrelated one. What is more, policies developed without a whole-of-society dialogue have the potential of causing significant unintended consequences, such as triggering a spike in prices across sectors for components and materials, or affecting the competitiveness of companies and provoking the relocation of industrial capabilities outside of the EU. **To this end, Dutch and European policymakers should**

engage a diverse group of stakeholders across sectors to ensure effective de-risking strategies.

Third, the type and timing of Chinese retaliation to de-risking follows hard to predict patterns, but the Chinese economic statecraft toolbox is relatively well understood. Based on recent diplomatic outings, it appears that China perceives the EU's de-risking actions as increasingly hostile and counterproductive. Additionally, policymakers must consider that China's retaliatory economic measures may extend beyond the sectors directly affected by de-risking policies; and that retaliation might also come in the form of non-economic interventions. The dispute surrounding import tariffs on Chinese-made electric vehicles could mark a turning point in Sino-European trade relations, setting precedence for increased direct confrontations in the future. **To this end, Dutch and European policymakers should prepare for the risk of cross-sectoral retaliation.**

In conclusion, effective de-risking requires a clear, sector-specific approach, broad stakeholder engagement, and proactive preparation for potential Chinese retaliation. By refining de-risking objectives, fostering collaboration across sectors, and anticipating adverse responses, Dutch and European policymakers can develop more resilient and adaptive strategies to safeguard supply chains of vital sectors.

Annex 1 Methodology for evaluating interventions

Each intervention is scored on a scale for 1-3 for two effort indicators and three effectiveness indicators, defined in Table 13. The scores are given based on relative differences in interventions rather than absolute assessments. The final evaluation is based on the method in Table 14.

Category	Indicator	Definition	Scoring
Effort	Cost	The financial resources required to design and implement the intervention.	A low score refers to low cost and therefore low effort.
	Time	The time required to design and implement the intervention.	A low score refers to low time intensity and therefore low effort.
Effectiveness	Contribution to de-risking	The extent to which the intervention directly contributes to de-risking goals, as opposed to indirectly creating conditions that would still need additional interventions to achieve de-risking.	A high score refers to a strong contribution to de-risking and therefore high effectiveness.
	Ability to sustain long-term	The responsible actor's ability to sustain it in the long term, which tends to decrease the higher the required effort.	A high score refers to a strong ability to sustain in the long-term and therefore high effectiveness.
	Ability to mitigate associated risks	Risks associated with the implementation of the intervention, including unintended market effects and the likelihood of retaliation from China.	A high score refers to a strong ability to mitigate associated risks and therefore high effectiveness.

Table 13 Definitions of evaluation criteria for policy interventions

Effort x Effectiveness	Method
High investment, high reward	Applies if an intervention scores **at least 5 for effort** (possible combinations are High Medium; High High) and **at least 7 for effectiveness** (possible combinations are High Medium Medium; High High Medium; High High Low). It is not relevant which indicator within which category has a specific score.
Low hanging fruit	Applies if an intervention scores **at most 4 for effort** (possible combinations are Low Low; Low Medium; Low High), and **at least 7 for effectiveness** (possible combinations are High Medium Medium; High High Medium; High High Low). It is not relevant which indicator within which category has a specific score.
Moderate gains	Applies if an intervention scores **at most 4 for effort** (possible combinations are Low Low; Low Medium; Low High), and **at most 6 for effectiveness** (possible combinations are Low Low Medium; Low Medium Medium; Low Medium High). It is not relevant which indicator within which category has a specific score.

High investment, low reward	**This category is excluded as it is not recommended to implement a very costly and inefficient intervention.** Applies if an intervention scores **at least 5 for effort** (possible combinations are High Medium; High High), and **at most 6 for effectiveness** (possible combinations are Low Low Medium; Low Medium Medium; Low Medium High). It is not relevant which indicator within which category has a specific score.

