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CFG's response to the European Commission's call for evidence for the 2025 Strategic Foresight Report

Contents

Introductory remarks

The following pages contain additional research and analysis that supports the Centre for Future Generations feedback to the 2025 Strategic Foresight Report (2025 SFR) call for evidence (Ref. Ares(2025)1341453) launched on 19 February 2025. The insights shared in this document seek to support the Commission's efforts to enhance coherence and synergies between all policies that are relevant to strengthening long-term resilience. Our focus in preparing our feedback has been the intended purpose of the 2025 SFR to provide a comprehensive framework for long-term resilience across policy priorities, provide actionable advice and policy recommendations. We have combined our topical expertise with broader issues that the Commission is looking to tackle, to contribute to shaping the Commission's general approach to strategic foresight and its use in the new mandate. Our response thus combines broader, horizon long-term EU resilience issues and opportunities, and specific emerging technology policy topics where our expertise sits across: advanced AI, biotechnology, climate interventions, neurotechnology, foresight, governance.

Responses to the Guiding Questions

1. Scope: What are the main challenges to long-term EU resilience and what are the strengths on which Europe can build?

In considering the main challenges and the strengths that contribute to the EU's long-term resilience, there are several dimensions that CFG considered which are elaborated below: governance and geopolitical context, economy and competitiveness, emerging technologies and climate.

Governance & geopolitical context

Europe's longstanding reputation as the beacon of social democracy in the world is now challenged as both geopolitical tensions and rapid technological advancements collide. Concerns around democracy in the digital age have long been raised[1], but typically centred on the quality of democracy and democratic representation in view of digital technologies.

Over the past decade, however, leading private companies behind these technologies have shifted power away from citizens and governments onto themselves, evading democratic oversight and accountability[2]. U.S. President Trump's inauguration revealed an alarming inflection point: tech and politics are deeply entangled, threatening the very survival[3] of Western liberal democracy. The Trump administration, reportedly backed by major US tech companies, have pushed back on the EU's tech regulatory playbook[4] by instrumentalising free speech and "freedoms" to attack European values and democracy. This has led to calls by experts for Europe to step up and safeguard its democratic and technological future so as to avoid becoming a digital colony[5] under the weight of American techno-imperialism.

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[1] J. Anderson, L. Rainie,'Concerns about democracy in the digital age', *Pew Research Centre*, 21 February 2020, https://www.pewresearch.org/internet/2020/02/21/concerns-about-democracy-in-the-digital-age/ (accessed 18 March 2025).

[2] M. Schaake, *The Tech Coup: How to Save Democracy from Silicon Valley,* Princeton University Press, 2024.

[3] M. Wolf, 'Trump's threat to US liberal democracy', *Financial Times,* 14 January 2025, https://www.ft.com/content/49de4739-6ed8-4b67-a332-1602e89d61a5 (accessed 18 March 2025).

[4] L. Cerulus, 'Vance's week of waging war on EU tech law', *Politico*, 15 February 2025, https://www.politico.eu/article/jd-vance-waging-war-eu-tech-law-msc-ai-summit/ (accessed 18 March 2025).

[5] J.I. Torreblanca, 'Big tech, Donald Trump, and "techno imperialism": How Europe can avoid becoming a digital colony', *European Council on Foreign Relations,* 20 January 2025, https://ecfr.eu/article/big-tech-donald-trump-and-techno-imperialism-how-can-europe-avoid-becoming-a-digital-colony (accessed 18 March 2025).

As Europe confronts this threat to its democracy, it simultaneously faces ever-more powerful technologies[6]—climate interventions, AI-assisted biotechnology and neurotechnology—with enough disruptive potential to fundamentally reshape society. A weakened democratic foundation endangers all pillars of open societies and markets: peace, prosperity, sustainability, security, equality, innovation, and sovereignty. This erosion specifically compromises Europe's ability to responsibly research climate interventions, prepare for biothreats, establish ethical boundaries for neural interfaces, and develop safe and trustworthy AI within a rules-based framework.

The EU's current democratic and regulatory toolbox will need significant reinforcement towards building long-term resilience. Beyond initiatives such as the Democracy Shield to combat foreign interference, the EU will need to defend democracy at home—including between election periods. The EU will need to consider implications for the integrity of Europe's democratic institutions and processes, rule of law, and citizens' civil liberties, all throughout its tech agenda. It will need to double down on closing the enforcement gap and ensuring a democratic future for the bloc. This will require investing into strong and resilient tech policy implementation and enforcement, taking every opportunity to show the value of tech policy to citizens, raising the bar for regulatory and investment transparency and accountability, prioritising social fairness and intergenerational equity, and strengthening the rule of law[7], particularly in the development and adoption of emerging technologies.

Economy and competitiveness

Today, the number of critical technologies to manage is growing and they are getting more complex, at the same time population and economic growth in Europe are slowing down. Between 2010 and 2023, the European Union's economy grew at an average annual rate of 1.39%, significantly trailing the United States' at 2.34%. This persistent gap highlights Europe's struggles with economic dynamism and technological advancement[8]. If this trend continues, it will become increasingly difficult to sustain the social economy and maintain competitiveness with geopolitical rivals.

The technology gap with the US partly explains why the EU is lagging behind in productivity growth and, thus, innovation—as pointed out by the Draghi report[9]. To date, the EU's strategy has been to try and replicate the US model without fully following through on it— as catching up is strenuous and delivers lacking results like those we can, for example, see in replication of cloud infrastructure and hyperscalers.

The EU has and should focus on the following comparative advantages:

- The EU is already home to world-class engineering and computer science schools[10] and can leverage its high levels of human capital.
- Europe has a comparative advantage in strategic sectors such as quantum communications and sensing, and advanced photonics. These technologies need to benefit from the scaling effect through private sector collaboration, rather than research consortia that dilute resources.

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[6] J. Grabaak, M. Koomen, M. Reddel, 'Five emerging technologies to act on now', *Centre for future generations,* 2024, https://cfg.eu/wp-content/uploads/Five-Emerging-Technologies_ICFG_2024.pdf (accessed 18 March 2025).

[7] C. Seeber, M. Neven, 'Policy Discussion - Forging the European Democracy Shield', *International IDEA*, 12 December 2024, https://www.idea.int/news/policy-discussion-forging-european-democracy-shield (accessed 18 March 2025).

[8] World Bank and OECD (2025) – with minor processing by Our World in Data, 'Gross domestic product (GDP)', *World Bank and OECD*, "World Development Indicators" [original data], https://ourworldindata.org/grapher/gdp-worldbank-constant-usd (accessed 8 March 2025).

[9] M. Draghi, 'The future of European competitiveness', *The European Commission*, 9 September 2024, https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en (accessed 8 March 2025).

[10] L. Quattrucci, 'Europe has a competitiveness problem. But it's not what you think.', *Voices [web blog],* Blavatnik School of Government, University of Oxford, 25 February 2025, https://www.bsg.ox.ac.uk/blog/europe-has-competitiveness-problem-its-not-what-you-think (accessed 19 March 2025).

- Procurement is 14% of European GDP, and can become a strategic tool for innovation if reformed well[11]. In the political guidelines for the new European Commission[12], then president-candidate Ursula von der Leyen underlined that, "a 1% efficiency gain in public procurement could save EUR 20 billion a year. And it is one of the main levers available to develop innovative goods and services and create lead markets in clean and strategic technologies."

Emerging technologies

The EU is well-positioned to develop new emerging technologies that articulate innovation, competitiveness, resilience, and which are trustworthy while responding to a broad set of critical trends in society that can be a make it or break it for long-term resilience.

