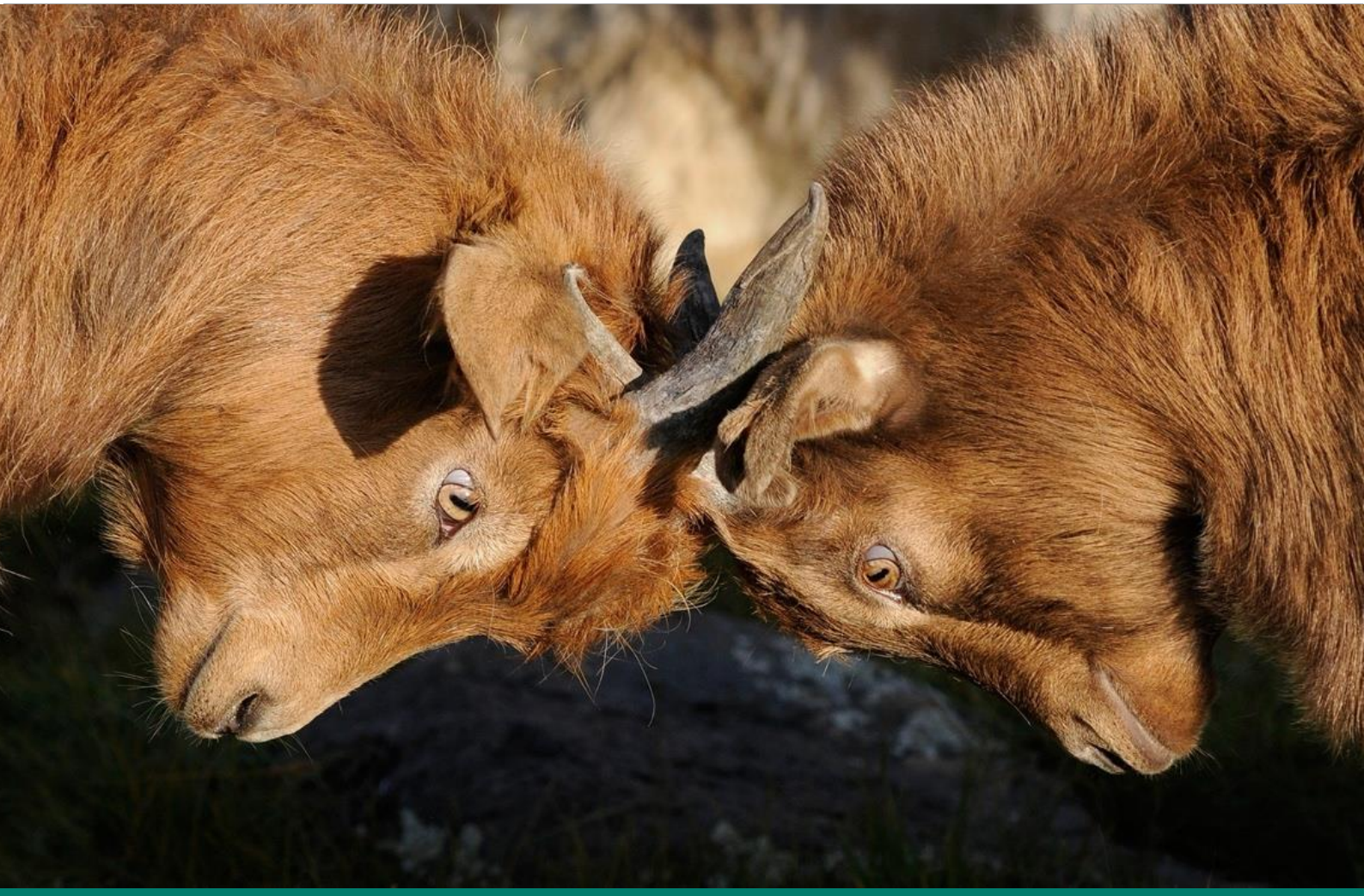
ETC ST Report 2025/3

Beyond Competitiveness

Futures of EU's competitiveness and sustainability and the importance of bioeconomy, industrial transformation, and critical raw materials



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European Environment Agency
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Executive Summary

This technical report presents the approach, steps of analysis and results of a foresight study which was set up to support the EEA in exploring of how Europe could combine competitiveness with sustainability, while avoiding environmental harm. To this end, the first step was to identify key factors influencing future European competitiveness. Subsequently, with the help of key factors, five scenarios were developed with the participation of experts and stakeholders, in which sustainability and competitiveness ambitions were achieved to varying degrees. In the third step, these visions of the future were used for a critical analysis of the EU's current competition-focused policy agenda. Sustainability experts from Eionet were then surveyed using the Delphi method. In the final stage of the analysis, the gaps and areas for action identified in the current policy agenda about impacts on social and environmental sustainability were reflected upon in a futures dialogue with EU policy experts, and options for closer integration of competitiveness and sustainability were discussed.

This combination of different foresight methods enables the gradual integration of diverse foresight expertise and perspectives, as well as interdisciplinary analyses of the social, technological, economic, environmental and political factors that influence Europe's future. The process takes uncertainties into account, promotes broad participation by experts and stakeholders, and encourages debate on interactions and potential tensions between competitiveness and sustainability goals. Scenario analysis forms the core of the study, as it systematically develops plausible but differing futures and illustrates that, depending on the different characteristics of the key influencing factors, very different degrees of policy goal achievement are possible. This leads to the realisation that, depending on future developments towards one of the possible scenarios, an adjustment of strategic targets and policy instruments will also be necessary.

Key results

Across social, technological, economic, environmental, and political domains, several high impact and high uncertainty factors drive Europe’s future space: global power dynamics, AI and deep learning, trust and fragmentation in policy, availability of raw materials, global security and conflicts, climate change vulnerability, trade and supply chain structures, and energy system transformation. Most lie outside the EU’s direct control, underscoring the need for robust, adaptive strategies.

Based on combinations of different future developments of these key factors, five scenarios for Europe in 2040 have been developed and analysed regarding the achievements of sustainability and competitiveness goals. Cross-cutting challenges to achieve both, a sustainable and competitive Europe in the coming years synthesis identified are: A persistent geopolitical flux, intensifying climate impacts, AI as a central productivity and governance driver, growing competition for materials, and erosion of trust requiring renewed social contracts, energy fragmentation, governance complexity, data/AI standards divergence, monopoly power of data and platform companies, and digital security risks. Recurring opportunities include trustworthy AI and open ecosystems, circularity and efficiency, adaptation tech, coordinated grids and flexibility, strategic autonomy in bottleneck inputs, and ESG anchored partnerships.

The gap analysis based on expert consultation in a Delphi survey and a Futures Dialogue with policymakers and stakeholders reveal the following needs for action to achieve both the competitiveness and social and environmental sustainability ambitions:

- Feasibility and timing: Most experts see 2040 targets (90% emissions cut, full circularity, zero pollution heavy industry) as possible in principle but unlikely at current pace; most expect longer timelines. Delivery hinges on stable, coherent regulation; deep investment; skills; social fairness; and resilient supply chains.

- Competitiveness paradigm: Strong calls to redefine competitiveness around wellbeing, resilience, and sufficiency. Without redistribution and participation, fragmentation and democratic erosion risk derailing transition.
- Strategic autonomy: Necessary but difficult; reduce demand for critical raw materials; accelerate circularity and substitution; diversify partnerships—without exporting externalities.
- Regulation and finance: Aim for smart, coherent, mission oriented regulation that reduces burdens without weakening safeguards. Attach green conditionalities to public funding; build enabling capital markets for transformative innovation while guarding against monopoly lock-in.-oriented regulation that reduces burdens without weakening safeguards. Attach green conditionalities to public funding; build enabling capital markets for transformative innovation while guarding against monopoly lock-in.
- Narrative and implementation: Reclaim the Green Deal narrative as prosperity and identity-building; invest in local adaptation; demonstrate visible benefits; monitor and course correct fast.-correct fast.

Further analyses of how these opportunities and risks can be addressed in the future were based on deep dive workshops on the three policy action areas Bioeconomy, Industrial Transformation and Critical Raw Materials and expert and policymaker consultations.

Central tensions arise between short-term economic competitiveness and long-term ecological resilience. Examples are intensive agriculture or on-demand delivery. In agriculture, yields can be maximised via synthetic fertilizers and pesticides, which entails risks of long-term soil degradation, loss of biodiversity or water contamination. In logistics, next-day shipping helps win and keep customers, while transport emissions and congestion increase and put pressure on climate targets and air quality. Particularly, the pursuit of rapid industrial transformation and decarbonisation is constrained by technical challenges, investment needs, and critical raw materials availability. In addition, the scenarios illustrate impacts of challenges Europe is facing such as social fragmentation, uneven adaptation to technological change, and geopolitical fragility, all of which could undermine both environmental goals and economic stability. Thus, relying exclusively on technological solutions to increase competitiveness without also considering the need to reduce demand, restore nature and maintain social cohesion could result in no sustainable competitive advantage being achieved.

This study concludes that a redefinition of the concept of competitiveness as a compass and overarching goal of the EU is highly needed, according to the foresight analysis of key influencing factors, the illustration of future challenges and opportunities in five scenarios, and the expert and stakeholder consultations. The recommended key policy measures are intended to contribute to promoting the circular economy, improving resource efficiency and promoting ecosystem restoration to preserve natural capital. Establishing sound governance that embraces openness, stakeholder engagement, and flexibility will strengthen legitimacy and adaptive capacity. Developing strategic autonomy through diversified supply chains and localised markets is vital to reduce vulnerabilities. Finally, ensuring social inclusiveness and investment in skills is critical to manage transitions fairly and maintain public trust. Achieving these goals requires not only technological innovation but also strong institutional frameworks and clear political direction that align economic ambitions with environmental imperatives.

Thus, the foresight study concludes that Europe can achieve sustainable competitiveness by 2040 only by prioritising resilience and justice, reducing structural dependencies, and investing in enabling systems and social cohesion. The solutions are known; the challenge is pace, coherence, and legitimacy. Designing strategies that work across both cooperative and “hard” worlds and anchoring competitiveness in wellbeing will determine whether the EU shapes the global transition or adapts to others’ terms.

Key messages

- Sustainable competitiveness must be reframed around resilience, justice, and wellbeing, not GDP alone. Social cohesion is a hard precondition for delivery.
- Structural pressures as geopolitical volatility, accelerating AI, climate impacts, and resource constraints shape all plausible 2040 futures, thus the strategy must be adaptive.
- No regret priorities across all scenarios are (1) scale circular economy and demand reduction; (2) invest in climate adaptation and resilient infrastructures; (3) build selective autonomy in compute, data, and critical materials; (4) strengthen skills and just transition systems; (5) ensure trustworthy AI/data governance; (6) deepen participatory, coherent institutions.-regret priorities across all scenarios-transition systems;
- Experts and stakeholders consulted judge high ambition 2040 goals (90% emissions cut, fully circular economy, zero pollution heavy industry) as stretching targets, which are feasible only with clear, long term policy signals, major investment, and distributional fairness.-ambition 2040 goals (90% emissions cut, fully circular economy, zero-pollution heavy industry) as stretching targets-term policy signals, major investment, and distributional fairness.
- Deep dive analysis for key policy areas confirms robust solutions (sufficiency, eco-design, restoration, deep electrification) and flag conditional ones (e.g. megaprojects, globally integrated bio chains) that rely on cooperative geopolitics and stable finance.-design, restoration, deep electrification) and flag conditional ones (-projects, globally integrated bio-chains) that rely on cooperative geopolitics and stable finance.
- Policy implications of priority are reanchoring the Competitiveness Compass in resilience and welfare; reduce structural dependencies; co-shape global standards; invest in enabling systems (grids, data/compute, skills); attach green conditionalities to public finance; and monitor early signals to pivot fast.-anchor the Competitiveness Compass in resilience and-shape global standards; invest in enabling systems (grids, data/compute, skills); attach green conditionalities to public finance; and monitor early signals to pivot fast.

1 Introduction

1.1 Competitiveness at the heart of EU 's strategy to 2029

The Competitiveness Compass for the European Union (EU), launched as the first major initiative of the European Commission's 2024-2029 mandate, provides a strategic framework for the EU's economic development for the next five years and beyond (European Commission 2025). It places both competitiveness and sustainability at the heart of the EU's economic agenda.

According to the EC's Competitiveness Compass Communication, 'competitiveness' is defined as the economy's ability to maintain "a sustained high rate of productivity growth". More specifically, a competitive economy is one "whose sustained productivity rate can drive growth and, consequently, income and welfare". This definition reflects the Commission's broader view that competitiveness is not merely about market dominance but about building a sustainable economic foundation that maintains and enhances the prosperity of European citizens (ibid.).

The Competitiveness Compass is structured around three interconnected pillars:

1. **Innovation:** Technological advancement and creative solutions are essential drivers of productivity growth and economic dynamism.
2. **Decarbonization:** Future competitiveness is intrinsically tied to sustainable economic practices and the transition to a net-zero economy by 2050, as outlined by the European Green Deal and enshrined in the EU Climate Law.
3. **Security:** Economic resilience and strategic autonomy are fundamental to maintaining competitiveness in an increasingly uncertain global geopolitical environment.

This three-pillar framework for Europe's economic empowerment aligned with the European Green Deal is supported by specific policies for each action. There are dedicated frameworks such as the Clean Industrial Deal[1], the Bioeconomy Strategy[2], and the Critical Raw Materials Act[3], each advancing critical pillars of this transformation. The Clean Industrial Deal, launched in February 2025, aims to decarbonize and enhance the EU industrial base while maintaining competitiveness. It emphasizes renewable energy adoption, circular production, and investments in clean technologies. A total of €100 billion is allocated to mobilize clean manufacturing and support industrial transformation. The Bioeconomy Strategy, adopted in November 2025, focuses on using sustainable biological resources—such as biomass—for industries. It drives circular economy innovations and improves rural economies, while emphasizing biomanufacturing and resource-efficient bio-based solutions. The Critical Raw Materials Act (CRMA), enacted in April 2024, ensures a secure supply of essential materials like lithium and rare earth elements vital for digital and green technologies. Goals include strengthening domestic capacities, promoting sustainability, and reducing dependence on single-country imports.

1.2 The concept of competitiveness

Competitiveness, however, is not clearly defined in the literature (Boltho 1996) and is a multi-dimensional concept that can include different factors, depending on the focus (Davidson et al. 2021). Competitiveness could pertain to a specific company, a sector, an industry, a nation or EU at large. In addition, policy settings may have a significant influence on competitiveness, as it requires different levels of regulation, conditions

[1] https://commission.europa.eu/topics/competitiveness/clean-industrial-deal_en

[2] https://environment.ec.europa.eu/strategy/bioeconomy-strategy_en

[3] https://commission.europa.eu/topics/competitiveness/green-deal-industrial-plan/european-critical-raw-materials-act_en

and interventions (Davidson 2023). It is also important to distinguish short-, and long-term competitiveness - as the factors that support competitiveness for the incumbent industries may or may not help the industries or activities a country needs in the long term. It is important to be aware of potential trade-offs over time and across sectors of the economy (e.g. heavy industry and service sectors).

Furthermore, there can be important trade-offs to consider when promoting competitiveness, e.g. where supporting competitiveness leads to:

- Social losses and negative impacts on societal cohesion: such as child labour, poor health and safety conditions in vulnerable groups, uneven and unjust distribution between regions and communities, various forms of exploitation (e.g. creating a "working poor" of those who cannot make ends meet with one job and live in poverty), illness, stress and lack of confidence in the products bought (e.g. where contaminated with harmful chemicals).
- Climate and environmental impacts and loss of resilience of ecosystems due to climate change, which then impact people, society, and the planet; or overexploitation of resources leading to destruction of ecosystems and impacts on health - these are not only harmful but can also undermine competitiveness.
- Short-term focus can weaken long-term competitiveness, such as when the government supports the competitiveness of incumbents with outdated technologies, which slowed the emergence of the need for transformative technologies, leaving space for others outside of the EU to take up market share and leadership on innovation on sustainability.

Over the past ten years, competition policy has been increasingly shaped by technological disruptions such as AI, rapid digitalisation and changes in geopolitical power relations. Furthermore, sustainability goals have gained significantly in importance, not only at various policy levels but also in corporate strategies, processes and risk management (OECD 2025b). Against this backdrop, new instruments and legal approaches are needed to promote competitiveness (OECD 2025a) and to combine it with sustainability goals.

1.3 Objectives of the project

It is therefore important to look at synergies of competitiveness with environmental and social concerns (inter alia), and what trade-offs must be considered, i.e. where policy must extend beyond competitiveness. On the one hand, sustainability features are prominently placed among the strategic priorities of the 2024-2029 Commission and are embedded in key policy frameworks such as the European Green Deal, the 8th EAP, the EU's Open Strategic Autonomy, and its broader sustainability goals. On the other hand, success heavily depends on the effective implementation of the European Green Deal legislation, and the EU's ability to balance competing priorities. Failure to acknowledge the interdependent relationship between nature, biodiversity and climate could not only hinder progress towards decarbonization but also jeopardise the EU's long-term competitiveness in the long term.

The European Environment Agency (EEA) supports the EU's ambitions in this area by developing innovative, cross-sectoral knowledge linking together climate, environment and broader social and economic thinking about sustainability and systemic transformations. In particular, the EEA's Sustainability Department offers forward-looking analysis and qualitative insights into emerging risks and opportunities in crucial policy areas such as bioeconomy, industrial transformation, and circular economy and critical raw materials. This work forms part of a foresight research project Beyond Competitiveness - Futures of EU's competitiveness and sustainability: Exploring the role of bioeconomy, industrial transformation, and critical raw materials conducted in collaboration with the European Topic Centre for Sustainability Transitions (ETC ST).

The project aims to develop a set of context scenarios for Europe in 2040 and to explore how both competitiveness and sustainability could be successfully combined in EU's policies. The scenarios have been co-created through a participatory, two-part online workshop with academic and policy experts.

1.4 Approach and methodology

The approach and methodology for exploring the intersection of competitiveness and sustainability in EU policy is intentionally pluralistic and participatory, reflecting the complex and evolving nature of the interplay between competitiveness and environmental and social sustainability.

The concepts of competitiveness and sustainability are both vague and need to be interpretated and concretised in political processes. Different stakeholders and interest groups will have different opinions and preferences about what is competitiveness and sustainability. In addition, the current global but also national contexts are shifting towards more uncertainties and emerging geopolitical tensions. In such a volatile and uncertain setting different possible solutions need to be explored and discussed, as robust policymaking relies on methods capable of navigating uncertainty, fostering inclusive debate, and integrating interdisciplinary perspectives (European Environment Agency 2024).

Stakeholder participation and expert consultation are foundational to this approach. Effective engagement means incorporating input from industry, civil society, academia, and regional actors, while maintaining balanced representation and clear channels of accountability. As resources to realise a full stakeholder engagement and consultation process are not given, in such an early stage of exploration we are relying on various expert consultation and linking to policy experts in Brussels.

Scenario analysis is a well-tested method of strategic foresight that is used, on the one hand, to examine major future uncertainties in the context of sustainable competitiveness and, on the other hand, to actively involve a necessary diversity of experts and stakeholders in the assessment of possible impacts. It is also the primary method for exploring alternative futures and stress-testing policies in uncertain contexts. It offers a structured way to incorporate expert judgement, quantitative modelling, and stakeholder input, generating multiple plausible pathways rather than single-point forecasts.

In the EU context, scenario planning has demonstrated value in aligning strategic objectives with operational realities and in identifying risks and opportunities linked to supply chains, technological change, and regulatory shifts. A scenario analysis is grounded on a comprehensive situation or context analysis to identify relevant factors influencing the future environment. This was done by means of horizon scanning for signals of change in society, technology, the economy, the environment and policymaking, and by consolidating these signals into influencing factors. The scenarios where build in a scenario sprint with environmental policy experts from European Environment Agency and experts from national environment agencies (Chapter 0). The scenarios were analysed further in more detail with a specific focus on the three topic areas of bioeconomy, industrial transformation, and circular economy and critical raw materials (Chapter 3).

The next step was to conduct a gap analysis, reflecting the future challenges identified in the scenario analysis against the current policy priorities of the Competitiveness Compass. This was carried out with a Delphi survey. The Delphi methodology is used to systematically gather, correlate, and refine expert opinion across disciplines and stakeholder groups (Chapter 5). Its suitability for complex, ill-defined problems without single “correct” solutions is well-established in social policy research. By deploying iterative surveys and feedback rounds, the Delphi process helps identify underlying synergies and tensions, test the feasibility of scenario propositions, and build consensus or clarify disagreements among policy makers and researchers. The Delphi analysis was used to challenge the hypothesis derived from scenarios connected to the Draghi-report.

Deep Dives (Chapter **Error! Reference source not found.**) and a policy-oriented Futures Dialogue (Chapter REF _Ref215475235 \r \h 0) complement the scenario and Delphi analysis by fostering more granular exploration of specific topics - such as bioeconomy, circularity, and industrial transformation. The Deep Dives use approaches like the Dream Circle and X-Curve to surface visionary ideas, clarify system dynamics, and identify practical building blocks for sustainable transitions.

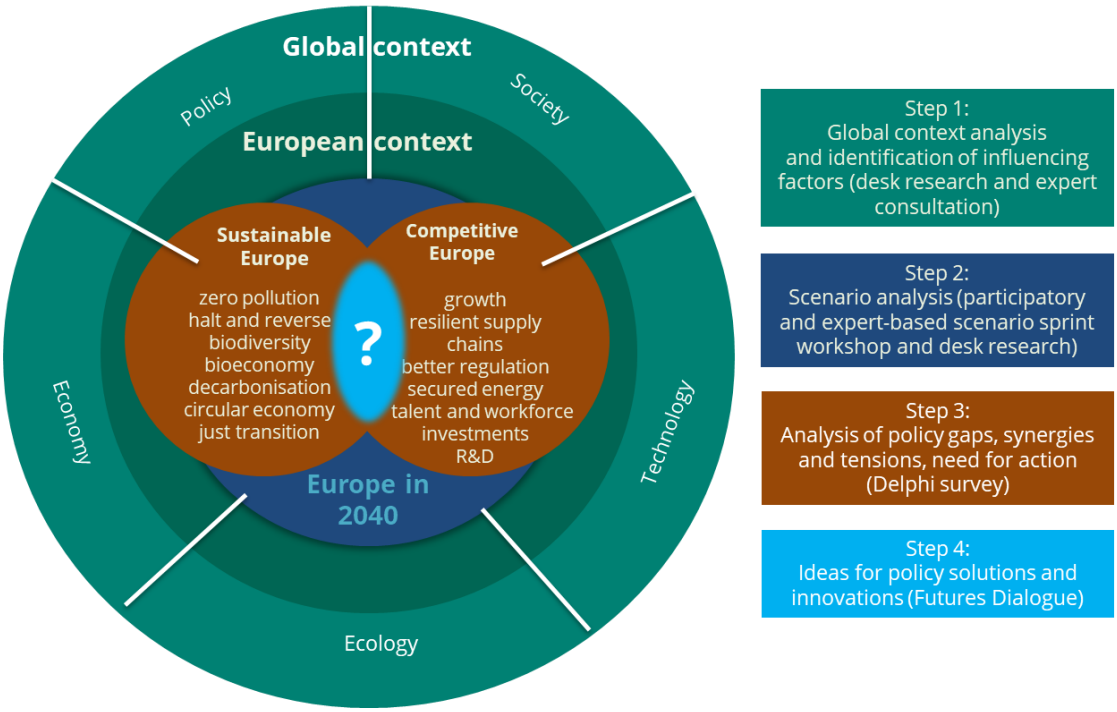
The Futures Dialogue further confronts stakeholders, experts and policymakers from the European Commission with key tensions and catalyses solution-focused debate.

The combination of participatory scenario analysis, Delphi, and targeted dialogues is grounded in international best practices for policy research under uncertainty. Each method offers distinct advantages:

- Scenario analysis addresses uncertainty and complexity in long-term planning.
- Delphi surveys ensure expert input is systematically integrated and helps synthesise knowledge across domains.
- Stakeholder engagement and futures dialogue increase inclusivity, legitimacy, and effectiveness of policy outcomes.
- Deep dives provide detailed, context-specific analysis necessary for credible recommendations.

Together, this multi-method approach ensures that EU policy can respond flexibly, inclusively, and robustly to the challenges and opportunities at the interface of competitiveness and sustainability (Figure 1).

Figure 1: Scheme of the project design



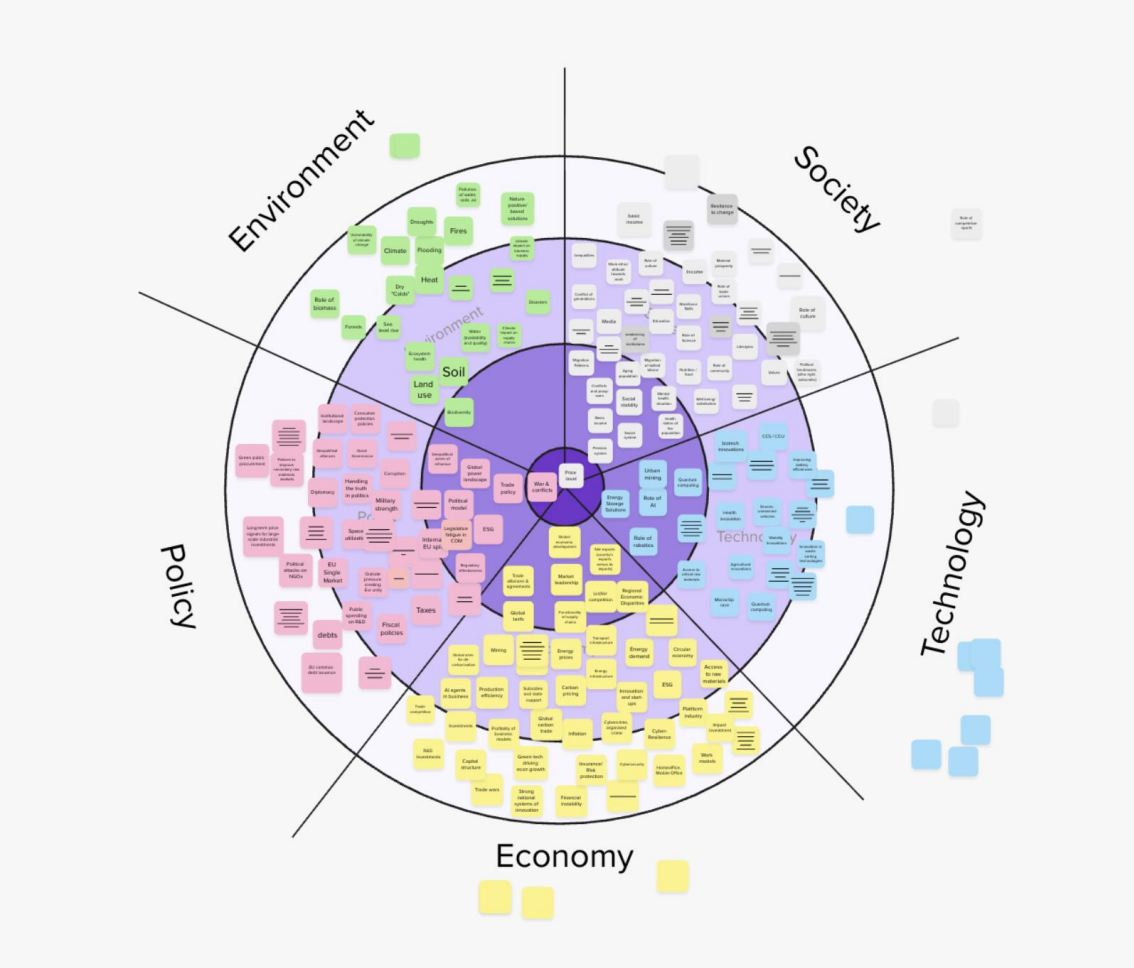
Source: ETC ST, own elaboration

2 Context analysis for a sustainable competitiveness in Europe

Context analysis, as the foundational step in scenario development within strategic foresight, involves the systematic identification and examination of influencing factors that are likely to shape the future of the subject under study. Influencing factors are broadly defined as domains where trends and drivers are expected to impact long-term developments. These factors, often referred to as context factors, capture the range of potential trajectories a theme may follow and illuminate interactions with other variables that collectively define future scenarios.

Context analysis is grounded in extensive literature review and expert consultation. For example, in the ETC-ST foresight process, factors are distilled in dialogue with project managers and subject-matter experts, ensuring a comprehensive and unbiased selection. For this purpose, an online whiteboard (see Figure 2) was created, and experts were invited to contribute adding aspects and factors they considered to be relevant. This information was collected from end of March to the mid-April 2025 and integrated into the full catalogue. The full catalogue was completed with additional desk research and finalised as an input to the scenario process (beginning of May).