Table 14 Method for evaluating interventions

Annex 2 Evaluation of interventions

Antibiotics

Intervention: Priority sectors in Europe

Develop sector-specific industrial policy to enhance the competitiveness of priority sectors and increase global market share, including the implementation of financial aid, permitting, administrative reform and other necessary conditions.

Category	Indicator	Score	Explanation
Effort	Cost	3 (High)	High costs associated with the issuance of indirect subsidies and public supportive measures.
	Time	3 (High)	The development of policies tailored to the specific needs of the industry requires time.
Effectiveness	Contribution to de-risking	3 (High)	Contributes directly to de-risking by offering a business-friendly environment for the manufacturing of antibiotic ingredients and products.
	Ability to sustain long-term	2 (Medium)	Easier to maintain over time than direct subsidies as costs are more spread. The costs may become lower once SEZs are set up. Still, it is questionable whether Europe would be realistically able to compete with China in the production of KSMs and intermediates, as the advantages manufacturers currently enjoy in China are particularly large for these manufacturing steps. Moreover, environmental regulations are a hurdle to the reshoring of primary production.
	Ability to mitigate associated risks	3 (High)	Low risks of retaliation from China and undesired effects.
Effort x Effectiveness	6 X 8 → **High investment, high reward**		

Intervention: Direct subsidies

Provide subsidies, e.g., through state aid, boosting the production capacities within the EU and the NL to enhance autonomy.

Category	Indicator	Score	Explanation
Effort	Cost	3 (High)	High fiscal costs over a long period of time.
	Time	2 (Medium)	Considerable time needed to set up subsidy schemes, including regulatory policy and screenings, though it remains less than establishing a full-blown industrial policy. Effects on de-risking will be seen only in the long-run, once subsidies

			enter into effect and once they are able to substantially boost productivity.
Effectiveness	Contribution to de-risking	3 (High)	Contributes directly to de-risking by reducing the dependence on foreign and particularly China-based manufacturers. Attracts manufacturers to the market.
	Ability to sustain long-term	1 (Low)	Difficult to maintain in the long-term. The costs amount to the same every year and have a direct fiscal impact. Therefore, they are potentially difficult to maintain under political and economic pressure. Moreover, subsidies classified as state aid are subject to EU competition law and are only approved under exceptional circumstances by the commission. The scalability of direct subsidies is thus limited.
	Ability to mitigate associated risks	2 (Medium)	No previous reference of Chinese retaliation in response to subsidies. However, they could pe perceived as a provoking signal to the major competitors China and India and therefore trigger trade disputes or a circle of overbidding. Moreover, subsidies risk reinforcing market inefficiencies.
Effort x Effectiveness	4 X 6 → **Moderate gains**		

Intervention: Incorporate criteria for the secure availability of antibiotics into procurement

Require insurance companies to incorporate criteria other than price into tendering process to improve resilience, i.e. parallel sourcing or sourcing from European suppliers.

Category	Indicator	Score	Explanation
Effort	Cost	2 (Medium)	Moderate administrative costs of reforming the private procurement system in the Netherlands. However, rise in price for antibiotics is inevitable.
	Time	2 (Medium)	Time is required to reform the private procurement system in the Netherlands.
Effectiveness	Contribution to de-risking	3 (High)	Contributes directly to de-risking by targeting the low profit margins as one the root cause for the concentration of production in Asia. Prevents a 'race to the bottom', rewards resilient supply chains and incentivises suppliers and manufacturers to engage in the antibiotic market.
	Ability to sustain long-term	3 (High)	The system is relatively easy to maintain once reformed.
	Ability to mitigate associated risks	2 (Medium)	Directly cuts off Chinese suppliers as local production sources are prioritised. May therefore be perceived as a direct offence by China and trigger retaliation.
Effort x Effectiveness	4 X 8 → **Low hanging fruit**		

Intervention: Supply chain monitoring, stress testing and contingency planning

Monitor supply chain risks, conduct stress tests and develop contingency plans with suppliers along the supply chain to increase resilience to potential disruptions.