Artificial intelligence has been most central to discussions around the EU's long-term resilience across a plethora of issues, from health to defence. An example of the EU's path to resilience in AI-space that can further be built on, is the initiative to mobilise €200 billion for AI investment launched in February 2025[13]. This announcement is a starting point in transforming the EU into a global leader in trustworthy and responsible AI. Adequate investment paired with regulation, alongside development of trustworthy AI systems, set the stage to bring Europe the title of a pioneer in safe and ethical AI innovation by 2040. In this vein, following the recommendations of the Draghi report on EU competitiveness on the increase of public and private R&D investment is a critical pathway to a resilient EU in 2040. For additional context around this specific example, CFG's report, Building CERN for AI[14], provides a concrete blueprint to address the creation of a pan-European AI research institution that could transform Europe's technological landscape, serving as both a driver for innovation and a safeguard for responsible AI development.

Another critical topic in society that is closely connected to long-term resilience is mental health which has risen as a prominent public health topic in the light of the COVID-19 pandemic and broader future resilience debates. The declining mental health of young people,[15] influenced by complex factors like social media, digital technologies, climate change, and geopolitical tensions and uncertainties, signals a major threat to the resilience of future generations.[16] Mis-/disinformation, cyberbullying, discrimination, information polarisation, doomscrolling, and constant online engagement are eroding

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[11] L. Quattrucci, 'While paper #002: A well-architected framework for public procurement', *Tial*, 25 February 2025, https://tial.org/publications/a-well-architected-framework-for-public-procurement/ (accessed 19 March 2023).

[12] Ursula von der Leyen, Europe's Choice, Political guidelines for the next European Commission 2024-2029, The European Commission, 18 July 2024, https://commission.europa.eu/document/download/e6cd4328-673c-4e7a-8683-f63ffb2cf648_en?filename=Political%20Guidelines%202024-2029_EN.pdf (accessed 19 March 2025).

[13] Speech by President von der Leyen at the Artificial Intelligence Action Summit, *The European Commission,* February 11, 2025, https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_25_471 (accessed 12 March 2025).

[14] A. Petropoulos, B. Pataki, D. Juijn, D. Janků, M. Reddel, 'Building CERN for AI. An Institutional blueprint', *The Centre for Future Generations,* January 2025, https://cfg.eu/building-cern-for-ai/ (accessed 12 March 2025).

[15] World Health Organization,'World mental health report: transforming mental health for all', 16 June 2022, https://www.who.int/publications/i/item/9789240049338 (accessed 19 March 2025).
The Organisation for Economic Co-operation and Development (OECD), *Mental health*, 2022, https://www.oecd.org/en/topics/sub-issues/mental-health.html (accessed 19 March 2025). N. W. Anderson, F. J. Zimmerman, A. J. Markowitz, N. Halfon, D. Eisenberg, K. A. Moore, '*Child and adolescent mental health outcomes are declining despite continued improvements in well-being indicators*', Child Trends, 3 August 2023, https://www.childtrends.org/publications/child-and-adolescent-mental-health-outcomes-are-declining-despite-continued-improvements-in-well-being-indicators (accessed 19 March 2025). The New York Times, '*Global Issues are Taking a Major Toll on Young People's Mental Health*', 13 August 2024, https://www.nytimes.com/2024/08/13/well/mind/mental-health-young-adults-trends.html (accessed 19 March 2025). J. Twenge, D. Blanchflower, '*Declining Life Satisfaction and Happiness Among Young Adults in Six English-speaking Countries*', National Bureau of Economic Research, Working papers, February 2025, https://www.nber.org/papers/w33490 (accessed 19 March 2025).

[16] V. Mahieu et al., '*Declining mental health and well-being of young Europeans*', *Future Shocks 2023: Risk 15*, European Parliamentary Research Service, 20 July 2024, https://www.europarl.europa.eu/thinktank/en/document/EPRS_STU(2023)751428 (accessed 19 March 2025).

cognitive resilience, emotional skills, and trust in society.[17,18] Furthermore, early signals indicate that digital technologies may be harming attention[19] and emotional regulation,[20] while novel Generative AI technologies may impact cognitive skills,[21] which are all crucial for developing mental resilience. This is particularly concerning for children and adolescents, whose cognitive development is still ongoing.

Emerging technologies, such as brain-computer interfaces and neurofeedback devices, offer potential benefits for mental health but could also pose risks to cognitive development,[22] especially as they provide more direct access to the brain than current technologies.

Europe has significant strengths to address these challenges:

- Robust regulatory frameworks (e.g., GDPR, AI Act) promoting ethical tech development, and fostering trust and safety.
- Established cross-border coordination for health information sharing and crisis mitigation.
- Strong welfare and healthcare systems based on human rights.
- Strong research capacity in mental health and emerging technologies.
- A rich history and cultural foundation supporting societal well-being.

Climate interventions

The EU faces profound challenges in ensuring long-term resilience as global temperatures head toward 3°C warming[23], leading to significantly warmer inland regions[24] and escalating threats to infrastructure, public health, and food security[25]. Despite the advances in understanding climate risks[26], early warning systems and societal preparedness remain insufficient to address the escalating social and economic impacts of extreme weather events[27].

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[17]The U.S. Surgeon General's Advisory, *Social media and youth mental health*, 2023, https://www.hhs.gov/sites/default/files/sg-youth-mental-health-social-media-advisory.pdf (accessed 19 March 2025).. M. C. Murphy, '*Cyberbullying among young people: Laws and policies in selected Member States*', European Parliamentary Research Service, 13 June 2024, https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2024)762331 (accessed 19 March 2025). World Health Organization, *Teens, screens, and mental health*, 25 September 2024, https://www.who.int/europe/news-room/25-09-2024-teens--screens-and-mental-health (accessed 19 March 2025).

[18] N. Bentzen, '*Strategic and systemic threats to the democratic information sphere*', *Future Shocks 2023: Risk 13*, European Parliamentary Research Service, July 2023, https://www.europarl.europa.eu/RegData/etudes/STUD/2023/751428/EPRS_STU(2023)751428_EN.pdf (accessed 19 March 2025).

[19] M. George, M. Russell, J. Piontak, C. Odgers, '*Concurrent and Subsequent Associations between Daily Digital Technology Use and High-Risk Adolescents' Mental Health Symptoms*', Child Development, 3;89(1) 2019, https://pmc.ncbi.nlm.nih.gov/articles/PMC5670031/ (accessed 19 March 2025).

[20] C. Haughton, M. Aikan, C. Cheevers, '*Cyber babies: The impact of emerging technology on the developing Infant*', Journal of Psychology Research, Vol. 5(No. 9):504-518, 2015, https://www.researchgate.net/publication/284028810_Cyber_babies_The_impact_of_emerging_technology_on_the_developing_InfantPsychology_Research (accessed 19 March 2025).

[21]H. P. Lee, A. Sarkar, L. Tankelevitch, I. Drosos, S. Rintel, N. Wilson, '*The Impact of Generative AI on Critical Thinking: Self-Reported Reductions in Cognitive Effort and Confidence Effects From a Survey of Knowledge Workers'*, Microsoft Research, 2025, https://www.microsoft.com/en-us/research/uploads/prod/2025/01/lee_2025_ai_critical_thinking_survey.pdf (accessed 19 March 2025). M. Gerlich, '*AI Tools in Society: Impacts on Cognitive Offloading and the Future of Critical Thinking*', *Societies*, 15(1), 2024, https://www.mdpi.com/2075-4698/15/1/6 (accessed 19 March 2025).

[22] Global Office for Research and Foresight, 'Neurotechnology and Children', UNICEF Working Paper, June 2024, https://www.unicef.org/innocenti/media/8956/file/UNICEF-Innocenti-Neurotechnology-and-Children-2024.pdf (accessed 19 March 2025).

[23] United Nations Environment Programme, 'Emissions Gap Report 2024: No more hot air… please! With a massive gap between rhetoric and reality, countries draft new climate commitments', 24 October 2024, https://www.unep.org/resources/emissions-gap-report-2024 (accessed 19 March 2025).

[24] Intergovernmental Panel on Climate Change (IPCC), 'Climate Change 2021 The Physical Science Basis Working Group I - Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change' *Chapter 11: Weather and Climate Extreme Events in a Changing Climate,* https://www.ipcc.ch/report/ar6/wg1/ (accessed 19 March 2025).

