Balancing openness, economic security and national security

The future of export controls on quantum technologies

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Clingendael Report

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Executive summary

The European Union and its Member States are hard-pressed to define their strategic interests and devise appropriate measures to uphold technological sovereignty in the field of critical technologies. Export controls have become an instrument for this purpose. Following new controls in 2023 on semiconductor manufacturing equipment, the expectations are that curbs on quantum, artificial intelligence and biotechnologies will follow. The challenge originates from China's rapid rise to technological prowess and the stalemate in multilateral export regimes, as well as unprecedented unilateral action by the United States since 2018.

There is a need to balance national security and economic security interests with global technological leadership; research security with the scramble for talent and scientific freedom; and to regulate intangibles, such as algorithms and artificial intelligence models. Importantly, existing policy frameworks designed for the semiconductor sector are not necessarily replicable and transferable across different technologies and their subdomains. Controls on quantum technologies are particularly sensitive as the key players, supply chains and choke points are still unfolding.

In order to balance openness and security, the Netherlands needs to act, ideally aligned with the EU and other Member States. The following practical steps emerge from this report's analysis.

- Work towards **greater intra-EU harmonisation** on export controls, and aim for an increasingly trustworthy and equal partnership with the US, for instance in the EU-US Trade and Technology Council (TTC).

- Invest significantly in **capacity-building**. This ranges from **nurturing innovation ecosystems** and 'European champions' that develop and commercialise critical technologies within Europe, to **investing in manpower** to design and implement export controls.

- **Identify and own choke points** in the developing supply chains, in order to become indispensable.

- Strive for a **pragmatic two-step approach** in which **EU coalitions of technology holders** lead the way to new EU-wide export controls. This addresses the need for speed and can assist like-minded Member States with less capacities to adopt export-control measures efficiently.

- Promote **EU-wide academic and industry cooperation** to forge a sense of collective responsibility based on a **deeper understanding of each other's industries and academic research priorities and concerns**.

- Leverage existing digital partnerships to engage in **closer collaboration with trusted countries** like Japan, the Republic of Korea, Singapore and India in the field of information-sharing, joint risk assessments and common regulatory frameworks.

Introduction

In 2023 the Netherlands and Japan – global leaders in lithography systems – presented novel export controls on semiconductor manufacturing equipment. The new measures of the two crucial technology holders broadly aligned with unilateral controls implemented earlier by the United States (US) against China, albeit country neutral. Dissatisfied with the stalemate in existing multilateral export-control regimes, specifically the Wassenaar Arrangement,[1] the US government had unilaterally pushed its two allies to follow suit.

The stalemate in existing regimes is mainly because of three reasons. First, membership of the regimes is causing difficulties in decision-making processes. Discussions on dual-use export controls in the Wassenaar Arrangement, for example, are at deadlock because of Russia's membership. Second, export-control regimes are ill-equipped to match the unprecedented speed of technological innovation in private-sector companies. Export-control regimes were established to deal with technology traditionally deriving from military innovation, occurring much closer to governments. Third, existing regimes are challenged to address controls on intangible items, such as software and knowledge, which are a growing concern for the national security of many governments.

Besides the stalemate in the multilateral export-control regimes, another reason for Washington's turn to unilateral measures in recent years is the growing willingness to use export controls as a tool to stall the technological advancement of adversaries – China in particular. Export controls are no longer only guided by traditional military and dual-use concerns, but also by economic security considerations. This approach of leveraging export controls in the competition with China is adopted by trusted partners of the US – including the Netherlands and Japan.

1 The existing export-control regimes are the Wassenaar Arrangement (mostly focused on conventional arms and dual-use goods and technologies), the Nuclear Suppliers Group, the Australia Group (focused on chemical weapons) and the Missile Technology Control Regime.

Given this backdrop, policymakers, industry stakeholders and academics alike are vested in finding an adequate equilibrium between establishing additional export controls on critical technologies and maintaining open economies with few trade restrictions. The challenges posed by China's pursuit of technological leadership, as well as by the US's unilateral action, require that the European Union (EU) and its Member States re-evaluate their stance on export controls and align their action among themselves to build a more robust alliance to uphold and strengthen their technological sovereignty.