Figure 2: Screenshot from whiteboard for the collection of influencing factors with experts



Source: Screenshot from the Muralboard used for asynchronous factor collection along the STEEP scheme (Social, Technological, Economic, Ecological and Political)

Each factor is described concisely, followed by a delineation of relevant aspects, current developments, and emerging trends, all supported by literature. The STEEP (Social, Technological, Economic, Environmental, Political) framework is commonly adopted to avoid blind spots and to methodically scan across domains, ensuring that critical and often overlooked influences, such as social dynamics, are included. This method highlights not only direct impacts but also systemic interconnections, helping practitioners map out complex dependencies such as how technological advances may drive economic shifts or how environmental regulations interact with social and political trends. Engaging diverse stakeholders and subject experts, and triangulating sources, helps minimize cognitive biases in factor selection and ensures coverage of cross-cutting themes vital to the future context.

A central aspect of influencing factors in strategic foresight is recognising that most lie outside the immediate control of the organisation or commissioning body, in our case the EU Commission. Many factors operate independently of direct intervention but must be considered to provide a realistic and holistic view of the evolving future space. Each context or influencing factor is documented using a standardised template:

- **Title:** A clear, descriptive heading summarizing the factor.
- **Description:** A brief account of the factor's nature.
- **Scope:** Aspects and elements that outline the factor's breadth.
- **Current Developments:** Notes on present trends and signals indicating future directions.
- **Relevance:** A concise explanation of why the factor is pivotal for competitiveness and sustainability.

The full catalogue of influencing factors can be found in the Annex 1. The following table 1 gives a quick overview of the researched factors following the STEEP categories.

Table 1: List of the influencing factors identified in the research phase

Source: own elaboration

Social influencing factors

1 Demographic dynamics
2 Social inequalities
3 Living standard
4 Information, communication and public opinion
5 Health and wellbeing

Technological influencing factors

6 Raw materials
7 Advanced materials
8 Transport technologies
9 Infrastructures
10 R&D spending and investment
11 AI and deep learning
12 Quantum technology and deep tech
13 Biotechnology
14 Carbon Capture and storage CCS / usage CCU
15 Space technologies and services
16 Cyberphysical systems
17 Robotization and automation
18 Electrification and energy system
19 Standardization

Economic influencing factors

20 Global economic development
21 Structure of EU economy
22 Consumption patterns
23 Global price levels and inflation
24 European single market
25 Investment and financing Europe
26 Global trade and supply chains
27 Attitude of business towards sustainability
28 Work and employment

Environmental influencing factors

29 Global pollutions
30 Biodiversity and ecosystems
31 Vulnerability to climate change

Political influencing factors

32 Global political power landscape
33 Governance of digital transformation
34 Global security and conflicts
35 Fragmentation and trust in policy
36 European cohesion and ability to act

3 Context scenarios for Europe in 2040

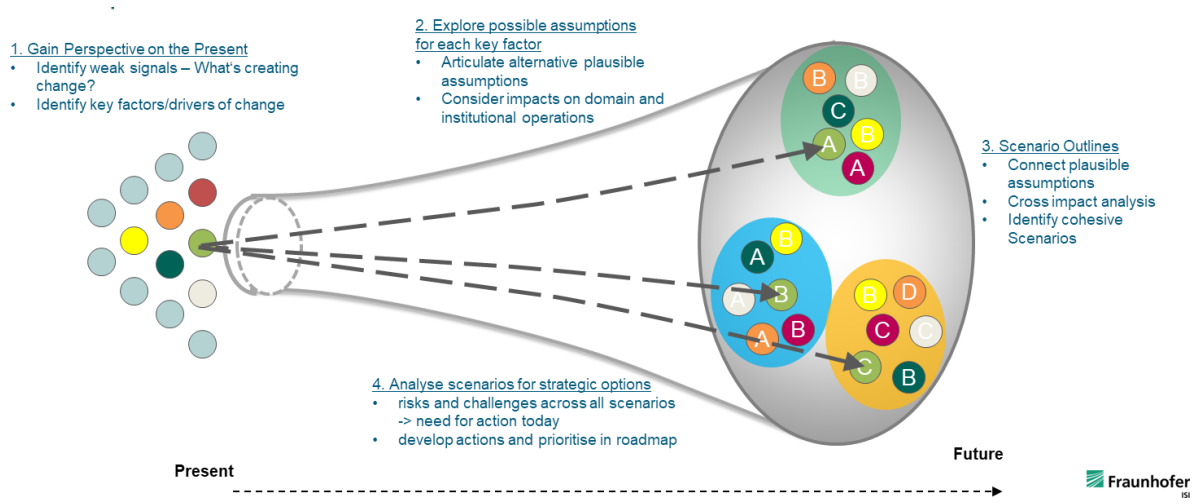
3.1 Approach and Methodology

The project aims to develop a set of context scenarios for Europe in 2040 and to explore how both competitiveness and sustainability could be successfully combined in EU's policies through a participatory scenario analysis.

This foresight approach is chosen because, with long-term goals such as decarbonization and sustainability, the need for action should not be derived from the current situation. Instead, future changes in the "actual situation" must also be considered. This is even more important if it can be expected that there will be very different assumptions for some key influences on the future. The scenario approach is suitable for dealing with this uncertainty in policy strategy development, especially an explorative approach, as it spans this range of possibilities. It is not about which one is more likely, and there will be opportunities and risks for green competitiveness in all scenarios. The future will lie somewhere in between. It therefore makes sense to consider the cross-cutting opportunities and risks that occur in several scenarios when developing the strategy, and to prepare for these.

Figure 3 introduces the process design of a typical scenario process. Step 1-3 have been carried out in the scenario sprint workshops (1. Selection of key factors out of long list of influencing factors, 2. Exploring several alternative assumptions how things might develop into future, 3. Development of scenario outlines, called raw scenarios), step 4 has been implemented in the futures dialogue.

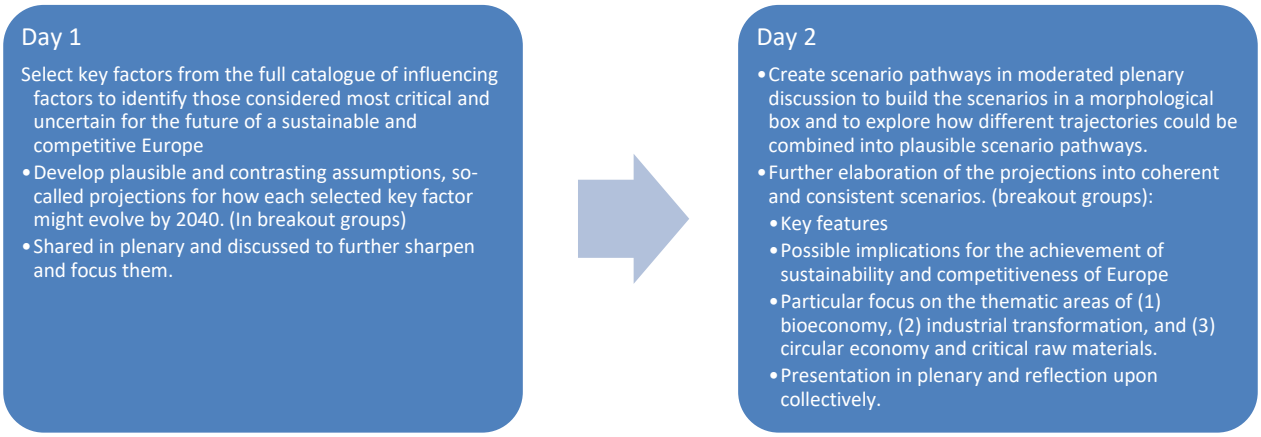
Figure 3: Process design for the scenario sprint



Source: Fraunhofer ISI, based on (Voros 2003)

The scenario sprint workshop took place in two online sessions: Day 1 covered step 1-2 and the third step on day 2. The two-day scenario sprint workshop with experts from across Europe representing diverse policy domains, institutions, and areas of knowledge developed the scenarios by following this workplan (Figure 4).

Figure 4: Scenario-Sprint workshop concept



Source: Fraunhofer ISI

The further elaboration of the draft scenarios and the assessment of their potential impacts (Step 4) have been conducted by the ETC-ST project team by combining different participatory foresight methods and desk research. These follow-up steps will be described in the next chapters, including a validation of the proposed choices of action in the Futures Dialogue with policymakers in Brussels.

3.2 Key factors on Europe's future sustainability and competitiveness

The context scenarios were developed based on the strongest influencing factors; those with both the highest impact and the greatest uncertainty. These were selected out of the longlist of factors from the context analysis (see Table 1 in Chapter 2 and Annex 1) at the beginning of the scenario sprint workshop together with experts.
After identifying eight key factors, the workshop participants generated three to five possible future developments (assumptions) for each factor. The eight key factors and their corresponding projections were as follows.

Key factor "Global political power landscape"

The factor refers to the distribution and dynamics of political power among countries and regions in the world. It encompasses the relationships, influences, and interactions between various state and non-state actors, including governments, international organizations, and multinational corporations, as they navigate global issues such as security, economics, and diplomacy. Critical aspects of the future projections for the factor are geopolitical zones of influence, political governance models (e.g. democracy vs autocracy), types of global power relationships (e.g. multilateralism vs. multipolarity), military strength, defence and security measures and alliances, technological sovereignty and the future roles of global institutions (e.g. UNO, NTO). (See Factsheet in Annex 1: 5.1 Global political power landscape).

Projection A: A polarised world with the return of the blocs: US global power decline and global politics regress into imperial competition as Russia, China, and the US pursue new spheres of influence. The global power landscape is divided in two blocs, characterized by a return of two competing superpowers gathering the countries around them. The two blocs are in imperial competition, defending their spheres of influence.

Projection B: Redefining globalisation: the Sino-European pact: China leads a new era of globalisation on its own terms. As the US turns inward, the EU and China deepen trade and collaboration. Mutual trust grows, reversing past dynamics.

Projection C: Western resurgence: transatlantic alliances: The US has renewed strong ties with the EU, Canada, and Australia. This revitalises the Western alliance with well-balanced power relations between Europe and the other partners. Although global power remains competitive, these allies form a stable economic front, emphasising shared values and coordinated prosperity.

Projection D: Multipolar world with power rise of African and Asian countries: The world shifts toward multipolarity. African nations, India and Southeast Asia rise, with China in key role, reshaping global dependency. Though political alignment varies, collaboration drives growth across diverse centres of power.

Projection E: Collapse of the state: rise of the decentralised world: Traditional state structures falter, giving way to powerful non-state actors. Corporations, networks, and decentralised systems take over governance, security, and economic functions. The global order is rewritten by those who control data, technology, and infrastructure, not by nations.

Key factor "AI and deep learning"

This factor encompasses the future development of AI and related technological capabilities (including generative AI) for individuals, companies, ecosystems, and/or economies. AI offers many opportunities, such as improved healthcare, more efficient energy consumption, and longer-lasting products. However, AI also brings new risks. Critical aspects of the future development of this factor include the future AI regulation and risk assessments, the high energy demand, raw materials and water related to large server farms needed for AI and the ways AI will be adapted in different societal contexts. Highly relevant is the question of technology dependency, e.g. a growing dependence on U.S. platform and tech companies or Chinese AI solutions in the future. This leads to emerging issues such as data security and ownership and ethical or legal requirements and regulatory frameworks. Additionally, AI is changing jobs and the workplace, thus qualification and skills requirements. (See Factsheet in Annex 1: 2.5 AI and Deep learning).

Projection A: Monopolies in Motion: The big AI Boom: AI and deep learning development are dominated by a small number of global tech giants, mainly in the US and China, with significant hardware providers like Nvidia holding substantial market power. Most advanced models remain proprietary, fuelling innovation while intensifying concerns about ethical governance, cybersecurity vulnerabilities, and job disruption. Global energy demands increase, as do resource and water consumption. Society adapts unevenly, resulting in widening skills gaps and few checks on monopolistic practices or risk assessment.

Projection B: AI for All: The Regulated Revolution: Strong, agile regulatory frameworks emerge globally, breaking up monopolies and promoting open competition. Legislation emphasises ethical AI, robust cybersecurity and fair access, while investments in education and upskilling reduce the digital divide and labour disruptions. Energy and resource use is tightly managed, with sustainability as a core principle. AI's benefits are widely shared, and societal adaptation is actively supported by both the public and private sectors.

Projection C: Fragmented Futures: Parallel AI Worlds: The globe splits into distinct AI ecosystems. Some regions enforce strict legislation, ethical standards, and sustainability, while others allow unregulated private and commercial AI innovation. This fragmentation leads to a patchwork of standards, capabilities, and risks—cross-border data flows, cyber threats, and labour markets become more complex. Key players and research hubs operate within these silos, affecting global cooperation and equitable benefits.

Projection D: Algorithmic Sovereigns: The Rule of Machines: AI becomes deeply embedded in strategic and political decision-making, with systems capable of self-improvement and rapid, largely autonomous evolution. Human oversight diminishes as AI's role expands across all sectors.

Projection E: Algorithmic abstinence: humanity reclaims control: After years of AI turbulence, Europe has imposed strict legislative controls and widespread barriers to wide deployment. In the public, AI does not play a significant role.

Key factor "Fragmentation and trust in policy"

This influencing factor refers to the actual or perceived ideological, cultural, and institutional divisions both within societies and across political entities, notably within the EU. Critical aspects are the capacity of institutions to adapt, and implement participatory governance, and the use of deliberative democracy formats (e.g., citizens' assemblies), as well as levels of trust in institutions, legitimacy of public engagement, polarization dynamics, and civic literacy. Relevant for the future projections are in addition political engagement trends, voter turnout, depth and temporal sustainability of participation, and the role of key actors including youth and marginalized groups. The leads to the aspect of access to participation, inclusivity of policy processes, and the role of civil society in bridging divides. The digital transformation reshapes political participation, introducing new forms of engagement but also risks such as online harassment and misinformation. (See Factsheet in Annex 1: 5.4 Fragmentation and trust in policy).

Projection A: Erosion of Public trust: conflicts and fragmentation in society: Trust in political institutions and democratic processes continues to decline, accompanied by rising authoritarianism, securitization, and opaque governance. Public engagement and participation weaken, polarization increases, and societal values shift from development to survival. Fragmentation in policy and the rising influence of private actors further increase.

Projection B: Local experimental spaces for democratic processes: There is an increasing cohesion and trust in policies and more experimental spaces for democratic processes. In response to the crisis and growing awareness of authoritarian risks, democratic processes emerge through local experimentation and participatory innovation. Evidence-based policymaking to deal with emerging risks gains traction, and public demand for transparent, accountable systems increases. New public media and digital participation tools support a shift toward more democratic, data-sovereign platforms of/for public opinion.

Projection C: Trust is high in data-driven governance: The trust in governance actors and institutions is high. Public trust increases as data-driven governance becomes more transparent, value-based, and oriented toward the public good. Citizens respond to democratic decline, prompting reforms in research, education, and AI.

Projection D: Political institutions safeguard trust & social cohesion: Public trust is rebuilt through strategic long-termed policy goals, supported by institutional transparency, responsiveness, and inclusive governance mechanisms. Institutions are established for different specific issues and policy areas, providing structures and regulations supported and adapted worldwide.

Key factor "Raw materials"

1. Raw materials are unprocessed or minimally processed substances used in manufacturing, encompassing minerals, metals, agricultural products, and chemicals. They are fundamental to producing goods across diverse sectors such as electronics, automotive, construction, and energy. Their scarcity can become a bottleneck for green transition (e.g. renewable energy, electrolysers, batteries, catalysts) and the sector continues to face significant uncertainties due to geopolitical tensions, supply chain disruptions, and rapid shifts in demand. Alternative projections depend on the availability of recycling technologies and circularity solutions, the environmental and social impact of extraction of materials, and Innovations in material efficiency. (See Factsheet in Annex 1: 2.1 Raw materials).

Projection A: Global availability high – Europe´s economy is dependent, but access stays secure: Amid tightening global competition for raw materials and critical resources, supply chains are under strain and prices are rising sharply. Europe, while still heavily dependent on imports, has maintained stable access through strategic initiatives like supplier diversification, stockpiling, and investment in domestic production. These measures have improved resilience, helping to secure availability even as costs continue to climb.

Projection B: Global availability declines – Europe's high dependency meets growing access struggles: Global scarcities intensify, driven by depletion, conflict, and resource nationalism. Europe's high dependency becomes a major weakness as access deteriorates sharply. Supply disruptions ripple through industries, exposing systemic gaps. Europe faces mounting challenges as global pressures escalate.

Projection C: Global availability declines – Europe's dependency softens through innovation: Global scarcities worsen, but Europe has already stabilized its systems through innovation. Dependency on some materials remains, but exposure is reduced. Other regions struggle more acutely with resource shortages and conflicts.

Projection D: Global availability declines sharply – Europe reduces exposure but remains entangled: Severe global scarcities disrupt markets, and Europe partially already reduced its dependency. In previous year´s installed circular systems and efficiency gains help, but critical imports keep Europe tied to unstable suppliers. Exposed sectors face strain as adaptation gaps persists.

Projection E: Global depletion of raw materials leads to systemic crisis – no region escapes impacts, including Europe: Global depletion triggers systemic crises, overwhelming adaptation capacities. Europe is drawn into cascading disruptions alongside other regions. Material shortages collapse industries, economies, and social systems. No region escapes the widespread instability of resource scarcity.

Key factor "Global security and conflicts"

Global Security and Conflicts encompass a broad and interconnected set of challenges that impact international stability and peace. This factor includes traditional geopolitical and military security concerns such as ongoing conflicts and wars (e.g., Russia-Ukraine, Israel-Hamas, China-Taiwan), defence capabilities, and strategic autonomy. It also covers emerging threats like cyberattacks and hybrid warfare targeting critical infrastructure and democratic institutions, internal threats from terrorism and radicalisation, and migration and border pressures driven by conflicts, climate change, and economic crises. Additionally, the weaponisation of economic interdependence, nuclear proliferation, space security vulnerabilities, climate driven security threats, and Arctic geopolitical competition are increasingly significant. Critical aspects are the geopolitical and military security landscape (conflicts, wars, regional tensions), cyberattacks and hybrid threats, and internal European security challenges such as terrorism, radicalisation, societal polarisation, migration. In addition, strategic autonomy and its implications for EU security policy as well as nuclear

proliferation and evolving WMD threats need to be considered, as do space security and satellite vulnerability in a global context. Furthermore, climate-driven security threats, arctic geopolitics, and security of critical infrastructures like energy, health systems, food supply, or transport must be considered. (See factsheet in Annex 1: 5.3 Global Security and Conflicts).

Projection A: Geopolitical tensions and war: Geopolitical tensions, and war pushing nations to prioritise defence over sustainability. Global instability is growing.

Projection B: Global renewal towards peace: There is a global value shift toward peace and cooperation. Global institutions like the UN gain strengths in a more unified, environmentally conscious world.

Projection C: The fractured globe: hidden chaos: Conventional warfare isn't increasing, but an era of hybrid conflicts, cyber warfare, and fragmented alliances brings chaos and uncertainty. Ideologies clash, global cooperation disintegrates, and sustainability efforts falter in a complex world of diplomatic standoffs, nuclear threats, and proxy wars.

Projection D: Awakening order: a new global ethic: In response to years of geopolitical fragmentation and ecological strain, first initiatives to a renewed global ethic are emerging centred on cooperation, sustainability, and shared responsibility. This shift marks the try to find back to a more ordered international landscape, driven less by dominance and more by mutual accountability.

Key factor "Vulnerability to climate change"

Vulnerability to climate change is the degree to which systems are susceptible to harm from climate-related hazards such as heatwaves, droughts, floods, and storms. It reflects both exposure to climate impacts and the capacity to adapt or cope with these changes. Relevant aspects for future projections of the factor are the exposure to climate hazards such as extreme heat, drought, flooding, and wildfires; the sensitivity of natural ecosystems, agriculture, infrastructure, and human health to climate impacts; and the adaptive capacity, including socioeconomic resilience, governance, and technological readiness. Furthermore, regional disparities in vulnerability, with southern Europe facing higher risks of drought and wildfires, and northern Europe more prone to flooding, need to be considered. In addition, the interdependencies between climate, biodiversity, and economic sectors like energy, agriculture, and industry could change the future vulnerabilities, as well as social vulnerability factors, including age, income, and health status, which affect the ability to cope with climate stress. (See Factsheet in Annex 1: 4.3 Vulnerability to climate change).

Projection A: High vulnerability globally and in Europe managed by strong adaptation systems: Severe climate hazards, which occur permanently both globally and in Europe, challenge social systems, economies and ecosystems. Despite widespread vulnerabilities, robust technological, governance and social adaptation efforts contain most of the damage.

Projection B: High vulnerability globally and in Europe meets weak adaptation capacity: Severe climate impacts overwhelm both Europe and the world, with cascading crises on the ecosystems and social crises. Weak governance, limited technological readiness, and deep social divides erode societies' ability to cope. Europe struggles alongside global regions, facing disproportionate impacts in vulnerable groups and ecosystems.

Projection C: High vulnerability beyond Europe; low vulnerability in Europe enabled by strong adaptation: While global regions face escalating climate stress, Europe maintains low vulnerability through proactive adaptation. Strong governance, social safety nets, and resilient infrastructures protect both people and nature within Europe. However, Europe remains entangled in global vulnerabilities through trade, migration, and geopolitical instability.

Projection D: Vulnerability to climate change is on an acceptable level: Europe's vulnerability to climate change is moderate, as AI systems are increasingly able to forecast extreme weather events at an early stage and coordinate adaptive measures locally. The low human adaptive capacity is compensated for by technological intelligence, making critical infrastructures more resilient.

Projection E: System overload – adaptation no longer feasible: Global tipping points drive unprecedented biophysical and social collapse, overwhelming any remaining adaptive capacities. Europe, despite initial advantages, is swept into systemic failure as ecosystems, economies, and societies unravel. No region escapes; adaptation becomes obsolete as cascading crises cross thresholds of manageability.

Key factor "Global trade and supply chain"

Global trade and supply chains encompass the complex networks and systems through which goods, services, data, and intellectual property move across borders. This factor reflects the dynamic interplay of geopolitical realignments, technological advancements such as AI and digital trade corridors, and the role of sustainability demands. Critical aspects of the future projections for this factor are shifts in global trade routes and supply chain configurations, vulnerabilities of data and infrastructure networks against cyber threats and natural disasters, and the integration of AI, digital trade corridors, and advanced logistics to enhance efficiency, transparency, and adaptability of supply chains. Important are roles of green trade standards, CBAM, ETS, waste management, and circular economy principles. Furthermore, the future role of the Global South must be considered. (See Factsheet in Annex 1: 3.7 Global Trade and Supply Chains).

Projection A: Fragmented, limited trade: Regional trade and supply chains: Global trade is fragmented into regional supply chains. New institutions emerge to support multilateralism. The shift toward regionalization influences global equality. Might change the pressure on regional areas and land use.

Projection B: Global single market: Globalization is higher than ever: Tariff barriers are lifted, and global integration intensifies, creating a highly interconnected single market. Consumption is accelerated.

Projection C: One actor dominates trade and supply chain structures: China has solidified its position as the central force in global trade and supply chain networks, leveraging scale, infrastructure, and strategic investments. Its dominance spans key sectors, from critical minerals to advanced manufacturing, leaving many economies reliant on Chinese production and logistics. While some nations pursue diversification, shifting away remains slow and complex, reinforcing China's pivotal role in the global economy.

Projection D: Lack of Everything: No Institutions, imploding politics: Traditional state institutions collapse, and political systems break down, leaving a prolonged vacuum of governance. In the absence of formal structures, decentralized networks and principle-based coordination emerge to maintain basic functions.

Key factor "Electrification and energy system"

Electrification and energy system transformation are central factors for the economy and well-being. The shift from nuclear and fossil energy carriers requires effective grid infrastructure to accommodate rising electricity demand and the integration of renewable energy sources. Energy storage and system flexibility are critical to balancing supply and demand amid variable renewables. Critical aspects for the future development of this factor include the transition of transportation, industries, and residential uses of electricity to reduce carbon emissions and possible impacts on energy demand. In addition, the upgrading and expansion of electricity grids to handle increased loads and renewable integration will be key, as well as possible solutions for energy storage and flexibility or alternative energy carriers (e.g. hydrogen, battery systems) for a resilient energy mix. The digitalisation of the energy systems calls for cybersecurity and infrastructure resilience actions, as well as related infrastructure investment needs. Environmental and social impacts should be considered, too, particularly just transition principles. From a global perspective, shifts in global dependencies and power structures and the roles of oil-producing countries must be

considered, as well as impacts on global emission trading. (See Factsheet in Annex 1: 2.13 Electrification & Energy System)

Projection A: Fragmented pathways: EU member states pursue divergent energy strategies, leading to a patchwork of national solutions. Electricity demand rises as fossil fuels are phased out, but the lack of a unified European approach results in uneven progress, limited cross-border energy flows, and persistent regional disparities.

Projection B: Local Efficiency Networks: Driven by sufficiency and efficiency, countries and regions focus on minimizing energy use and maximizing local self-sufficiency. The European energy system becomes decentralized and loosely connected, with limited integration between national grids and a strong emphasis on local solutions and demand reduction.

Projection C: Uncoordinated Sourcing: Europe's energy demand continues to grow, with electricity produced and imported from a diverse array of sources in the absence of strategic coordination. This creates a reactive, market-driven system characterized by fluctuating prices, supply risks, and a constantly shifting mix of energy carriers. The energy landscape is shaped by a complex, multi-layered global trade environment, where Europe navigates intricate supply chains and dynamic international markets, further amplifying volatility and exposure to external shocks.

Projection D: Global Green Hubs: Europe relies heavily on large-scale renewable energy imports from global regions with optimal conditions (the Global South). International energy hubs export electricity and hydrogen to Europe, reshaping global dependencies and requiring robust infrastructure and diplomatic ties to ensure security and sustainability.

Projection E: Fusion Breakthrough World [wildcard]: A technological leap in fusion energy delivers abundant, clean, and affordable electricity worldwide. This breakthrough transforms the global energy landscape, making energy scarcity and carbon emissions largely obsolete, and fundamentally altering geopolitical and economic power structures.

Figure 5 provides an overview of the up to five (A-E) different projections for each key factor.

Figure 5: Morphological box of key factors and projections

Projection	Global Political Power Landscape	AI & Deep Learning	Fragmentation & Trust in Policy	Raw Materials	Global Security & Conflicts	Vulnerability to Climate Change	Global Trade & Supply Chain	Electrification & Energy System
A	A Polarised World with the Return of Blocs	Monopolies in Motion: The Big AI Boom	Erosion of Public Trust: Conflicts and Fragmentation in Society	Global Availability HIGH – Europe's Economy is Dependent but Access Stays Secure	Geopolitical Tensions & War	High Vulnerability Globally and in Europe Managed by Strong Adaptation Systems	Fragmented, limited: Regional trade and supply chains	Fragmented Pathways
B	Redefining Globalisation: The Sino-European Pact	AI for All: The Regulated Revolution	Local Experimental Spaces for Democratic Processes	Global Availability Declines – Europe's High Dependency Meets Growing Access Struggles	Global Renewal Towards Peace	High Vulnerability Globally and in Europe Meets Weak Adaptation Capacity	Global single market: Globalization is higher than ever	Local Efficiency Networks
C	Western Resurgence: Transatlantic Alliances	Fragmented Futures: Parallel AI Worlds	Trust is High in Data-Driven Governance	Global Availability Declines – Europe's Dependency Softens Through Innovation	The Fractured Globe: Hidden Chaos	High Vulnerability Beyond Europe; Low Vulnerability in Europe Enabled by Strong Adaptation	One actor dominates trade and supply chain structures	Uncoordinated Sourcing
D	Multipolar World with Rise of African & Asian Countries	Algorithmic Sovereigns: The Rule of Machines	Political Institutions Safeguard Trust & Social Cohesion	Global Availability Declines Sharply – Europe Reduces Exposure but Remains Entangled	Awakening Order: A New Global Ethic	Vulnerability to Climate Change is on an Acceptable Level	Lack of Everything: No institutions, imploding politics	Global Green Hubs
E	Collapse of the State: Rise of the Decentralised World	Algorithmic Abstinence: Humanity Reclaims Control		Global Depletion of Raw Materials Leads to Systemic Crisis – No Region Escapes		System Overload – Adaptation No Longer Feasible		Fusion Breakthrough World

Source: ETC ST

3.3 Draft scenario paths

The next step in the participatory scenario process was to combine the projections into consistent scenarios. For this, the experts in the workshop developed so-called scenario paths in a moderated discussion. Plausible interrelations between the different projections were identified, beginning with projection A of the first key factor, “Global Political Power Landscape.” Based on this starting point, the participants selected a consistent projection (A, B, C, D, or E) for the second key factor, “AI & Deep Learning.” After agreeing on projection C, they proceeded to the third key factor, “Fragmentation & Trust in Policy.” Once projection connections had been determined across all key factors, the process was repeated, starting with projection B of the first key factor and following the same procedure. During the path development, the scenario paths were colour-coded, and then appropriate titles were formulated based on the key characteristics that had been identified. Figure 5 shows the final titles of the scenarios. Figure 5 shows the final scenario pathways as discussed in the workshop.

