

Call for Evidence for the 2025 Strategic Foresight Report

TNO supports the Commission's continued commitment to foresight and the focus on resilience, especially considering the recent fast and drastic changes in geopolitics. We welcome the opportunity to contribute to the 2025 Strategic Foresight Report through this Call for Evidence and stand ready to provide further clarification or elaboration, if required.

Scope

Strengthening Europe's resilience, competitiveness, and strategic autonomy starts with a candid assessment of current weaknesses to address and strengths to build on. We note the following:

Challenges

- **Overreliance on non-European partners** for energy, raw materials, and defence increases supply chain risks and weakens strategic autonomy. Recent geopolitical events highlight the urgency of diversification and domestic capacity building.
- **Complicated and slow governance** limits Europe's ability to respond swiftly to emerging challenges. Bureaucratic inefficiencies and complex decision-making processes hinder progress in key sectors.
- **Lack of available capital for innovation deployment** slows commercialization and scale-up of deep-tech industries. European startups face significant barriers in securing growth funding compared to global competitors.
- **Fragmented investment efforts** dilute impact. A more strategic, coordinated approach is needed to maximize returns and strengthen leadership in key technologies.
- **Overemphasis on GDP as a success metric** risks sidelining broader objectives like sustainability, resilience, and social well-being. Policy frameworks should incorporate more holistic indicators of progress.

Strengths

- **Strong R&I ecosystem** supports world-class research and innovation, with potential for greater commercialization if funding gaps are addressed.
- **European values promote broader success metrics** beyond GDP, aligning with global trends in sustainability and responsible innovation.
- **Largest single market** enables economies of scale, cross-border trade, and a harmonized regulatory environment, making Europe attractive for investment.
- **Regulatory leadership** in areas like data protection and sustainable finance positions the EU as a global standard-setter.
- **Stable political climate** reduces investment risks, offering predictability in an increasingly uncertain global landscape.

Imagine 2040

We described below how we would characterise a resilient EU in 2040

By 2040, the European Union has established itself as a **global leader in key industrial and technological sectors**, securing economic control points – high-value, high-barrier nodes within global supply chains – across many major value chains.

The cornerstone of this industrial resilience is a highly skilled workforce, supported by a world-class **research, development, and innovation (RD&I) ecosystem**. By investing in specialized

education and training programs, the EU ensures that its labour market remains competitive in the face of rapid technological change.

Europe in 2040 measures **prosperity** through a broader lens, incorporating health and well-being, environmental sustainability, and social cohesion. Investment and policy decisions are explicitly made to maximize general prosperity, ensuring that technological advancements, including quantum computing, artificial intelligence, and biotech (among others), are harnessed to improve quality of life rather than exacerbating inequalities.

Polarization within society is significantly reduced. By embracing localized decision-making and **participatory democracy**, Europe ensures that diverse voices are actively involved in shaping policies that affect them. This is further helped by a widespread adoption of digital platforms for civic engagement. Proactive measures against disinformation and digital manipulation preserve trust in public discourse, reinforcing societal cohesion.

Long-term Resilience

Ensuring Europe's long-term resilience requires proactive investment in a high-tech industry and a robust research & innovation base capable of securing economic control points in emerging value chains. By fostering cutting-edge sectors such as quantum computing, artificial intelligence, biotechnology, and next-generation materials, Europe can position itself at the forefront of technological innovation. This requires **sustained funding for RD&I**, support for **deep-tech startups** and mechanisms to **accelerate technology transfer** from research institutions to industry, as well as societal adoption. A long-term vision ensures that the EU does not merely adopt technologies developed elsewhere but actively shapes global technological trajectories.

Resilience is an essential component of steering transitions, allowing crises to be managed effectively without adversely affecting longer-term aims. Europe must develop the institutional capacity to **track economic, technological, and societal shifts in real time**, using data-driven insights to inform policy adjustments. This includes establishing **early warning systems** for economic disruptions, anticipating geopolitical shifts, and responding dynamically to technological breakthroughs. Crucially, resilience also requires the political courage to **discontinue policies and investments that are underperforming**. Policymakers must move away from inertia-driven governance and embrace a culture of adaptive learning—one that allows for recalibration in response to new evidence, even if it means reversing prior decisions. This shift demands a governance environment where experimentation is encouraged, and failures are recognized as opportunities for refinement rather than political liabilities.