Aiming to contribute to actionable steps for the EU and its Member States in the coming years, this Clingendael Report delves into the multifaceted dimensions of export controls and geopolitical shifts. Its findings derive from multiple interviews and two scenario workshops with Dutch and international experts in the field of export controls and quantum technologies, a key subset of critical technologies.[2]

The report is divided into five sections. First, it briefly outlines four scenarios on export-control cooperation within the EU and with the US by 2030, as well as their likeliness and desirability.[3] Sections 2 and 3 delve into the two key challenges that emerged from the scenario workshops, namely the extent of intra-EU and transatlantic cooperation, as well as the stalemate in existing export-control regimes that have made these regimes increasingly unfit for action. These two challenges point to three dilemmas that define the future of export controls, discussed in section 4. Section 5 then outlines routes for future action that can help to ensure that the EU and its Member States, with trusted partners, move from the reactive approach that characterised new export controls on semiconductor industry, towards more sustainable, balanced action on quantum and other critical technologies.

2 The authors are grateful to all participants in the scenario workshops and the interviewees consulted for this study.

3 See the Appendix for more details about the scenarios' building blocks.

1 Scenarios for 2030

The unilateral export controls introduced by the US, and subsequently the Netherlands and Japan, initially focused on the advanced semiconductor industry, where China is still trying to catch up with the West. By hindering the export of advanced lithography equipment, Washington aims to slow the development of Chinese advanced technology.

More recently, the debate on export controls has been turning to other critical technologies – especially quantum technologies, artificial intelligence (AI) and biotechnologies. China is already a key player in some of these fields: in quantum communications, for example, it is on a par with the US or even in the lead.[4] Overall, Europe is lagging behind, although several EU Member States – notably the Netherlands, Germany and France – are investing in quantum technologies and an innovation ecosystem. Unlike semiconductors, the international quantum technology landscape is not yet a mature market with known key players and choke points and established commercial supply chains. The nascent quantum industry currently thrives in the innovation stage, largely driven by collaborations between universities and companies.

The scenario workshops were geared to imagine the potential situation for intra-EU and transatlantic export-control cooperation by 2030. They departed from the assumption that competition with China is a given – an assumption deemed realistic for the next five to ten years, given the current geopolitical environment. Having established this basic premise, scenarios were derived from two uncertainties that will shape the Dutch – and the EU's – ability to determine export controls on critical technologies: (1) the extent of cooperation within the EU; and (2) the extent of cooperation with the US. Expert interviews and the workshops' scenario discussions highlighted that both industry and governments stand to benefit from greater EU harmonisation, in combination with a trustworthy and equal partnership with the US. The outcomes of the scenario workshops are visually summarised in Figure 1.

4 ASPI, ASPI's critical technology tracker – sensors and biotech updates.

Figure 1 Scenarios for 2030 on intra-EU and transatlantic cooperation on export controls

The Netherlands and US unilateral action

Likeliness: ★★★☆☆ Desirability: ★☆☆☆☆

The Netherlands – as well as other EU Member States – are individually dealing with export controls. EU-level coordination has not evolved since 2023. The US takes advantage of this situation, as it can target individual Member States with unilateral export-control measures to push its agenda forward.

The Netherlands owns choke-point technology as well as a leadership position in subsets of critical technologies. The US benefits from conducting unilateral talks with the Netherlands, which consequently has limited negotiation power to uphold its preferences.

Coordinated EU and US unilateral action

Likeliness: ★★★★☆ Desirability: ★★★☆☆

The EU and its Member States are able to align and cooperate on export controls, while the mandate to act remains a national competence. Together, they form a unified bloc that enters into discussions with the US in settings such as the Trade and Technology Council. Unilateral US action is addressed by the EU as a whole.

The EU Member States own several choke points in critical technologies' supply chains, making them a key player in export controls. As one of the most technologically advanced EU Member States, the Netherlands takes a leadership role within the EU. Together, the EU and its Member States are able to respond jointly to US unilateral action, thereby upholding their technological sovereignty.

The Netherlands with cooperative US

Likeliness: ★★☆☆☆ Desirability: ★★☆☆☆

The Netherlands – as well as other Member States – are individually dealing with export controls. EU-level coordination has not evolved since 2023. The US negotiates with individual Member States as equals, and builds partnerships based on the role each MS plays in critical technologies supply chains.

The Netherlands owns choke-point technology as well as a leadership position in subsets of critical technologies. The Netherlands builds a strong relationship with the US, whereby decisions on export controls with an impact on the Dutch industry are carefully considered. This comes with unintentional negative consequences on other Member States' industries.

Coordinated EU with cooperative US

Likeliness: ★☆☆☆☆ Desirability: ★★★★☆

The EU and its Member States are able to align and cooperate on export controls, while the mandate to act remains a national competence. The EU has developed a trustworthy and more equal partnership with the US on export controls.