[25] European Environment Agency, 'European Climate Risk Assessment' *EEA Report 01/2024*, 111 March 2024, https://www.eea.europa.eu/en/analysis/publications/european-climate-risk-assessment (accessed 19 March 2025),

[26] European Environment Agency, 'European Climate Risk Assessment' *EEA Report 01/2024, ibid.*

[27] "The EU's Joint Research Centre (JRC) recently projected the economic fallout for the EU from the cross-border impacts of climate change via trade at EUR 10.32 billion per year in a 2°C warming scenario and EUR 27.38 billion in a 3°C scenario." European Environment Agency, 'European Climate Risk Assessment' *EEA Report 01/2024*, p.292, *ibid.*

Current climate risk evaluations consistently highlight the inadequacy of adaptation policies both at the EU[28] and international levels[29], which fall short of addressing the increasingly severe effects of climate change. A particularly alarming risk is the potential shutdown of the Atlantic Meridional Overturning Circulation (AMOC) within the next few decades - a critical tipping point that could plunge Northern and Western Europe into drastic cold while intensifying heat, droughts, and monsoon disruptions elsewhere[30]. This risk is part of a broader cascade of tipping points - for which extensive scientific literature exists[31] - where destabilization in one system, for example, the Greenland ice melting, could trigger irreversible shifts in others, including the Amazon rainforest and the West Antarctic Ice Sheet[32]. The EU has already put in place enhanced disaster preparedness and early warning capabilities. Mechanisms such as the EU Civil Protection Mechanism, the Copernicus Emergency Management Services and the upcoming preparedness strategy can help address gaps in societal preparedness, ensuring a proactive response to climate risks.

In addition, even with adaptation efforts, there are limits to what societies can withstand. The recognition of 'loss and damage' under the UN Climate Convention is insufficient to address the inevitable suffering, societal disruption[33], and migration pressures[34] that will arise from climate-induced collapses. As the impacts of climate change grow worldwide, the risk of unilateral deployment of technologies aiming at mitigating some of the worst effects of climate change increases. One technology in particular that CFG has been following closely is Solar Radiation Modification (SRM). SRM could rapidly cool down the planet after merely a few years of focussed technology development. Given its rapid effect, it may seem more like a global adaptation tool for managing climate threats such as extreme heat, but it also poses serious geopolitical, ethical and environmental concerns[35]. These need to be carefully considered in meeting the urgent need for rigorous and responsible research on the topic that comprehensively examines SRM's potential, risks and side-effects[36].

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[28] "The assessment shows that the EU's policies and adaptation measures are not keeping pace with the rapidly growing risks. Incremental adaptation will often not be sufficient and urgent action is likely to be needed even on risks that are not yet critical, because many measures which improve climate resilience take effect slowly over prolonged periods." European Commission, *'Leading the way: from plans to implementation for a green and competitive Europe. Climate action progress report 2024',* p.32, 31 October 2024), https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52024DC0498 (accessed 19 March 2025).

[29] "Despite progress, adaptation gaps exist between current levels of adaptation and levels needed to respond to impacts and reduce climate risks" IPCC, '2022: Summary for Policymakers' Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Section C: Adaptation Measures and Enabling Conditions.

[30] Although climate models assessed by the IPCC suggest a complete collapse within the 21st century is unlikely, some studies suggest that an AMOC collapse could occur around mid-century. Such an event would especially impact Northern and Western Europe and the Sahel. For further details, see P. Ditlevsen and S. Ditlevsen, 'Warning of a forthcoming collapse of the Atlantic Meridional Overturning Circulation', Nature Communications, 14, 4254 (2023) and P. Good, Bamber, P., and al. 'Recent progress in understanding climate thresholds: Ice sheets, the Atlantic meridional overturning circulation, tropical forests and responses to ocean acidification'. Progress in Physical Geography: Earth and Environment, 42(1), 24-60, 2018.

[31] See IPCC, 'Climate Change 2021: The Physical Science Basis', The Working Group I contribution to the Sixth Assessment Report, specifically Box TS.9 'Irreversibility, Tipping Points and Abrupt Changes'; T. Lenton, et al., 'Global Tipping Point Report', Exeter University, 2023; D. Armstrong McKay, et al. 'Exceeding 1.5°C global warming could trigger multiple climate tipping points', Science, 2022; J. Van Passel, et al., 'Critical slowing down of the Amazon forest after increased drought occurrence', Proc. Natl. Acad. Sci. U.S.A., 2024.

[32] See OECD, '*Climate Tipping Points: Insights for Effective Policy Action'*, 2 December 2022, https://www.oecd.org/en/publications/climate-tipping-points_abc5a69e-en.html (accessed 19 March 2025). The increasing risk of crossing several tipping points with global warming rapidly approaching 1.5 °C has recently been stressed also by the JRC in its Earth System Tipping Points are a threat to Europe' report (2025).

[33] J. Peñuelas, S. Nogué, 'Catastrophic climate change and the collapse of human societies', *National Science Review*, Volume 10, Issue 6, June 2023.

[34] IPCC, '2022: Health, Wellbeing, and the Changing Structure of Communities'. Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

[35] For an overview of the what Solar Radiation Modification is and the risks and uncertainties it entails, please see European Commission, Group of Chief Scientific Advisors, 'Scientific Opinion on Solar Radiation Modification (SRM)', 2024; European Group on Ethics in Science and New Technologies' 'Opinion on ethical implications of SRM', 2024 and SAPEA 'Solar radiation modification' evidence review report, 2024; UNEP, 'One Atmosphere: An independent expert review on Solar Radiation Modification research and deployment', 2023; UNESCO 'Report of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) on the ethics of climate engineering' 2023; Center for Future Generations 'Policymakers FAQ', 2024.

[36] See European Commission: Directorate-General for Research and Innovation and Group of Chief Scientific Advisors, *Solar radiation modification*, Publications Office of the European Union, 2024, https://data.europa.eu/doi/10.2777/391614 (accessed 19 March 2025). 'Solar radiation modification is risky, but so is rejecting it: a call for balanced research' a letter signed by more than 170 academics in climate, March 2023, https://www.call-for-balance.com/letter (accessed 19 March 2025). 'Open letter regarding research on reflecting

Europe has demonstrated strong leadership in climate action, which could serve as a foundation for broader resilience efforts. The EU additionally has a strong foundation in climate science and earth system modeling, which enables a rigorous assessment of climate risks and SRM interventions, such as stratospheric aerosol injection (SAI). This scientific expertise coupled with Earth Observation infrastructures like Copernicus positions the EU to play a key role in evaluating the potential impacts, risks, and uncertainties associated with tipping points and climate interventions technologies.

Moreover, the EU has extensive expertise in establishing environmental safeguards, and regulatory oversight and risk management especially in the environmental and climate field. This regulatory expertise can be extended to SRM and broader climate intervention governance, ensuring that decisions align with democratic values, environmental justice principles, and the EU's precautionary approach[37]. Its leadership in international climate diplomacy and climate action, combined with democratic leadership, enables the EU to take the lead on the development of global norms, transparency, and comprehensive risk assessment standards for SRM research, reinforcing the importance of multilateralism and precaution in climate interventions.

2. Imagine 2040: How would you characterise a resilient EU in 2040?

A resilient EU in 2040 can be characterised as a democratically strong, politically stable and socially just society, that has the capacity to drive technological leadership, anticipate and mitigate emerging risks, successfully competing globally, with regulatory and policy-making capacity underpinned by strategic foresight. Emerging technologies, across AI, climate, neurotech, biotech, and quantum, are integrated into public systems across healthcare, education and economy at large, to address societal needs and challenges, with equal access for all citizens and a strong complementary digital safety literacy levels. In 2040, the EU remains at the forefront of climate adaptation[38] and mitigation, having successfully decarbonized its economy, established climate-resilient infrastructure[39], and pioneered nature-based solutions to protect both ecosystems and communities. Its agriculture, urban planning, and economic systems are fully adapted to a changing climate, ensuring long-term stability and prosperity across the continent[40].