Category	Indicator	Score	Explanation
Effort	Cost	2 (Medium)	Substantial administrative costs of establishing and maintaining monitoring systems. These are however

			lower relative to subsidies or priority sectors, and they also decrease after the system has been established.
	Time	2 (Medium)	Gaining oversight over the fragmented and complex supply chain is expected to require substantial time. Barriers to sharing of sensitive information across actors must be overcome.
Effectiveness	Contribution to de-risking	2 (Medium)	Helps crisis response and enables targeted action but does not address root cause of dependencies.
	Ability to sustain long-term	3 (High)	Established monitoring systems are relatively easy to maintain once set up, despite persistent moderate costs of maintenance.
	Ability to mitigate associated risks	2 (Medium)	No previous known case where China directly retaliated monitoring measures. Unintended market effects could emerge if additional regulatory requirements to monitor and track supply chains lead to market withdrawals. This could be averted through the pursuance of public-private partnerships based on the voluntary sharing of supply chain information.
Effort x Effectiveness	4 X 7 → **Low hanging fruit**		

Drones

Intervention: Supply chain monitoring, stress testing and contingency planning

Monitor supply chain risks, conduct stress tests and develop contingency plans with suppliers along the supply chain to increase resilience to potential disruptions.

Category	Indicator	Score	Justification
Effort	Cost	2 (Medium)	Substantial administrative costs of establishing and maintaining monitoring systems. These are especially pronounced given the complexity of the supply chain and the multiplicity of suppliers involved at all stages.
	Time	2 (Medium)	Gaining oversight over the complex supply chain is expected to require substantial time. Barriers to sharing of sensitive information across actors must be overcome. However, once acquired, oversight of the supply chain would be relatively easy to maintain in the long run.
Effectiveness	Contribution to de-risking	2 (Medium)	Indirectly targets dependencies.
	Ability to sustain long-term	3 (High)	Once established, monitoring systems are relatively easy to upkeep, and costs of maintenance can be kept relatively low.
	Ability to mitigate associated risks	2 (Medium)	Low risks of retaliation from China. Unintended consequences might emerge if additional regulatory requirements to monitor and track supply chains would involve the sharing of classified information, especially in the case of military drones. This could slow down tracking and monitoring efforts.
Effort x Effectiveness	4 X 7 → **Low hanging fruit**		

Intervention: Stockpiling

Create stockpiles of critical materials, components, assemblies and super assemblies to overcome short-term supply disruptions.

Category	Indicator	Score	Justification
Effort	Cost	2 (Medium)	Substantial costs related to acquiring stockpiles not only of materials, but also of other supply chains' components', up to super assemblies. Additional costs derived from necessity of storage capacity. Still, compared to direct subsidies or industrial policy, costs are relatively less.
	Time	1 (Low)	Comparatively, a relative short time is needed to set up stockpiling policies and execute them, as the measures aims at mitigating short-term supply disruptions.
Effectiveness	Contribution to de-risking	2 (Medium)	Directly targets risks but it is more of a short-term mitigating intervention rather than a long-term solution.
	Ability to sustain long-term	2 (Medium)	Can be maintained in the long-term, but costs will pile up and it will be difficult to estimate amount of materials/components needed in the long run. Space for storage will also need to be increased over time. Components, assemblies, and super assemblies might become outdated.
	Ability to mitigate associated risks	2 (Medium)	Direct retaliation from China appears to be unlikely, but stockpiling might have unintended consequences, such as the triggering of a race to the bottom between sectors or hampering with market dynamics.
Effort x Effectiveness	3 X 6 → **Moderate gains**		

Intervention: Diversification of suppliers

Ensure a diversified supplier base (both in terms of geographical location and corporate ownership) along the supply chain to increase resilience to potential disruptions.