The EU Member States own several choke points in critical technologies' supply chains, making them a key player in export controls. As one of the most technologically advanced EU Member States, the Netherlands takes a leadership role within the EU. It sets the EU agenda on export controls on critical technologies, especially in the areas and supply chains where it holds choke points. The EU builds a strong relationship with the US, whereby the impact of export controls on American and European industries are equally considered.

Concluding from the scenarios, export controls on critical technologies are complicated by two key challenges. One is the question of competence: the European Commission currently lacks a mandate to act in the field of export controls, given that national security remains the sole responsibility of each EU member state. This is unlikely to change and will complicate intra-EU, as well as transatlantic, relations in the years ahead. Second, current export-control regimes are unfit for their changing purpose – especially as the main driver of technological development turns from military to private actors. In considering the future of export controls, there is a need to balance national security and economic security interests with global technological leadership; research security with the scramble for talent; and to regulate intangibles, such as algorithms and artificial intelligence models. These challenges are further elaborated in the following sections.

2 Critical technologies: A national or EU affair?

The export controls on semiconductors implemented by the Netherlands in September 2023 highlight a key facet of European governance: within the EU, the granting of export licences is a national competence, implemented by each member state based on national regulations and informed by national security considerations. Accordingly, EU Member States' government officials participate in multilateral export-control institutions, while the EU is an official member only of the Australia Group. This complicates coordination across the bloc, such as information-sharing and the coherent, EU-wide export controls. Nevertheless, a trend towards more EU cooperation in export controls is emerging, even if an EU mandate to act in this field is highly unlikely to arise.

Towards more EU cooperation

The European Commission increasingly shapes and influences Member States' measures by devising common lists of dual-use items and technologies. An important measure to foster coherence of EU Member States' export controls came with the European Dual-Use Regulation of 2021, which enables EU Member States to request that other Member States adopt similar national control measures.[5] Moreover, the EU aims to strengthen its knowledge base that informs action on export controls. A push in this direction came in January 2024, when the European Commission presented a White Paper that seeks to stimulate discussion and calls for more rapid and coordinated action in the field of export controls.[6] The White Paper outlines the shortcomings of current EU export controls, highlighting the lack of a single EU approach, voice and coordination among the Member States. To address these shortcomings, the Commission seeks to advance intra-EU coordination and information-sharing, proposes a

5 Article 9 of the EU Regulation 2021/821 provides EU Member States with a way to notify other Member States about national export controls, while Article 10 enables other Member States to impose an authorisation requirement for the export of items on the basis of a national control list adopted by a member state and published by the Commission.

6 European Commission, *Factsheet: White Paper on export controls*, 24 January 2024.

high-level forum and aims to improve coordination of Member States' National Control Lists ahead of their adoption. The response of two countries that have officially reacted to the White Paper – the Netherlands and Sweden – illustrates the growing support for an enhanced EU role to strengthen cooperation and coordination on export controls among Member States, as elaborated below. At the same time, the responses also show the view that export controls should remain a national competence and that an enhanced EU role should not detract from various EU Member States' role as members of existing multilateral regimes.[7]

Also in January 2024, initiatives were launched to improve support for research and development (R&D) involving technologies with dual-use potential; and to enhance research security at national and sector levels.[8] These actions build on a list of ten critical technologies, presented by the European Commission in October 2023 and selected based on their 'transformative nature', the risks of civil and military fusion, and of enabling violation of human rights. Four of the ten critical technologies identified by the EU are now subject to a risk assessment: advanced semiconductor technologies (including photonics); quantum technologies; artificial intelligence technologies; and biotechnologies.

Although more analytical than actionable in nature, the risk assessment and the White Paper on export controls show the Commission's sense of urgency for rapid action. Such moves are warranted given the potential risk of dual-use applications (including military use and decryption of information), restrictive export and import policies that negatively affect the development of the nascent quantum industry in Europe and the global needs of its burgeoning start-up ecosystem. Yet stakeholders operating in these fields – both in industry and in research and innovation – are concerned these moves will securitise (emerging) critical technologies, jeopardising international collaboration in R&D and the build-up of international supply chains of quantum technologies. Anticipated implementation in the future of export controls on certain critical technologies is already putting a brake on engagement – and hence innovation – of Western

7 Government of the Netherlands, *Kamerbrief over kabinetsappreciatie witboek over exportcontrole*, 1 March 2024 (in Dutch); Government of Sweden, *Vitbok om exportkontroll av produkter med dubbla användningsområden*, 27 February 2024 (in Swedish).