Set against an even more volatile geopolitical environment, the EU's resilience in 2040 should ladder onto:

- Energy independence and diversification.
- Autonomous defence, with at least 70% of weaponry produced in and bought from the EU.
- Elimination, to the extent possible, of barriers to the single market.
- A single regime for startups across the EU, and a favourable bankruptcy law.
- Effective government procurement (14% of EU GDP/year) that is easier to distribute and easier for startups to access.

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sunlight to reduce the risks of climate change' signed by more than 110 academics in the natural sciences, February 2023, https://climate-intervention-research-letter.org/ (accessed 19 March 2025). D. Carrington 'Climate change target of 2C is 'dead', says renowned climate scientist', *The Guardian*, 4 February 2025, https://www.theguardian.com/environment/2025/feb/04/climate-change-target-of-2c-is-dead-says-renowned-climate-scientist (accessed 19 March 2025).

[37] "One of the main issues for international cooperation will be to develop institutions and norms to address potential negative consequences of SRM in other social or environmental fields, or for parts of the world either not protected or negatively affected by the SRM option chosen." IPCC, '2014: International Cooperation: Agreements and Instruments.' Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[38] As the world heads toward nearly 3°C at the close of the century, twice the Paris temperature goal (UNEP Gap Report, 2023), adaptation is an essential response.

[39] "Even temporarily exceeding this warming level will result in additional severe impacts, some of which will be irreversible. Risks for society will increase, including to infrastructure and low-lying coastal settlements." IPCC, 'Climate change: a threat to human wellbeing and health of the planet. Taking action now can secure our future', Press release, 28 February 2022

[40] "The increasing impacts of extreme weather events already today lead to severe economic losses. For example, for droughts they amount to around EUR 9 billion annually and for river floodings EUR 7.6 billion." European Commission, 'Sustainability and wellbeing at the heart of Europe's Open Strategic Autonomy' *Strategic Foresight Report 2023*

- More private spending in critical areas, by converting pension funds into strategic investment vehicles.
- Greater attractiveness and retention for top tech talent, through increased pay and the creation of economies of networks in innovation zones

By 2040, the EU will have strengthened its resilience toolbox through democratic innovation, including that enhanced by emerging technologies,[41] renewed institutional integrity to govern ethical and sustainable technologies including AI,[42] and the ability to govern for the public interest of both current and future generations. By 2040, the EU is a global leader in climate resilience, leveraging world-class climate data collection and strategically applying it to inform emergency response, infrastructure planning, and early warning systems. A fully integrated climate security foresight system enables the EU to anticipate and mitigate risks from extreme weather events, biodiversity collapse, and geopolitical climate disruptions. Through strategic foresight, advanced environmental monitoring, and integrated policy frameworks, the EU has strengthened its economic resilience[43], disaster preparedness and ensured a coordinated response to emerging climate-related challenges.

By 2040, the EU will consistently show[44] that democratic nations recover more swiftly from disasters, economic shocks, and health crises than their non-democratic counterparts—a strength the EU will continue to embody. The EU will also have increased its credibility at home and internationally as a standards setter with ambitious and robust laws to protect and promote its people and planet via good governance, democratic values, and the rule of law at home, and to help ensure the same of its partners and allies abroad.It will have increased global trust as a responsible leader through economic and climate diplomacy and strategic net-zero partnerships, beyond trade agreements and the Global gateway strategy.

As the world has emerged from the COVID-19 pandemic, the importance of readiness in the biotech space has surfaced as one the critical areas that will underpin how the EU will show up in 2040. In the area of biotechnology, by 2040, a resilient Europe will combine strategic autonomy in critical biotech value chains (health, defence and energy) with competitive bioeconomy systems that prioritise resilience, circularity and technological sovereignty. The ambition for Europe should be to balance security with openness, avoiding isolationism while safeguarding European values. This requires sustained investment in R&D, adaptive governance frameworks for emerging technologies, and collaborative frameworks that position Europe as a stable anchor in an increasingly volatile global order.
The path to resilience includes also prioritising the development and governance of technologies designed to protect European citizens and uphold European values. Through strategic innovation and governance today, in 2040 Europe should be prepared to respond effectively to a range of potential future scenarios, and operate as a global leader in high-impact innovation. Fostering technological sovereignty in a range of areas, Europe can secure its economic leadership while ensuring long-term prosperity for its citizens. Some of the instruments that can support this ambition include targeted investments, public-private partnerships, but also the effective use of early warning systems which can help successfully navigate societal, economic and political challenges driven by technology-framed transformation.

Considering the specific and critical context of EU's resilience to climate change in 2040, the EU will have developed and implemented a comprehensive Climate Security Strategy that accounts for

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[41] M H Tessler et al, 'AI can help humans find common ground in democratic deliberation', *Science*, 18 October 2024, https://www.science.org/doi/10.1126/science.adq2852
[42] Elysee, 'Statement on Inclusive and Sustainable Artificial Intelligence for People and the Planet', 11 February 2025, https://www.elysee.fr/en/emmanuel-macron/2025/02/11/statement-on-inclusive-and-sustainable-artificial-intelligence-for-people-and-the-planet
[43] "The increasing impacts of extreme weather events already today lead to severe economic losses. (...) Boosting the resilience to climate change in key areas, such as transport infrastructure, digital, energy, resource storage, health, food, buildings, or manufacturing plants will also entail significant resources. (...) All this builds as well a strong case for prevention: every euro invested in early warning systems returns an average of EUR131 from avoided losses, response costs, and additional societal benefits." European Commission, 'Sustainability and wellbeing at the heart of Europe's Open Strategic Autonomy' *Strategic Foresight Report 2023*
[44] M Sozan, 'Democracies deliver better economic opportunities, rights, and health for their people', *Center for American Progress*, 26 September 2024, https://www.americanprogress.org/article/democracies-deliver-better-economic-opportunities-rights-and-health-for-their-people/

climate tipping points[45], climate intervention risks, and geopolitical uncertainties. This strategy informs defence, infrastructure, adaptation, trade, and migration policies, ensuring the EU's strategic ability to anticipate and respond to climate-driven developments. By 2040, the EU's leadership in climate resilience, adaptation, scientific governance, and security foresight ensures that it is prepared for the challenges of a rapidly changing world, maintaining stability, prosperity, and environmental integrity for future generations.

In 2040, the EU has taken a leading role in establishing global norms, legal frameworks, and accountability mechanisms for climate intervention governance[46]. It has prevented destabilization of global climate systems through UN-based governance structures, ensuring that SRM remains a globally coordinated last-resort tool. This EU-backed global governance integrates world-leading climate intervention monitoring, particularly stratospheric aerosol injection detection, providing real-time, publicly available intelligence on any large-scale, unilateral testing or deployment of SRM technologies[47].

On the climate interventions research side, in 2040 the EU leads in scientific research including on SRM – with a comprehensive view on potentials, risks and side-effects. It continues[48] to conduct regular rigorous scientific assessments, evaluating both the potential benefits of temporary temperature regulation and disaster risk reduction - as nearly 19% of Europe's population is exposed to multiple natural hazards[49], as well as the associated risks, including regional climate disruptions and moral hazard concerns. By leveraging its advanced climate modeling capabilities, maintaining transparent, open-access research, and collaborating with international institutions, the EU ensures that SRM remains scientifically guided and governed in line with the precautionary principle. In addition, in 2040 SRM governance involves public and stakeholder engagement-informed decisions aligned with climate justice, and responds to some of the moral hazard concerns raised.