Figure 67: Draft scenario pathways

Scenario	Global Political Power Landscape	AI & Deep Learning	Fragmentation & Trust in Policy	Raw Materials	Global Security & Conflicts	Vulnerability to Climate Change	Global Trade & Supply Chain	Electrification & Energy System
The age of fragmentation	A Polarised World with the Return of Blocs	Monopolies in Motion: The Big AI Boom	Erosion of Public Trust: Conflicts and Fragmentation in Society	Global Availability HIGH – Europe's Economy is Dependent but Access Stays Secure	Geopolitical Tensions & War	High Vulnerability Globally and in Europe Managed by Strong Adaptation Systems	Fragmented, limited: Regional trade and supply chains	Fragmented Pathways
Status Quo 2.0: western cohesion and balanced alliances	Redefining Globalisation: The Sino-European Pact	AI for All: The Regulated Revolution	Local Experimental Spaces for Democratic Processes	Global Availability Declines – Europe's High Dependency Meets Growing Access Struggles	Global Renewal Towards Peace	High Vulnerability Globally and in Europe Meets Weak Adaptation Capacity	Global single market: Globalization is higher than ever	Local Efficiency Networks
AI takes over: from nations to networks	Western Resurgence: Transatlantic Alliances	Fragmented Futures: Parallel AI Worlds	Trust is High in Data-Driven Governance	Global Availability Declines – Europe's Dependency Softens Through Innovation	The Fractured Globe: Hidden Chaos	High Vulnerability Beyond Europe; Low Vulnerability in Europe Enabled by Strong Adaptation	One actor dominates trade and supply chain structures	Uncoordinated Sourcing
Sunrise in the South: the African-Asian Century	Multipolar World with Rise of African & Asian Countries	Algorithmic Sovereigns: The Rule of Machines	Political Institutions Safeguard Trust & Social Cohesion	Global Availability Declines Sharply – Europe Reduces Exposure but Remains Entangled	Awakening Order: A New Global Ethic	Vulnerability to Climate Change is on an Acceptable Level	Lack of Everything: No institutions, imploding politics	Global Green Hubs
China-led convergence	Collapse of the State: Rise of the Decentralised World	Algorithmic Abstinence: Humanity Reclaims Control		Global Depletion of Raw Materials Leads to Systemic Crisis – No Region Escapes		System Overload – Adaptation No Longer Feasible		Fusion Breakthrough World

Source: ETC ST

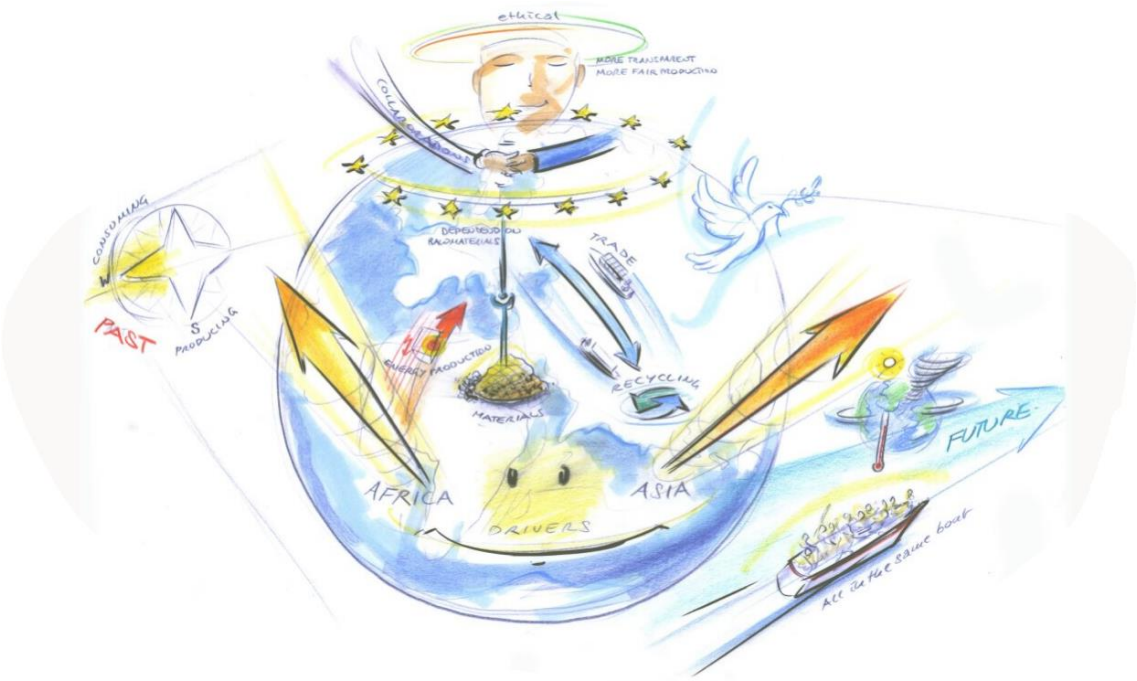
After the scenario workshop, the draft scenarios were further elaborated regarding their key characteristics and implications for competitiveness and societal or environmental sustainability. The scenario descriptions were validated with a literature analysis, key statements in the scenarios were examined for plausibility and illustrative narratives were formulated. In addition, they were evaluated in terms of their opportunities and challenges for Europe's sustainability and competitiveness, and strategic policy options to address the nexus between competitiveness and sustainability e.g. using synergies and addressing conflict lines. The analysis was based on the experts' discussions in the scenario workshop and additional literature research to ensure evidence-based plausibility and consistency of the scenarios.

4 Five scenarios of a sustainable and competitive Europe in 2040

This chapter presents the five scenarios with a short description of the key characteristics, implications for Europe's sustainable competitiveness and resulting opportunities and challenges for the achievement of the EU Competitiveness Compass.

In addition to the scenario-specific opportunities and challenges, cross-cutting implications for Europe's sustainability and competitiveness policies will be summarised in Chapter 4.6.

4.1 Scenario "Sunrise in the South: The African-Asian Century" (green scenario)



Source: ETC ST, Graphics: Heyko Stöber

4.1.1 Summary of the scenario

By 2040, global power has shifted toward Asia and a rapidly rising Africa - called the "African-Asian Century". The world is multipolar: no single hegemon dominates. The US struggles to regain geopolitical relevance, while China and Russia benefit significantly. Many other Asian and African countries gain new self-confidence, building influence through growing economic, demographic, and technological strength, even under intensified impacts of climate change. After years of geopolitical turbulence, a global ethic of sustainability and cooperation is born out of necessity. Countries across continents invest in green transitions for climate protection but also to secure economic advantage in green industries. Africa is becoming a frontrunner here, mainly because of its seemingly endless availability of renewable energy. Many countries in Europe and beyond are racing to optimising their trade and supply chains against the gaining economic prominence of the Global South. Indeed, Europe remains a stable actor but faces eroding social systems due to demographic change, an over-burdened society, the urgent need for innovation and the struggle for strategic autonomy in critical resources and infrastructure.

In this scenario, Europe must adapt to a world in which new actors in other regions are catching up significantly in economic terms. This is due to their growing economic power, innovation and productivity,

as well as the challenge for Europe to find solutions to various external and internal social and political challenges.

4.1.2 Scenario Description

The Global Shift to a multipolar world in 2040 - with emerging powers in Asia and Africa

Since the late 2030s, global power has shifted toward Asia and Africa: China, India, Southeast Asia, and a cohort of African states (especially Nigeria, Kenya, and South Africa) have high economic growth figures. Africa´s demographic dividend is materialising, as millions of young Africans join the workforce annually, more than anywhere else. What began as an extended workbench for cost-effective production for richer countries has led to independent markets and ecosystems for innovation, logistics and education by 2040.

Accelerated by years of Chinese infrastructure investments and knowledge transfers, some African states scaled up beyond low-cost manufacturing into more advanced technologies, especially in renewable energy systems, agri-technologies, and digital public services. China is still holding the reins, using its Belt and Road Initiative to assert its influence over trade, raw materials, digital infrastructure and data, and multilateral institutions, and are still benefitting from the success. Meanwhile, also India, ASEAN economies, and key African coalitions gain weight across UN agencies and other international institutions.

Russia, after decades of war-induced isolation, has become increasingly dependent on China, reduced to a resource supplier and junior partner. Despite occasional attempts at regional influence, particularly in Central Asia and the Arctic, it lacks the economic base to compete independently. Its authoritarian model survives but without the global weight of earlier decades.

The emerging Asian and African powers might not have reached their high global influence by 2040 if the Western markets and trade and tariffs agreements had remained stable and innovation capacities would have been cultivated. But the transatlantic alliance is broken since the eight years of Trump’s presidency, leaving behind a deep erosion of trust between Europe and the US. A weak America is preoccupied with rebuilding its dysfunctional democratic institutions and financial markets. The US economy is still vulnerable due to the tariff policy of the mid-2020s. Yet, the US retains pockets of global leadership, particularly in frontier technologies such as AI and space industry. American companies continue to shape European innovation ecosystems, because Europe remains dependent on access to digital platforms and the necessary transatlantic agreements. This partly hinders Europe's efforts to build relationships with the new players. Meanwhile, Europe still struggles under the burden of debt from defence spending in response to Russia´s war of aggression against Ukraine. At the same time, persistent structural challenges are ranging from overwhelmingly expensive social systems, the inertia of a mature low-growth economy to inefficient political decision-making processes and have further decreased Europe´s ability to act. These dynamics have opened the door for other actors to take a stronger role in global institutions and markets.

However, as no single hegemon dominates the global stage, regional blocs and emerging powers shape international agendas. Innovation hotspots and economic centres of influence, from Beijing and New Delhi to Brasília and Abuja, span the globe, turning it into a polycentric world. Latin America, especially Brazil is becoming a food production and bioenergy superpower. While not matching Africa or Asia in global weight, the region’s resources make it a critical balancing partner in trade and climate diplomacy.

Which was once a unipolar, the Western-led global order has given way to a diversified power architecture in which Asia and Africa stand increasingly at the centre.

A new global ethic in a heated world

By the mid-2030s, the global climate crisis has moved from warning signs to disruptive realities, hitting Africa and Asia hardest. Severe droughts across the Sahel, rising sea levels along South Asia’s coastlines,

and deadly heatwaves in megacities like Dhaka and Lagos have pushed millions to the edge. Crop failures and water scarcity fuel regional instability and internal migration, despite the rising economic prosperity. Europe in its geographically climate change buffered position, increasingly faces the knock-on effects: disrupted trade, rising food prices, and intensified pressure on asylum proposals.

These climate related turbulences are increasingly forming a new global ethic not of idealism, but of urgent necessity. In the 2030s it became clear: no nation, however wealthy or well-adapted, is immune from a destabilized earth system. This ethic dubbed "pragmatic planetary solidarity" is not about moral grandstanding, it is about survival. Under this new logic, climate actions became key for geopolitical and economic strategy in the Global South. Countries that once viewed climate adaptation measures, green transition funding, or protection of natural resources as aid now see them as investments in social stability, long-term security and the prospect of immense economic return.

Economically, the world takes on new climate functions. The Global South, rich in sunlight and wind, became the renewable engine of the world, exporting green energy and components at scale. The Middle East is also changing. The Gulf states have successfully shifted towards green hydrogen and critical mineral refining and are investing in energy markets across the globe. Other oil-based economies have not managed the transition smoothly, including the United States, which is suffering from falling demand and thus falling oil prices.

Europe is a net energy importer, increasingly reliant on African and Asian hydrogen, solar, and storage systems to meet high demand from electrification and digitalization. But access is contested: China, having bankrolled early infrastructure, controls many trade routes and energy nodes. Meanwhile, Europe is positioning itself as the planet's largest "carbon sink", selling afforestation credits and ecosystem services, reframing its forests and rural landscapes as global climate infrastructure.

Some regions of Europe have become flagships for high-tech climate adaptation. Heat-proofed cities, circular water systems, and resilient agriculture have reduced domestic risk. Yet this resilience has created a new diplomatic tension: how to justify investments in exclusive local adaptation measures while millions in southern regions still suffer? European policymakers face mounting pressure to act not just from moral obligation, but to preserve trade stability, manage climate migration within Europe, and avoid reputational fallout. In the new global ethic, insulation without contribution is no longer an option.

4.1.3 Implications on Europe´s competitiveness and sustainability

In this scenario the African and Asian countries require significantly more resources. Europe faces difficulties in accessing raw materials to moderate prices and in having access to the new markets in the Global South, particular because of China´s immense political and economic influence in those regions. In relative terms, Europe is losing influence on the world market and is having to take a back seat to Africa, Asia and other emerging economies. From the aspect of fairness, this shift is beneficial for a more balanced and just global distribution of resources. This scenario underscores the necessity for Europe to transition to a circular economy, to build new partnerships with African & Asian countries and to change to more sustainable consumption practices, as its industries need to reduce resource use. Europe can also position itself as a provider of natural climate sinks, offering financial opportunities and win-win outcomes in green innovations as well as climate adaption for vulnerable countries in the Global South. Europe´s competitiveness will depend on its ability to adapt to the changing global economic landscape, where sustainability becomes a central concern for all. Furthermore, Europe must manage the loss of power and influence, as both the EU and the US decline in global leadership. Competition in digital and data sovereignty intensifies. While China dominates infrastructure and Africa scales digital public services, the US still leads in AI and biotech. Europe must find niches in regulation, ethical AI, and digital trust to stay relevant.

This scenario presents several challenges, but also opportunities for Europe, as listed below.

Key Challenges for Europe

- Strategic dependency on external energy and raw materials remains a major vulnerability. As Europe becomes a net importer of green energy from Africa and Asia, it faces increasing constraints, particularly due to China's dominance over key infrastructure, trade routes, and energy nodes.
- Diminishing geopolitical influence in a multipolar world weakens Europe's ability to shape global agendas. With the transatlantic partnership frayed and the EU no longer setting the tone in multilateral institutions, Europe often finds itself reacting rather than leading.
- Internal structural burdens e.g. an ageing population, high-cost social systems, and the inertia of a mature, low-growth economy hinder Europe's competitiveness and slow its green transition
- Mounting ethical and diplomatic pressure challenges Europe's climate leadership. While adaptation at home is effective, the continent faces criticism for failing to adequately support the Global South, raising questions about fairness, solidarity, and global responsibility.
- Fragmented political decision-making remains a barrier to coordinated action. The EU's complex governance structures and divergent member state interests make it difficult to respond swiftly to global shifts, especially in migration, technology, and resource policy.
- Technological dependence on the US persists. Despite political frictions, Europe remains reliant on American companies for critical innovations in AI, biotech, and space technologies, limiting its strategic autonomy in key future industries.

Key Opportunities for Europe

- Leadership in high-tech climate adaptation positions Europe as a global model. Its investments in urban resilience, water management, and sustainable agriculture are not only protective domestically but also exportable as systems and services to vulnerable regions.
- Global influence through green finance and regulation remains a strong asset. Europe continues to shape ESG standards, carbon markets, and sustainable investment frameworks, setting benchmarks that many global actors adopt or align with.
- Natural carbon sinks become strategic resources. Europe's forests, soils, and rural ecosystems offer not only climate benefits but also economic returns through international offset schemes, enabling new income streams and soft power in climate diplomacy.
- Partnerships with Africa and Asia offer a reset of international relations. By co-investing in renewable energy, adaptation technologies, and sustainable trade, Europe can build long-term alliances grounded in mutual benefit rather than dependency.
- Advancing a circular economy as a survival strategy. Resource constraints force Europe to lead in reuse, repair, recycling, and circular design, creating new industries and reducing vulnerability to global supply shocks.

4.1.4 Strategic policy options to address the nexus between competitiveness and sustainability

In the "Sunrise in the South" scenario, global competition shifts toward green industrial capacity, access to renewable resources, and climate-aligned economic strategies. Asia and Africa emerge as economic engines powered by vast renewable energy potential, demographic growth and rapidly expanding innovation ecosystems. Europe's traditional regulatory centrality weakens as new players set standards, build alliances, and dominate manufacturing hubs in renewable energy, agri-tech, and digital public services.

In this world, sustainability becomes a driver of economic dynamism rather than a constraint. Competitiveness is shaped by access to green energy, productive partnerships with emerging regions, and the ability to integrate into global renewable value chains. The question for Europe is whether it can reposition itself within a system where the locus of innovation, resource abundance and economic growth has moved south and east, and where green transition leadership is no longer Western by default. The synergies are summarised in table 2, the tensions and possible conflicts in table 3.

Table 2: Synergies - Where sustainability strengthens competitiveness and vice versa

Source: own elaboration

Synergy	**Strategic value for Europe**	**Why it matters in this green-growth world**
Partnerships in renewable energy corridors (Africa–Europe, Middle East–Europe)	Access to abundant, low-cost green hydrogen, solar power and storage technologies	Regions that are rich in renewables set the pace of green industrialisation
Co-development of agri-tech and water-efficient systems	Strengthens Europe's food security under climate stress	African and South Asian markets become hubs for scalable climate-smart agriculture
Joint digital public infrastructure projects	Builds trust and long-term influence in rising digital ecosystems	Africa and Asia shape future digital standards and governance models
High-tech adaptation solutions	Creates export markets for European engineering and urban planning expertise	Demand rises as Asia and Africa confront severe climate impacts
Nature-based climate services & carbon sinks	Generates new revenue streams and reinforces Europe's soft power	Global carbon markets expand and value high-integrity sinks

Table 3: Conflict lines - Where competitiveness and sustainability pull in opposite directions

Source: own elaboration

Conflict line	**Tension for Europe**	**Long-term risk**
Green industrial growth vs. Dependence on raw materials	Rising African and Asian demand strain supplies and drive-up prices	Limited bargaining power, slower domestic industries
Climate adaptation at home vs. Expectations of climate solidarity abroad	Europe invests heavily in its own resilience while facing calls for greater support to climate-vulnerable states	Reputational strain and reduced political capital
EU regulatory leadership vs. Competing African and Asian standards	European norms face alternatives shaped by China, India or African unions	Loss of influence in global rulemaking

Digital sovereignty vs. Transatlantic dependency	EU relies on US AI and cloud ecosystems yet seeks alignment with Global South partners	Strategic ambiguity, limited negotiating leverage
Circularity vs. Resource-intensive consumption patterns	Europe must reduce material use even as green manufacturing demand grows globally	Lag in competitiveness if transition is too slow

Strategic choices for Europe

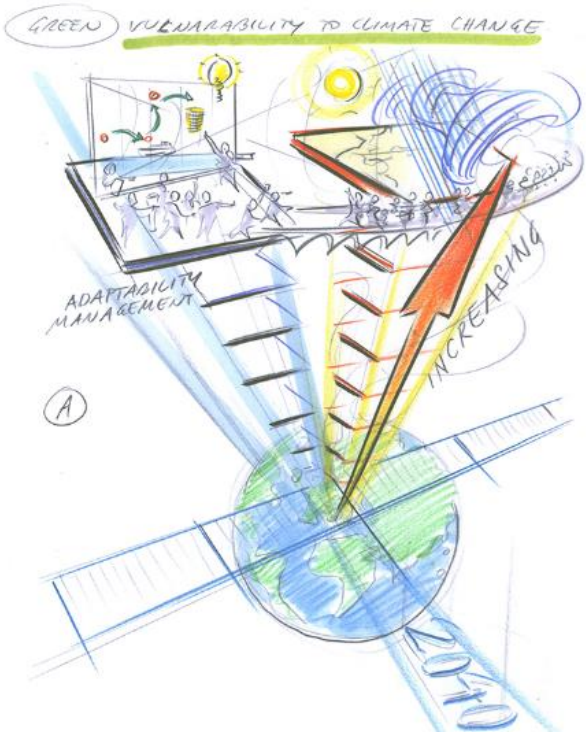
To maintain competitiveness in a sustainability-driven global economy, Europe must redefine its strategic priorities. The following choices determine whether it remains a relevant global actor or becomes a reactive player in a multipolar order, as described in table 4.

Table 4: Strategic choices for Europe

Source: own elaboration

Strategic Choice	Expected policy implication (scenario-specific)
1. Building long-term green industrial partnerships with Africa and Asia	Cooperative investment in renewable energy, green hydrogen, agri-tech and digital public goods enables Europe to access large emerging markets. Such co-development models strengthen Europe's integration into global South-led value chains and reduce the risk of marginalisation.
2. Making circularity as competitive accelerator	Advanced circular design, repair ecosystems and material-efficient manufacturing reduce exposure to global raw-material competition. Circularity becomes a source of exportable expertise and supports Europe's repositioning as a high-value technology provider.
3. Leveraging Europe's adaptation leadership through exportable systems	Urban cooling solutions, climate-proof infrastructure, water circularity and early-warning systems become signature European offerings. These technologies meet rising demand from African and Asian megacities facing acute climate stress.
4. Maintaining regulatory influence through coalition-building	Europe retains relevance by co-setting standards with African unions, ASEAN and Latin American partners instead of relying on transatlantic alignment. This pluralistic approach sustains the value of Europe's human-centric sustainability frameworks.
5. Positioning Europe as a global hub for nature-based climate services	High-integrity carbon sinks, biodiversity credits and ecosystem restoration allow Europe to act as a "climate stabilisation zone". This strengthens Europe's diplomatic weight in climate negotiations dominated by Africa and Asia.
6. Developing dual digital ecosystems (transatlantic and Global South)	Creating interoperable frameworks that link EU digital standards with emerging African and Asian digital public infrastructures expands influence and supports innovation networks.
7. Investing in social resilience to sustain competitiveness	Strong social safety nets, skills transitions and adaptive labour markets help Europe manage demographic pressures and maintain a productive workforce in a world where other regions benefit from demographic dividends

4.2 Scenario "The Age of Fragmentation: A World in Imperial Competition" (blue scenario)



Source: ETC ST, Graphics: Heyko Stöber

4.2.1 Summary of the scenario

In 2040, the world fragments into rival regional blocs led by the US and China. Global governance weakens, giving way to lose alliances and ad hoc deals. Economies are split into regional markets, with politicized supply chains and diverging technology standards. Bloc leaders and private actors gatekeep critical resources and AI/data ecosystems, while weak privacy safeguards persist. Fragmentation breeds patchy standards, complex data flows, and heightened cyber risks. Trust erodes, polarisation deepens, and AI-enabled disinformation flourishes. Resource nationalism intensifies as raw materials tighten. Meanwhile, climate shocks hit in waves, with Asia and Africa facing heat, food collapse, and migration surges. For Europe, this world is volatile and tense. Its human-centric AI rules struggle with interoperability and waning cooperation.

In this scenario, Europe struggles to find its role in a fragmented order, forced to balance resilience and cooperation below the fault lines of major power competition.

4.2.2 Description of the scenario

A World of Rival Blocs: Fragmented Markets, Divergent AI, and Resource Nationalism

By 2040, the international order is fractured into rival regional blocs shaped by imperial competition among the United States, the European Union, Russia, India, and China. Former global governance institutions have been shuttered or hollowed out; what remains are non-binding alliances and pragmatic, ad-hoc collaborations. Private actors exert substantial influence over public decision-making.

The global economy has splintered into regional markets with brittle, politicized supply chains. Diverging technological standards and regulations entrench the drive for strategic autonomy as states seek to reduce

dependence on US and Chinese big-tech ecosystems. Bloc leaders police access to critical resources and IT/AI/data infrastructures, while ethical standards for privacy and surveillance are poorly enforced. This fragmentation leads to a patchwork of standards, capabilities and risks; cross-border data flows, cyber threats and labour markets are becoming more complex. Key players and research centres operate within these silos. This severely limits opportunities for international cooperation and participation in cross-border value chains.

The United States retains dominance in advanced AI through market-driven innovation, while China excels in state-directed, mass-market AI for industry and pervasive surveillance. Chip supply restrictions and trade barriers constrain both powers' progress, intensifying geopolitical tensions over access to Taiwan's semiconductor capacity.

Public trust in institutions erodes as governments struggle to manage economic and societal transitions. Authoritarian movements imply stability by suppressing frustrations, migration pressures, and socio-economic fragmentation. Polarized societies in both blocs exposed to large-scale, AI-enabled disinformation campaigns and authoritarian responses, become fragile and unstable.

Decades of overconsumption intensify resource nationalism as producer countries guard access and demand political alignment or higher prices. This is reinforced by climate impacts striking in waves across the world. Asia and Africa suffer severe heat stress and food-system collapse, triggering surges in internal and cross-border migration that overwhelm asylum systems and border regimes.

Global trade reorganizes into regional supply chains and economic blocs, with new trade alliances and financial systems reshaping flows. Energy security becomes contingent on shifting geopolitical alignments rather than coordinated global markets.

Europe´s humancentric AI, critical dependencies, and energy and climate strain

The EU maintains restrictive, human-centric AI governance to protect fundamental rights under strict privacy and sustainability laws, emphasizing democratic oversight and cybersecurity. However, the absence of interoperable standards, weak shared ethical foundations abroad, and high cyber risk sap interest in international AI cooperation. Europe's heavy dependence on AI components and critical minerals, especially lithium, undermines strategic autonomy and increases vulnerability to price shocks and coercive trade tactics from resource-rich partners in Asia and Africa.

Climate change overwhelms Europe with alternating floods and water shortages, triggering ecological and social crises and intensifying migration pressures. Weak governance capacity in climate adaptation, uneven technological readiness, and persistent social hamper impede effective responses, leaving low-income households and rural communities disproportionately exposed with limited adaptive resources.

Europe's energy system is marked by uncoordinated, reactive sourcing: growing demand is met through diverse imports without strategic coherence, resulting in volatile prices, persistent supply risks, and a constantly shifting mix of energy carriers. In this fractured world, Europe's viable path is to consolidate its own resources and competencies, strengthen internal coordination, and forge carefully targeted partnerships that remain below the fault lines separating the major hegemonic powers.

4.2.3 Implications on Europe´s competitiveness and sustainability

In this scenario, the EU's sustainability goals are strained by resource nationalism, fragmented trade, and intensifying climate shocks, while competitiveness is squeezed by diverging tech standards, brittle supply chains, and dependence on imported AI hardware and critical minerals. Uncoordinated energy sourcing amplifies price volatility and supply risks, undermining industrial decarbonization and investment

certainty. Climate-driven floods and water stress raise adaptation costs and deepen social disparities, complicating just-transition delivery, while eroding trust and AI-enabled disinformation from outside Europe slow policy execution. Yet Europe´s human-centric AI and strong sustainability rules can serve as premium market differentiators if paired with interoperable standards, targeted strategic autonomy in key inputs, and trans-lateral partnerships that avoid great-power fault lines; a focus on circularity, resilience, and secure data/energy infrastructures can cut exposure and unlock productivity gains.

Key challenges for Europe

- Dependency on critical minerals and AI components (e.g., lithium, semiconductors) raises costs, coercion risk, and delays green deployment.
- Energy fragmentation and reactive sourcing drive price volatility and supply insecurity, hurting industrial competitiveness.
- Divergent tech standards and weak AI cooperation limit interoperability, scale, and innovation.
- Climate impacts (floods, water shortages) disrupt production, lift adaptation spending, and strain just-transition commitments.
- Declining trust and AI-enabled disinformation impede policy delivery and investment.
- Weaker global institutions reduce collective crisis management and security coordination.

Key opportunities for Europe

- Build strategic autonomy via domestic/nearshore capacity in clean tech, chips, power electronics, and secure compute.
- Lead on trustworthy AI, privacy, and sustainability standards as premium propositions for regulated single markets.
- Scale circular economy for critical materials (recycling, substitution, repair), plus strategic reserves and transparent sourcing.
- Coordinate EU energy policy: efficiency, storage, grids/interconnectors, and diversified long-term contracts to stabilize prices.
- Invest in adaptation tech (water management, resilient infrastructure, agri-tech) to cut risk and create exportable solutions.
- Forge trans-lateral, ESG-anchored partnerships with mid-sized resource holders to de-risk supply chains.
- Develop common EU data spaces and open-source AI tooling to boost SME productivity and diffusion.