8 European Commission, *New initiatives to strengthen economic security*, 24 January 2024.

researchers, start-ups and companies with research and commercial initiatives in adversary countries.[9]

The call by both industry and academia is for the risk assessment – and potential subsequent export controls – of critical technologies to be specific and to consider duly the level of technological readiness. This is important as export controls are not necessarily replicable and transferable across different technologies and their subdomains. Quantum technologies, for instance, include quantum sensing, quantum communication and quantum computing – each of which is at a different stage of development and should thus be considered independently.

The transatlantic challenge

The EU and its Member States have so far been unable to respond adequately to the increasing US pressure to match the American export controls against China. This is caused in part by the European Commission's lack of mandate to act, as export controls are a national security matter. In addition, EU Member States have been unwilling (for political reasons) or unable (because of a lack of expertise) to engage with the Commission on the issue. The Netherlands, for one, was initially hesitant to grant a bigger role to the European Commission on export controls – even for coordination.[10] This has slowly changed over the past five years, and more clearly since the end of 2022. Catapulted into a frontrunner position because of the Dutch company ASML's unique role in semiconductor supply chains, the Dutch government initially discussed export controls with the US bilaterally. Over time, realisation grew that the Netherlands' role as a technology holder and choke point also made the country vulnerable to foreign pressure.

The Dutch government came to favour a more coordinated European approach that could offer a shield against such pressure – from both Washington and Beijing. The Hague is now actively pushing other EU Member States to adopt similar new national control measures, in accordance with Articles 9 and 10 of

9 CESAER, *Keeping science open? Current challenges in the day-to-day reality of universities*, 18 October 2023.

10 Brigitte Dekker and Maaike Okano-Heijmans, The US–China trade–tech stand-off and the need for EU action on export control, August 2019.

the European Dual-Use Regulation. However, not all EU Member States share the same interests. There is economic competition among the bloc's members, and national security considerations vary too. Eastern and Nordic Member States, for instance, regard the dependency on US military power through the North Atlantic Treaty Organisation as a core element of their security, and often have an accommodating and supporting approach to the US posture. Moreover, the different stages of technological development of EU Member States create different levels of urgency and sensitivity to the importance of a unified approach to export controls.

Interestingly, European Commission officials do discuss export controls with the United States in the Trade and Technology Council (TTC), which also covers technology standardisation and export control of critical technologies.[11] The TTC format facilitated the rapid coordination of sanctions on Russia – including in the dual-use domain – within weeks of Russia's invasion of Ukraine in February 2022. Even so, these transatlantic discussions on export controls are contentious because Commission officials lack the detailed knowledge of export controls that the Member States have, as well as a mandate to implement or steer such controls.

Beyond the willingness of EU Member States to act in a coordinated manner, a second element that defines the future of European export controls on critical technologies is the extent to which future US administrations will engage with partners before implementing new export controls. The US will likely continue to engage individual EU Member States rather than the EU as a bloc, as long as export controls are a national responsibility. Although the TTC creates some space for greater cooperation between the US and the EU, the US is unlikely to refrain from unilateral action and pressure on partners to follow suit. After all, export controls are not negotiated and implemented in a vacuum. EU Member States will be more able to resist pressure from Washington if they manage to reduce their dependencies on the US in other areas – especially in the military and defence domains.

11 European Commission, *EU–US Trade and Technology Council inaugural joint statement*, 29 September 2021.

3 Unfit for purpose: The need for new export-control regimes

Existing export-control regimes were established with a national security effort in mind, focused on the objective of minimising the chance of proliferation of nuclear weapons, biological weapons and trade in dual-use goods, software and technology. The regimes' focus has been on sensitive technologies developed in a military context, historically the main driver for technological innovation. Once such technologies could be commercialised for civilian purposes, export-control regimes were the forums to discuss whether export controls should be limited to minimise national security threats. For instance, the Global Positioning System (GPS) is still owned by the US military, but can be used by civilians for everyday tasks. Through a process of careful consideration, countries within the Wassenaar Arrangement could add newly determined dual-use technologies to their dual-use export-control lists to limit their exports to nations of concern.

In recent decades, however, private companies have become the main drivers of technological development, thereby changing the way societies are organised. New technologies are developed out of governments' sight, and are commercialised before regulation on their potential national security threats is in place. New goods, products and services are now moving into the military domain rather than the other way round.