Category	Indicator	Score	Justification
Effort	Cost	3 (High)	Substantial costs related to moving production facilities and diversify investments as well as individuating new viable sources of materials, components, assemblies, and super assemblies.
	Time	3 (High)	Individuating viable alternative suppliers (taking into account that most existing suppliers are in China as of 2025), changing market habits, establishing trade relations and frameworks with new suppliers (both states and industry) entails a considerable amount of time.
Effectiveness	Contribution to de-risking	3 (High)	Directly targets dependencies and tackles overreliance on one supplier.
	Ability to sustain long-term	3 (High)	Established trade relations and supply chains are relatively easy to upkeep in the long run.
	Ability to mitigate associated risks	2 (Medium)	Direct retaliation from China appears to be unlikely, but not impossible, as re-directing purchases from China cuts a share of Beijing's revenue. Still, China is likely to find other buyers to supplement losses from the Dutch market.

Effort x Effectiveness	6 X 8 → **High investment, high reward**

Intervention: Direct subsidies

Offer tax breaks, operational or capital expenditure support to increase the competitiveness of domestic industry of civil drones and components.

Category	Indicator	Score	Justification
Effort	Cost	3 (High)	Substantial costs and funds necessary to set up and maintain consistent subsidies.
	Time	2 (Medium)	Considerable time needed to set up subsidy schemes, including regulatory policy and screenings, though it remains less than establishing a full-blown industrial policy. Effects on de-risking will be seen only in the long-run, once subsidies enter into effect and once they are able to substantially boost productivity.
Effectiveness	Contribution to de-risking	3 (High)	Directly targets dependencies by incentivising the creation of market alternatives.
	Ability to sustain long-term	1 (Low)	Difficult to maintain in the long-term. The costs amount to the same every year and have a direct fiscal impact. Therefore, they are potentially difficult to maintain under political and economic pressure. Moreover, subsidies classified as state aid are subject to EU competition law and are only approved under exceptional circumstances by the commission. The scalability of direct subsidies is thus limited.
	Ability to mitigate associated risks	2 (Medium)	Low risks of retaliation from China and undesired effects.
Effort x Effectiveness	5 X 6 → **Moderate gains**		

Intervention: Priority sectors in Europe

Develop sector-specific industrial policy to enhance the competitiveness of priority sectors and increase global market share, including the implementation of financial aid, permitting, administrative reform and other necessary conditions.

Category	Indicator	Score	Justification
Effort	Cost	3 (High)	Considerable costs at the beginning for setting up and developing sector-specific policy, but lower in the long run.
	Time	2 (Medium)	The development of nuanced policies to tailor the offered benefits to the specific needs of the industry requires time but can be achieved in the short-to medium run, as drones are already seen as a priority at the EU level.
Effectiveness	Contribution to de-risking	3 (High)	Directly contributes to de-risking by enhancing competitiveness of domestic/EU production of drones.
	Ability to sustain long-term	2 (Medium)	Relatively easy to maintain in the long run, once industrial policy has been established, but with costs of maintenance.
	Ability to mitigate associated risks	3 (High)	Low risks of retaliation from China and undesired effects.

Effort x Effectiveness	5 X 8 → **High investment, high reward**

Intervention: R&D investments for substitution

Invest in research and development (R&D) programmes that investigate the substitution of materials or components to decrease unwanted dependencies.

Effort	Cost	3 (High)	Substantial costs and funds necessary to set up and maintain consistent R&D investments, e.g. subsidies that stimulate research into substitution.
	Time	3 (High)	Considerable time needed to set up investment schemes, including regulatory policy and subsidisation. Effects on de-risking will be seen only in the long-run, once investments produce an actual return.
Effectiveness	Contribution to de-risking	2 (Medium)	Directly targets dependencies by stimulating the research on substitution opportunities and creating a domestic ecosystem. However, uncertainties qua research results hinders predictability of returns on investment and thus actual contribution to de-risking.
	Ability to sustain long-term	2 (Medium)	Once the regulatory frameworks for investments are established, they are relatively easy to maintain and adjust over time. However, maintaining investments in the long run entails considerable costs.
	Ability to mitigate associated risks	3 (High)	Low risks of retaliation from China and undesired effects.
Effort x Effectiveness	6 X 7 → **High investment, high reward**		

The electricity grid

Intervention: Stockpiling

Create stockpiles of products needed for the expansion of the grid to overcome short-term supply disruptions.