3. Society and Generations: How can we ensure a resilient society and fairness between generations?

A resilient society learns from the past, adapts to present challenges, and stays committed to democratic principles, sustainability, and social fairness. By drawing lessons from historical disruptions like WWII, nuclear threats, and the Cold War, but also the more recent COVID-19 pandemic, we can anticipate risks and make informed decisions. Resilience demands patience, courage, and dedication, especially in turbulent times. Rather than abandoning hard-won legal achievements like GDPR, DSA, or the AI Act in moments of geopolitical turbulence, the EU should focus on refining and future-proofing its democratic and regulatory toolbox to meet evolving needs, ensuring stability and cohesion while preserving legal and governance integrity.

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[45] "With global warming rapidly approaching 1.5 °C, the risk of crossing several Earth System Tipping Points (ESTP) becomes an emerging security threat." See European Commission: Joint Research Centre, 'Earth System Tipping Points are a threat to Europe', Ispra, 2025, JRC140827, https://publications.jrc.ec.europa.eu/repository/handle/JRC140827 (accessed 19 March 2025).

[46] This is in line with the policy direction provided by the European Commission Communication, 'A new outlook on the climate and security nexus: addressing the impact of climate change and environmental degradation on peace, security and defence', 28 June 2023, https://www.eeas.europa.eu/eeas/joint-communication-climate-security-nexus_en (accessed 19 March 2025). The Joint Communication on the climate-security nexus says that "the EU will support international efforts to comprehensively assess the risks and uncertainties of climate interventions, including solar radiation modification, and will promote discussions towards a potential international governance framework, including research-related aspects". It also aligns with recommendation no. 3 of the European Commission Chief Scientific Advisors' Scientific Opinion on SRM, which advises the EU to "proactively negotiate a global governance system for SRM deployment through a multilateral process with international legitimacy".

[47] Recommendation no. 3 of the European Commission Chief Scientific Advisors' scientific opinion on SRM also proposes developing a monitoring system "*to improve the EU's capability to detect and quantify any undeclared deployment of SRM by public or private actors, anywhere in the world*".

[48] The Group of Chief Scientific Advisors and the European Group on Ethics in Science and New Technologies published their opinions on the scientific and ethical perspectives of SRM (2024) calling for responsible research on impacts of solar radiation technologies.

[49] T.-E. Antofie, S. Luoni, and al. 'Spatial identification of regions exposed to multi-hazards at the pan-European level', *Nat. Hazards Earth Syst. Sci.*, 25, 287–304.

Future generations are Europe's democratic blindspot.[50] The EU lacks mechanisms for representing future generations, with no planning beyond 2050, resulting in short-term policy prioritization that neglects intergenerational equity. At the same time, fostering intergenerational dialogue is vital for creating policies that reflect the needs and perspectives of both younger and older generations. Decisions made today, particularly on climate action, economic policies, and technological interventions, can be evaluated through intergenerational impact assessments, among other, that account for their long-term material, economic, and environmental consequences[51]. Policies must prioritize not just short-term political cycles but also the well-being of future societies.

We see three pillars that will help achieve a fair, resilient EU society: leaving behind a healthy, inhabitable planet; taking a systemic, intergenerational lens to the rising challenges in the intersection of technology, democracy, mental health, sustainability, etc.; and embracing more-than-human governance[52] processes that make voices[53] of future generations and non-human nature heard by considering a wider range of interests . Ensuring resilience across generations requires reinforcing democratic long-term decision-making. It also requires foresight capacity to identify the long-term consequences of our actions. Additionally, long-term resilience requires investment in safe technology to boost innovation which drives competitiveness and has a positive impact on society, and entails addressing existing obstacles to innovation that stem from lack of access to funding and investment in research.

Looking specifically into the hugely significant area of emerging technologies, Europe must address the impacts of digital (especially emerging) technologies on mental health, and foster a sense of cultural cohesion and solidarity. As digital technologies (especially artificial intelligence and neurotechnologies) become further embedded in daily life, longitudinal research on benefits and risks of digital tech (including social media, AI, and neurotechnology) for cognitive development and mental health will be essential in order to support an evidence-based, forward-looking approach to policy.

In this regard, a systems perspective is essential—examining the complex interplay between socio-economic, psychological, technological, and governance factors will help identify effective policy interventions. By prioritising a mental-health-in-all-policies approach, we can counter the potentially detrimental impacts of digital technologies and build a more resilient society.

Additionally, climate intervention technologies—like earlier described SRM—carry profound intergenerational implications. In the case of Stratospheric Aerosol Injection (SAI), deployment would likely need to continue for decades, if not centuries, as the only viable off-ramp would be achieving net-negative emissions through carbon dioxide removal (CDR) and deep mitigation. This means SRM would shape the climate for future generations in every country, though its effects would not necessarily be distributed equally, raising critical questions of equity, governance, and long-term responsibility.

Given the implications of SRM for future generations and to ensure intergenerational fairness, EU should:

- Support responsible and inclusive research on SRM to provide future decision-makers with the knowledge needed to assess risks and opportunities, ensuring they can make well-informed

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[50] A Alemanno, 'Future generations as Europe's democratic blindspot', *European Democracy Hub,* 20 February 2024, https://europeandemocracyhub.epd.eu/future-generations-as-europes-democratic-blind-spot/ (accessed 19 March 2025).

[51] "Decisions being taken by those currently living can affect the lives and rights of those born years, decades, or many centuries in the future. In recent decades, the need to recognize the intergenerational dimensions of present conduct have taken on increasing urgency. Humanity, the Earth on which we live, the natural systems of which we are but one part, and our political, social, cultural and economic systems, are in the midst of profound, rapid, and perilous change at humanity's own hands." 'Maastricht Principles on The Human Rights of Future Generations', adopted on 3 February 2023.

[52] C Chwalisz & L Reid, *'*More-than-human governance experiments in Europe*', Democracy Next*, 30 October 2024, https://www.demnext.org/projects/paper-more-than-human-governance (accessed 19 March 2025).

[53] M Francesca et al, 'Introducing the unheard: from exploitation and oppression to interconnection and regeneration?, *Deliberative Democracy Digest*, 3 April 2024, https://www.publicdeliberation.net/introducing-the-unheard-from-exploitation-and-oppression-to-interconnection-and-regeneration/ (accessed 19 March 2025).

choices in the face of escalating climate crises. Without solid research in the field, all we have is speculation, which forces future generations to make high-stakes decisions without reliable knowledge of the risks and potentials of such interventions.

- Strengthen international safeguards and governance mechanisms to prevent short-term, unilateral decisions on the deployment of climate interventions technologies - and especially SRM techniques. For instance, if SAI is deployed at scale as a temporary measure to curb global warming, SRM would require sustained implementation over decades, if not centuries, creating a potential lock-in effect that could severely constrain the choices and agency of those who come after us.

- Ensure meaningful youth participation in discussions on if, when, and how climate intervention technologies - especially SRM - might ever be used. This can be realised through the establishment of permanent participatory platforms that guarantee fair representation of diverse societal groups, including minorities, indigenous communities, and voices from the Global South. These platforms must be inclusive, transparent, and designed to empower future generations, who will bear the long-term consequences of these decisions.

4. Long-Term Resilience: Which critical policy actions should be initiated today to strengthen resilience in the EU by 2040?

Under increasing political pressure from within and especially beyond EU borders, the EU needs to double down on its ability to effectively implement and enforce existing laws—especially in climate and digital domains. One way to do so is to create centralised enforcement bodies for such complex legislative domains. Thinking beyond this EU mandate, the AI Office could provide a blueprint for a future EU digital enforcement agency [54], for example, if it is structured with appropriate imagination and ambition. As the EU's tech policy landscape increases in volume and complexity, such a central institution could enhance the EU's ability to oversee such enforcement more effectively, with more technocratic candour and with a better view to cohesion.

Additionally, combining the public and private R&D investment increase recommendation from the Draghi Report—with a targeted strategy in cutting-edge AI research is another critical policy priority. At the same time, establishing a simplified funding framework that channels resources quickly through direct grants, venture capital matching, and targeted tax incentives or procurement preferences. Streamlining disbursement procedures to cut bureaucracy while ensuring full transparency and accountability throughout the process. CFG's report Building CERN for AI provides a concrete blueprint to address this and create a pan-European AI research institution that could transform Europe's technological landscape, serving as both a driver for innovation and a safeguard for responsible AI development.