Moreover, these new technologies are developed at a much higher speed than in the past. As a result, export-control regimes continuously lag behind critical technology development. Regimes now face the question of whether civilian technology can – in the wrong hands – be used in ways that threaten national security.[12] The challenge of regulating surveillance technologies that damage human rights in authoritarian states was dissipated by new regulation adopted in the 2021 EU Dual-Use Regulation. Future challenges include commercial drones,

12 CSIS, *Advanced technology: Examining threats to national security*, Congressional Testimony by Gregory C. Allen, 19 September 2023.

which have been prominently used in the war between Russia and Ukraine, and AI that could be used to develop bioweapons.[13]

Beyond the wish to restrict the export of civilian technologies that may also have military or otherwise undesirable uses, the United States in particular has come to regard export controls as a tool to address economic security considerations as well. Upholding technological leadership, while applying a brake on the rapid technological advancement of adversaries, is a new justification. Hence, today's reality reflects a more complex interplay of economic and national security considerations than was traditionally anticipated when establishing the regimes.

13 University of Birmingham, *AI could be used to develop bioweapons if not regulated urgently*, 30 October 2023.

4 Export control 2.0: Three dilemmas

The challenge in the current new phase of export controls is to devise measures that suit the omnipresence of dual-use critical technologies rather than traditional military technologies. The challenge is to balance three prominent characteristics of today's reality: (1) national security, economic security and technological leadership; (2) research security versus the scramble for talent; and (3) tangibles versus intangibles.

National security, economic security and technological leadership

In the last five years, export controls have become intricately linked to economic security, reflecting the growing importance of technological dominance in global competition. The semiconductor industry exemplifies this development, as governments of technologically advanced countries – starting with the US – have begun to employ export controls strategically, to reduce adversaries' access to the latest generations of this technology, while maintaining a lead of their own by fostering domestic innovation. Export controls have thus become a tool to slow China's technological development in particular, and to strengthen the technological leadership of the EU and its partners.

Current multilateral export-control regimes are not yet equipped to foster the objectives of economic security and technological leadership, however, leading certain governments to implement export controls outside of the current export-control regimes. While this shift has mostly occurred only tacitly, technological leadership was explicitly codified in the announcement on new export controls of March 2023 by the Netherlands' government. It was included as one of three strategic objectives under the umbrella of national security, namely: '(1) preventing a situation in which Dutch goods contribute to undesirable end use, such as military deployment or weapons of mass destruction; (2) preventing undesirable long-term strategic dependencies; and (3) preserving

the Netherlands' technological leadership position'.[14] The challenge ahead is to balance the restrictive measures and industrial policies that may be needed to secure national security, with the objectives of economic security, as well as with trade openness that has so effectively fostered innovation, efficient markets and technological leadership in recent decades. A first step in this direction could be to incorporate, into multilateral export-control regimes, discussion on potential new controls informed by economic security concerns. In doing so, this new category of controls would ideally be kept distinct from debates on measures stemming from national security concerns – such as nuclear weapons or missiles – on which there is broad alignment.

Research security versus the scramble for talent

As technological leadership has become a feature in export controls on critical technologies, research security[15] has become a matter of concern as well. The January 2024 European Commission's proposal for a Council Recommendation on research security recommends following the principle 'as open as possible, as closed as necessary'.[16] While the proposal advocates for academic freedom and risk-based and proportionate measures, it also highlights the risks related to undesirable transfers of critical technology and external influence by third countries, underpinned by a sense of urgency to address research security risks. After all, by virtue of the international nature of talent flows in critical technologies' research, the risk of leakages of know-how – even if inadvertent – raises security challenges.

While governments aim to implement measures to protect critical intellectual property, including via export controls, companies want to attract international talent. New export-control measures will apply a brake, however, on international R&D collaboration and will negatively impact the fierce competition for talent as well. In the race for technological supremacy, attracting skilled professionals and R&D talent becomes of paramount importance. This is of particular importance in critical technologies. Concerns about safeguarding classified information

14 Government of the Netherlands, *Letter to Parliament on additional export-control measures concerning advanced semiconductor manufacturing equipment*, 10 March 2023.

15 Note that the Dutch government has until now referred to this as 'knowledge security'.

16 European Commission, *Commission proposes new initiatives to strengthen economic security*, 24 January 2024.

and proprietary knowledge must thus be balanced with the pursuit of talent and international R&D collaboration.

Tangibles versus intangibles

The existing multilateral export-control regimes are unfit to deal with the complexities of intangible goods and services[17] that support today's economy, such as AI-enabled software systems and knowledge. The traditional focus on physical inspections at borders falls short when dealing with the export of intangible goods and services. The Wassenaar Arrangement essentially deals with software that is coupled with dual-use hardware and that is used to manage and run it. Besides, the Wassenaar Dual-Use Goods and Technologies List includes a category called 'intrusion software', which is geared to controlling surveillance software. Industry stakeholders note, however, that it is extremely difficulty to describe the characteristics of a piece of software that can be of dual use without including legitimate applications under the same control mechanisms.[18] The very nature of intangible goods, with their non-physical, decentralised and often publicly available attributes, poses unprecedented challenges to effective control.