Category	Indicator	Score	Explanation
Effort	Cost	2 (Medium)	Requires substantial investments in storages, facilities and their maintenance.
	Time	1 (Low)	Stockpiles can be built over a relatively short period of time.
Effectiveness	Contribution to de-risking	2 (Medium)	Directly targets risks but it is more of a short-term mitigating intervention rather than a long-term solution.
	Ability to sustain long-term	3 (High)	Relatively easy to maintain once set up. Moderate fixed costs. Unlike with drones where the technology evolves rapidly and components may become obsolete, for grids the same components and products will likely be used for a long time.
	Ability to mitigate associated risks	2 (Medium)	Direct retaliation from China appears to be unlikely, but stockpiling might have unintended consequences, such as the triggering of a race to the bottom between sectors or hampering with market dynamics.

Effort x Effectiveness	3 X 7 → **Low hanging fruit**

Intervention: Procurement requirements for GOES

Impose procurement requirements for minimum local content of GOES to increase the market share of domestic industry or industry in partner countries.

Category	Indicator	Score	Explanation
Effort	Cost	2 (Medium)	Moderate administrative costs associated with the implementation.
	Time	2 (Medium)	Moderate time of policy development and implementation.
Effectiveness	Contribution to de-risking	3 (High)	Enforces de-risking through local sourcing, rewards resilient supply chains and prevents the concentration of production in China.
	Ability to sustain long-term	3 (High)	The system is relatively easy to maintain once reformed.
	Ability to mitigate associated risks	1 (Low)	Directly cuts off Chinese suppliers as local production sources are prioritised. May therefore be perceived as a direct offence by China and trigger retaliation.
Effort x Effectiveness	4 X 7 → **High investment, high reward**		

Intervention: Standard setting

Develop and uphold technical and/or environmental standards that align with domestic industries to expand global market share.

Category	Indicator	Score	Explanation
Effort	Cost	2 (Medium)	Low costs associated with policy reform.
	Time	2 (Medium)	Moderate time effort for policy development and implementation.
Effectiveness	Contribution to de-risking	3 (High)	Effectively improves crisis response by enabling interoperability and the sharing of inventories.
	Ability to sustain long-term	3 (High)	Low fix costs associated with monitoring of standards.
	Ability to mitigate associated risks	3 (High)	Not a direct offence against China. Therefore unlikely to trigger Chinese response.
Effort x Effectiveness	4 X 9 → **Low hanging fruit**		

Intervention: R&D investments for substitution

Invest in research and development (R&D) programmes that investigate the substitution of materials or components to decrease unwanted dependencies.

Category	Indicator	Score	Explanation
Effort	Cost	3 (High)	Substantial costs and funds necessary to set up and maintain consistent R&D investments, e.g. subsidies that stimulate research into substitution.
	Time	3 (High)	Considerable time needed to set up investment schemes, including regulatory policy and subsidisation. Effects on de-risking will be seen only in the long-run, once investments produce an actual return.

Effectiveness	Contribution to de-risking	2 (Medium)	Directly targets dependencies by stimulating the research on substitution opportunities and creating a domestic ecosystem. However, uncertainties qua research results hinders predictability of returns on investment and thus actual contribution to de-risking.
	Ability to sustain long-term	2 (Medium)	Once the regulatory frameworks for investments are established, they are relatively easy to maintain and adjust over time. However, maintaining investments in the long run entails considerable costs.
	Ability to mitigate associated risks	3 (High)	Low risks of retaliation from China and undesired effects.
Effort x Effectiveness	6 X 7 → **High investment, high reward**		