Additionally, critical policy action is necessary with respect to procurement reform to unlock investment in innovation. Reforming procurement to move to the replication of the DARPA model of "tour of duty," where buyers are experts in the domain at hand and manage the commissioning, the maintenance and operations for the entire lifecycle of the product.

Looking specifically into the area of mental health and neurotech, to supplement more broader points earlier, we propose following critical actions:

- Embed "Mental-Health-In-All-Policies". Mental health must be integrated into all policy areas, ensuring that long-term resilience strategies address the known determinants of mental health. It is also critical to recognise mental health as a biopsychosocial phenomenon, particularly in relation to technology and its impact on well-being.

[54] M Koomen & R MacDonald, Enforcement in an Age of Accelerated Innovation, Centre for Future Generations, 4 June 2024, https://cfg.eu/enforcement-in-an-age-of-accelerated-innovation/

- Revisit the digitalisation agenda. Prioritise digital literacy in education that prevents digital addiction and cognitive harm in young people. Educate on safe tech use, the risks of cyber threats, data misuse, and excessive social media. Encourage data protection and the value of in-person relationships, promoting a balanced approach to digital engagement.

- Address the risks and opportunities of neurotechnologies. Emerging neurotechnologies, such as neurofeedback and brain-computer interfaces, offer promising potential for mental health, but must be approached cautiously: there is a risk of techno-solutionism, where these technologies may provide temporary fixes without addressing the underlying causes of mental health issues. We need a balanced approach that leverages their benefits while avoiding over-reliance on technological solutions for complex psychological and social challenges that must be addressed systemically.

To enhance the EU's long-term resilience, a strategic, integrated approach is required to address climate change as a security risk[55]. This includes leveraging existing foresight capabilities and closing governance and research gaps[56], particularly in potential risks linked to tipping points and SRM deployment.

To this aim, the EU must develop a comprehensive Climate Security Strategy as part of its broader Preparedness strategy and in line with the key message of the Niinistö's report[57] (i.e., the EU should prepare for worst-case scenarios). This should outline response options for major disruptions such as a halt of Atlantic meridional circulation, atmospheric destabilisation from polar ice melt, or unilateral climate interventions with regional or global impacts[58]. This strategy should utilise the foresight capabilities of European Union Institute for Security Studies (EUISS) and the European External Action Service (EEAS), along with the expertise of European Space Agency (ESA), the European Research Council (ERC), the Joint Research Centre (JRC), the European Defence Agency (EDA) and the Commission to drive scenario-based assessments on tipping points and climate interventions and their geopolitical implications, as well as leverage European research through Horizon Europe to reflect the full risk-management landscape for climate and potential interventions[59]. It should inform defence, infrastructure, adaptation, trade, and migration policies, enhancing the EU's strategic capabilities to anticipate and respond to developments that can arise within years.

In line with the recommendations of the Chief Scientific Advisors of the Commission in their recent report on SRM, key actions to build a governance framework for SRM should also be initiated today to govern the risk of a potential deployment of SRM in 2040, namely:

- Mission-driven research and international assessments on SRM's feasibility, risks, scientific uncertainties and climate security implications should be prioritized. Research should remain publicly funded and independent of commercial interests to prevent policy capture[60].

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[55] Climate change is already a security risk for the EU and will increasingly be so as the planet warms. The role of climate change as a risk multiplier was emphasized by the European Commission in its recent communications on a New Outlook on the Climate and Security Nexus and by the 2025 German National Interdisciplinary Climate Risk Assessment.

[56] The UK's new ARIA program for tipping-point detection systems reveals important knowledge gaps on the topic.

[57] S. Niinistö 'Safer Together: Strengthening Europe's Civilian and Military Preparedness and Readiness', European Commission, 20 March 2024, https://commission.europa.eu/document/download/5bb2881f-9e29-42f2-8b77-8739b19d047c_en?filename=2024_Niinisto-report_Book_VF.pdf (accessed 19 March 2025).

[58] The need for anticipatory governance to prepare for widespread systemic risks resulting from crossing tipping points was recently stressed by the JRC in its 'Earth System Tipping Points are a threat to Europe' report. European Commission: Joint Research Centre, ROMAN CUESTA, R.M., DENTENER, F., GALMARINI, S., MILKOREIT, M., ARMSTRONG MCKAY, D., DE GROEVE, T., DENNIS, D.P., JANSSENS-MAENHOUT, G., LORIANI, S. and RUIZ MORENO, A., Earth System Tipping Points are a threat to Europe, European Commission, Ispra, 2025, JRC140827, https://publications.jrc.ec.europa.eu/repository/handle/JRC140827 (19 March 2015).

[59] CFG, 'Why the EU needs a comprehensive climate security strategy', Brief, 12 September 2024, https://cfg.eu/why-the-eu-needs-a-comprehensive-climate-security-strategy/ (accessed 19 March 2025).

[60] The importance of responsible research on SRM was also stressed by the European Commission´s Chief Scientific Advisor´s in recommendation n. 4 of the report on SRM.

- To enhance transparency and accessibility, a public registry of SRM research and funding must be established, which could be created under the auspices of UNEP or WMO[61].

- Global governance structures - including a monitoring system to detect the deployment of SAI - must be reinforced, ensuring SRM remains a globally coordinated, last-resort measure. Collaborating with UN agencies, the IPCC, and other governance bodies, the EU should advocate for multilateral legal frameworks and accountability mechanisms[62].

- Establishing inclusive forums for stakeholder engagement - such as permanent foresight citizen assemblies - for structured public deliberation to guide climate intervention policies - will enable broad, informed consensus on SRM governance[63]. Moreover, structured deliberation can preempt social conflict by providing an open forum for discussing contentious issues (such as SRM) thereby mitigating misinformation, fear, and polarization.

Looking additionally at the area of biotech, there are three policy pillars where potential for resilience can be unpacked by action taken today: securing biomanufacturing supply chains and capacity through biofoundries, strengthening bio-based autonomy via defence and strategic industries, and biosecurity and safe innovation. These are further broken down below.
Securing biomanufacturing supply chains and capacity through biofoundries. Biofoundries are pivotal for EU resilience. These facilities integrate synthetic biology, machine learning, and robotic automation to enable on-demand production of vaccines, therapeutics, and bio-based materials. Path for the EU to explore here is:

- Investing and fostering the development of an European biofoundries network (can be inspired by the Biofoundries Global Alliance[64], but Europe focused). A geographically distributed network of European biofoundries would reduce dependencies on centralised production hubs. Regional facilities will ensure capacity during crises (e.g., pandemic surge capacity for mRNA vaccines, providing bio-medicines to conflict zones or after catastrophic climatic events). These infrastructures would greatly contribute to ensuring resilient supply chains for biomedicines and biomaterials (see later on).

- Prioritize modular vaccine platform technologies that use synthetic biology to engineer “plug-and-play” platforms (e.g., lipid nanoparticles adaptable to multiple pathogens, portable and modular lab instruments). This requires sustained R&D funding for academia-industry consortia specialising in platform optimisation and modularity.

- Scale bio-based material manufacturing for resilient supply chains. Biotech impacts a lot of fields and industries. With the technological advances observed in synthetic biology and AI, one may anticipate the democratization of biomaterials for food, textile, energy , reducing reliance on the classical plastic/petrochemical supply chains. Similarly different biosolutions are already emerging with the objective to solve societal problems (e.g., pollution with engineered bacterial systems that sequester C02, health with synthetic components that could work as blood substitute for transfusion).