Designed for the hardware age, and with a consensus-based structure and limited targeting capabilities, the Wassenaar Arrangement is unfit to address the evolving national security concerns associated with intangibles. Attempts by member countries to incorporate controls on intangible goods linked to specific end-uses or threats have not solved this problem. As critical technologies develop, there is a pressing need for upgraded export-control mechanisms that navigate the intricate landscape of intangible goods, thus balancing innovation with security.

17 Emily Benson, *Export controls and intangible goods*, CSIS, 11 April 2023.

18 Lawfare, *Wassenaar export controls on surveillance tools: New exemptions for vulnerability research*, 5 January 2018.

Balancing purposes and pitfalls: Harnessing export controls

Policymakers, industry stakeholders and academics all share an interest in creating an adequate balance between additional export controls on quantum technologies – and other critical technologies – and open economies with few trade restrictions. Especially as global supply chains are still unfolding and their choke points are unknown, there is a risk that implementing export controls too soon will hinder innovation in Europe as well as international collaboration, and result in a loss of competitive advantage for the domestic industry. Even if not on purpose, these are unintended consequences of imposing export controls on critical technologies. Besides, any reduced industrial presence and innovation cooperation between industries in different countries mean that export controls come with loss of visibility over rivals' research efforts and technological state of play. Introducing export controls too soon may hinder supply chains and create uncertainty about market opportunities, as well as the innovation climate for industries in the long run.

The particularities of each quantum technology and its subsets – and, more broadly, of all critical technologies – add another layer of complexity for potential future export controls. Bulking different subsets of technologies together obfuscates the vast differences between them, their industries and level of technological readiness.[19] Devising effective and tailor-made export controls for every single subfield of each critical technology requires additional categorisation and consultation with industry and R&D communities. Current export-control regimes are not designed to accommodate this in a sensible manner.

19 While the phase of fundamental scientific knowledge development necessitates more openness and sharing, the second phase of development of practical (military and commercial) applications warrants more caution.

5 Actionable steps

Based on the above analysis and meetings with industry and academia, this section presents a summary of actionable steps that European stakeholders/ policymakers can take to prepare for a future in which export controls on critical technologies become more pertinent. If acted upon, these steps will contribute, over time, to the scenario for 2030 that was deemed most desirable – that is, a future in which the EU and its Member States align and coordinate more on export controls, and have forged a trusted partnership with the US and other key partners.

As a starting point, **both industry and governments stand to benefit from greater EU harmonisation**, in combination with **a trustworthy and equal partnership with the US**. After all, while the partners broadly share concerns about China, approaches for how best to deal with these differ. However, considering the ongoing geopolitical and technological tensions, EU alignment and a cooperative relationship with the US in this regard offer an optimal but utopian vision for many. A next-best and more plausible scenario is a lighter version thereof: a degree of cooperation within the EU and alignment with the US that are at least higher than today. This assumes that the US will continue to prefer to negotiate with individual EU Member States and that Member States will – for the foreseeable future – lack leverage to chart their own path. This is because of dependencies in other fields, especially in the military domain, that make for insurmountable divergences of interests among EU Member States in their relationship with the US – for example, the Baltic countries and West European countries. That said, the turn to greater EU harmonisation that is evident from the January 2024 White Paper is unmistakable and can be reinforced in several ways. In the policy domain, greater investments are needed to enhance awareness of the benefits of EU-wide information-sharing and cooperation to all and each individually. This goes both ways: from EU capitals to Brussels on export-control discussions in multilateral regimes; and from Brussels to EU capitals on the TTC. Making the TTC a success will strengthen the EU as a whole, as the EU will then be a more trustworthy partner in the eyes of the US. At the same time, the EU and its Member States need to brace for a future in which the US will still see a benefit to engaging specific EU Member States individually if it suits Washington's interest.