4.2.4 Strategic policy options to address the nexus between competitiveness and sustainability

In the “Age of Fragmentation” scenario, sustainability and competitiveness intersect under conditions of strategic rivalry, resource pressure, and technological decoupling. Unlike in cooperative global contexts, sustainability here is primarily shaped by risk exposure rather than shared ambition. Europe operates in a world where supply chains are weaponised, AI ecosystems diverge aggressively, and climate shocks amplify geopolitical tensions. Competitiveness therefore hinges less on global integration and more on maintaining functional autonomy, stabilising essential systems, and reducing vulnerability to coercion or disruption.

In this environment, sustainability becomes a matter of defensive capacity, ensuring that Europe can continue its transition despite fractured partnerships, contested resources, and volatile markets. Conversely, competitiveness becomes inseparable from the ability to absorb shocks and protect Europe’s productive base.

The key challenge is how Europe can remain a technologically relevant and ecologically resilient actor when the global system no longer provides predictable frameworks, shared standards, or reliable supply routes. Synergies are summarised in table 5, tensions in table 6.

Table 5: Synergies - Where sustainability strengthens competitiveness and vice versa

Source: own elaboration

Synergy	Strategic advantage for Europe	Why it gains relevance in a fractured world
System resilience and climate-proof infrastructure	Reduces damage costs, stabilises productivity and prevents regional collapse	Climate shocks disrupt trade, labour mobility and industrial zones
Energy demand reduction and efficiency	Shields industries from volatile import prices	Energy flows are politicised and unpredictable
Circular use of critical minerals	Mitigates exposure to coercion and export restrictions	Resource nationalism escalates, especially for batteries and chips
High-assurance, privacy-centric digital environments	Creates trusted spaces for SMEs and public administration	Cross-border cyber risks and disinformation intensify
Deep internal market integration in clean-tech supply chains	Allows scaling despite limited external cooperation	Global value chains fragment and reliability of partners decrease.

Table 6: Conflict lines - Where competitiveness and sustainability pull in opposite directions

Source: own elaboration

Conflict Line	Tension for Europe	Long-term risk
Mineral dependency vs. Autonomy in green technologies	Access to lithium, rare earths and chips is highly politicised	Slowdown of the green transition; rising costs
Strict AI governance vs. Global divergence of standards	Europe's high safeguards reduce interoperability	Reduced scale, delayed adoption, competitive erosion
Reactive energy sourcing vs. Long-term decarbonisation	Fragmentation forces short-term fixes and emergency imports	Instability for clean-tech investment and industry
Adaptation needs vs. Social cohesion	Uneven climate impacts worsen inequality and local grievances	Social fragmentation and lower acceptance of transition costs

Disinformation vs. Coordinated sustainability action	External manipulation feeds polarisation and mistrust	Slower policy implementation and weaker institutional capacity
Weak global institutions vs. Transboundary crises	Fragmented crisis management limits cooperation	Growing losses from climate, migration and cyber shocks

Strategic choices for Europe

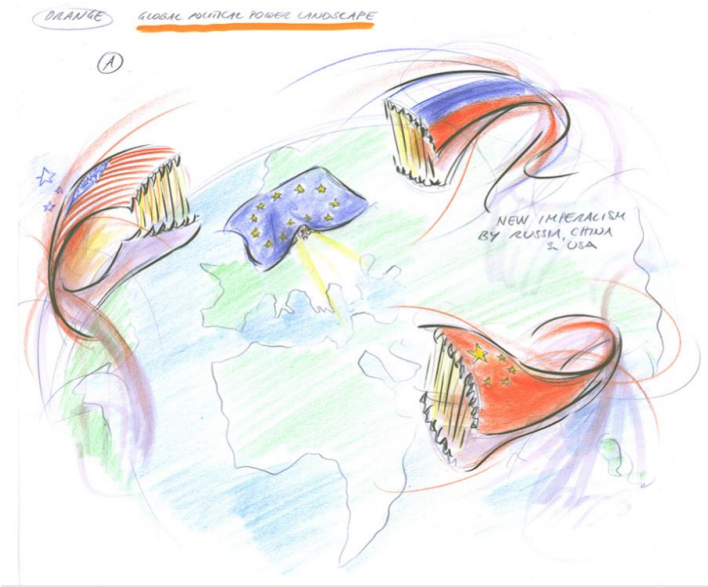
In the fragmented world of 2040, Europe's strategic options differ fundamentally from those in more cooperative scenarios. The emphasis shifts from alignment and partnerships to controlled interdependence, system robustness, and risk-aware diversification. Table 7 below presents the main strategic orientations and their embedded logic.

Table 7: Strategic choices for Europe

Source: own elaboration

Strategic Choice	Expected policy implication
1. Resilience and quality of essential systems (energy, water, digital, transport)	Prioritising resilience of key infrastructures supports economic stability under recurrent climate shocks and cyberattacks. Such hardening strengthens Europe's ability to maintain industrial activity during disruption periods.
2. Targeted autonomy in critical inputs (minerals, chips, secure compute)	Building selective capacity in bottleneck technologies reduces vulnerability to resource nationalism and geopolitical coercion. This orientation supports continuity of the green transition despite fragmented supply networks.
3. Internal scaling of clean-tech value chains	Strengthened single-market integration for batteries, power electronics, hydrogen components and heat pumps lowers dependence on unreliable external partners and supports industrial competitiveness within the bloc.
4. High-assurance data spaces and secure algorithmic environments	Unified European data spaces and verifiable AI tooling enhance productivity while mitigating disinformation and cyber risk. This provides a competitive position for SMEs that cannot rely on US or Chinese ecosystems.
5. Expansion of circularity as a security strategy	Intensifying recycling, substitution and repair capacities for critical materials reduces exposure to unstable markets and supports Europe's industrial resilience. Sustainability thus functions as a buffer against geopolitical volatility.
6. Climate adaptation as an economic stabiliser	Investment in water resilience, fire prevention, climate-proof agriculture and flood defences lowers economic disruption and eases social pressures in regions most affected by climate impacts.
7. Translateral and low-visibility partnerships	Selective cooperation with mid-sized resource producers avoiding alignment with either US or Chinese blocs creates diversified, politically safer supply corridors and supports Europe's strategic neutrality

4.3 Scenario "AI Takes Over: From Nations to Networks" (orange scenario)



Source: ETC ST, Graphics: Heyko Stöber

4.3.1 Summary of the scenario

By the late 2030s, state structures in many regions of the world erode. Power shifts to companies, civil society organisations, and citizen networks, coordinated through data-driven systems and AI which are taking over political and economic roles. Power of traditional states decline due to political crises, especially in the Western world; national borders matter less than access to clouds and networks. Advanced AI drives innovation and provides governance solutions for different demands. Review mechanisms and algorithmic constitutions are still evolving to align AI with public mandates. A democratic awakening, spurred by crises, infrastructure neglect, and data abuses, drives demand for transparency and accountability. Citizen initiatives increasingly control companies often with the help of AI. By boosting engagement and local agency of citizens, the far-right shift slows down. By 2040, labs across Europe test citizens' councils, participatory budgeting, and data trusts. Evidence-based, participatory policymaking spreads via monitored pilots, public media, and digital deliberation platforms on the local level as well as on a broader scale.

There is a global scarcity of raw materials, IT components, and usable data which hinder innovation and growth. A looming compute/data trade war sees platforms weaponize access to chips, bandwidth, and datasets. De-escalation efforts by infrastructure coalitions and civil networks introduce embargoes, verification, and standards. AI early warning and local coordination moderate climate risk as decentralized governance maintains core services. Blocs re-form around infrastructure and data pools. Europe plays an active role in AI-coordinated, data-driven network governance, prioritising interoperable open standards and institutionalised citizen participation to stay competitive in a transactional, post-state landscape.

4.3.2 Description of the scenario

Post-State Governance: AI as the Nervous System, Citizen-Led Democracy at Scale

By the end of the 2030s, traditional state structures around the world had begun to falter, and a new order has since emerged in which companies, civil society networks and decentralised systems are increasingly taking on central functions in the areas of governance, security and the economy. Power is increasingly

concentrated in the hands of those who control data, computing power, global platforms and the worldwide logistics infrastructure. National borders play a lesser role than access to clouds, networks and fibre optics. Advanced AI is becoming the nervous system of this order, deep learning AI coordinates markets, mediates disputes and controls complex systems with limited human supervision. Review processes and algorithmic 'constitutions' are still being developed to keep AI systems in line with public mandates. This development is supported by a kind of democratic awakening in many countries, especially in Europe. Repeated crises, lack of investment in the maintenance of critical and supply infrastructures, and revelations of data misuse have led to massive demands for greater transparency and accountability in governments.

Innovative approaches to organising citizen initiatives in several countries have helped to slow down the shift to the right in society by increasing citizens' engagement in their own affairs. Now, in 2040, there are local experimental labs in many places with citizens' councils, participatory budget planning and data trust companies. These approaches are being scientifically monitored in studies on evidence-based and participatory policymaking with the aim of identifying and disseminating best practices. An important building block for this new form of participatory governance is social media and digital participation tools, as well as data-rich platforms where communities can discuss compromises and set priorities in near real time.

Decentralized resilience based on circular economy, data geopolitics, and energy localism

The desired economic development towards more competitive innovations is being hampered by the worldwide difficulty of accessing raw materials and components for the AI-based economy, as well as limited availability of data. A 'computing and data trade war' is looming, with platforms outside Europe using access to chips, bandwidth and data as weapons. Hope for de-escalation comes from a coalition of infrastructure providers and civil society networks that want to create a new basis for the markets through trade embargoes, verification protocols and standardisation. The basis for this new "self-made" market regulation is to be resource efficiency, circular economy and ecological restoration. European partners are driving forces behind this development, as they have been able to partially reduce their dependence on external factors through earlier investments in circular systems and energy efficiency. Nevertheless, critical imports (advanced chips, rare minerals, special components) continue to tie important sectors to unstable suppliers, leading to adaptation gaps and episodic stresses in exposed key industries in Europe. The threats posed by climate change have greatly reduced globally networked forecasting models. AI-driven early warning systems and local coordination limit climate losses and make Europe's overall vulnerability moderate. With weakened national institutions, the EU's basic functions are maintained through principle-based, decentralised coordination: municipal networks, cooperatives and sectoral consortia manage social services, security and standards.

Blocs are aligned more by infrastructure and data pools than by flags; initial trade conflicts in the single market give way to agreements on resource sharing that reward sufficiency and verifiable sustainability. Next, the European energy system is to be further decentralised to better integrate local renewable energies. Efficiency and self-sufficiency take precedence over continent-wide integration.

In this cooperative but post-national order, Europe's competitiveness depends on trustworthy AI, open standards, circular material flows and the resilience of local and regional systems that can adapt flexibly amid ongoing global scarcity.

4.3.3 Implications on Europe´s competitiveness & sustainability

In this scenario, EU sustainability is not a high priority of all actors, in some cases it benefits from a democratic awakening of certain sustainability-oriented initiatives, circular systems out of necessity, and decentralized energy from some projects. Among all activities are also other priorities e.g. making profit,

improving neighbourhood, and pursuit of individual happiness. Competitiveness is constrained by global scarcities, a looming compute/data trade war, limited data access, and persistent dependencies on chips and critical minerals. AI-driven early warning and local orchestration keep climate vulnerability moderate, yet power concentrated in data/compute holders and limited human oversight pose governance and security risks; decentralized, principle-based coordination preserves functions and accelerates evidence-based policy, but fragmented markets and grids can hinder scale, interoperability, and cost efficiency.

Key challenges for Europe

- Ongoing dependence on advanced chips, rare minerals, and special components from unstable suppliers.
- Looming compute/data trade war limiting access to chips, bandwidth, and data; external platforms weaponize access.
- Limited data availability and weakened global forecasting networks hindering AI performance and planning.
- Concentration of power in data/compute holders with limited human oversight, risking capture and misalignment.
- Decentralized energy with limited cross-border integration reducing economies of scale and system balancing.
- Weakened state capacity and fragmented governance complicating coordination, standards, and enforcement.

Key opportunities for Europe

- Market rules centred on resource efficiency, circularity, and ecological restoration align with EU strengths and cut material intensity.
- Trustworthy AI, open standards, data trusts, and participatory tools boost legitimacy, productivity, and market differentiation.
- AI-driven early warning and local coordination reduce climate losses and protect critical infrastructure.
- Decentralized energy, local renewables, storage, and demand reduction increase resilience and lower import dependence.

4.3.4 Strategic policy options to address the nexus between competitiveness and sustainability

In the "AI Takes Over" scenario, competitiveness and sustainability unfold in a world where the basic structures of governance have changed. Traditional state authority weakens, and networks built around AI systems, data platforms, and digital infrastructures take on major roles in organising economies and public services. At the same time, global scarcity of raw materials, chips, and usable data limits industrial growth and puts pressure on all regions, including Europe.

Power increasingly depends on who controls compute, data access, and essential materials, while political legitimacy stems less from national governments and more from transparency, citizen participation, and trustworthy algorithmic systems.

Under these conditions, sustainability becomes less about long-term national climate plans and more about practical constraints: how to save resources, recycle materials, stabilise local energy systems, and keep digital infrastructures reliable. Competitiveness, in turn, depends on whether Europe can keep its core systems functioning (energy supply, material cycles, data flows, and trusted digital services) despite shortages and tighter control over computing and information.

The key question in this scenario is how Europe can maintain economic and social stability when AI networks and decentralised actors increasingly handle tasks that were once the domain of the state. The synergies are summarized in table 8, the potential conflicts in table 9.

Table 8: Synergies - Where sustainability strengthens competitiveness and vice versa

Source: own elaboration

Synergy	**Strategic advantage for Europe**	**Why it increases relevance under a post-state AI-driven order**
Reducing material flows	Reduce exposure to global scarcity of critical materials, chips, and components	Scarcity becomes a structural condition; circular systems are essential for continuity
AI-supported evidence-based policymaking	Improves quality and speed of decisions in fragmented governance systems	Network-driven governance depends on verifiable data and adaptive learning
Decentralised renewable energy and local energy balancing	Increases resilience as national systems weaken and imports fluctuate	Energy localism replaces centralised market coordination
Participatory governance and data trusts	Enhance legitimacy and reduce risks of AI misalignment	Citizen oversight becomes essential when traditional institutions lose authority
AI early-warning for climate and infrastructure risks	Protects critical assets and reduces disaster losses	Global forecasting networks deteriorate; local AI systems fill the gap

Table 9: Conflict lines - Where competitiveness and sustainability pull in opposite directions

Source: own elaboration

Conflict Line	Tension for Europe	Long-term risk
Compute and data scarcity vs. Digital competitiveness	Access to chips, bandwidth, and datasets becomes weaponised	Innovation slows; vital sectors experience periodic shutdowns
Decentralised energy vs. Efficiency and scale	Localised systems offer resilience but undermine integration	Higher system costs, less balancing capacity, and uneven reliability
AI-led governance vs. Human oversight	Power centralises in compute-rich actors with opaque incentives	Risks of misalignment, capture, and algorithmic dominance
Citizen-driven decision-making vs. Regulatory coherence	Participatory models vary widely across regions	Fragmentation of standards; difficult EU-wide coordination
Circularity vs. Persistent critical imports	Some inputs (advanced chips, rare minerals) remain non-circular	Exposure to chokepoints persists despite local resilience
Data/compute blocs vs. Sustainability alignment	Networks form around infrastructure providers, not climate goals	Misaligned incentives hinder coordinated sustainability action

Strategic choices for Europe

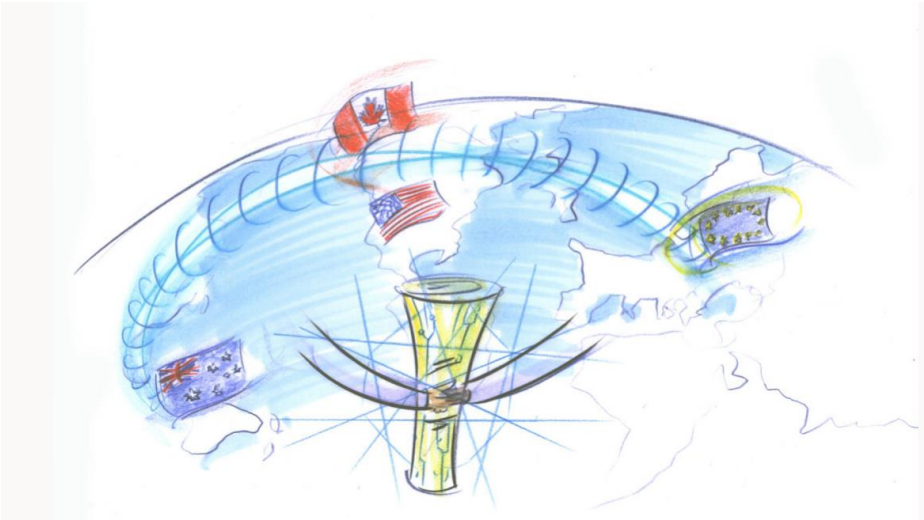
Strategic choices in this scenario reflect the shift from state-led coordination to network-led governance, where resilience emerges from decentralised systems, transparent data architectures, and trusted AI. The following strategic orientations highlight how Europe could reconcile competitiveness and sustainability under conditions of scarcity, fragmented authority, and AI mediation. Table 10 summarises the strategic choices.

Table 10: Strategic choices

Source: own elaboration

Strategic Choice	Expected policy implication
1. Embedding circularity as the operating system of Europe's material economy	Circular flows for minerals, components, and products become essential as global scarcity persists. This reduces vulnerability to compute/material shocks and stabilises key industries operating with limited inputs.
2. Building open, verifiable, and citizen-aligned AI governance architectures	Algorithmic accountability, data trusts, and transparent audit trails strengthen legitimacy and allow AI systems to coordinate services without undermining democratic mandates. This enhances both trust and competitive differentiation.
3. Developing decentralised, self-balancing energy systems	Expanding local renewables, storage, and demand management supports continuity when national grids weaken. Energy localism improves resilience but requires robust interoperability protocols to prevent fragmentation.
4. Establishing secure, interoperable European data and compute commons	Shared data spaces, federated learning, and EU-based compute pools reduce dependence on external platforms and mitigate risks from compute/data embargoes. This supports innovation and safeguards critical functions.
5. Strengthening local climate resilience via AI-driven risk management	AI-enabled forecasting and local coordination reduce climate losses, protect infrastructure, and maintain productivity in decentralised governance environments.
6. Supporting network-based economic governance and community-level innovation	Municipal networks, cooperatives, and sectoral consortia gain a stabilising role when states weaken. Supporting these networks increases Europe's adaptive capacity and allows sustainability solutions to scale through replication rather than central direction.
7. Forming resource-sharing alliances based on verification and sufficiency	Agreements with like-minded infrastructure providers and civil networks ensure access to materials, data, and compute through transparent protocols. Such alliances provide reliability when states can no longer guarantee predictable supply chains.

4.4 Scenario “Status Quo 2.0: Western Cohesion and Balanced Alliances” (yellow scenario)



Source: ETC ST, Graphics: Heyko Stöber

4.4.1 Summary of the scenario

By 2040, the Western alliance is revitalized: The US and Europe stand together, form a stable economic and political front based on shared values and balanced power. Tariffs are lifted and global integration accelerates, resulting in a highly interconnected single market without rigid blocs. Growth is fuelled by research, innovation, and collaboration, but consumption rises alongside integration. In the digital sphere, AI and platform power remain dominated by US and Chinese tech giants, with proprietary AI models and hardware platforms shaping market power. Europe innovates but remains structurally dependent on external platforms and technologies. Severe climate hazards persist globally and in Europe, but robust technological, governance, and social adaptations contain most damage. A global value shift toward peace and cooperation strengthens institutions like the UN, spurred by crises and democratic movements. Within the EU, uneven collaboration, and divergent national strategies create a patchwork of systems, with limited integration across borders and regional disparities. This leaves the EU cohesive on the global stage yet constrained by its dependency and limited autonomy.

4.4.2 Description of the scenario

Research and innovation-led integration with coordinated prosperity and no blocs

By 2040, the Western alliance is revitalized with well-balanced power relations between Europe and its partners. Although global power remains competitive, these allies form a stable economic front that emphasizes shared values and coordinated prosperity, driven by research, innovation, and economic collaboration. Tariff barriers are lifted, and global integration intensifies, creating a highly interconnected single market that operates without rigid blocs; consumption accelerates as cross-border flows deepen and standards align. Within this framework, a continuing debate examines whether the distribution of power truly remains balanced and how emerging alliances or latent conflicts could reshape cooperation.

AI and deep learning development are dominated by a small number of global tech giants, mainly in the United States and China with significant hardware providers like Nvidia holding substantial market power. Most advanced models remain proprietary, a dynamic that fuels rapid innovation while intensifying concerns about ethical governance, cybersecurity vulnerabilities, and job disruption across sectors. Global energy demands rise in step with expanding compute, accompanied by increased resource and water

consumption. Society adapts unevenly, widening skills gaps and leaving few checks on monopolistic practices or systematic risk assessment, even as the competitive edge of proprietary platforms grows.

Trust in political institutions and democratic processes continues to decline, accompanied by rising authoritarianism, securitization, and opaque governance. Public engagement and participation weaken, polarization intensifies, and societal values shift from a focus on development to a focus on survival. Policy fragmentation increases alongside the growing influence of private actors, who fill gaps in agenda-setting, standardization, and service delivery as public capacity is stretched.

Persistent scarcity, patchwork energy, and declining trust amid accelerated global integration

Global scarcities worsen, but Europe has already stabilized its systems through innovation. Dependency on some materials remains, yet exposure is reduced compared to other regions. Elsewhere, resource shortages and conflicts become more acute, underscoring Europe's partial resilience and the uneven global distribution of adaptive capacity. Severe climate hazards occur permanently both globally and in Europe, challenging social systems, economies, and ecosystems. Despite widespread vulnerabilities, robust technological, governance, and social adaptation efforts contain most of the damage, sustaining critical functions and protecting core infrastructure.

Amid these stresses, a global value shift toward peace and cooperation gathers momentum. Global institutions gain strength in a more unified, environmentally conscious world that seeks to reconcile accelerated integration with sustainability. Triggers for this value shift include natural catastrophes that exposed systemic fragilities, while democratic movements and governance reforms work to channel public demand for accountability and risk management into institutional renewal.

Within the EU, member states pursue divergent energy strategies, producing a patchwork of national solutions. Electricity demand rises as fossil fuels are phased out, but the lack of a unified European approach results in uneven progress, limited cross-border energy flows, and persistent regional disparities. The result is a continent that participates fully in the interconnected single market while grappling with internal asymmetries in energy security, resilience, and affordability, pressures that interact with proprietary AI dominance, resource constraints, and eroding political trust to define the contours of Europe's competitiveness and sustainability.

4.4.3 Implications on Europe´s competitiveness & sustainability

In this scenario, EU sustainability gains from a revitalized Western alliance, open trade, and robust adaptation that contains climate damages, but faces headwinds from accelerated consumption, rising energy/resource use, and a fragmented, patchwork energy system. Competitiveness benefits from a tariff-free, interoperable market and innovation-led collaboration, yet is constrained by proprietary AI dominance (mainly US/China), concentrated hardware power, widening skills gaps, and eroding public trust that complicates execution. Persistent global scarcities still pose supply risks despite Europe's partial stabilization, while limited cross-border energy flows and regional disparities raise costs and hinder scale. Stronger global institutions and evidence-led cooperation create room for EU standard-setting on ethics and security, but monopolistic dynamics and cybersecurity exposures threaten sovereignty and resilience. Overall, the EU must balance scale advantages from integration with strategic autonomy in compute, skills, and clean tech to align sustainability with long-run competitiveness.

Key challenges for Europe

- Dependence on proprietary AI ecosystems and concentrated hardware suppliers increases costs and weakens bargaining power.
- Rising energy, resource, and water demand plus accelerated consumption risk overshooting climate and biodiversity targets.

- Patchwork national energy strategies, limited interconnection, and regional disparities hinder efficiency and raise prices.
- Eroding public trust, securitization, and polarization slow policy delivery and just-transition measures.
- Widening skills gaps and uneven labour transitions reduce productivity and technology adoption.
- Cybersecurity vulnerabilities and opaque governance in private platforms heighten systemic risk.
- Global scarcities persist; material dependencies and supply disruptions remain possible.
- Weak checks on monopolistic practices constrain SME participation and innovation diffusion.

Key opportunities for Europe

- Tariff-free, highly integrated markets expand scale for EU clean-tech, efficiency, and adaptation solutions.
- Stronger UN and evidence-based governance open pathways for EU-led standards on ethical AI and cybersecurity.
- Europe's innovation-driven stabilization positions it to export resilient infrastructure and climate adaptation tech.
- Strategic investment in European compute, open models, and trustworthy AI creates a differentiation premium.
- Accelerated upskilling reduces the digital divide and boosts competitiveness across regions and sectors.
- Targeted grid modernization and cross-border flexibility improve reliability while enabling renewables.
- Circular material strategies, recycling, and substitution lower import exposure and lifecycle emissions.
- Alliance-wide competition policy and transparency regimes curb monopoly power and improve market access for EU firms.

4.4.4 Strategic policy options to address the nexus between competitiveness and sustainability

In the 'Status Quo 2.0' scenario, Europe operates in a world that feels familiar yet has undergone subtle changes. Western unity is strong, tariffs have been abolished, supply chains are thriving once more, and transatlantic research ecosystems are generating a steady stream of innovation. However, this stability masks underlying tensions: Europe's dependency on proprietary AI and hardware is increasing, consumption and resource use are rising faster than efficiency gains, and uneven national energy strategies are producing internal asymmetries. Climate hazards remain severe but are mostly contained thanks to robust adaptation systems, even though political trust and societal cohesion continue to erode.

While Europe benefits from a stable global order and open trade, its long-term position hinges on its ability to convert integration gains into strategic autonomy in computing, skills, and clean technology manufacturing. The central challenge is to maintain prosperity without drifting further into overconsumption, patchwork governance and technological dependency.

The overarching question is: Can Europe upgrade its strengths, esp. innovation, adaptation and multilateralism, quickly enough to meet the growing demands of a stable but resource-intensive world?

The following tables summarise the synergies (table 11) and conflict lines (table 12) for Europe.

Table 11: Synergies - Where sustainability strengthens competitiveness and vice versa

Source: own elaboration

Synergy	Value for Europe	Why it matters in this scenario
Tariff-free, deeply integrated Western markets	Expands scale for European clean-tech and efficiency solutions	Integration boosts demand for low-carbon technologies
Innovation-driven cooperation with the US	Accelerates R&D for renewable energy, grids, biotech and AI	Shared standards and joint research platforms reduce duplication
Robust climate adaptation systems	Protects infrastructure and productivity despite severe hazards	Climate shocks continue, but damage is largely contained
Strengthened multilateral institutions	Enhances Europe's ability to shape global ethics, cybersecurity and sustainability norms	The UN, OECD, and G20 regain influence and legitimacy
Circular and resource-efficient production models	Reduce exposure to global scarcity despite rising consumption	Material pressures remain high, so efficiency is a competitive asset

Table 12: Conflict lines - Where competitiveness and sustainability pull in opposite directions

Source: own elaboration

Conflict Line	Tension for Europe	Underlying risk
Proprietary AI dominance vs. European tech sovereignty	Europe relies on US/Chinese platforms for models and hardware	Innovation continues, but bargaining power weakens
High consumption vs. Climate and biodiversity limits	Rising living standards fuel resource and energy demand	Harder to meet emissions targets even with adaptation
Patchwork energy strategies vs. System efficiency	National choices diverge; cross-border integration remains limited	Costs rise, grid stability weakens regionally
Declining public trust vs. Need for large-scale transition	Securitisation and polarization hinder public support	Harder to implement just-transition or behavioural policies
Skills gaps vs. Rapid technological change	Labour markets lag innovation	Productivity and diffusion slow, especially for SMEs
Monopoly power vs. SME competitiveness	Platforms control data, cloud, and compute resources	Innovation bottlenecks and weaker European competition dynamics

Strategic choices for Europe

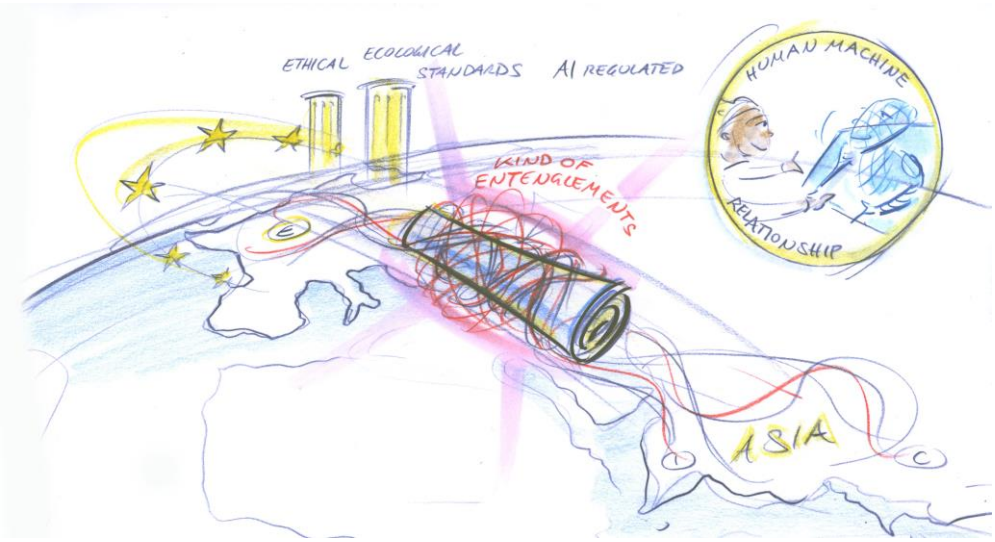
Strategic priorities in this scenario focus on turning stability into structural strength while reducing reliance on external technological ecosystems. Europe must convert today's integration gains into tomorrow's resilience. This is summarized in Table 13.