To ensure that decision-making aligns with Europe's long-term vision, the EU must establish a harmonized **European General Prosperity Framework**—a comprehensive assessment model that moves beyond traditional economic indicators like GDP. This framework should integrate measures of environmental sustainability, public health, social equity, and technological sovereignty, creating a more holistic understanding of progress. By embedding this framework into policy evaluation and investment decision-making, Europe can systematically prioritize actions that enhance societal well-being while maintaining economic competitiveness. Such a model would serve as both a strategic guide for policymakers and a transparency tool for the public, reinforcing accountability and trust in governance.

Synergies and Tensions

When pursuing multiple priorities, synergies and tensions inevitably arise. For instance, balancing industrial protection with support for free trade is a complex trade-off, while growing well-being seems synergistic with restoring natural capital. However, these priorities are not isolated; they interact within a complex system with numerous feedback loops that span different geographical regions, sectors, and timescales. What might appear as a simple policy choice can have far-reaching consequences, with both positive and negative effects that unfold over time.

The interconnection of priorities means that investments or policies in one area can have cascading impacts in others. For example, advancing cutting-edge industries such as quantum computing could strengthen Europe's technological sovereignty, but without careful regulation, it might exacerbate inequalities between regions. Similarly, policies aimed at restoring natural ecosystems might initially slow industrial growth, but they can lead to long-term economic resilience by enhancing environmental sustainability.

Truly understanding the synergies and tensions requires **consideration of higher-order impacts, delayed feedback loops**, and the unpredictable nature of human behaviour. For instance, short-term economic benefits from certain policies might overshadow their longer-term societal or environmental costs. Likewise, policies aimed at improving citizen well-being may not immediately align with growth objectives but could ultimately contribute to a more productive and resilient workforce.

Enhancing Strategic Foresight

To strengthen the European Union's strategic foresight capabilities, it is essential to integrate advanced methodologies that can capture the complexity of future systems and identify the interactions and feedback loops that shape them. One powerful approach is **combining foresight with System Dynamics**, a technique that models the interdependencies and feedback loops within complex systems. By incorporating System Dynamics into foresight work, the EU can develop more accurate, flexible, and actionable insights into future developments, enabling better decision-making for long-term planning.

System Dynamics allows for a deeper understanding of how various elements within a system influence one another over time, making it an ideal tool for capturing the nuanced feedback loops that often drive unexpected outcomes. This approach can take several forms:

1. **Developing future scenarios and then modelling the system of the future:** This involves envisioning different potential futures and using System Dynamics to model how the system would behave in each of those scenarios. By focusing on how elements interact in the future, the EU can anticipate risks, identify opportunities, and prepare for multiple possible outcomes.
2. **Creating a System Dynamics model of the current system, while developing future scenarios in parallel:** In this approach, policymakers first build a model of the current system, then explore how it might behave under different future scenarios. This allows for an understanding of how existing structures and processes might respond to future shocks or shifts, helping to identify areas that need adaptation.
3. **Creating a model of the current system while developing a preferred future and backcasting:** Backcasting involves starting from a desirable future state and working backwards to understand the steps necessary to achieve that vision. This method helps

pinpoint the changes that need to be made within the current system to reach the preferred future, ensuring that strategic decisions are aligned with long-term goals.

For all of these approaches, **scoping the system-of-interest** is crucial. The scope must be narrow enough to be manageable, yet broad enough to incorporate the key factors that will shape the envisioned future. For instance, in the context of Europe's strategic autonomy and global competitiveness, the system-of-interest could focus on sectors like the **European space industry**, which relies on international collaboration, critical raw materials, and has far-reaching impacts on defence, high-tech innovation, and geopolitical stability. The system must be relevant at the European level, considering the complex interactions across borders, industries, and policies.

At TNO we have piloted combining **System Dynamics** with **foresight methodologies** to model the cascading effects of Arctic melting (as an illustrative use case). This pilot demonstrated the potential for System Dynamics to enhance foresight work, allowing for a better understanding of the complex feedback loops at play in global and regional systems.

Building on this, we believe that the EU can benefit from a collaborative methodology that incorporates these insights and pilot findings. By combining the insights from System Dynamics and foresight, Europe can not only anticipate future challenges but also create actionable pathways for achieving its long-term objectives. Our experience with this approach positions us well to support the development of such methodologies, ensuring they are practical, robust, and tailored to European priorities.