The EU and its Member States need to invest significantly in capacity-building, to strengthen their technological sovereignty in the face of China's rapid technological development and the US's unilateral export-control measures. This includes nurturing innovation ecosystems and 'European champions' like ASML that develop and commercialise critical technologies within Europe, in order to enhance Europe's technological leadership and ownership of choke points and thereby more opportunities to exploit technological prowess. Yet it also extends to investments in manpower to design and implement export controls. The US now has an immense advantage, as it has an extensive team and resources within the US Commerce Department's Bureau of Industry and Security to design, implement and enforce those mechanisms. In contrast, the EU's strength – both at the national level and combined – could be jeopardised without efforts to build and bolster its regulatory cooperation and capabilities. As the EU is involved in discussions in the TTC, also when it comes to export controls, an in-depth understanding of affairs within the individual EU Member States is a necessity for defending and creating a beneficial EU position. Without such investments and information, the EU risks being perpetually reactive to American initiatives, and even being reduced to jumping on the bandwagon – unable to assert its interests in the face of unilateral decisions by the US or other countries with extensive capacities.

The Netherlands could actively shape export controls within Europe, **striving for EU coalitions of technology holders** – that is, Member States with advanced capabilities in specific technologies – rather than immediately aiming for EU-wide consensus. Such coalitions could bring together EU Member States that are technologically more advanced on certain critical technologies and therefore directly impacted by potential export controls on them, serving as forums to discuss preferred approaches before taking it to the EU level. This can also assist like-minded Member States with less capacities to adopt export-control measures efficiently. As EU governments are awaiting the EU's risk assessment on ten critical technologies, the Dutch and Spanish governments have already taken the first steps to push the intra-EU debate and entice other EU Member States to follow their national controls (on semiconductors and quantum technologies, respectively) by utilising Articles 9 and 10 of the EU Dual-Use Regulation.

Over time, this pragmatic two-step approach – in which frontrunner countries lead the way to new EU-wide export controls – addresses the need for speed and the limited capabilities of some EU Member States, and can foster a more

coordinated and harmonised EU export-control mechanism. By engaging in coalitions of technology holders and utilising the EU Dual-Use Regulation, European governments not only **share the burden** of deciding and designing export controls and/or managing potential geopolitical backlash, but also forge a **sense of collective responsibility**. In addition, enhanced discussions will promote a **deeper understanding of each other's industries and academic research priorities and concerns**. As the EU Member States collaborate closely, they are more likely to align their interests and policies, creating a cohesive front that can address emerging challenges in a coordinated manner. In essence, the use of coalitions of technology holders and Article 10 not only optimises capacity usage, but also fosters a culture of cooperation that reinforces the EU's resilience and influence on the global stage. As a frontrunner in critical technologies as well as a country that already invoked Article 9, the Netherlands can take a leadership role in identifying potential like-minded technology holders and initiate talks.

Finally, **the European Union can leverage its existing digital partnerships to engage in closer collaboration** with Japan, the Republic of Korea, Singapore and even India, which are frontrunners in economic security, research security and/or specific critical technologies. The EU has established robust digital alliances with those governments through initiatives such as the Digital Partnerships and the EU–India TTC. Building upon these foundations, the EU can facilitate comprehensive dialogues encompassing export controls on critical technologies. This cooperation can include information-sharing, joint risk assessments and the development of common regulatory frameworks to address shared concerns and enhance cooperation on future export-control measures with trusted partners other than the US. Such dialogues can also present opportunities for the EU to work towards economic and technological security approaches that promote open science and scientific freedom with its trusted partners. Such cooperation can also include a broader group of countries, as long as that happens at an early stage of technological development and with appropriate guardrails in place.

In recent years, cooperation on semiconductor export controls emerged from crisis mode. Now is the time for the European Union and its Member States to plan for balanced action in critical technologies.

Appendix Four scenarios for 2030: The future of export controls on critical technologies

This appendix outlines the scenario analysis discussed in two expert workshops on export controls on critical technologies convened in November and December 2023. The output of these workshops has been incorporated into this Clingendael Report.

The scenario exercise departed from a specific **assumption** on China, namely that competition with China is a given. This assumption seems realistic for the next five to ten years, given the current geopolitical environment. Having established this basic premise, **two uncertainties** – or building blocks – stand out as key variables that will shape the Dutch – and EU's – ability to determine export controls on critical technologies:

1. **the extent of cooperation within the EU**; and
2. **the extent of cooperation with the US**.