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[61] As outlined in the SAPEA’s Evidence Review Report (p.139 and 170) on which the Chief Scientific Advisors’ report is based, many experts at the EU and international level advocate for an international registry of SRM research to increase transparency about research, patent applications and technology developments. The creation of a such an international repository is also a topic of political convergence at the international level (UN system), as recently stressed by the European Commission in recent ‘Report on the implementation of the Joint Communication - "A New Outlook on the Climate and Security Nexus"’ published on February 18th, 2025 (“*At UNEA-6 (...) a key area of convergence was the creation of an UNEP repository of information on SRM. However, the resolution fell over the inability to agree on a proper framing, which the EU considers a missed opportunity to engage on this critical issue*”).
[62] In line with recommendations n. 4 of the Chief Scientific Advisors´ report on SRM.
[63] The importance of an inclusive discussion on SRM already at the early stage of the conversation was stressed by the SAPEA’s Evidence Review report ‘Solar radiation modification’ (p.116-119, 141) and reflected in recommendation n. 5 of the Chief Scientific Advisor´s SRM Report.
[64] N. Hillson, M. Caddick, Y. Cai, *et al.*, ‘Building a global alliance of biofoundries’, *Nat Commun* 10, 2040 (2019), https://www.nature.com/articles/s41467-019-10079-2 (accessed 19 March 2025).

Defense & strategic industries: bio-based autonomy. Establishing a holistic approach to reduce reliance on non-EU suppliers for critical materials is an elementary step that can be worked on today by:

- Incentivizing R&D for EU-made bio-based critical materials like microbial production of rare earth elements, engineered silk for ballistic substitutes or engineered systems for alternative energy sources.
- Securing infrastructure by mapping production of defense-critical biotech tools (DNA synthesiser, portable bioreactors and incubators) and ensuring they operate under EU-controlled entities, avoiding dependencies on third-country vendors.

Biosecurity and safe innovations. Geopolitical volatility and ecological challenges represent key challenges to EU resilience; making biosecurity a key consideration for strengthening European resilience. Critical actions that can be taken today are:

- Identifying critical bioeconomy supply chains. Mapping dependencies on non-EU inputs in different bio-industries (enzymes, instruments, biotechnology process). Ensuring joint procurement mechanisms exist to obtain needed resources and stimulate European biotech ecosystems. The Critical Medicines Act goes some way to implementing such measures in the EU's pharmaceutical supply chain; however this logic can be extended to other parts of the European bioeconomy reliant on.
- Establishing leadership in biosecurity standards. Europe is a leader regarding the establishment and implementation of biosafety procedures and guidelines in research and biotechnology. When effectively integrated with strategic foresight, biosecurity governance can proactively anticipate emerging risks that future technology may present, especially in a context where biotechnologies are becoming more accessible. Ideally the EU should mandate a security-by-design approach in biomanufacturing R&D embedding biosecurity as a competitive advantage.
- Enforce export controls on duals use biotech like synthetic biology strains that could be weaponised, while ensuring transparency to avoid stifling research and innovations. Ideally Europe should apply stringent biosecurity rules only to high-risk projects (e.g., gain-of-function research) while simplifying approvals for low-risk bioinnovations (e.g., industrial biomanufacturing).

5. Synergies and Tensions: What crucial synergies and tensions can be identified across various EU priorities which might, respectively, help or hamper EU's long-term resilience? How can we enhance these synergies and mitigate these tensions?

Tech and defense sovereignty present significant synergies, as advancements in technology can strengthen Europe's strategic autonomy and security. Investing in cutting-edge innovation while fostering a strong defense ecosystem - without compromising the EU's social model - can reinforce the EU's ability to respond to geopolitical challenges independently.

However, the urgency of both tech and defense sovereignty may create tensions with democratic processes, particularly if security concerns lead to hasty policy decisions that sideline transparency, public accountability, or fundamental rights. Additionally, priorities such as defense and economic competitiveness must be carefully balanced and effectively communicated alongside other essential EU principles, including the welfare state, environmental sustainability, and social innovation. Mitigating tensions requires a governance approach that prioritizes democratic oversight, safeguards civil liberties, and integrates sustainability into security and competitiveness strategies. Further, bold

investment into defense, technology, and economic security must be paired with adequate risk communication and citizen deliberation to ensure the European public, whose main priority is the cost of living[65], is sufficiently informed and adequately prepared for all potential outcomes.

Looking more broadly, additional tensions come from the speed of technological change versus societal adaptation. Technological disruption is accelerating, but society's ability to adapt remains challenged. Proactive policy interventions are required to address issues like job displacement and social fragmentation which could become major risks. A part of this tension is the one that exists between digitalisation and digital literacy. The EU's strong focus on a digital transition of society, particularly on digital literacy and skills in education, could be a double-edged sword. The skills not just of using and immersing oneself in tech (AI, social media, neurotech), but also knowing how to still be a human and maintain real inter-personal relationships will be absolutely critical to maintain healthy brain development and a cohesive society.

Another challenge is the balance between regulatory ambition and bureaucratic inertia. While robust regulatory frameworks are needed to mitigate risks, excessive bureaucracy can slow down innovation. Achieving synergy in this area requires streamlining processes and ensuring that regulations evolve in step with technological advancements.

Emerging tech innovations are at the same time synergising and in tension with mental health and wellbeing. For instance, AI and neurotechnology can synergise with health and social policies, providing personalised mental health tools and improving healthcare accessibility – particularly for conditions that are difficult to treat – thus fostering better societal resilience. While AI and neurotechnology offer potential benefits for mental health, they also pose significant risks to privacy and individual freedoms. The collection and use of sensitive personal data could lead to data misuse, profiling, surveillance, manipulation, and discrimination, while unequal access to these technologies may deepen existing inequalities. Without proper regulation (and enforcement), these tools could erode public trust and infringe on human rights.

To mitigate some of the tensions that could hamper long-term resilience, enhancing strategic foresight is an overall priority. Strengthening the ability to anticipate future developments will be key to ensuring EU resilience. This can be further emboldened by promoting a strategic approach to regulating emerging technologies with clarity, and consistency front-of-mind to ensure innovation is aligned with privacy and ethics. Finally, facilitating public dialogue and consultation processes to build consensus around the trade-offs between economic growth and environmental sustainability, especially in sectors where both can coexist, can help enhance synergies and mitigate identified tensions.

Another crucial synergy and tension has arisen against the backdrop of an increasingly volatile geopolitical context: the portfolios of what's deemed a "critical" public innovation has widened and deepened. The United States, China, the European Union, and NATO–among others–have all published critical innovation lists of varying lengths, where each of the listed categories are complex and multifaceted. The Australian Strategic Policy Institute has estimated that there are 64 technologies which are foundational for our economies, societies, national security, defence, energy production, health and climate security[66]. Europe cannot cover it all, it must focus on comparative advantage.

With growing resources and bold objectives, the EU should move to a moonshot approach to achieving long-term resilience. This includes shifting strategies and white papers into actionable policies that fuel the number of investors that chose Europe in the next five years, and the number of builders and entrepreneurs who see the Single Market as an opportunity to create equitable and competitive technologies.

Climate is another area that offers crucial synergies and tensions. While the EU champions ambitious climate policies, short-term energy security concerns, such as continued dependence on fossil fuels

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[65] European Parliament, "Cost of living is citizens' main concern going into new legislature," 3 October 2024, https://www.europarl.europa.eu/news/en/press-room/20240930IPR24358/cost-of-living-is-citizens-main-concern-at-the-start-of-the-new-legislature (accessed 19 March 2025).

[66] Australian Strategic Policy institute, ASPI's two-decade Critical Technology Tracker, 28 August 2025. Retrieved 18 March 2024 from https://www.aspi.org.au/report/aspis-two-decade-critical-technology-tracker

during geopolitical crises[67], may conflict with long-term climate commitments[68]. Without careful policy alignment, investments in decarbonization and adaptation risk being deprioritized, potentially leading to SRM being viewed as a justification for delaying emissions reductions rather than as a last-resort complement to mitigation and adaptation. To mitigate this moral hazard, strong governance and guardrails for SRM research and related funding are essential, ensuring that it does not undermine the efforts for sustained emissions cuts.