Table 13: Strategic choices for Europe

Source: own elaboration

Strategic Choice	Expected implication for Europe
1. Build strategic autonomy in compute, open AI models, and enabling hardware	Reduces dependency on proprietary US/Chinese systems and improves Europe's control over critical digital infrastructures.
2. Strengthen skills systems and labour transitions	Helps close widening digital divides and enables broad adoption of new clean-tech and AI solutions across all regions.
3. Modernise grids and expand cross-border energy flows	Enhances efficiency, reduces regional disparities, and allows Europe to make full use of renewables in a growing electricity system.
4. Advance circular economy as a buffer against rising consumption	Reduces material footprint despite market expansion and positions Europe as a leader in low-resource production technologies.
5. Reinforce climate adaptation as an economic stabiliser	Sustains productivity and protects key sectors as climate hazards intensify.
6. Promote alliance-wide competition policy and transparency frameworks	Prevents monopolistic behaviour by global platforms, enabling fairer markets for EU firms and SMEs.
7. Strengthen multilateral ethics, cybersecurity, and sustainability standards	Builds global frameworks that reflect European values and reduces vulnerability to systemic shocks.

4.5 Scenario "China-Led Convergence" (grey scenario)



Source: ETC ST, Graphics: Heyko Stöber

4.5.1 Summary of the scenario

By 2040, China shapes a new era of globalization. With the U.S. turning inward, Beijing becomes the central hub of trade, regulation, and standard setting. The EU is seeking stability and market access, deepens its trade and cooperation with China. Tariffs fall, supply chains remain stable, and Europe secures access to critical resources and technologies through Chinese partnerships. The growth is underpinned by low regulation & open competition, fostering innovation and efficiency but at the cost of human rights standards and ethical safeguards. Europe accepts these compromises in return for economic stability and predictable access to global markets. The EU benefits from resilient infrastructure and strong social safety nets, keeping climate vulnerability relatively low. Yet in strategic terms, Europe operates increasingly under China's wing, dependent on Chinese trade routes, technologies, low prices and political frameworks. While Europe still advances in areas like sustainability, decentralised energy, and circular economy practices, its autonomy narrows in a world where China sets the rules of globalization.

4.5.2 Description of the scenario

China leads the New Globalization: trust-building, open markets, and ethical AI

By 2040, China sets the pace for a renewed, rules-based globalization as the United States turns inward. Rather than blocks, a highly interconnected single market emerges with tariff barriers lifted and interoperability standards spreading across finance, data, and clean technology. The EU deepens trade and collaboration with China, building mutual trust through stringent data-security arrangements, shared clean-tech roadmaps, and joint standards that break up monopolies and ensure fair access. Power flows to those who control data, compute, and infrastructure, but agile global regulation is anchored in ethical AI, robust cybersecurity, and competition policy and keeps platforms open and contestable.

A broad value shift toward peace and cooperation follows a series of global shocks that make the costs of fragmentation undeniable. Stronger global institutions, especially a re-energized UN, coordinate evidence-based governance, with science playing a central role in policy design, auditing, and impact evaluation. Public trust rises as data-driven decision-making becomes more transparent and aligned with public

welfare. Even formerly authoritarian leaders pivoted toward more democratic governance practices when comparative data demonstrate superior outcomes. Large-scale investments in education and upskilling narrow the digital divide and cushion labour transitions as AI diffuses across sectors.

Decentralized energy, sufficiency, and a circular economy for competitiveness

Technology and clean innovation drive growth. AI's benefits are widely shared through open interfaces, auditability, and safety baselines that enable trusted deployment in health, mobility, and industry. Energy and resource use are tightly managed globally, with circularity and efficiency embedded in supply chains. Raw materials remain plentiful and move through resilient, verifiable supply networks; Europe stays import-dependent yet secures access via diversified contracts, diplomacy, and certification regimes.

Europe's climate vulnerability is low thanks to proactive adaptation, resilient infrastructure, and strong social safety nets. Yet interdependence keeps Europe exposed to distant shocks via trade, migration, and geopolitical aftershocks. To reconcile accelerated global consumption with sustainability, Europe doubles down on sufficiency and efficiency at home: a decentralised, loosely connected energy system prioritises local renewables, storage, and demand reduction. Competitiveness rests on trustworthy AI, open standards, clean-tech leadership, and circular material flows, leveraging tight global integration while maintaining European data sovereignty and high security benchmarks.

4.5.3 Implications on Europe´s competitiveness & sustainability

In this scenario, EU's sustainability and competitiveness is supported by opening a tariff-free, interoperable global market, embedding ethical AI, cybersecurity, circularity, and efficiency into supply chains, and strengthening evidence-based, transparent governance. Europe benefits from trusted AI, clean-tech leadership, resilient infrastructure, and a decentralized energy system that lowers emissions and import exposure. However, deep interdependence, persistent import reliance for critical inputs, concentration of power in data/compute infrastructures, and accelerated global consumption create risks of rebound effects, sovereignty tensions, and competitive pressure on EU firms and SMEs.

Key challenges for Europe

- Continued import dependence on critical materials, chips, and infrastructure despite resilient supply chains.
- Concentration of power in data/compute platforms risks lock-in, IP leakage, and sovereignty tensions.
- Accelerated global consumption may undermine climate goals via rebound effects and higher absolute footprints.
- Cross-border data governance and security complexity increase compliance burdens, especially for SMEs.
- Competitive pressure from Chinese and global firms in AI and clean tech; risk of standard-setting drift away from EU values.
- Exposure to external shocks via trade, migration, and geopolitics despite low domestic climate vulnerability.
- Uneven skills upgrades and labour transitions could leave regional gaps in productivity and adoption.

Key opportunities for Europe

- Access to a highly integrated single market with shared interoperability standards boosts scale and lowers transaction costs.

- Joint EU–China standards on ethical AI and cybersecurity create a trust premium for EU products and services.
- Circular, resource-efficient supply chains raise material productivity and reduce environmental impact and costs.
- Decentralized energy, local renewables, storage, and demand reduction enhance resilience and cut import bills.
- Strong global institutions and science-led governance enable coordinated risk management and policy learning.
- Education and upskilling investments narrow the digital divide and lift innovation capacity.
- Open, contestable platform markets reduce monopoly power and improve market access for EU firms.
- Certification and transparency regimes secure raw material access with lower political and ESG risk.

4.5.4 Strategic policy options to address the nexus between competitiveness and sustainability

In the "China-Led Convergence" scenario, Europe operates in a world where globalisation has not collapsed but been re-anchored around Beijing. Tariffs are broadly removed, interoperability standards spread across trade, finance, data and clean technology, and global institutions regain strength under a more coordinated, science-driven governance model. Europe enjoys stable access to markets, raw materials and clean technologies through dense economic links with China and other partners in this integrated system.

At the same time, this stability comes with structured dependence. Power concentrates in data and compute infrastructures, many of which are influenced or shaped by Chinese standard-setting. Europe remains import-dependent for critical materials, chips and infrastructure, and faces constant competitive pressure from Chinese and other global firms in AI and clean tech. Global consumption continues to rise, even as circularity and efficiency become embedded in supply chains, creating the risk of rebound effects and renewed pressure on planetary boundaries.

Europe's long-term position depends on whether it remains a rule-taker in a China-centred system or emerges as a co-shaper of global norms, using its strengths in circularity, sufficiency, ethical AI, decentralised energy and science-based governance to influence the direction of convergence.

The central question is: Can Europe leverage China-led convergence to advance its own model of sustainable competitiveness, while protecting autonomy and values in a deeply interdependent world? The resulting synergies and possible conflict lines are listed in the following tables 14 and 15.

Table 14: Synergies - Where sustainability strengthens competitiveness and vice versa

Source: own elaboration

Synergy	Value for Europe	Why it matters in this scenario
Highly integrated, tariff-free global market	Provides scale for European clean-tech, efficiency and adaptation solutions	China-led openness lowers transaction costs and accelerates diffusion of low-carbon technologies

Joint standards on ethical AI and cybersecurity	Creates a trust premium for EU products and services in sensitive sectors	Convergence on "safe and auditable AI" makes compliance an asset rather than a barrier
Circular, resource-efficient global supply chains	Raises material productivity and reduces exposure to raw material volatility	China and the EU embed circularity in value chains, making efficiency core to competitiveness
Science-led multilateral governance (UN, standards bodies)	Enhances Europe's capacity to influence global norms on climate, biodiversity, and risk management	Evidence-based convergence opens space for European expertise and regulatory leadership
Decentralised energy and sufficiency at home within a global open market	Reduces import exposure and improves resilience, while keeping access to global technology flows	Europe can combine local resilience with benefits from a tightly integrated global system

Table 15: Conflict lines - Where competitiveness and sustainability pull in opposite directions

Source: own elaboration

Conflict Line	Tension for Europe	Underlying risk
Import dependence vs. Strategic autonomy	Europe still relies on imported critical materials, chips and infrastructure, even if supply chains are more resilient	Vulnerability to political pressure, pricing power or subtle standard-setting bias
China-centred standards vs. European value priorities	Convergence may gradually reflect Chinese preferences more strongly than EU norms	Drift away from strong human rights, social and environmental safeguards over time
Global consumption growth vs. Planetary boundaries	Efficiency and circularity rise, but absolute consumption and throughput stay high	Rebound effects threaten climate and biodiversity goals despite "green" supply chains
Concentration of power in data/compute platforms vs. Sovereignty	Global platforms, often China-linked or China-influenced, control infrastructures	Risks of lock-in, IP leakage and reduced bargaining power for EU firms
Regulatory complexity vs. SME capacity	Cross-border data, ESG and cybersecurity rules remain demanding	Compliance burdens weigh heavily on smaller European companies
Interdependence vs. Resilience to external shocks	Europe is less climate-vulnerable domestically but strongly exposed via trade and migration	External crises can still disrupt European economies and politics despite internal robustness

Strategic choices for Europe

To prepare for the future synergies and conflict lines between competitiveness and sustainability in this scenario, some strategic choice should be made, as outlined in table 16.

Table 16: Strategic choices for Europe

Source: own elaboration

Strategic Choice	Expected implication for Europe
1. Co-shaping global standards with China instead of merely adopting them	Active engagement in joint standard-setting for AI, cybersecurity, ESG, and circularity helps ensure that global norms reflect European values (rights, labour, environment) rather than drifting solely toward Chinese preferences. This preserves both competitiveness and normative influence.
2. Using circularity and sufficiency as Europe's competitive signature	Building on tight, circular material flows and sufficiency-oriented business models positions Europe as a global reference for "high value, low footprint" production. This reduces import dependence and differentiates EU firms in a world of converging baseline rules.
3. Developing "sovereign interoperability" in data and compute	Ensuring European infrastructures can plug into China-led networks while remaining independently governable supports autonomy. This includes EU-based data spaces, secure clouds, and trusted chips that comply with global standards but are not fully controlled by external actors.
4. Anchoring Europe as a clean-tech and adaptation frontrunner within the integrated market	Specialisation in advanced renewables, grid technologies, storage, industrial efficiency and adaptation infrastructure allows Europe to benefit from the scale of the China-centred market while avoiding direct price competition in all segments.
5. Leveraging multilateral institutions as a buffer against bilateral asymmetry	Strengthening UN bodies, technical standardisation organisations, and science panels provides forums where Europe and other actors can balance Chinese dominance and collectively shape long-term trajectories for climate, biodiversity, and digital governance.
6. Investing in skills and "governance capacity" as key competitive assets	Education and upskilling strategies focused not only on technical skills but also on ethics, risk management and system governance give Europe an edge in running complex, high-trust systems in health, mobility, finance and public services.
7. Diversifying strategic partnerships beyond China while staying in the convergence regime	Deepening ties with India, ASEAN, African unions and Latin America within the converged rules-based framework provides alternative innovation and supply options. This hedges against over-reliance on China without exiting the integrated market.

4.6 Cross-cutting synthesis

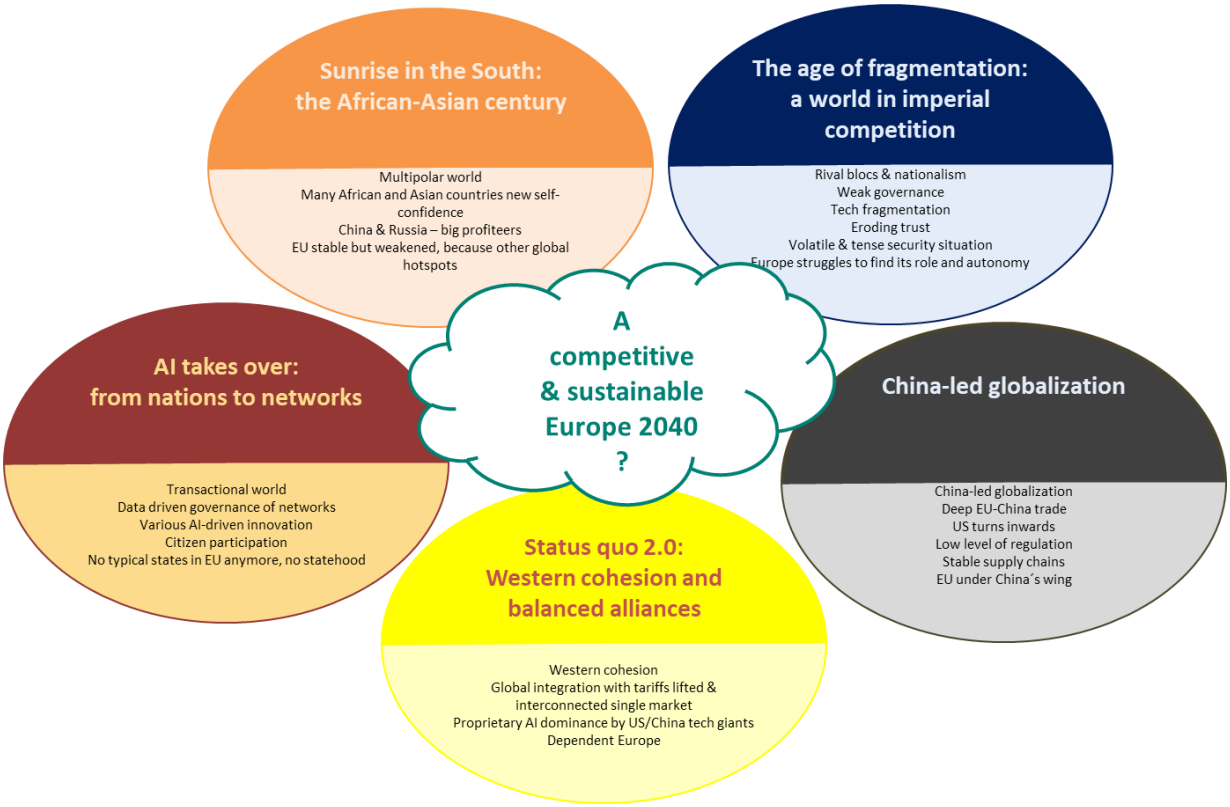
The five scenarios describe different strategic environments for Europe in 2040 (figure 6). Together, they outline a cone of plausible futures for the EU's sustainable competitiveness from a green, multipolar

"African–Asian century" to a fragmented bloc world, post-state AI network governance, renewed Western cohesion, and China-led convergence.

Developments that have an impact on either achieving competitiveness or sustainability goals (or both) and that occur in several or even all scenarios were identified with a content analysis of the scenario descriptions. These are particularly relevant for the development of policy strategies for the following reason. A scenario-specific analysis, as performed in the previous chapter, is strategically relevant if it is assumed that we are moving towards precisely this scenario. However, it has been emphasised above that it would not make sense to evaluate the scenarios according to their probability of occurrence, as all scenarios are plausible and therefore fundamentally possible if the factors develop accordingly. One option is to determine indicators for each scenario to identify early signals of development towards that scenario. If these indicators are monitored, it is possible to respond strategically in a timely manner and only consider measures that are precisely tailored to the scenario and its challenges and opportunities. Another option is to focus strategically on the challenges that are present in several or even all scenarios. This is because it is essential to be prepared for these challenges, as they must be faced anyway. Measures to address them are therefore also referred to as no-regret measures, as they should be implemented in any case despite the remaining future uncertainty. In this study the focus was only on the challenges that span all scenarios. The design of a monitoring system for the early detection of scenario-specific challenges was outside the scope of the study but can be implemented additionally at a later stage.

Figure 8 provides an overview across all scenarios and their key characteristics, emphasising the respective special features.

Figure 89: Overview of all scenarios



Source: ETC ST

4.6.1 Common developments across the scenarios

Despite their differences, all five scenarios reveal several structural developments that shape Europe's scope for action regardless of how the future unfolds. These are not surprising as they correspond to long-running megatrends that continue under all five trajectories:

- **Persistent geopolitical instability and shifting power balances:** All scenarios show a world in flux: whether power gravitates toward Africa/Asia (green scenario), China (grey scenario), the West (yellow scenario), blocs (blue scenario) or networks (orange scenario).
- **Climate change and mounting adaptation needs:** Across all scenarios, climate change intensifies heatwaves, floods, water scarcity, crop failures and supply-chain disruptions. In each scenario climate resilience becomes a core condition for economic stability and social cohesion.
- **Accelerating technological transformation driven by AI:** Whether proprietary (yellow scenario), fragmented (blue scenario), cooperative (grey scenario), Southern-led (green scenario) or network-governed (orange scenario), AI becomes the central driver of productivity, governance, and geopolitical influence.
- **Growing resource constraints and material competition:** All scenarios involve scarcity of critical raw materials, minerals, chips or energy inputs, even those with open trade (green and grey scenario) or more localised systems (orange scenario).
- **Erosion of social cohesion and rising political pressures:** Trust in institutions declines in nearly all scenarios (yellow, blue, and orange scenario), while demographic shifts, inequality, and labour-market turbulence appear across the board.

4.6.2 Common challenges and opportunities for sustainable competitiveness

Across the five scenarios, several challenges and opportunities recur, suggesting areas where Europe's Competitiveness Compass needs robust attention. Challenges and opportunities at the scenario level could be used for a monitoring of critical indicators as an early warning system for starting strategic measures as soon as possible only applicable to the related scenario.

In contrast, the cross-scenario opportunities and challenges, defined by their occurrence in more than one scenario, can be interpreted as more likely to happen and thus to be prepared for strategically with policy measures.

The following tables list the crosscutting challenges (Table 17) and opportunities (Table 18) for Europe's sustainable competitiveness.

Table 17: Crosscutting challenges for Europe

Source: own elaboration

Challenges	Scenarios					Relevance for	
	The age of fragmentation	Sunrise in the South: African-Asian century	AI takes over: from nations to networks	Status quo 2.0: western cohesion and balanced alliances	China-led convergence	Social cohesion	Environment
Dependence on external critical materials/energy/AI hardware and components (imports, export restrictions and limits, chips)	x	x	x	x	x	x	x
Energy system fragmentation/limited interconnection causing inefficiency, higher prices, and supply insecurity		x	x	x		x	
Fragmented governance and coordination challenges (state capacity, complex EU decision-making, patchwork policies)	x		x	x		x	
Data/AI standards and cross-border data governance fragmentation; compliance burdens/limited data access		x	x		x	x	
Dependence on and concentration of power in proprietary tech ecosystems/platforms (AI/data/compute)	x		x	x	x	x	
Declining public trust, polarization, and disinformation hindering policy delivery/investment		x		x		x	
Climate pressures undermining goals and straining just transition (impacts, accelerated consumption)		x		x	x		x
Skills gaps and uneven labour transitions reducing productivity/adoption				x	x	x	
SME disadvantages (compliance burdens, constrained participation/ innovation diffusion)				x	x	x	x
Weaker EU/global influence and institutions; risk of standards drifting from EU values	x	x			x		x
Industrial competitiveness pressures (from energy costs/volatility, foreign competitors, structural burdens)	x	x			x	x	x
Digital security risks (cybersecurity vulnerability, weaponized access, cross-border data security complexity)			x	x	x	x	

Table 18: Crosscutting opportunities for Europe

Source: own elaboration

Opportunities	Scenarios					Relevance for	
	The age of fragmentation	Sunrise in the South: African-Asian century	AI takes over: from nations to networks	Status quo 2.0: western cohesion and balanced alliances	China-led convergence	Social cohe-sion	Environ-ment
Climate adaptation tech leadership and exportable solutions	x	x	(x)[4]	x			x
Circular economy/resource efficiency (recycling, substitution, repair)	x	x	x	x	x		x
Trustworthy AI and interoperable/open ecosystems (standards, open models, data spaces)		x	x	x	x	x	
Strategic investment in European/secure compute capacity		x		x			
Integrated single market/interoperability to scale EU solutions and cut costs				x	x	x	
Decentralized energy (local renewables, storage, demand reduction) to boost resilience			x		x		x
Grid/interconnector upgrades and coordinated energy policy to stabilize prices/enable renewables		x		x		x	x
ESG-anchored international partnerships to de-risk supply chains/energy (e.g., Africa/Asia, resource holders)	x	x				x	
Education/upskilling to narrow the digital divide and raise competitiveness				x	x	x	
Competition policy/open, contestable platforms to curb monopoly power and improve market access				x	x	x	
Strong global institutions and science/evidence-based governance enabling standard-setting and coordination				X	x	x	x
Securing raw materials via transparent sourcing/ certification/strategic reserves		x			x		x

[4] via AI early warning

4.6.3 Policy implications: robust priorities and scenario-specific nuances

From a policy perspective, the scenarios suggest both robust "no-regret" priorities and scenario-specific strategies.

Robust policy priorities (across scenarios)

These appear as necessary in almost all futures, regardless of who leads or how the world organises.

- Scaling circular economy and efficiency to reduce material and energy dependence and support competitiveness under any geopolitical configuration.
- Investing in climate adaptation and resilient infrastructures as a core part of economic strategy, not a separate environmental agenda.
- Developing European capabilities in compute, AI, and secure digital infrastructures, at least in key strategic segments.
- Strengthening skills, education, and just-transition mechanisms to manage technological, demographic, and regional shifts.
- Supporting social cohesion and trust-building to enable long-term policy continuity and public backing for transitions.
- Maintaining an active role in international standard-setting and multilateral institutions to preserve influence in shaping rules, even when others hold more economic power.

Scenario-specific emphases and trade-offs

Scenario "Sunrise in the South": Emphasis falls on co-development partnerships with Africa and Asia, shared green value chains, and managing Europe's relative loss of influence while leveraging its niches in regulation, adaptation, and carbon sinks.

Scenario "Age of Fragmentation": Policy focus-shifts towards risk management, strategic autonomy, and system hardening. Priority lies in buffering against shocks, weaponised trade, and divergent AI ecosystems.

Scenario "AI takes over": Governance tools evolve toward network-level standards, transparency in AI, data trusts, and community-based resilience. Policy levers centre more on infrastructures, protocols, and participation than on traditional interstate diplomacy.

Scenario "Status Quo 2.0": The main task becomes avoiding "comfortable drift": turning Western cohesion and open trade into genuine autonomy in compute and clean tech, while preventing overconsumption and addressing internal disparities.

Scenario "China-led Convergence": Policy choices concentrate on co-shaping, not just complying with, China-led standards, using circularity, sufficiency, and high-trust systems as Europe's signature, and diversifying partnerships to mitigate strategic dependence.

5 Analysis of robustness of current strategies

5.1 Introduction

In this sub-task, a Realtime Delphi survey with experts was conducted to analyse the robustness of certain current EU competitiveness strategies, most of them following recommendations from the Draghi report (Draghi 2024a). The Draghi report, published in September 2024 and operationalised through the European Commission's Competitiveness Compass in January 2025, sets out a comprehensive strategy to restore Europe's economic dynamism and global competitiveness. The report identifies three core imperatives: closing the innovation gap, decarbonising the economy, and reducing dependencies on external suppliers, especially in critical sectors such as technology and defence. The report diagnoses Europe's lagging productivity, fragmented capital markets, and slow adoption of new technologies as key challenges. It recommends a coordinated, EU-wide approach to industrial policy, including a significant increase in public and private investment (up to €800 billion annually) to drive innovation, digital transformation, and green transition. The report calls for the completion of the Capital Markets Union, regulatory simplification, and the creation of a "28th legal regime" to harmonise rules for startups and scale-ups across the EU.

The overall research question was to challenge the assumption and objectives mentioned in the Draghi report (Draghi 2024c; 2024b). Specifically, the concepts and recommendations mentioned in the report linked to sustainability were assessed by creating statements from the text with a future perspective until. 20240 assuming the mentioned objectives would be achieved. 37 experts from National Environment Agencies and the Scientific Advisory Board of the EEA answered the Delphi-Survey[5]. The Delphi survey was launched on the 12th of June and was kept open until the end of August. The results were assessed in September and the beginning of October. In the following sections, first, the statements are presented, then the insights in relation to each statement are summarised. In Section 5.4 a cross-cutting perspective is taken.

This expert consultation is a parallel process to the Scenario-exercise (Chapter 4), the deep-dives (Chapter 6) and the Futures Dialogue (Chapter 7). The different perspective and their interrelations are discussed in the respective chapters (6, 7 and 8).

5.2 Key statements from the Draghi report

The following statements based on the Draghi report were addressed in the survey:

- **Resilience:** In 2040, the EU's competitiveness is resilient against cascading climate, social, and environmental risks.
    - Do you agree that this is possible by 2040?
    - What are the key success factors or barriers to achieving this target?
- **2040 Emission reduction target:** In 2040, the EU has achieved its intermediate emission reduction target of 90%, while reducing excessive dependencies and enhancing security through strategic trade agreements.
    - Do you agree with this statement?

[5] A Real-Time Delphi (RTD) is an online variant of the classical Delphi method, designed to enhance efficiency and interactivity in expert consultations. The core innovation of RTD lies in its immediate updating and display of group responses, allowing participants to view, compare, and revise their opinions as often as they choose within the study's timeframe. This dynamic interaction fosters a fluid exchange of perspectives and reduced the overall duration of the survey (Gnatzy et al. 2011; Gordon and Pease 2006). The Real-Time Delphi-Survey was realised in the Foresight-Strategy-Cockpit by 4strat: https://www.4strat.com/foresight-strategy-cockpit/

    - What are the key success factors or barriers to achieving this target?
- **Environmental restoration, social and economic benefits:** In 2040, the EU's competitiveness model prioritizes environmental restoration and innovation while ensuring equitable social and economic benefits.
    - Do you agree that this model will be feasible and effective by 2040?
    - What policies or investments are most critical to achieving this balance?
- **Strategic autonomy:** In 2040, the EU has strengthened its strategic autonomy by establishing strong trade partnerships with third countries (enhancing supply chain resilience) and by reducing internal demand for critical raw materials.
    - Do you agree that the EU will achieve this level of strategic autonomy by 2040
    - What are the most important measures the EU should take today to help realise this vision?
- **Circular Economy:** In 2040, a fully operational circular economy is established in the EU, based on digitally optimised resource allocation technologies, advanced recycling systems and regenerative, nature-positive business models.
    - Do you agree with this statement?
    - What is the key blind spot or risk that could hinder the EU's transition to a circular economy?
- **Zero pollution and decarbonisation:** In 2040, the EU's hard-to-abate industries are zero-pollution, fully decarbonised and supported by a competitive energy market that provides affordable and clean energy to all citizens and businesses.
    - Do you agree that the EU's hard-to-abate industries will achieve zero-pollution and full decarbonization by 2040?
    - What are the most critical technologies or policies needed to enable this transformation?
- **Regulatory environment:** In 2040, the EU has implemented a smart and coherent regulatory environment that significantly reduces the administrative burden on businesses, while fostering a culture of innovation and competitiveness.
    - Do you agree that the EU will be able to achieve this regulatory environment by 2040?
    - What safeguards should be in place to ensure that reducing administrative burdens does not undermine environmental or social protections?
- **Biotech innovations:** In 2040, the EU is the global leader in biomaterials, bio-manufacturing, biochemistry, and agri-biotechnology, with these sectors making a significant contribution to its competitiveness.
    - Do you agree that the EU will attain this level of leadership in biotech innovations by 2040?
    - What are the most significant risks or opportunities for the EU in achieving and sustaining this leadership?
- **Single capital market for biotech innovations:** In 2040, the EU has a single capital market system dedicated to biotech innovations, enabling biotech startups to scale up effectively within the EU and compete successfully.
    - Do you think achieving this will be possible by 2040?
    - What are the key enablers or barriers to creating such a capital market system?