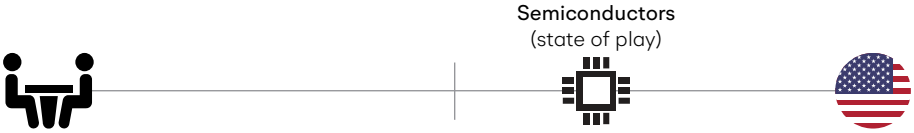
Building block (1): The extent of cooperation within the EU will vary.
The two opposite ends of this variable are the following:

- **The Netherlands as an independent player within the EU context.** The Netherlands acts completely by itself, with neither cooperation nor information exchange whatsoever within the EU context, nor awaiting for the EU's and other (leading) Member States' input. The Netherlands also engages with the US and other countries in minilateral settings, formally independent of the EU and other EU Member States.
- **The Netherlands aligned with EU Member States in an EU-wide export-control regime.** The Netherlands is part of an EU-wide export-control regime in which the EU has the mandate to develop new regulations that are implemented in all Member States. The EU has the mandate to speak in multilateral regimes and in bilateral settings on behalf of EU Member States, and when the Netherlands engages with the US and other countries in minilateral settings, it does so in full alignment with the relevant EU actors.

1. The Netherlands as an independent player within the EU context
2. The Netherlands aligned with EU member states in an EU-wide export-control regime

Building block (2): The extent of cooperation with the US will vary.
The two opposite ends of this variable are the following:

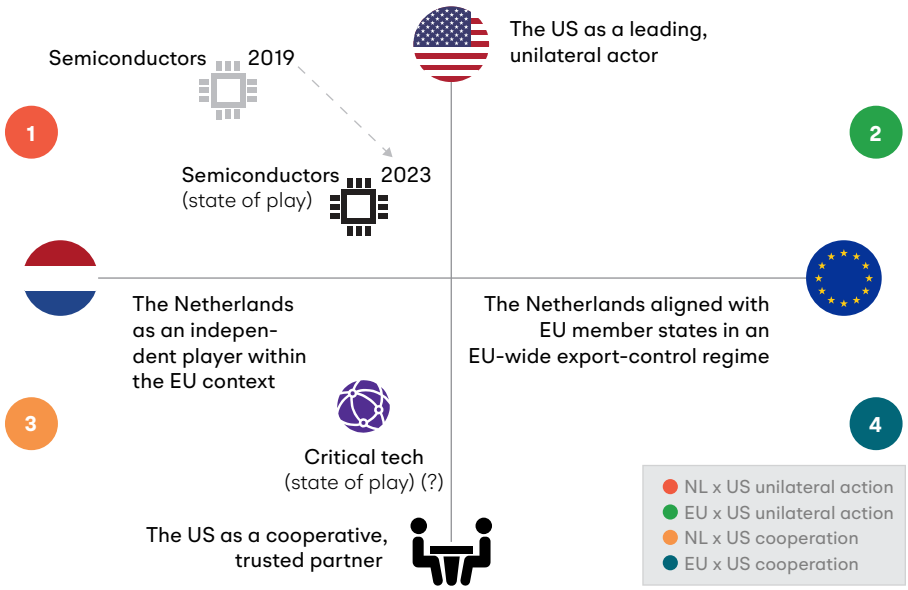
1. **The US as a cooperative, trusted partner.** The US proactively and unilaterally takes the lead in imposing export controls on critical technologies, regardless of the EU and its Member States. EU tech sovereignty is enhanced because of the ability of the Netherlands and the EU to align measures with their own interests.
2. **The US as a leading, unilateral actor.** The US proactively and unilaterally takes the lead in imposing export controls on critical technologies, regardless of the EU and its Member States. EU tech sovereignty is jeopardised by the lack of alignment and decision-making power.



1. The US as a cooperative, trusted partner
2. The US as a leading, unilateral actor

The aforementioned building blocks and uncertainties inform the following **four potential future scenarios**.

Figure 2 Four scenarios for the future of export controls on critical technologies



1. **NL x US unilateral action:** The Netherlands moves forward individually and is forced to follow the US on new export controls. While the Netherlands is now on better terms with the US, how does sidelining the EU Member States and moving forward alone impact the EU's tech sovereignty?
2. **EU x US unilateral action:** The EU and its Member States manage to develop a new EU export-control regime that gives the EU a bigger mandate to act on export controls. Meanwhile, the US is unilaterally pushing the needle on export controls on critical technologies, in ways that go beyond the EU's desired approach. With its strengthened mandate and enhanced knowledge base, are the EU and its Member States better able to deal with the consequences of US policies?
3. **NL x US cooperation:** The Netherlands – and other technology holders in the EU – jointly reach to a new export-control regime in partnership with US and other like-minded partners. Is the Netherlands able to get the EU on board with this new partnership, or is the Netherlands merely a US satellite state?
4. **EU x US cooperation:** In partnership with the US and other countries that hold advanced technologies – such as Japan and South Korea – the EU establishes a new export-control regime. Which steps were taken to get to this point, what are the advantages of and challenges to this coordinated approach, and how does China react to this aligned Western block?