A strong precautionary approach[69], if interpreted in a very narrow way, may inadvertently slow down critical research on SRM or other climate intervention technologies, despite the need for greater scientific understanding to enable informed future decision-making. For this reason, a balance must be struck between preventing risky deployments and allowing controlled, transparent research, ensuring that governance remains proactive rather than reactionary. Precautionary stance on SRM[70] must strengthen rather than restrict climate security research, allowing for informed and science-driven decision-making.

6. Enhancing Strategic Foresight: How could the European Commission further improve its approach to strategic foresight to increase its impact on designing EU policies for a desirable future?

As an introduction, there are broad good-governance pillars to consider when it comes to improving design of EU policies: strategic hindsight, insight, and foresight. Designing future-proof tech policy requires learning from past policy success and failure, taking care of tomorrow, and bringing the public into policy processes. To stress test EU policy, policymakers must test their assumptions as new evidence and insights are revealed throughout the process of policy design to implementation and enforcement, and back again—test, reflect, and iterate. The EU's new Competitiveness Compass provides a crucial opportunity to ensure EU policies undergo due evaluation and reform to ensure they are fit for purpose with an eye to the public and future—with the protection and promotion of EU values at their core.

Moving to a more granular level, recent technological and security challenges, ranging from the increasing importance of advanced AI systems, cyber threats, and geopolitical instability, demonstrate that quantitative additions to strategic foresight are required. Quantification strengthens strategic foresight by converting vague uncertainties into comparable probabilities, enabling clearer communication, comparable inputs, and easier feedback loops for institutional learning. To craft policies that shape a desirable future, the EU must complement its current foresight methods with rigorous empirical approaches. This includes complex systems modelling, structured impact analysis, collective intelligence platforms, fault tree analysis, and early warning systems. These techniques will allow policymakers to better compare uncertainties and identify "big if true" scenarios where early interventions can make the biggest difference. This does not entail predicting the future with certainty. Instead, it allows for consistent, transparent, and systematic gears-level if-then understanding of what could happen and what the main drivers of uncertainty are.

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[67] A. Niranjan 'European imports of liquefied natural gas from Russia at 'record levels', *The Guardian*, 9 January 2025

[68] "(29) In light of the objective of achieving climate neutrality by 2050 and in view of the international commitments under the Paris Agreement, continued efforts are necessary to ensure the phasing out of energy subsidies which are incompatible with that objective, in particular for fossil fuels" Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999

[69] Highlighted in the 'Scientific opinion' on *Solar radiation modification*' of the Group of Chief Scientific Advisors published 9 December 2024.

[70] Reaffirmed in the 'Progress Report on the implementation of the Joint Communication - "A New Outlook on the Climate and Security Nexus" published 18 February 2025

"Action 23: Guided by the precautionary principle, the Commission and the High Representative will support international efforts to comprehensively assess the risks and uncertainties of climate interventions, including solar radiation modification (SRM)"

As an example for use case of early warning systems, the profound disagreement regarding AI's impact on growth rates highlighted in the High-Level Panel of Experts' Report to the G7 on Artificial Intelligence and Economic and Financial Policy Making[71], spans orders of magnitude in projected economic outcomes, with some economists anticipating modest productivity gains while others predict unprecedented economic transformation. This kind of extreme uncertainty—where estimates differ not by percentage points but by factors of 10 or 100—underscores why economic indicators need to be monitored closely through early warning systems. When uncertainty is this vast and potential impacts are so significant, strategic foresight resources should be disproportionately allocated to understanding and preparing for high-variance outcomes.

Climate resilience is another example where developing early warning systems must be prioritised.The JRC emphasizes that "Europe needs anticipatory governance to prepare for widespread systemic risks" from breaching tipping points[72]. Responding to this call, developing early warning systems for climate tipping elements[73] must be a priority. The EU's scientific agencies (JRC, European Environment Agency, Copernicus Climate Services, etc.) should be mandated and resourced to detect early signs of abrupt changes and ensure these warnings reach policymakers in real time. Improving foresight also means integrating such warning indicators into emergency planning and foreign policy deliberations, given the cross-border nature of many tipping point impacts.

Effective foresight systems require robust feedback mechanisms and continuous evaluation to maintain their relevance and credibility. Continuous learning and feedback mechanisms within the foresight process are another critical step. Foresight practitioners should evaluate the impact of their products, and continually monitor whether and where their insights have proven their value or otherwise. Some challenges—such as immediate geopolitical shifts or technological disruptions—require short-term, reactive foresight, while others—like demographic changes or climate resilience—demand long-term scenario planning. Foresight should not only inform EU policymaking but also be embedded into the implementation phase, ensuring that insights translate into adaptive and resilient policies. Mechanisms for continuous reassessment should be strengthened to allow policy adjustments as new data emerges.

Integration of evaluation frameworks ensures that foresight methodologies are regularly refined based on real-world outcomes. This iterative approach helps create a feedback loop where insights from policy implementation continuously help improve the foresight system, enhancing both practical relevance and credibility. A more quantitative and gears-level approach allows for tighter feedback loops and rapid learning. This enables policymakers to quickly assess new information based on which components of the system it affects, leading to more nimble and targeted adjustments to foresight products.

At CFG, we are working on foresight methods innovation with the idea to complement the widely used concept of futures literacy as a necessary stepping stone for successful foresight in the age of emerging technologies. While futures literacy refers to expanding the imagination of policymakers and exploring a range of possibilities for how the future could play out, putting innovative foresight tools to use will help additionally rigorously assess long-term risks and uncertainties, and prioritise concrete actions. We are currently working on projects to develop and implement this approach, ensuring that EU policymaking remains visionary while grounded in robust analysis.

Integrating context-specific methodologies is one aspect where strategic foresight could be tailored to different policy areas, ensuring that methodologies are adapted/correspond to the unique challenges and complexities of each sector. A one-size-fits-all approach may not be sufficient to capture the nuances of rapidly evolving fields like technology, security, or environmental sustainability.

Looking more broadly beyond a specific policy or foresight methodology, the Commission should continue mainstreaming foresight methodologies throughout the policy cycle by popularising existing

[71] G7 Italia, Artificial intelligence and economic and financial policymaking. A high-level panel of experts' report to the G7, December 2024. Retrieved on March 12, 2025 from https://www.dt.mef.gov.it/export/sites/sitodt/modules/documenti_it/HLPE-Report-on-AI.pdf.
[72] European Commission: Joint Research Centre, 'Earth System Tipping Points are a threat to Europe', Ispra, 2025, JRC140827.
[73] Following the example of the ARIA 'Forecasting Tipping Points' funding program that aims at creating an early warning system for tipping points that equips the world with the information needed to build resilience and accelerate proactive climate adaptation.

internal upskilling Futures Literacy programmes for staff across all DGs and EU institutions – from Policy Officers drafting legislation to Heads of Units attending trilogues. This doesn't mean that all staff should be foresight experts, but by focusing on transferrable principles of foresight (even as small as tips and tricks), officials of all types can deploy these skills to help make their mindset more forward-looking throughout their day-to-day work.

Rather than treating foresight as a separate exercise done by a small team and then broadcasted to decision-makers – which is not conducive to long-term success – foresight should be a habit and a culture embedded throughout the fabric of EU policy-making. We should be sensitive to the fact that the big surge of EU technology policy has not resulted in more technologists among public servants[74]. Having the capacity to put the right expertise to work means not just upskilling, but also hiring technologists and moving implementers from the industrial-age into the AI-age. Such a sea change will require alignment of institutional means with political ends.

[74] L. Quattrucci, 'The European Commission needs a policy entrepreneur-in-chief', Euroviews, Euronews, 21 June 2026, https://www.euronews.com/my-europe/2024/06/21/the-european-commission-needs-a-policy-entrepreneur-in-chief (accessed 19 March 2025).