Annex 3 Drones

1. Complete breakdown of the drones' supply chain

Stage in supply chain	Stage 1: Raw materials	Stage 2: Processed materials	Stage 3: Components	Stage 4: Assemblies	Stage 5: Super-assemblies
Building blocks *CRMs[1]	Aluminium/bauxite, **antimony**, boron, cerium, chromium, **cobalt**, copper, dysprosium, erbium, europium, feldspar, fluorspar, gadolinium, **gallium**, gold, **hafnium**, holmium, **indium**, iron ore, lanthanum, lead, limestone, **lithium**, lutetium, **magnesium**, manganese, molybdenum, **natural graphite**, neodymium, nickel, **niobium**, palladium, platinum, potash, praseodymium, rhenium, ruthenium, samarium, **silicon** metal, silver, **tantalum**, tellurium, terbium, thulium, tin, **titanium metal**, **tungsten**, **vanadium**, ytterbium, yttrium, zirconium, cerium, zinc	Aluminium-magnesium alloys, Ni-Ti alloys, magnesium alloys, titanium alloys, specialty steels, high performance alloys, refractory metal powder, CFC (carbon fibre composites), aramid fibres (kevlar), ferroniobium, Al sheet, carbon paper/ cloth, carbon nanotubes (CNTs), Cu semis, graphene, NMC (nickel-manganese-cobalt-oxide) active material, NCA (nickel cobalt aluminium oxide) active material, LFP (lithium iron phosphate) active material, LCO (lithium cobalt oxide) active material, LMO (lithium manganese oxide) active material, natural graphite anode material (batteries), mica, LSC (lanthanum strontium chromite), LSCF (strontium-doped lanthanum cobaltite ferrite), LSM (strontium-doped lanthanum manganite), Ni alloys, Ni oxide, PTFE (polytetrafluoroethylene) - teflon, Pt-Ru alloys, steel, steel (stainless), synthetic graphite anode material (batteries), thermoplastics, Ti oxide, ZrO2/Y2O3 (yttria stabilised zirconia)	Aggregated components for fuel cells - PEM, aggregated components for fuel cells - SO, anodes Li-ion, cathodes Li-ion, catalysts, electrolyte, electrolyte (ceramic, SO), gears, NdFeB permanent magnets, semiconductors (avg.), semiconductors (memory), semiconductors (logic < 10 nm), semiconductors (logic 10-22 nm), semiconductors (logic 28-45 nm), semiconductors (logic > 45 nm), semiconductors (DAO) discrete, analogue, and other chips, separators	Actuators, communications system, CPU (central processing unit), fuel cells, GPU (graphics processing Unit), IMU (inertial measurement unit), Li-ion batteries cells, LiPo (lithium polymer) batteries, navigation and control systems, sensors	Drones
Dependency on China	In 2019: 32% of raw materials relevant for UAVs were supplied by China.[170] In 2020: 39% of raw materials relevant for UAVs were supplied by China.[171]	In 2019: 17% of processed materials relevant for UAVs were supplied by China.[173] In 2020: 22% of processed materials relevant for UAVs were supplied by China.[174]	In 2019: 14% of components relevant for UAVs were supplied by China.[176] In 2020: 14% of component relevant for UAVs were supplied by China.[177] In 2023: 31% of components relevant	In 2019: / In 2020: / In 2023: 21% of assemblies relevant for UAVs were supplied by China.[179]	In 2023: 78% of civilian drones in Europe were supplied by China.[180]

[170] Blagoeva, 'Material Dependenices for Dual Use Technologies Relevant to Europe's Defence Sector', 52.
[171] Bobba et al., 'Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study', 48.
[173] Blagoeva, 'Material Dependenices for Dual Use Technologies Relevant to Europe's Defence Sector', 53.
[174] Bobba et al., 'Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study', 49.
[176] Blagoeva, 'Material Dependenices for Dual Use Technologies Relevant to Europe's Defence Sector', 53.
[177] Bobba et al., 'Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study', 49.
[179] Carrara et al., 124.
[180] Carrara et al., 124.