5.3 Expert based assumptions check of current EU ambitions – Delphi results

The analysis of the Delphi results was carried out in several steps. First, all open responses were coded to identify recurring themes such as uncertainties, success factors, barriers, critical policies, general observations, etc. These elements were then compiled for each question, with duplications removed to ensure a clean thematic structure. Based on these consolidated lists, summary interpretations were developed for every question. The final step involved synthesising the findings across all questions to identify broader, cross-cutting issues that shape Europe's future sustainability and competitiveness.

5.3.1 In 2040, the EU's competitiveness is resilient against cascading climate, social, and environmental risks.

Most respondents doubt that the EU will achieve resilience of its competitiveness in the face of cascading climate, social, and environmental risks by 2040. A small minority believes this outcome is possible within the timeframe, while nearly half expect it will take longer, and a significant share sees it as unachievable or remains uncertain. The responses highlight that the EU does have the capacity to move toward resilience, but only if it delivers fast and coherent implementation of sustainability policies, pursues a coordinated long-term transition strategy, and invests substantially in critical infrastructure and social stability. Strengthening public trust, ensuring fairness and solidarity, and fostering broad societal engagement are seen as essential foundations, alongside Europe's ability to act decisively in a volatile geopolitical landscape and leverage its global research leadership. Major barriers include economic structures that lock in unsustainable practices, declining trust in institutions, and the diversion of resources toward crises and security priorities. Respondents also emphasized that new types of emerging risks are difficult to anticipate. Several participants questioned the premise of competitiveness itself, arguing that resilience, well-being, and sustainability should replace it as guiding principles.

5.3.2 In 2040, the EU has achieved its intermediate emission reduction target of 90%, while reducing excessive dependencies and enhancing security through strategic trade agreements.

Most respondents do not expect the EU to achieve a 90% emission reduction and reduce excessive dependencies through strategic trade agreements by 2040. A small minority considers the goal feasible, while the majority believes it will take longer, and a notable share remains uncertain. The inputs suggest that progress is possible only with drastic and sustained emission-reduction measures, coherent long-term transition strategies, and transformative changes in how institutions, companies, and societies operate. Success will require a new Social Contract that fairly distributes costs and benefits, effective and fair carbon taxation, strengthened circular systems, and much stronger global engagement beyond traditional partners. Respondents also emphasized the importance of Europe's scientific and innovation capacity as a strategic advantage. However, the barriers are substantial. Short-termism, political fragmentation, dependencies on critical raw materials, uncertain technological readiness, and the high costs of implementation may slow or derail progress. External risks, such as geopolitical tensions, conflicts, global supply disruptions, and potential climate tipping points add further uncertainty. Most respondents see the 90 % emission-reduction target as extremely ambitious under these conditions.

5.3.3 In 2040, the EU's competitiveness model prioritises environmental restoration and innovation while ensuring equitable social and economic benefits.

Respondents were divided on whether the EU can establish a competitiveness model that prioritises environmental restoration, innovation, and equitable social and economic benefits by 2040. Only a quarter believe the model could be feasible within the timeframe, while most expect it will take longer or may never be achieved. Key enablers include strong implementation of the Nature Restoration Law, Social Climate Fund, and Industrial Deal, large-scale investments in innovation and community-based solutions, and building socially resilient systems that enable broad participation in the green transition. Strengthening justice considerations across all policies, developing viable business models for restoration, and ensuring evidence-based and adaptive governance also emerge as essential. However, numerous barriers could impede progress. These include entrenched growth-oriented economic paradigms, profit-driven corporate logics, institutional blockages within the EU, and persistent social inequalities that limit participation and benefit-sharing. Resistance from vested interests and ideological mindsets also threatens transformative change. Several respondents stressed that the current economic system is incompatible with the scale of restoration needed and argued that standard economic notions of competitiveness must be replaced with a model grounded in resilience, justice, ecological stability, and well-being.

5.3.4 In 2040, the EU has strengthened its strategic autonomy by establishing strong trade partnerships with third countries (enhancing supply chain resilience) and by reducing internal demand for critical raw materials.

While over a third of participants believe in EU's ability to reduce its demand for critical raw materials and achieve strategic autonomy through diversification and sustainability measures by 2040, the majority either expect it will take longer, doubt its feasibility, or remain uncertain. Participants identified several key measures needed to move toward strategic autonomy. Essential measures include full implementation of the Net-Zero Industry Act, major investments in research and development for recycling, substitution, efficiency, rapid expansion of renewable energy and associated recycling technologies, and strengthening the bioeconomy. Respondents also highlighted the need to move beyond GDP as the primary metric of progress, strengthen institutional capacity and political stability, and cultivate resilient long-term trade partnerships aligned with sustainability values. However, numerous barriers stand in the way of achieving this vision. Critical raw materials remain difficult to substitute, circular use rates are still very low, and progress in alternative materials has been slow. Many potential partners are already closely tied to global powers such as the US or China, and strong partnerships may unintentionally undermine efforts to reduce demand or weaken strategic autonomy. Internally, reducing CRM demand is still not taken seriously enough, and policymaking processes remain slow, fragmented, and reactive. Structural features of the current economic system lock in linear, resource-intensive models, while geopolitical instability complicates long-term planning. Some stressed that policymaking itself must undergo a fundamental shift to become more effective, proactive, and coherent across governance levels.

5.3.5 In 2040, a fully operational circular economy is established in the EU, based on digitally optimised resource allocation technologies, advanced recycling systems and regenerative, nature-positive business models.

Most respondents do not expect the EU to achieve a fully operational circular economy by 2040. While a small share believes the goal is attainable within the timeframe, two-thirds expect it will take longer, and an equal share considers it unachievable under current conditions. Achieving a fully operational circular economy will require long-term, stable policy frameworks with strong enforcement, comprehensive tax reforms to favour repair and reuse, and much more substantial financing. EU should aim for a shift toward a digitally enhanced, low-material economy powered by clean energy, enabling advanced circularity and regenerative business models. Respondents also stressed the need for design standards for durability and recyclability, market creation for circular products, widespread skills development across value chains, and broad public engagement. Participants highlighted significant opportunities, especially the potential of AI, digital tools, and advanced recycling technologies. Continued policy progress at EU level and the possibility that global supply chain disruptions could spur circularity were also seen as enabling factors. Barriers include weak incentives for industry and consumers, weak business case for circularity, and multiple economic and ecological limits that make full circularity technically or financially unviable. Persistent lock-ins remain major obstacles, namely product design that ignores repairability to inadequate infrastructure, low market demand for circular goods, and a linear growth logic embedded in the current economic system.

5.3.6 In 2040, the EU's hard-to-abate industries are zero-pollution, fully decarbonised and supported by a competitive energy market that provides affordable and clean energy to all citizens and businesses.

Most respondents do not believe that full decarbonization and zero pollution in the EU's hard-to-abate industries will be achieved by 2040. Only a small minority considers this target realistic within the timeframe, while half expect significantly longer timelines, and a quarter doubts it will ever be possible. Respondents stressed that progress depends on long-term policy clarity that reduces investment risk, strong regulatory frameworks, and financial incentives that accelerate technology adoption. Hard-to-

abate sectors such as steel, metals, cement, bricks, and parts of the chemical industry require specific transition pathways supported by expanded renewable and hydrogen infrastructure. Some respondents argued that full decarbonization may be unrealistic for certain sectors even in the long term and large-scale material reuse is still unproven. According to some respondents, current policy tools, such as the EU ETS, are considered insufficient for the required pace of change. Economic model lock-ins, affordability challenges, and rising inequality further undermine the feasibility of a rapid transition. Therefore, social stability also emerged as a necessary condition for managing the impacts of industrial transformation. Despite this, respondents pointed to significant opportunities. Technological development could advance faster than expected if reinforced by consistent policies and strong incentives. Recent EU initiatives, including the Clean Industrial Deal, the Industrial Decarbonization Accelerator Act, and the Budapest Declaration, were highlighted as positive drivers, alongside continued expansion of renewable and hydrogen solutions and emerging nature-positive industrial innovations.

5.3.7 In 2040, the EU has implemented a smart and coherent regulatory environment that significantly reduces the administrative burden on businesses, while fostering a culture of innovation and competitiveness.

A clear majority of respondents believe the EU can achieve a smart and coherent regulatory system by 2040, one that reduces administrative burdens while safeguarding environmental and social objectives. A smaller share expects this will take longer, and a minority doubts it will be achievable within the timeframe. Progress depends on simplifying outdated rules, improving coherence across legislation, and developing pragmatic frameworks that work for SMEs, prosumers, and fast-evolving technological sectors. Respondents stressed the need for transparent policymaking, strong impact assessments, stakeholder participation, and regular auditing. Capacity building within national administrations was viewed as essential for consistent implementation. Several highlighted the potential of AI and digital tools to support simplification and strengthen coherence, monitoring, and data transparency. At the same time, participants warned that deregulation driven by market expansion or profit-orientation could weaken social and environmental protections. Diverging capacities and political preferences across Member States, as well as the adaptability of firms in bypassing safeguards, were cited as ongoing risks. Respondents emphasized that without clear minimum standards, enforcement mechanisms, and a strong social market economy foundation, simplification could easily drift from smarter governance to the erosion of protections. While current EU initiatives such as the Better Regulation Agenda, REFIT, and the Omnibus approach indicate effort in this direction, respondents noted that administrative burden is often still increasing. Some saw potential in private-sector coalitions acting as forerunners for coherent regulation.

5.3.8 In 2040, the EU is the global leader in biomaterials, bio-manufacturing, biochemistry, and agri-biotechnology, with these sectors contributing significantly to its competitiveness.

The respondents were overwhelmingly uncertain whether the EU can become a global leader in biotech innovations by 2040. More than half indicated they do not know, while the rest were split between believing it is achievable, expecting it will take longer, or doubting it altogether. Respondents highlighted that the EU already has several enabling conditions in place, namely strong research institutions, an established biomaterials market, and new policy frameworks such as the EU Biotech Act, the updated Bioeconomy Strategy, and CBE JU. Yet the path to global leadership is constrained by significant gaps. Participants pointed to persistent underinvestment in scaling and commercialization, fragmented research initiatives, and regulatory frameworks that are not fully adapted to emerging technologies such as gene editing. Public resistance and accountability concerns ("not in my backyard") were viewed as additional barriers that could slow progress compared with competitors in the US and Asia. Structural constraints, like high innovation costs and difficulties reforming the Common Agricultural Policy were also cited. According to some, overreliance on technological fixes without reducing Europe's bio-footprint could undermine environmental goals or introduce biological risks. Respondents stressed the need for global

R&D collaboration, integration of traditional knowledge, open data, and closer synergies with AI research to ensure responsible and sustainable biotech development.

5.3.9 In 2040, the EU has a single capital market system dedicated to biotech innovations, enabling biotech startups to scale up effectively within the EU and compete successfully.

Most respondents are uncertain whether the EU will establish a dedicated capital market system for biotech innovations by 2040. While over a third believe it is achievable, the overwhelming majority either doubt the timeline or do not know. Respondents acknowledged that several ongoing EU initiatives (the Savings and Investment Union, the EU Biotech Act, and the Startup and Scaleup Strategy) provide a strong foundation by improving financial mechanisms, supporting biotech scaling, and aiming to create more coherent capital markets. However, significant barriers were identified. National divergence in risk tolerance, reluctance to pool financial sovereignty, and structural limitations of the EU's economic model undermine progress toward a unified capital market system. Public scepticism about prioritizing biotech over climate adaptation or well-being further weakens political support. Respondents also warned that the EU risks losing talent and investment to more agile and investor-friendly markets abroad. Additional concerns include the possibility that mergers and acquisitions by large incumbents could suppress innovation by absorbing or sidelining emerging biotech firms.

5.4 Cross-cutting opportunities and challenges

Across the Delphi responses, several cross-cutting tensions and enabling conditions emerged that shape Europe's ability to navigate the transition toward sustainability, resilience, and competitiveness:

5.4.1 Competitiveness vs sustainability

Participants warned that an excessive focus on competitiveness risks undermining ecological and social resilience. Short-term economic pressures can undermine sustainability goals in the long term. Several respondents stressed the need to redefine competitiveness around resilience, well-being, and quality of life rather than GDP growth.

5.4.2 Social resilience and equity

Social fairness and equitable burden-sharing are highlighted as prerequisites for any successful transition. Polarization, inequality, and declining trust in institutions are viewed as cross-sectoral barriers. A recurring theme is the need for strong motivation and clear benefits to drive change. Capacity building for a just transition is mentioned several times. Without widely accepted rules, incentives, and cultural shifts, industry, governments, and consumers are likely to move too slowly or even regress.

5.4.3 Market logic vs social innovation

While market-driven innovation and scale-up are viewed to be key to being globally competitive, concerns were raised that market logic alone leaves behind non-profitable or justice-oriented sustainability measures. Social innovation, community initiatives, and public-sector experimentation require stronger support.

5.4.4 Regulation vs deregulation

Respondents highlighted the need to balance stricter safeguards (polluter-pays principles, environmental and social standards) with reducing administrative burdens and overly rigid rules that slow down innovation. The challenge is designing regulation that enables transformation rather than obstructing it.

5.4.5 Full decarbonization vs policy flexibility

Some sectors are ready for rapid decarbonisation, while others still face significant constraints. For some participants, full decarbonisation with strict rules is the preferred pathway. For others, it remains a long-term goal that requires transitional flexibility to avoid economic disruption. Flexibility can help manage adjustment costs, but it also risks slowing progress if it creates loopholes or weakens overall commitments.

5.4.6 EU centralization vs subsidiarity

Calls for greater EU integration, harmonized rules, and capital markets often clash with recognition of subsidiarity, diverse national interests, and uneven implementation capacity.

5.4.7 Financing and investment gap

Sufficient, well-directed, and long-term financing is repeatedly identified as a critical enabler, while lack of investment, fragmented funding, or short-term profit motives appear repeatedly as systemic barriers.

5.4.8 Implementation gap

Across many responses, participants noted that existing strategies are not being implemented at the required pace. Even well-designed policies lag the speed of mounting climate, economic, and geopolitical risks. New or updated policies will be needed as well in areas where current frameworks are no longer adequate for the scale and urgency of the transition.

5.4.9 Technology as enabler

Innovation (AI, recycling technologies, biotech, decarbonization) is widely seen as a major opportunity. At the same time, many stress that technological solutions alone cannot deliver systemic change without social acceptance, behavioural adaptation, and governance reform.

5.4.10 Geopolitical instability

Wars, shifting alliances, and reliance on non-EU markets are cited across questions as major uncertainties and barriers. Concerns were raised about third countries, especially the US and Asia, moving faster in areas like biotech, innovation, and technology. This creates pressure on the EU to accelerate, while also balancing sustainability goals with competitiveness.

5.4.11 Strategic partnerships vs autonomy

Securing strong trade partnerships with third countries to ensure supply of critical raw materials is viewed as an enabler, but such partnerships may reduce incentives to decrease demand or accelerate circularity, leaving the EU structurally dependent on unstable external suppliers. Several participants described the tension between strategic autonomy and external dependence as a fundamental structural dilemma.

5.5 Conclusions and recommendations – how they correspond to the scenarios

The Delphi results broadly confirm the core message of the scenarios: combining high competitiveness with deep sustainability transformations by 2040 is possible in principle, but only under demanding and uncertain preconditions that are not simultaneously met in all futures. Experts see resilience, near-full decarbonisation, strategic autonomy and a fully circular economy as stretching targets rather than central trend lines, echoing the more challenging blue, green and orange scenarios rather than the more benign assumptions in the yellow and grey scenario. Across questions, many respondents question “competitiveness” as a guiding paradigm and argue for a shift towards resilience, justice, well-being and

sufficiency, which resonates most strongly with the circularity and social-contract elements embedded in the green, orange and grey pathways.

A first set of common assumptions cuts across both scenarios and Delphi responses. All futures implicitly assume: (i) sustained, large-scale investment in infrastructure, skills and innovation; (ii) strong and adaptive institutions capable of long-term steering; and (iii) a significant upgrading of circular systems and demand-side measures to reduce material and energy intensity. Experts generally share these conditions but doubt their timely and coherent realisation, particularly given current lock-ins in energy-intensive industry, critical raw material dependencies and fragmented governance. This creates a systematic gap between desirable end-states that appear in several scenarios (e.g. smart regulation, resilient infrastructure, advanced circularity) and the political and social capacity to deliver them within 15 years.

A second, more contested set of assumptions concerns the external context. Several scenarios presuppose relatively stable access to global markets, raw materials and digital infrastructures, whether under a revitalised Western alliance (yellow scenario), a China-centred order (grey scenario) or a polycentric "Sunrise in the South" world (green scenario). By contrast, Delphi respondents repeatedly highlight geopolitics, resource nationalism, conflicts and climate tipping points as major downside risks that could derail even well-designed strategies. Here the blue and orange scenarios, with their emphasis on fragmentation, compute and data wars, and brittle supply chains, align more closely with the experts' concern that strategic autonomy and circularity must be built for "hard" worlds rather than assumed away through optimistic trade and technology narratives.

These tensions point to key frictions between the scenario logics and the Delphi findings. First, the high-ambition narratives on circular economy and zero-pollution industry clash with expert scepticism about full circularity and full decarbonisation by 2040, especially in hard-to-abate sectors. While some scenarios describe circularity and deep industrial transformation as broadly accomplished, the Delphi highlights persistent economic, technical and social barriers, from weak business cases and design lock-ins to affordability concerns and social acceptance. Second, several scenarios still rely on relatively strong growth in consumption and trade, whereas many experts argue that sufficiency, demand reduction and new metrics beyond GDP are preconditions for credible restoration, circularity and autonomy. Third, in governance terms, scenarios such as the yellow and grey scenario assume that smarter regulation and stronger global institutions can be realised in time, while the Delphi underlines declining trust, polarisation and institutional capacity constraints as major obstacles to implementation.

Seen through the lens of the five scenarios, not all solution packages emerging from the Delphi appear equally plausible or equally effective. For instance, a fully operational circular economy, zero-pollution heavy industry and a smart, low-burden regulatory regime are most compatible with relatively cooperative, innovation-rich futures (yellow and grey scenario), but even there the experts' doubts about pace and depth suggest that only partial achievement by 2040 is likely. In more conflictual and fragmented settings (blue scenario), or in post-state, networked configurations (orange scenario), ambitious circularity and restoration remain possible but would require very different coalitions, instruments and sequencing than under the Draghi-type assumptions of integrated capital markets and coordinated industrial policy. The green "Sunrise in the South" scenario, in turn, implies that Europe can only maintain sustainable competitiveness if it accepts a relative loss of global dominance and doubles down on circularity, adaptation technologies and fair partnerships; this is consistent with many Delphi recommendations but conflicts with expectations of continued EU standard-setting primacy.

Across scenarios, the Delphi points towards a set of robust, cross-context priority fields rather than a single blueprint solution. These include accelerating climate adaptation and resilience technologies; scaling circular economy practices and CRM demand reduction; investing in skills and just-transition mechanisms; strengthening trustworthy, interoperable AI and data governance; and building more coherent, transparent and participatory regulatory frameworks. The scenarios help stress-test these priorities: some

worlds make them harder or slower to achieve, but none make them obsolete. Conversely, strategies that rest on optimistic assumptions of seamless globalisation, cheap resources, rapid decarbonisation without sufficiency, or depoliticised technology governance appear fragile across most futures and are treated with caution by Delphi participants.

For policy, the combined insights suggest three main recommendations.

- First, EU strategies anchored in the Competitiveness Compass should be reframed explicitly as resilience and justice strategies, integrating competitiveness into a broader well-being narrative that remains viable across cooperative and conflictual worlds.
- Second, measures that reduce structural dependencies (materials, energy, AI hardware, proprietary platforms) and strengthen circular, decentralised and socially robust systems deserve priority, because they are beneficial in the green, yellow and grey scenarios and essential in the blue and orange ones.
- Third, institutional reform, public trust-building and participatory governance are not "soft add-ons" but hard preconditions for delivering any of the high-ambition solutions identified in both the scenarios and the Delphi. Taken together, the findings imply that many of the envisioned solutions remain possible across the different scenarios, but only in adapted, context-sensitive forms and only if underlying assumptions on governance quality, sufficiency and social justice are made explicit and addressed.

6 Exploring experts' perspective on best solutions

6.1 Introduction

To identify experts' perspective about best-solution, given current knowledge, so-called "deep dives" were conducted. Three Deep Dives explored how sustainable competitiveness should or could look like, and what kind of challenges, trade-offs, and synergies can be described between core systems of relevance: Bioeconomy, Circular Economy, and Industry.

This workshop series invited experts from the EEA, other ETCs, and the Scientific Committee. Each workshop was 90 minutes long. It was designed to harvest the expert knowledge in the most productive way.

For the Deep Dives, two steps have been taken. Firstly, the experts were asked to freely brainstorm about an ideal, visionary future state of the respective topic. This approach is called a dream circle. In the second step, the x-curve approach was used to identify the building blocks that need to be established to achieve the ideal future state and those elements that need to be phased out.

The Dream Circle is an approach designed to catalyse the emergence of a shared vision through collective dreaming and deep listening. Participants are forming a "Dream Team" and expressing their personal views and ideas without judgment or critique from others.

The process begins with the facilitator welcoming the group and briefly presenting the intention of this collection of ideas. This is followed by a generative question, such as, "What must a circular economy/the industry/ the bioeconomy look like in the future that you can say, if it is designed this way, I can fully say this is sustainable and competitive", which invites participants to share meaningful, value-based visions of the ideal future state. To avoid judgment or critiques during the collection phase of the ideas and concepts allows for creative and deep solutions. Dreams, wishes, and visions have been captured on a Mural Board, ensuring that each contribution is recorded in essence, not word-for-word, and that no idea is disregarded, even if contradictory. The circle continues until all participants have shared and feel a sense of completion, or in the case of the workshops here, after approximately 40 minutes.

The essence of the vision is captured – in our case – in a concise bullet-point list. This vision is then transferred to the x-curve, a visual methodology developed to sense, map, and facilitate an understanding of complex socio-technical transition dynamics, particularly in the context of sustainability transformations. It supports groups and organisations in analysing how systems such as Circular Economy, Bioeconomy or Industry undergo fundamental shifts involving both breakdown of old, unsustainable structures and build-up of innovative, sustainable alternatives. In the present case, each vision (a future state that should be achieved) from the three topics should be realised. The participants first engaged in a 15-minute brainwriting session, followed by an exchange of ideas in a clarification phase. In this phase, the first trade-offs and synergies between different concepts in the x-curve were also collected.

The X-Curve illustrates transition as an interplay of two interwoven processes depicted graphically by an "X": a declining curve representing the destabilisation and phase-out of existing regimes (unsustainable systems and practices) and a rising curve representing the emergence, acceleration, and mainstreaming of novel, sustainable niches. Between and around these curves unfold phases of chaotic disruption and eventual system stabilisation. The model provides key insights into patterns of build-up (innovation, experimentation, scaling) and breakdown (decline, exnovation, dismantling), highlighting that transitions are neither linear nor smooth but involve overlapping cycles of destruction and creation. The X-Curve approach facilitates a deeper grasp of systemic change complexities by visualising transition patterns in a simple yet profound manner.

6.2 Deep Dive on Circular Economy

6.2.1 The ideal future

- Reduced import dependencies
- Sufficiency of material use
- Political shift from supply to (reduced) demand (CRM)
- Majority of CRM available from r-strategies
- Internalization of external costs of resources extraction at global level

By 2040, the circular economy will be fully sustainable and competitive, characterised by significantly reduced import dependencies and a sufficiency of material use. There will be a political shift from focusing on supply to actively reducing demand for critical raw materials (CRMs). Most CRMs will be sourced through circular strategies such as reuse, recycling, and remanufacturing, with the external costs of resource extraction internalised at a global level. Demand-side regulation will ensure material extraction remains within planetary boundaries, and critical raw materials will be substituted with non-critical alternatives wherever possible.

The EU will lead as a global standard-setter for circular economy practices, with more jobs in repair, recycling, and remanufacturing than in primary production. Companies will be required to develop substitution plans for CRM use, and consumers will be empowered by clear labelling and incentives to choose products that minimise CRM use or promote reuse. Recycling systems will be highly efficient, supported by real-time data monitoring and advanced technologies, and circular economy approaches will be cheaper than producing new materials.

Fossil fuels will be phased out of production, and all products will undergo life-cycle assessments at the design stage, incorporating circularity aspects. Remanufacturing will play a central role, and recycling facilities will use the best available technologies to minimise environmental impacts. Circularity will be integrated across sectors, and social and environmental impacts of extraction will be accurately priced if unavoidable. Innovation will support eco-designs for enhanced repairability, durability, and recyclability, and digital product passports will be widely implemented.

The circular economy will foster a well-being economy, with green jobs supported by focused training programmes and a coherent market for sustainable products. Policies will phase out environmentally harmful subsidies, single-use products, and wasteful use of CRMs, while promoting regional mining where necessary and minimising new mining activities. The focus will shift from GDP growth to increased well-being and sufficiency, ensuring long-term resilience and sustainability.

6.2.2 What needs to be phased out?

Conversely, certain practices require phasing out to fully realise Circular Economy ambitions. The sector must critically examine the role of carbon chemistry in its current form. Single-use and non-recyclable products face bans to curb waste generation. Addictive consumer incentives, often driven by social media, demand elimination due to their unsustainable stimulation of consumption. The export of waste to non-EU countries, illegal export of Waste Electrical and Electronic Equipment (WEEE), and mass imports especially from China expose trade dependencies and environmental risks that need addressing. Harmful subsidies that encourage fossil fuel usage or unsustainable mining distort resource allocation and require removal. Losses during recycling processes must be reduced to improve material recovery rates. Disposable CRM-containing products like e-vapes and gadgets, alongside wasteful uses such as over-dimensioned car batteries, are targeted for elimination. Broader societal shifts include moving away from GDP growth and consumption paradigms towards a focus on well-being and sufficiency, including phasing out fossil fuel subsidies and reducing meat and dairy consumption, considering phosphorus is a critical raw material. Social dynamics, such as consumption tied to social status encouraged by social media, are

challenged through bans on advertising fossil fuels and unsustainable products. Importantly, new mining activities should be minimised or avoided altogether where possible to reduce environmental degradation and enhance sustainability.

6.2.3 Systems to be established

The established elements of the Circular Economy encompass a comprehensive integration of sustainable practices and technological innovation designed to enhance resource efficiency and reduce environmental impact. A key focus is embedding life-cycle assessments (LCA) that incorporate the use of critical raw materials (CRMs) while outlining clear re-use options. Innovations in eco-design promote products with enhanced repairability, durability, and recyclability. Local cooperatives receive support for recycling activities, ensuring community engagement and efficiency. The rapid import and retention of renewable energy technologies within the EU underpin the transition. Taxation policies encourage CRM reuse in product manufacturing, supported by dedicated funding for recycling technology under frameworks such as Horizon Europe. The implementation of digital product passports and advanced lifecycle assessments together with emerging technologies like quantum sensors and quantum computers improve monitoring and traceability across supply chains. The EU actively shares knowledge with developing countries and advances urban mining strategies. Research and development efforts target more effective CRM recycling technologies. Citizens and consumers are empowered through labelling systems and incentives, fostering sustainable choices. Hydrogen facility installations contribute to decarbonising energy supply. Efforts to identify CRM use precisely and promote efficient reuse via improved sorting and processing methods are ongoing, with continuous monitoring to enhance these measures. Resource taxation, market instruments like a carbon border adjustment mechanism (CBAM), and investment redirection bolster the circular market. Financing increasingly favours circular business models. Furthermore, there is an evolving understanding of competitiveness that spans short-term linear views and broader long-term sustainable perspectives. Policies aim to shift market conditions to support circularity despite challenges relating to subsidy scales within liberal economic frameworks. Green jobs gain emphasis through targeted training, supported by an EU-wide recycling market, financial backing to incorporate best available technologies (BATs) in recycling facilities to reduce emissions and exposure, and integration of waste and recycling policies within EU trade treaties with third countries. This approach recognises sustainability not only as an environmental imperative but as a fundamental dimension of economic competitiveness.

6.2.4 Trade-offs and synergies

A key tension lies in the relationship between competitiveness and sufficiency. Continued GDP growth, historically tied to traditional competitiveness, stands at odds with degrowth imperatives necessary for reduced raw material extraction. The energy demand for recycling is high, and trade-offs must be managed between ambitions for digitisation, AI expansion, and the intensive CRM requirements of renewable energy systems. Tensions also arise between regional and EU-wide economic models and between short- and long-term investment horizons, with circularity increasingly recognised as a precondition for resilient long-term competitiveness.

Recent policy efforts seek to bridge competitiveness and circularity agendas, yet substantial challenges remain, particularly regarding the scale of subsidies required within liberal economic frameworks. Circular economy paradigms necessitate an expanded scope that transcends mere economic growth, emphasising sufficiency, resilience, and well-being. The workshop concludes that embracing circularity is imperative for the long-term sustainability and competitiveness of the European and global economies, requiring coherence between market, fiscal, and innovation policies at every level.

6.3 Deep Dive on Bioeconomy

6.3.1 The ideal future

- Cooperation across all levels
- Stay within the planetary boundaries
- Policy coherence and alignment
- Global dimension: EU is sustainable
- Engaging the local communities, cultural practises

The European Union's bioeconomy vision aspires to position the EU as a global frontrunner in industrial bioeconomy by fully implementing a circular biomass economy, where the use of biomass is optimised and looped. This entails living in bio-based buildings, utilising bio-based products, and adhering to planetary boundaries, with robust certification systems ensuring integrity. A comprehensive understanding of biotechnology risks and inclusive stakeholder engagement - from households to industry - is central to this vision.

The vision goes beyond biomass, valuing ecosystem services and encouraging collaboration across sectors like agrifood and forestry. The aim is to create resilient, well-established value chains that benefit EU regions, while also emphasising international cooperation. Bioeconomy is to be integrated into the EU's relationships, particularly with Africa, the Mediterranean, and the G20, fostering global collaboration through unified strategies.

Economically, the EU bioeconomy aims to lead with competitive biotechnology, offering favourable price–quality ratios. Achieving this requires overcoming fragmented national regulations by establishing a clear, harmonised, and stable legal framework that boosts market development and facilitates the transfer of knowledge and technology. Supporting innovation ecosystems through regional clusters and stakeholder networks is also highlighted.

Ecological restoration is another cornerstone, with bioeconomy activities designed to strengthen ecosystem and soil resilience, especially benefiting rural and coastal communities. Tailored regional and local bioeconomy concepts, aligned with EU policy and effective carbon management, are essential. The integration of bioeconomy strategies into broader industrial and economic policies is necessary for systemic coherence.

Digitalisation and artificial intelligence are identified as key tools for optimising the bioeconomy. Ultimately, the EU's bioeconomy vision is to minimise environmental impacts beyond Europe, promoting global sustainability and ensuring that bioeconomy growth aligns with ecological and social values.

6.3.2 What needs to be phased out

The transition to a sustainable bioeconomy requires phasing out practices and policies harmful to environmental integrity and economic fairness. The continued use of fossil-based products and materials, along with widespread mass meat consumption, needs to be minimised. Food waste needs to be systematically avoided to make better use of food resources. The import of wood, sourced from primary forests, undermines biodiversity and must be stopped. Exporting plastic waste contributes to global pollution and is a loss of resources.

Economic activities supported by subsidies that promote bioresource depletion, such as monoculture and intensive agriculture, as well as bioenergy crops grown on arable lands competing with food production, need to be phased out. Similarly, subsidies on oil-based products that distort markets against bio-based alternatives must be discontinued. Non-biodegradable bioplastics contradict circularity principles and require replacement with biodegradable options. Bioenergy relying on primary biomass sources that do

not meet sustainability criteria must be phased out. Unverified carbon credit schemes that undermine credible climate actions need to be removed. Finally, the regulatory ambiguity regarding genetically modified organisms (GMOs) demands resolution to prevent unintended environmental and social risks.

6.3.3 What needs to be established?

To establish a thriving and sustainable bioeconomy, several critical elements must be developed. These include ecological nutrient management and the introduction of carbon taxation to internalise environmental costs. Legislative coherence is vital; thus, stable and harmonised frameworks at national and EU levels must be adopted, facilitating a clear market environment for bio-based innovations.

Sustainability criteria should be embedded within public procurement to drive demand for bio-based products. Biorefineries optimising waste stream utilisation, alongside novel biomass production and ecosystem services exploitation methods, will support circular bioeconomy ambitions. Development of value networks connecting bio-based industries will foster systemic efficiencies.

Decarbonising hard-to-abate sectors, such as aviation, calls for the deployment of synthetic fuels. Design criteria need to be established to foster the use of pure plastics as they are easier to recycle, and technologies for carbon recovery from plastics will reduce environmental footprints. Expanding the knowledge base on bioeconomy risks and benefits is necessary for responsible innovation, alongside strong national and regional commitments that extend beyond strategy to legislation.

Agroecology and sustainable forestry, which require minimal inputs, promote environmental sustainability and must be scaled up. Building skills, fostering education, and encouraging entrepreneurship will support human capital development. Tailoring national bioeconomies to local contexts, particularly rural and coastal areas, enhances sustainability and circularity, favouring long-lasting bio-based products. Urban bioeconomy models and blockchain technologies can increase supply chain transparency and trust. International bioeconomy treaties and comprehensive sustainability reporting aligned with EU taxonomy will underpin governance.

Digital and AI technologies will optimise biomass logistics and reduce waste, supported by anticipatory governance frameworks in advanced biotechnology research. Prioritising cascading biomass use - from food to materials and energy - is critical. Broad stakeholder involvement, encompassing primary producers, citizens, and public bodies, will ensure inclusive governance. Finally, new economic indicators integrating social, economic and ecological dimensions will provide holistic assessments of bioeconomy impact.

6.3.4 Trade-offs and synergies

The development of the bioeconomy involves striking a balance between essential trade-offs and leveraging synergies. Regulation is necessary, but it must avoid over-complexity that could stifle innovation or create unfair competitive disadvantages among bio-based products. Comprehensive framework reviews are essential to ensure net positive impacts.

Competition between resource uses - food, materials, and energy - requires strategic prioritisation. Skill development represents a synergy, enhancing workforce capacity. Digitalisation and AI present optimisation opportunities but raise questions of data ownership and equitable access as well as energy demand. Trade-offs also arise between bioplastics' durability for carbon storage and the wish for rapid degradability.

Balancing knowledge generation and its management is crucial to maintain innovation momentum without losing public trust. Transparent, responsible biotechnology research and appropriate regulation

are necessary to avoid ecological harm such as deforestation. Lastly, consumer behaviour plays a significant role in ensuring sustainable food systems.

6.4 Deep Dive on Sustainable Industry

6.4.1 The ideal future

- Deep electrification
- Fairness
- Innovative and not harmful
- Integrated approaches
- Meeting evolving societal needs

This vision revolves around achieving zero carbon emissions and ensuring that all discharges to the environment are harmless. The industry will make a decisive shift towards producing higher-value, low-carbon commodities, driven by sustainable innovation at an accelerated pace. Financial self-sufficiency will underpin the industry, serving as a blueprint for global sustainable development that is a precondition for global-scale adoption.

Central to this vision is a focus on the wellbeing of people, efficient use of natural resources such as water, and achieving zero pollution through eliminating waste and harmful consumption impacts. Notably, waste generation and its handling-related impacts should not be offshored but managed responsibly within the EU. Innovation will be driven by the precautionary principle, encouraging circular and sustainable business models that avoid technological or resource lock-ins. The production systems will be circular and resource-efficient, aligning with a mostly electrified EU single market (with over 80% electrification).

Resilience to climate change and supply chain disruptions is critical. Investments supporting large-scale industrial transformation will be aligned with climate and environmental regulations. The principle of "prevention first" will be fully integrated into industrial processes. There will be ample opportunities for new entrants, including in traditionally energy-intensive process industries.

Energy efficiency will be paramount, with production based on sufficiency and reduced material consumption. Industrial symbiosis, deep electrification, and green hydrogen will underpin energy systems. The polluter-pays principle will be enforced, fostering a willingness to collaborate across sectors. A stable legislative and regulatory environment will prevail, incorporating natural-based solutions as standard practice. The industry will support sustainable living standards, ensuring fair and equal access to job markets and fostering a culture that supports risk-taking and innovation.

Harmful or false industrial practices will be phased out, access to affordable electricity will be guaranteed, and better use of Emission Trading System (ETS) revenues at the EU level will be ensured. The industry will adopt an integrated approach to sustainability, where trade deals and new configurations serve as enabling factors for green growth. Social resilience and a fair, just transition will be promoted, with continuous integration into communities and society through corporate social responsibility (CSR). Innovation will be incentivised, and green public procurement will accelerate demand for climate- and environmentally friendly industrial output. Skills development will be supported and made accessible, with people and citizens actively backing the sector's sustainable transformation.

6.4.2 What needs to be phased out

Regulation of artificial intelligence (AI), including general AI and superintelligence, needs refinement to avoid stifling beneficial innovation while disincentivising the use of the most harmful pollutants. Overemphasis on gross domestic product (GDP) growth as a success metric and siloed impact assessments for solutions lead to fragmented and ineffective policies, and these mindsets need to be abandoned.

Disincentives for efficient natural resource use and an exclusive focus on cost-efficiency detract from sustainable outcomes and should be discarded. Fossil fuel subsidies remain a significant distortion in the market, and false advertisements alongside unethical marketing practices - particularly those targeting vulnerable groups such as children - must be terminated. Policy incoherence regarding environmental and social goals undermines progress and requires urgent correction. Member states undermining incumbents and distorting the single market through protectionist tactics must cease.

The global race for competitiveness and productivity improvements that drives mass consumption of excess goods is counterproductive and must be reduced. Additionally, prioritisation of military and security spending over sustainability, overly stringent permit rules that stifle innovation, and 'industry first' policy mindsets that neglect ecological concerns should be critically reviewed and removed. Linear business models and unnecessarily long supply chains contradict sustainability and must be reformed to favour local or regional alternatives.

Techno-economic imaginaries that focus on cheap mass consumption and digitalisation dependencies rather than sustainable value creation must be abandoned. Hidden materials with negative environmental or social impacts must be brought to light and dealt with transparently. Finally, policymakers' susceptibility to capture by specific interest groups obstructing systemic change should be eradicated.

6.4.3 What needs to be established?

State and EU-level incentives should drive this transformation, supported by international green diplomacy that aligns EU trade rules to prevent carbon leakage, enforces border carbon adjustments (BCAM), and fosters resilient global supply chains. Ambitious short-, medium-, and long-term targets for emissions and sustainability should be established, accompanied by full carbon pricing and the reinvestment of revenues into sustainable initiatives.

Reducing raw material consumption must be a fundamental goal. A strengthened secondary raw materials market is essential. The establishment of an EU Industrial Resilience Fund will provide financial stability and support to innovative projects. A well-functioning carbon border adjustment mechanism (CBAM) across all sectors will protect against unfair competition while incentivising greener production.

The leave no one behind principle needs to be fostered during the transition, accompanied by the development of well-being indicators that go beyond GDP. Financial de-risking through public guarantees and targeted subsidies will support innovation and facilitate the adoption of early-stage technologies. Market-based instruments - such as carbon pricing, emissions trading, and green public procurement - should be designed to drive demand for green industrial products.

Significant infrastructure investments are necessary to expand electrification networks, upgrade grids, and establish hydrogen pipelines and storage facilities. Progressive public procurement policies will accelerate the adoption of innovation.

An EU innovation policy driven by the precautionary principle will safeguard health and the environment as it fosters technological progress. Affordable, decarbonised electricity, a united EU single market, and negotiating trade deals with like-minded international coalitions will enhance competitiveness.

Developing the EU capital markets union, expanding skills and training programmes, and promoting affordable, sustainable energy alongside sustainable agriculture will underpin systemic resilience. Considerations for basic income and the ability to manage recessions with fairness to intergenerational equity are part of the social framework needed.

Democratising industries and re-skilling the workforce with anticipation of future challenges will sustain long-term competitiveness. Public-private partnerships should forge a distinct EU industrial identity. Re-

establishing global cooperation and fairness will help address geographic and distributional imbalances arising from job creation and destruction due to industrial transformation.

Industrial production should be predominantly electrified and sustainable, with ethical marketing and transparent product information, enabling consumers to drive markets toward green options. It is crucial to fully understand the impacts of new materials and processes, ensuring lessons are learned promptly to avoid late-stage crises. Circular production models will dominate, with continued innovation to tackle emerging issues. Harmonised global standards, including ambitious and consistent emission limit values, will be crucial, especially in areas such as carbon management in the chemical industry.

6.4.4 Synergies and trade-offs

International trade agreements, mechanisms such as the Carbon Border Adjustment Mechanism (CBAM), and new green trade partnerships play a vital role in protecting European competitiveness while simultaneously enforcing robust environmental standards. By prioritising these instruments, the European Union can avoid a race to the bottom and ensure that high environmental and climate regulations are maintained even as global competition intensifies. European firms are therefore well positioned to assert global leadership, particularly by becoming principal suppliers of clean industrial technologies, innovative processes, and advanced environmental services. These capabilities provide a strong foundation for long-term competitiveness and enable the EU to set international benchmarks in sustainability.

Furthermore, forging alliances with like-minded partners such as Canada who also reward measurable sustainability progress, significantly enhances global cooperation and supports forward-looking policy coalitions. Such partnerships can accelerate the diffusion of sustainability standards and best practices worldwide. Internally, achieving consensus within Europe is a prerequisite for external effectiveness; divided national interests or conflicting approaches risk undermining the union's shared sustainability ambitions. Strong internal alignment ensures that a coherent European vision can be projected globally, bolstering credibility and collective impact.

Additional legislation is required to embed sustainability objectives effectively within both European internal markets and external trade interactions. Regulatory clarity and enhanced enforcement are critical to scaling up sustainable production and investment. Finally, a strategic focus on the higher end of the value chain such as advanced manufacturing and the export of high-value sustainable goods will not only benefit the EU but also enable third countries equipped for sustainable production to achieve greater value and developmental progress. This approach supports mutually reinforcing economic and environmental gains, helping to accelerate the global shift toward sustainability.

6.5 Analysis of synergies and trade-offs across all three topics

6.5.1 Overlaps and Synergies

Resource Efficiency and Circularity

All three concepts emphasise optimising the use of resources, minimising waste, and promoting recycling and reuse. The Circular Economy centres on reducing demand for critical raw materials (CRMs) and maximising recycling. The Bioeconomy focuses on cascading biomass use and biobased products designed for zero waste, and Sustainable Industry stresses circular production models and stronger secondary raw materials markets.

Sustainability and Environmental Protection

There is a shared commitment to environmental sustainability, including reducing emissions (zero carbon ambitions), minimising pollution (zero pollution targets), and ensuring no harmful discharges to the

environment. The Bioeconomy integrates ecosystem services and agroecology. The Circular Economy aims to minimise the social/environmental impacts of extraction. Sustainable Industry incorporates climate adaptation, decarbonization, and enforces the polluter-pays principle.

Innovation and Technology

Innovation is a common driver across all three, including digitalisation and AI for optimisation (especially in Bioeconomy), eco-design for durability and recyclability (Circular Economy), and clean industrial technologies (Sustainable Industry). There is an emphasis on anticipatory governance and the safety/regulation of emerging technologies, especially in the bio and digital domains.

Policy and Market Frameworks

Each domain calls for harmonised legislation and market support. There is a focus on stable regulatory environments, appropriate business cases, new economic indicators integrating sustainability, public procurement favouring green products, and strong international cooperation and trade agreements.

Social Dimensions and Job Creation

Green jobs, skills development, social resilience, fair and just transition, and inclusive market access are shared priorities. Circular Economy highlights jobs in repair/recycling, Bioeconomy promotes rural and coastal benefits, and Sustainable Industry emphasises workforce reskilling and social integration.

Global and Regional Integration:

Synergies include developing value chains that cross sectors and borders, regional tailoring of approaches (especially in Bioeconomy), and EU leadership ambitions across all three sectors alongside global cooperation to set standards and avoid environmental offshoring.

6.5.2 Possible Contradictions Between Circular Economy, Bioeconomy, and Sustainable Industry

Resource Use Priorities and Biomass Competition

Circular Economy aims to reduce resource extraction and maximise recycling, promoting longer product lifespans. In contrast, Bioeconomy prioritises optimised biomass use, with a cascading principle (food → materials → energy), which can compete with Circular Economy goals due to biomass limits. Sustainable Industry's demand for lower raw material use can conflict with Bioeconomy's biomass harvesting, risking competition between food, material, and energy sectors.

Regulatory Regimes and Innovation Tension

The bioeconomy faces contradictory demands for stringent regulation (e.g., regarding GMOs and biotech risks) versus the need to foster innovation and market development. Similarly, Sustainable Industry warns that tight regulations can stifle innovation and burden the industry, while the Circular Economy requires robust regulation for product design and lifecycle assessment, presenting potential friction between regulatory strictness and innovation agility across sectors.

Circularity vs. Renewables and Digitalisation

The Circular Economy prioritises product longevity and reuse. At the same time, Sustainable Industry pushes for deep electrification and the adoption of green hydrogen, sometimes requiring new materials or infrastructure that may undermine circularity goals. Additionally, the bioeconomy’s digitalisation and

reliance on AI raise concerns about energy demand, creating trade-offs related to emissions and resource intensity.

Data Governance and Knowledge Control

Bioeconomy's push for extensive digitalisation and AI optimisation of biomass logistics raises questions about data ownership and transparency. This concern contrasts with Sustainable Industry and Circular Economy's broad sustainability transparency and open innovation calls, leading to contradictions on data control and governance among sectors.

Economic Competitiveness vs. Environmental Ambitions

Short-term industrial competitiveness (Sustainable Industry) often favours linear models and cost-efficiency, contradicting the Circular Economy's long-term circular models that may appear costly initially. The bioeconomy also faces unfair competition due to differences in sustainability frameworks and subsidies between fossil-based and bio-based products.

Land Use and Environmental Impacts

The bioeconomy's reliance on biomass and bioenergy crops can lead to land-use conflicts with agricultural, biodiversity, and ecosystem protection goals, potentially clashing with the Sustainable Industry's focus on environmental safeguarding and the Circular Economy's emphasis on preserving planetary boundaries.

Consumer Behaviour and Market Barriers

Sustainable Industry highlights misleading marketing, mass consumption culture, and resistance to behavioural change, which undermine the Circular Economy's focus on product longevity and reuse. Meanwhile, Bioeconomy must navigate consumer acceptance challenges, especially around biotechnology and biobased products. These varying demands may create contradictions in market and consumer dynamics. Short-term competitiveness may rely on linear models, creating tension with circularity goals, which require longer-term perspectives. There is potential for unfair competition between products subject to different sustainability frameworks or subsidies, which can distort markets.

Resource Use vs. Demand

There are trade-offs in balancing longer product use (Circular Economy) versus the need for recycling especially in growing markets. In Bioeconomy, there is a conflict between using biomass for food, materials, or energy. Sustainable Industry must manage raw material consumption reductions without compromising industrial competitiveness.

Energy and Emissions

The ambition for renewable energy and deep electrification (Sustainable Industry) sometimes contrasts with digitalisation demands or bioenergy crops' land use (Bioeconomy). There is also a noted trade-off between the carbon storage benefits and the use of degradable bioplastics.

6.6 Relating the deep dives to the scenarios

The deep dives identify a broad portfolio of transition ideas for circular economy, bioeconomy and sustainable industry that can be stress-tested against the five scenarios. Some emerge as robust "no-regret" directions that are desirable and feasible in all worlds, though at different speeds and scales, while others are more contingent on favourable geopolitical, economic or governance conditions and are therefore scenario-specific or higher-risk.

6.6.1 Robust ideas across all scenarios

Several deep-dive ideas prove resilient when mapped onto the green, blue, orange, yellow and grey scenarios:

- Demand reduction and sufficiency (less material and energy throughput, longer product lifetimes, repair and reuse) remain feasible and desirable in all scenarios. In resource-tight, conflictual or fragmented worlds (blue and orange scenario), sufficiency is a necessity for resilience; in integrated, high-growth worlds (yellow and grey scenario), it helps manage resource constraints, external dependencies and environmental limits; and in the green scenario it underpins fair global burden-sharing.
- High-ambition circular economy measures such as eco-design, extended producer responsibility, high-quality recycling, urban mining and circular business models are also robust, though implementation conditions differ. They hedge against critical raw material risks and import dependencies in all futures and support competitiveness by lowering input costs and exposure to shocks.
- Nature-based solutions and ecosystem restoration are consistently valuable, because they reduce climate and biodiversity risks that threaten infrastructure, supply chains and social stability in every scenario. In cooperative worlds they are easier to finance and regulate; in harder worlds they become local protection strategies for communities and sectors.
- Deep electrification and energy efficiency in industry, coupled with expansion of renewables and flexible systems, are central to meeting climate targets and reducing vulnerability to volatile fossil markets across scenarios. The cost, speed and governance of this transition differ, but the direction of travel remains robust.
- Skill development and just transition mechanisms (re-skilling, social protection, place-based industrial and labour policies) are necessary everywhere to manage dislocation from automation, decarbonisation and restructuring. Without them, social cohesion erodes in all worlds, undermining competitiveness regardless of external context.

These ideas reduce systemic risk, lower structural dependencies and support long-term productivity under both benign and adverse conditions. Their main constraints are political will, investment capacity and institutional quality rather than intrinsic incompatibility with any scenario.

6.6.2 Ideas with conditional feasibility

Other deep dive ideas are clearly desirable but more sensitive to the external context, and therefore more plausible or impactful scenarios:

- Highly integrated, bio-based value chains geared to global markets (e.g. large-scale bio-refineries tightly coupled to international biomass trade) are more feasible in cooperative, rules-based worlds (yellow and grey scenario) with strong sustainability governance and reliable trade. In fragmented or conflictual worlds (blue scenario), and in the green scenario with intense land and water pressures, such models face higher risks of land-use conflict, supply disruption and legitimacy concerns, making smaller-scale, regional and diversified bioeconomy configurations more realistic.
- Very capital-intensive industrial megaprojects (large hydrogen clusters, CCS/CCU at scale, deep process changes in basic materials) depend on stable investment frameworks, strong public–private coordination and relatively low financing costs. They are more plausible in the yellow and grey scenario, and in parts of the green scenario where strategic alliances remain functional; in the blue or orange scenario, decentralised, modular and incremental industrial transformations are more feasible than single, mega-scale bets.
- Single European capital markets and strongly harmonised standards for bio-based and circular products are easier to realise in the yellow and grey scenarios, where institutions and alliances are

relatively strong and standard-setting is globally influential. In fragmented (blue scenario) or networked (orange scenario) futures, attempts to centralise capital and standards may meet stronger resistance, making more polycentric financial and regulatory arrangements a more realistic implementation of deep dive ambitions.

- High-tech, data-intensive optimisation of circular and bio-based systems (e.g. AI-driven resource allocation, digital twins and advanced tracking) is most readily scalable in the orange, yellow and grey scenarios, where digital infrastructures and innovation ecosystems are strong. In the green and especially the blue scenario, digital tools still play a role, but institutional, geopolitical or infrastructural constraints may shift emphasis toward simpler, more locally controlled solutions.
- Strong outward-oriented "green competitiveness" strategies that rely on preserving Europe's global market share and standard-setting power are more compatible with the yellow and grey and, to an extent, with parts of the green scenario. In the blue and orange scenario, Europe must accept more modest global influence and focus the deep-dive ideas on resilience, self-provisioning where critical and fair partnerships rather than on global techno-economic leadership.

6.7 Relating the Deep Dive results with the Delphi-Survey

The Delphi survey broadly confirms the strategic direction of many deep-dive ideas, but it also challenges their pace, feasibility and underlying assumptions, especially where visions rely on optimistic governance, finance and geopolitics. Several deep-dive proposals emerge as robust "no-regret" options that Delphi experts endorse across futures, while others appear over-ambitious or fragile when confronted with concerns about implementation gaps, social acceptance and hard geopolitical constraints.

6.7.1 Deep-dive ideas challenged by Delphi

The deep dives articulate high-ambition visions of a fully circular economy, near-zero pollution industry and strongly integrated bio-based value chains, including large hydrogen clusters, CCS/CCU megaprojects and tightly globalised biomass markets. Delphi experts clearly question the plausibility of such "full achievement" narratives by 2040, stressing persistent technical, economic and social barriers to full circularity and full decarbonisation, especially in hard-to-abate sectors. They point to weak business cases, design lock-ins, affordability concerns and limited social acceptance as reasons why "stretching targets" for resilience, strategic autonomy and a fully circular economy should be seen as aspirational rather than central trend lines.

Both, the deep dives as the Scenarios often assume relatively stable access to global markets, critical raw materials and digital infrastructures, which underpins visions of globally competitive, data-intensive circular and bio-based systems. By contrast, Delphi responses place strong emphasis on geopolitics, resource nationalism, fragmentation and climate tipping points, and thereby challenging deep-dive ideas that depend on seamless trade, low-cost capital and integrated European capital markets. Experts warn that outward-oriented green competitiveness strategies and megaproject-based industrial bets are fragile if they neglect these downside risks and the need to build circularity and autonomy "for hard worlds, not only for benign ones".

Delphi respondents also question the continued primacy of competitiveness as guiding paradigm, whereas some deep-dive visions implicitly rely on competitiveness-driven growth in consumption and trade as enabling condition for circular and bioeconomic expansion. Many experts call for sufficiency, demand reduction and metrics beyond GDP as preconditions for credible restoration, circularity and autonomy, thereby challenging deep-dive elements that treat efficiency, innovation and standard-setting alone as sufficient for sustainable competitiveness. This critique reinforces the need to embed deep-dive proposals in broader narratives of wellbeing, justice and resilience rather than assume competitiveness objectives will automatically align with sustainability.

6.7.2 Deep-dive ideas supported by Delphi

At the same time, the Delphi findings strongly support a set of core deep-dive ideas, even if the speed and scale of implementation remain uncertain. Demand reduction, sufficiency and longer product lifetimes, together with high-ambition circular economy measures such as eco-design, extended producer responsibility, high-quality recycling, urban mining and circular business models, are recognised as "no-regret" directions that reduce structural dependencies and systemic risks. Experts emphasise that significant upgrades of circular systems and demand-side measures are a shared precondition across futures, even if current governance and investment capacities cast doubt on timely delivery.

Similarly, the deep dives' emphasis on nature-based solutions, ecosystem restoration and deep electrification of industry, coupled with renewable expansion and energy efficiency, aligns closely with Delphi priorities around adaptation, resilience and risk reduction. The Delphi highlights acceleration of climate adaptation and resilience technologies, CRM demand reduction and circularity as cross-context priority fields rather than optional add-ons, reinforcing the strategic importance of these deep-dive building blocks for sustainable competitiveness. Strong focus on skills, just transition mechanisms, social protection and place-based industrial and labour policies in the deep dives is also echoed in Delphi concerns about social cohesion, equity and the risk of polarisation if distributional issues are neglected.

Both strands underscore that institutional reform, participatory governance and trustworthy AI and data governance are not peripheral but foundational enablers for the technical and economic solutions proposed in the deep dives. The Delphi's insistence on coherent, transparent and participatory regulatory frameworks to deliver circularity, decarbonisation and bioeconomy strategies supports the deep-dive intuition that governance innovations are as critical as technological ones. This convergence suggests that many of the granular transition ideas developed in the deep dives are directionally sound, provided they are embedded in realistic trajectories of institutional capacity-building and social licence.

7 Futures Dialogue

7.1 Introduction

The EEA Futures Dialogue, held on 16 October 2025 in Brussels, brought together policy experts and industry representatives to explore the challenges and opportunities for achieving Europe's sustainable competitiveness by 2040. Building on the scenarios developed in Section 4 and the Delphi findings in Section 5, the dialogue employed participatory foresight methods to stress-test the EU Competitiveness Compass against real-world implementation constraints and stakeholder concerns. Participants examined two interconnected dimensions—social cohesion and environmental resilience—to identify critical trade-offs, prerequisite actions, and shared priorities for transforming Europe's competitive model.