	In 2023: 50% of raw materials relevant for UAVs were supplied by China.[172]	In 2023: 34% pf processed materials relevant for UAVs were supplied by China.[175]	for UAVs were supplied by China.[178]		

2. Dutch imports of drones

	Drone type	Exporting country	Ranking (OEC, 2022)	Exporting value (OEC, 2022)	Exporting % (OEC, 2022)
Civil drones	HS code 880622**:** Small drones (250-7kg) RC only	China	1st	61M USD	90.2%
		Germany	2nd	2.36M USD	3.49%
		Belgium	3rd	1.25MUSD	1.84%
	HS code 880621: Mini drone (<250g), RC only	China	1st	77.7M USD	94.2%
		Belgium	2nd	922,000 USD	1.15%
		Germany	3rd	716,000 USD	0.9%
	HS code 880624 : Large drones (25-150kg), RC only	Germany	1st	174,000 USD	49.1%
		Estonia	2nd	114,000 USD	32.2%
		United Kingdom	3rd	37,700 USD	10.6%
	HS code 880623: Medium-sized drones (7-25kg), RC only	China	1st	2.13M USD	41.5%
		Slovenia	2nd	1.61M USD	31.5%
		Latvia	3rd	526,000 USD	10.3%
	HS code 880694: Large UAV (25-150kg)	Romania	1st	9,200 USD	42.2%
		China	2nd	7,500 USD	31.1%
		Switzerland	3rd	6,020 USD	25.6%
	HS code 880692: small UAV (250g-7kg)	Switzerland	1st	291,000 USD	73.1%
		Romania	2nd	87,400 USD	21.9%
		Germany	3rd	5,500 USD	1.38%
	HS code 880693: Medium-sized UAV (7-25kg)	Germany	1st	369,000 USD	89.9%
		Romania	2nd	35,100 USD	8.55%
		China	3rd	6,260 USD	1.53%
Military drones	HS code 880629: Heavy drones (> 150kg), RC only	United States	1st	1.42M USD	88.6%
		Canada	2nd	151,000 USD	9.42%
		Norway	3rd	30,800 USD	1.92%

[172] Carrara et al., 'Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study', 16 March 2023, 124.
[175] Carrara et al., 'Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study', 16 March 2023, 124.
[178] Carrara et al., 'Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study', 16 March 2023, 124.

Annex 4 The electricity grid

The main producers of materials used in electricity grid components.[181]

Material	Top 3 producers - Extraction	Top 3 producers - Processing
Bauxite (Aluminium)	Australia 28% China 21% Guinea 18%	China 56% Russia 6% India 6%
Chromium	South Africa 56% Kazakhstan 16% India 12%	South Africa 24% Kazakhstan 14% India 9%
Copper	Chile 28% Peru 12% China 8%	China 38% Chile 10% Japan 6%
Gallium	N/A	China 94% Ukraine 2% Russia 2%
Germanium	N/A	China 83% Russia 5% Belgium 4.5%
Iron (Steel)	Australia 37% Brazil 18% China 15%	China 52% India 6% Japan 6%
Silicon	United States 41% China 8% India 5%	China 76% Brazil 7% Norway 6%
Silver	Mexico 24% Peru 14% China 13%	N/A
Tin	China 29% Indonesia 24% Myanmar 17%	China 50% Indonesia 20% Malaysia 7%
Zinc	China 32% Peru 12% Australia 9%	China 45% South Korea 7% India 5%

Note: Only minerals and metals have been included in the analysis. Synthetic materials like insulation (cross-linked polyethylene like XPLE or VPE, polyvinyl chloride (PVC), or silicon rubber) and carbon fibre are excluded due to widespread global production.

[181] Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (European Commission), Grohol, and Veeh, 'Study on the Critical Raw Materials for the EU 2023'. Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (European Commission), Grohol, and Veeh.