7.2 Plenary Discussion: Current State and Future Direction

7.2.1 Where are we at with the Competitiveness Compass?

Participants offered a candid assessment of progress. Key observations highlighted:

- Raw Materials and Regulatory Risk: Industry representatives noted that capital and materials exist for sustainable transitions, but investments remain risky due to regulatory uncertainty and permitting delays.
- Lack of Strategic Progress: The consensus was that limited substantive progress has occurred on the Competitiveness Compass; current focus centres on simplification rather than strategic development.
- Polarisation and the Draghi Report: Participants identified growing polarisation around the competitiveness agenda, with policy increasingly wedded to short-term simplification, particularly in security and defence sectors, rather than the original integrative vision of the European Green Deal.
- Conceptual Confusion: The Compass was perceived as reliant on outdated twentieth-century methodologies, conflating competitiveness with growth whilst overlooking crucial determinants such as soil health and biodiversity. The loudest business voices do not necessarily represent the broader entrepreneurial community, skewing the frame towards narrow incumbents.
- Disconnects between EU and Local Levels: Decarbonisation strategies, such as electricity interconnectors, risk disconnection from local realities and community acceptance, signalling a gap between EU-level planning and ground-level feasibility.
- Positive developments included growing awareness among security actors of climate change as a systemic risk, and increased recognition that social cohesion underpins long-term competitiveness.

7.2.2 Building Blocks for the Future

- Participants converged on several essential ingredients for achieving sustainable competitiveness by 2040:
- Education and Scientific Evidence: Stronger emphasis on science-informed policy rather than opportunistic responses to crises.
- Resource Efficiency and Circularity: Decisive decoupling of environmental impact from economic development.
- Shared Long-Term Vision: Citizens need visible pathways to a prosperous future with genuine opportunities for participation and identity-building.
- Green Conditionalities: Public funding must be tied explicitly to sustainability criteria.
- Localised Climate Adaptation: Long-term perspective incorporating granular risk assessments and tailored responses.

- Narrative and Communication: Reclaiming the positive potential of the Green Deal; demonstrating that competitiveness and climate action are mutually reinforcing.
- Wellbeing as Central Paradigm: Sustainable wellbeing, rather than narrow GDP growth, should anchor competitiveness policy.

7.3 Actions needed for safeguarding social cohesion and environmental sustainability

7.3.1 Social Cohesion and Competitiveness

Participants envisioned potential trade-offs if competitiveness were pursued without safeguarding social cohesion and identified the following risks:

- Democratic erosion and polarisation
- Disproportionate youth unemployment from automation
- Deepening regional and sectoral inequalities
- Housing crises exacerbated by climate migration
- Exploitative relationships with the Global South
- Territorial fragmentation.

Recommended Actions

- Implement redistributive mechanisms and robust social security systems.
- Decentralise funding and decision-making to address cohesion at community level.
- Reimagine European identity around green jobs and sustainability rather than market integration alone.
- Adopt post-growth metrics beyond GDP.
- Transform labour paradigms—such as four-day work weeks—to distribute gains from efficiency.
- Strengthen democratic institutions and rule of law against anti-democratic movements.
- Invest heavily in education for transition preparedness.

7.3.2 Environmental Resilience and Competitiveness

Participants examined scenarios where competitiveness gains came at the expense of ecosystem health and identified these risks and possible trade-offs:

- Energy efficiency versus short-term competitiveness
- Nature restoration versus industrial performance metrics
- Controlling externalities of trade versus global market competition
- Balancing biomass demands with food security
- Managing dependencies on China for critical rare earths whilst avoiding excessive nuclear expansion
- Prioritising adaptation and resilience over mitigation-only strategies.

Recommended Actions

- Adopt consumption patterns compatible with planetary boundaries; reorient food systems and dietary choices.
- Learn from Mediterranean experience in water management and adapt approaches across regions.
- Implement nature-based solutions and ecosystem restoration as primary safeguards, not secondary measures.
- Tighten regulation of chemicals, water, and resource extraction whilst supporting compliance pathways.

- Scale circular economy and carbon-neutral pathways—reuse, regenerative agriculture, smart water systems.
- Develop coherent EU standards and funding mechanisms for industrial transformation.
- Identify and support pioneering actors to accelerate demonstration and uptake.

7.4 Implications for the scenarios

The Futures Dialogue findings reveal critical tensions between stakeholder expectations and scenario logics, illuminating which futures are robust and which rest on precarious assumptions.

Social Cohesion and Scenario Viability: The strong emphasis by participants on avoiding democratic erosion, inequality and exclusion align most closely with the green ("Sunrise in the South") and yellow ("Status Quo 2.0") scenarios, where institutional capacity and social contracts remain relatively intact. In contrast, the blue scenario ("Age of Fragmentation") and the orange scenario ("AI Takes Over") map more closely to the fragmentation risks participants highlighted (polarisation, unemployment spikes, and territorial conflicts). The Dialogue suggests that achieving competitiveness without securing social cohesion first is not merely a trade-off but a pathway to systemic failure, undercutting long-term prosperity. This echoes Delphi findings that resilience and justice must be integral, not ancillary, to competitiveness strategy.

Environmental Threshold and Scenario Constraints: Participants' insistence on nature-based solutions as foundational, rather than supplementary, contrasts sharply with scenario narratives that maintain relatively high consumption or assume technical fixes (CCS, advanced recycling) will suffice. In the yellow and grey scenarios, such confidence in technological substitution may be warranted if investment and innovation remain robust, in the green scenario, strict biomass and resource limits drive more austere but ultimately more resilient pathways. The blue scenario's fragmented supply chains and conflicts over resources make resource efficiency non-negotiable but governance constrained. Participants' caution regarding over-dependence on China and nuclear expansion points to the grey scenario's strategic vulnerabilities, whilst the orange scenario's distributed, networked economy might diffuse but not eliminate these risks.

Regulatory and Narrative Coherence: The Dialogue critiqued the current framing of the Competitiveness Compass as overly narrow and outdated. Participants advocated for reframing competitiveness as resilience, wellbeing, and fairness—a conceptual shift echoed in Delphi responses and embedded most clearly in the green and orange scenarios, where survival and adaptation supersede traditional growth metrics. The yellow and grey scenarios, predicated on managed globalisation and strong institutions, risk underestimating the narrative and legitimacy crises that participants identified as real obstacles. Without deliberate narrative work that connects green jobs to identity, demonstrates win-wins, and implements new formats for participatory governance the political coalitions needed for either scenario may fracture.

Feasibility of Cross-Scenario Priorities: Despite scenario divergence, the Dialogue and Delphi converge on robust priorities: circular economy scaling, decarbonised energy systems, nature restoration, skills investment, and institutional reform. These are beneficial in all five scenarios but take different forms. In the yellow and grey scenario, they manifest as scaled corporate and state programmes with premium standards. In the green scenario, they become survival imperatives with lower throughput and stronger commons. In the blue and orange scenario, they emerge as fragmented, adaptive initiatives by non-state actors, less coordinated but potentially more resilient to institutional failure. The Dialogue findings suggest that policy should design these priorities for adaptability across contexts rather than assume a single implementation pathway.

Unresolved Tensions: The Dialogue did not fully resolve whether post-growth frameworks (advocated by participants) are compatible with the productivity-growth assumptions underlying the Competitiveness

Compass and present in all five scenarios. This hints at a deeper fault line: if Europe's social contract and institutional legitimacy depend on delivering wellbeing growth decoupled from material throughput, then scenarios predicting continued high consumption or GDP-centric metrics may be politically fragile, regardless of their technical plausibility. This is particularly acute in the yellow and blue scenarios, where growth remains a central narrative, and poses a strategic question for policymakers: can competitiveness frameworks survive a shift in legitimacy criteria toward sufficiency, fairness, and regeneration?

7.5 Implications for the Delphi results

The Futures Dialogue and the Delphi survey converge on a core insight: sustainable competitiveness by 2040 is possible in principle, but only under demanding conditions that are not yet in place. Both processes stress that resilience to cascading climate, social and environmental risks require deep systemic change in energy, industry, governance and social policy, rather than marginal adjustments to the current growth model. At the same time, both reveal doubts that such change can be delivered at the required speed, especially given current polarisation, institutional capacity constraints and persistent short-termism.

On resilience, Delphi respondents agreed that enhancing Europe's capacity to absorb and adapt to shocks is essential, but identified governance quality, public trust and coherent long-term investment as critical bottlenecks. The workshop discussions on social cohesion and environmental resilience mirror this diagnosis, highlighting the risks of democratic erosion, widening inequalities and fragmented territorial development if competitiveness is pursued without adequate redistribution, participation and place-based policies. Both exercises therefore treat social and institutional robustness not as co-benefits, but as preconditions for any credible resilience strategy.

The Delphi questions on the 90 % emission reduction target, circular economy, zero-pollution industry and strategic autonomy elicited cautious optimism coupled with strong concern over feasibility and timing. Experts emphasised technology deployment, infrastructure investment, skills and stable regulatory frameworks as key enablers, but also underlined path dependencies in energy-intensive sectors and critical raw material dependencies as major barriers. Workshop participants translated these abstract risks into concrete tensions: short-term competitiveness pressures in energy-intensive industries, trade-offs in sourcing biomass and minerals, and the risk that mitigation dominates at the expense of adaptation and biodiversity. Both strands agree that circularity, restoration and strategic autonomy are central pillars of sustainable competitiveness, yet neither assumes that a "fully operational" circular economy or fully decarbonised heavy industry will be in place across the EU by 2040.

On strategic autonomy and trade, the Delphi pointed to reducing internal demand for critical raw materials and diversifying trade partnerships as necessary but politically and economically challenging. Dialogue participants similarly emphasised vulnerabilities linked to external dependencies, especially on China for rare earths and key technologies, and warned that attempts to secure these inputs can easily export environmental and social externalities to the Global South. Both processes therefore call for demand-side measures, circularity and nature-based solutions to complement or replace expansionary supply-side strategies, aligning industrial transition with planetary boundaries and justice concerns.

The Delphi questions on regulatory environments and biotech-driven innovation again resonate strongly with the Futures Dialogue. Experts supported the idea of smart, coherent regulation and a more enabling financial architecture but warned against deregulation that weakens social and environmental safeguards. In Brussels, participants criticised the current focus on "simplification" as too often detached from strategic aims and argued for attaching green conditionalities to public funding and mainstreaming wellbeing as a guiding metric. Both perspectives advocate regulation that is predictable, mission-oriented and protective of social and ecological standards, combined with stronger support for transformative innovation in areas such as bio-based materials, circular design and nature-based solutions.

A further point of convergence lies in the reframing of competitiveness itself. Delphi responses increasingly question a narrow productivity-growth lens and call for integrating justice, wellbeing and planetary boundaries into the EU's competitiveness model. Workshop participants articulated this shift explicitly, arguing for post-growth perspectives, new indicators beyond GDP, and narratives that link European identity to green jobs, fair transitions and quality of life. Taken together, these insights suggest that many of the Delphi targets—resilience, strategic autonomy, circular economy, zero pollution—remain desirable and, in part, achievable, but only within a redefined competitiveness paradigm that embeds sufficiency, equity and ecological restoration at its core.

In combination, the Delphi and Futures Dialogue give a consistent picture: most of the envisaged solutions are conditionally possible, but their feasibility depends less on individual technologies and more on governance reforms, distributional choices and public narratives. Without addressing these underlying factors, the quantitative goals explored in the Delphi risk remaining aspirational, while the trade-offs surfaced in the workshop—social fragmentation, ecosystem degradation and geopolitical tensions—may materialise and undermine Europe's long-term competitiveness

8 Conclusion - Navigating Europe's path to sustainable competitiveness

This foresight project has brought multiple perspectives and interdisciplinary expertise on the relation between competitiveness and sustainability together. The discussions and assessments of future trends, challenges and opportunities across different scenarios with experts and stakeholders helped to identify possible tensions and synergies, needs for action and ideas for policy actions.

Following the expert's opinion, Europe's future prosperity depends on its ability to become both sustainable and competitive in a rapidly changing global landscape. This dual ambition is no longer a strategic choice but a structural necessity. Economic resilience, social cohesion, ecological stability, and technological sovereignty are increasingly intertwined. At the same time, Europe's capacity to act decisively is increasingly uncertain, constrained by external dependencies and declining public trust.

The future of Europe's competitiveness and long-term sustainability might therefore depend a lot on its ability to navigate growing environmental, economic, and security pressures while preserving the capacity of democratic institutions to deliver coordinated, future-oriented action. A Europe that fails to reduce its resource dependencies, strengthen its innovation capacity, and accelerate ecological transitions risks sliding into geopolitical vulnerability, economic stagnation, and growing social divides; risks that are seen by experts. Conversely, a Europe that manages to align long-term sustainability with global competitiveness can shape the terms of tomorrow's global economy instead of adapting to the strategies of others.

The combined insights from the different foresight approaches—scenario development, Delphi, expert deep dives, stakeholder dialogues, and trend analyses—show that Europe's room for manoeuvre is shaped by several stable and persistent dynamics. Across all methods, a clear pattern emerges: Europe is entering a period of structural pressure marked by resource constraints, rapid technological shifts, intensified climate impacts, and rising geopolitical competition. Yet these same trends also reveal windows of opportunity: new markets for green technologies, digital trust architectures, resilient infrastructures, circular value creation, and skills systems that empower innovation. The plurality of perspectives confirms that Europe's strategic position will depend less on predicting a single future and more on preparing for a spectrum of plausible developments—ranging from high global cooperation to pronounced fragmentation, from state-led to network-led governance, and from proprietary to open technological ecosystems.

For policymakers in and of the EU, this foresight exercise offers practical value on several levels. First, it strengthens anticipatory governance by clarifying which developments cut across multiple futures—such as the need for circular material systems, secure and interoperable data and computing infrastructures, adaptive climate resilience, diversified supply chains, and strong skills ecosystems. These represent "no-regret" priorities that hold strategic relevance regardless of geopolitical or technological trajectories. Second, the foresight results help identify scenario-specific risks and opportunities: where Europe may need to hedge against resource coercion, where cooperation could be deepened, or where strategic autonomy must be expanded. Third, the exercises offer an evidence-based foundation for monitoring early signals, enabling policymakers to detect shifts in global markets, technological architectures, or societal dynamics before they solidify into structural constraints.

Taken together, these insights underscore the importance of a Europe that is proactive rather than reactive, capable of shaping standards, building resilient partnerships, and investing in systems that deliver long-term value. Sustainable competitiveness emerges not from isolated policies, but from a coherent strategic direction that integrates economic, ecological, technological, and social innovation. In this sense, the foresight process does not close with definitive answers; it equips European policymakers with a shared orientation, a sharper view of strategic uncertainties, and a clearer understanding of the capabilities Europe must build today to thrive in the futures ahead.

List of abbreviations

ABBREVIATION	NAME
EU	European Union
ETC ST	European Topic Centre on Sustainability Transitions
EC	European Commission
AI	Artificial Intelligence
RD	Research and Development
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilisation
STEEP	Social, Technological, Economic, Environmental, Political
CRM	Critical Raw Materials
EAP	Environment Action Programme
CBAM	Carbon Border Adjustment Mechanism
ETS	Emissions Trading System
GDP	Gross Domestic Product
SMES	Small and Medium-sized Enterprises
NEET	Not in Employment, Education or Training
FDI	Foreign Direct Investment
IOT	Internet of Things
ISO	International Organization for Standardization
ITU	International Telecommunication Union
IEEE	Institute of Electrical and Electronics Engineers
HESS	Hybrid Energy Storage Systems
SYKE	Finnish Environment Institute
UBA	Federal Environment Agency (Germany)
AIT	Austrian Institute of Technology
ISI	Fraunhofer Institute for Systems and Innovation Research
CENIA	Czech Environmental Information Agency
ICLEI	ICLEI European Secretariat
SEI	Stockholm Environment Institute
EIONET	European Environment Information and Observation Network
FSC	Foresight Strategy Cockpit, https://www.4strat.com/foresight-strategy-cockpit/

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Annex 1: Catalogue of influencing factors

1 Social factors

1.1 Demographic dynamics

Demographic dynamics encompasses various aspects: birth rates, migration flows, and the rate of the elderly population. More subtle characteristics include well-being, affluence, access to education, and family structures.

Aspects

- Ageing population & dependency ratios (e.g. workforce, social system, etc.),
- Youth demographics & social embedding/anchoring access to education
- Migration & inclusion (e.g. in the labour market), role of brain drain (Migration of skilled workers
- Gender dynamics and inclusion of minorities
- Regional demographic developments & disparities
- Model of border control & immigration policies
- Role of ethics in migration policies
- Integration models & social acceptance

Current developments

- Average age increase in Europe is rising (decline of birth rates and increase of life expectancy)
- Old-age dependency ratio in EU projected to almost double from 33.9% in 2024 to 59.7% in 2100 (with total dependency ratio projected from 56.8% in 2024 to 83.9% in 2100)
- Shrinking share of European population in the world (only about 4% in 2070, compared to 6% today)
- The number of households is increasing, while average household size is decreasing
- Number of displaced people worldwide is rising to 6.7 million by the end of next year, driven by ongoing conflicts, economic instability, and cuts in international aid.

Relevance

Demographic change defines future workforce and consumer base and has far-reaching consequences for society, economics, and politics, requiring tailored responses in various regions. It influences people's employability, consumption, travel and mobility practices and behaviour. Ageing populations challenge economic productivity, strain social security and healthcare systems, and require changes in infrastructure. Meanwhile, the well-being and educational attainment of younger generations will directly affect Europe's ability to innovate, adapt, and compete globally. Demographic developments in Europe will have an influence on how prosperity, productivity, and consumption develop, how resilient and sustainable the economy is, and how equitable the transition to sustainability can be for society. Uncertainties include future migration flows, whether family policies can reverse declining birth rates and how different regions within Europe adapt to increasing dependency ratios.

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1.2 Social inequality

This factor is about actual or perceived inequality in the distribution of wealth, prosperity, or income across society, e.g., growing or persistent poverty, economic polarization.

Aspects

- Level of income for consumption
- Tax revenue of governments, thus public and social spending for pension funds or insurances
- Access to affordable housing, health, education and social goods or social positions
- Opportunities for power, interaction, or other social and economic activities
- Development of social and economic inequality

Current developments

- In half of the EU countries, the mean consumption expenditure per person for the top 20% of households by income was more than double that of the bottom 20%
- In 2020, about 24% of the EU population was either at risk of poverty due to low income or had low levels of consumption expenditure.
- Lower income groups must spend a considerably higher part of their income on goods and services than higher income groups, thereby preventing them from saving part of their income, or even dissaving, as is the case for the first income quintile in almost all EU countries.
- Working from home during the pandemic created inequalities between low- and high-income groups, where temporary workers, young people and those in precarious employment emerged as more vulnerable to crises.
- No significant catching-up process among the EU Member States in their at-risk-of-poverty (AROP) rate from 2005 to 2021
- Income and wealth inequality within countries growing steadily, while inequality between countries declining since the 2000s due to rise of China and India.

Relevance

Who benefits and who is left behind in transitions to a low-carbon and digital economy, e.g., workers, rural populations, elderly is a key issue for transition governance. High levels of inequality can undermine trust in institutions, fuel political polarisation, and trigger social unrest. Social inequality is important for Europe's sustainability and competitiveness, as lower income influences consumer behaviour and the ecological footprint, among other things, and can restrict access to legal remedies, administrative justice, and the enforcement of rights, which in turn affects social mobility and equal opportunities and thus economic activity. Unequal access to education can reduce productivity and innovation potential.

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1.3 Living standard

Living Standard refers to the overall conditions shaping individual and collective wellbeing in society. It encompasses both material and immaterial factors that influence daily life, societal resilience, and a region's economic attractiveness.

Aspects

- Education quality
- Cultural landscape
- Aesthetic environments
- Social infrastructure
- Civic freedoms
- Societal mindset and openness

Current developments

- Across the EU, basic skills in reading, mathematics, and science have declined to record lows among 15-year-olds, with one-third unable to perform basic math, highlighting a growing educational gap.
- The European Union is increasingly focusing on enhancing the working conditions of artists and cultural professionals.
- Aesthetics is a driver of economic competitiveness, particularly in industries like architecture, design, tourism, and fashion. The global aesthetics market is projected to grow significantly, reaching €22.9 billion by 2028.
- A majority of EU cities plan to increase investments in social infrastructure, including public housing, schools, and hospitals, over the next three years to bolster climate action and community wellbeing.
- Civic freedoms have deteriorated in Europe over the past five years, with increased restrictions on NGOs, peaceful protests, and freedom of expression, raising concerns about the state of democracy and tolerance for others.
- There is growing concern about rising xenophobic attitudes and a narrowing of the concept of 'European identity' within the EU, which could undermine the Union's fundamental values of inclusion and diversity.

Relevance

Enhancing living standards is pivotal for Europe's competitiveness, as it directly influences productivity, innovation, and social cohesion. Higher living standards influence talent retention and Europe's ability to compete globally for skilled labor. Investments in education, cultural infrastructure, and civic freedoms not only improve individual well-being but also strengthen the EU's position in the global economy. The European Commission's Competitiveness Compass underscores the need for such investments. It is uncertain how living standards will evolve in the face of climate, economic, and geopolitical shocks.

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1.4 Information, communication and public opinion

Information, communication and public opinion refer to the exchange of information between individuals and institutions, the way in which this information is processed, and the resulting views and beliefs within a society.

Aspects

- Media landscape and pluralism
- Diversity of media
- Level of disinformation and misinformation
- Fake news and deep fakes
- Algorithms used by platforms
- Polarisation of public opinion
- Spread of conspiracy theories

Current developments

- Fake news is the biggest risk for the next two years (WEF Risk Report)
- Risks to media pluralism and freedom in Europe are increasing, attributing challenges to unregulated digital environment
- Russia seeking to undermine European sentiment, spreading disinformation across the EU to divide the public
- Public debate remains polarized over the conflict in the Gaza Strip
- Over 97% of working-age internet users globally access social networks or messaging platforms monthly
- Platforms like X are increasingly viewed as vectors for disinformation due to the presence of active disinformation actors, fake accounts, and political bots
- While recommendation algorithms predominantly create homogeneous opinion environments, users may increasingly exhibit self-filtering behaviours, amplifying users' political polarization

Relevance

Media literacy and critical thinking are essential for navigating today's complex information landscape. A well-informed and critically engaged public is essential for democratic legitimacy, effective governance, and societal resilience. The risks associated with deepfakes are considerable, e.g. when fake voices or videos are used to spread lies that influence voting behaviour or trust in policymaking. It is uncertain how societies will manage the growing risks of disinformation and manipulation, whether trust in institutions and journalism can be maintained, and how digital technologies will influence public opinion formation and democratic participation.

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1.5 Health and wellbeing

The health status of the population encompasses the overall physical and mental health of individuals within a community, reflecting the effectiveness of healthcare systems, social determinants, and lifestyle choices as well as workforce aspects.

Aspects

- Mental health and psychosocial well-being
- Influence of social relationships, economic stability and access to psychological health resources.
- Lifestyle, nutrition and preventive health care
- Environmental health risks, such as exposure to persistent organic pollutants (POPs), air pollution and noise
- Insurance and pension costs
- The role of ultra-processed food and the impact on health (hidden costs)

Current developments

- Access to healthcare and inequalities remain pressing issues
- Increasing digitalisation of healthcare systems is changing diagnosis and treatment
- There are significant differences in life expectancy between European countries, and the health of young people is also a cause for concern.
- Progress in tackling lifestyle risk factors has stalled, for example in the areas of nutrition and physical inactivity.
- The Mental Health Index shows a decline in the mental health of European workers, with 38% of workers at high risk of mental illness.
- Demographic change is bringing new challenges for the healthcare system.

Relevance

Prioritizing health and well-being is vital for fostering a sustainable and competitive society. It enhances human capital, boosts economic productivity, reduces costs, and contributes to social stability, all of which are crucial for long-term prosperity and resilience. It is uncertain how health systems will cope with ageing populations and chronic diseases and how future crises, environmental pressures, or inequality will impact overall population health.

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2 Technological factors

4.1 Raw materials

Raw materials are unprocessed or minimally processed substances used in manufacturing, encompassing minerals, metals, agricultural products, and chemicals. They are fundamental to producing goods across diverse sectors such as electronics, automotive, construction, and renewable energy.

Aspects

- Physical, economic and political scarcities (access and availability)

- Dependencies on raw materials
- Recycling technologies and circularity
- Environmental and social impact of extraction
- Innovation in material efficiency
- Stockpiling and strategic reserves
- Availability, cost, and quality of material

Current developments

- China has secured long-term contracts for lithium, cobalt, and nickel in Africa and Latin America.
- Export restrictions of CRMs are on the rise.
- Strategic partnerships on critical minerals, such as those between the European Union and the Democratic Republic of Congo, the United Kingdom or Zambia, the U.S. or Japan, are important.
- Metal extraction leads to unrest and protests: mining-related conflicts in Latin America.
- The U.S. secures its supply of (rare) raw materials, especially in response to China's dominance.
- The EU adopted the Critical Raw Materials Act (CRMA).
- Russia is a major producer of synthetic fertilisers.
- New technologies will demand critical materials, and the role of Africa becomes more important.

Relevance

Raw materials play a crucial role in enhancing industrial competitiveness and promoting sustainability. Its scarcity can become a bottleneck for green transition, e.g. renewable energy, for Electrolysers, for batteries, for catalysts. Their efficient and sustainable management directly affects production costs, technological advancements, and the capacity to meet changing regulatory and environmental standards. However, the sector continues to face significant uncertainties due to geopolitical tensions, supply chain disruptions, and rapid shifts in demand, making strategic investments and policy interventions vital for long-term economic stability and environmental stewardship.

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2.2 Advanced materials

Advanced materials have been engineered to exhibit superior properties and functionalities compared to traditional materials. They often incorporate innovative compositions, structures, and processing techniques to meet specific performance requirements across various sectors. These include advances in nanotechnology, composite materials and smart materials that respond to environmental stimuli, as well as improved strength, durability and versatility of use.

Aspects

- Material composition and innovation
- Role of sustainability and circularity
- Resource efficiency
- Research and collaboration

- Application domains
- Energy storage advancements
- Emerging construction materials

Current development

- Production often relies on critical raw materials that are essential to various industries but may be subject to geopolitical factors, resource scarcity or supply chain risks.
- Bio-based chemicals and materials offer alternatives to conventional petroleum-based products (e.g. polymers and composites in packaging, automotive and construction).
- The European advanced materials market was valued at approximately USD 153.8 billion in 2023, with a projected CAGR of 2.7% through 2030, reflecting growing demand for sustainable and high-performance materials.
- Innovations in battery technologies, including AI integration and solid-state batteries, are advancing energy storage solutions critical for electrification and renewable energy.
- New construction materials such as engineered timber, geopolymer concrete, bamboo composites, and waste-based materials are gaining traction for their sustainability and performance benefits.
- EU policy initiatives like the Critical Raw Materials Act and Horizon Europe funding programs are accelerating research, innovation, and supply chain resilience in advanced materials.
- Global circular economy initiatives emphasize eco-design, recyclability, and resource efficiency to minimize environmental impact.
- Global strategic autonomy efforts focus on reducing geopolitical risks by boosting domestic production, recycling, and sustainable sourcing of raw materials.

Relevance

Advanced materials are fundamental to the EU's ambition to lead globally in innovation, sustainability, and strategic autonomy. By enabling higher performance and more sustainable products, they support decarbonisation efforts and reduce environmental impacts across key industries. Their development mitigates supply chain vulnerabilities linked to critical raw materials, enhancing Europe's resilience and security. The development and deployment of advanced materials raise questions about scalability and industrial uptake.

Source
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2.3 Transport technologies

Transport technologies encompass innovations such as autonomous vehicles, drones, and multi-quad computers that transform fleet management, logistics, and passenger mobility across diverse transport modes including road, airspace, rail, and maritime shipping. These technologies are increasingly integrated with transport infrastructure, such as intelligent transport systems (ITS), electrified charging networks, and smart logistics hubs, to enable safer, more efficient, and sustainable mobility.

Aspects

- Autonomous vehicle integration
- Drone applications in logistics and monitoring
- Electrification and hydrogen propulsion
- Cybersecurity and data protection in transport systems
- Modernization of logistics and freight infrastructure
- Cross-modal and multimodal transport integration
- Urban air mobility and aerial transport solutions

Current developments

- NVIDIA leads the autonomous driving market with a valuation exceeding €3 trillion as of February 2025, surpassing Tesla
- The global drone market is projected to grow from USD 35.28 billion in 2024 to USD 67.64 billion by 2029, at a CAGR of 13.9%,
- Over 40% of drone companies are headquartered in Europe, yet 70-80% of the global commercial drone market is dominated by a single Chinese company
- Transport activities in Europe have increased significantly from 1995 to 2022: passenger travel (+24.9%), air travel (+142.5%), car transport (+24.8%), and freight transport (+44.6%).
- Europe's e-mobility transition faces challenges due to high costs and fragmented charging infrastructure, risking competitiveness against China and the U.S
- The EU's February 2025 work program prioritizes rail expansion, cross-border connectivity, and electrification to address regulatory fragmentation and funding gaps, aiming to modernize transport infrastructure.
- Airlines commit to carbon emissions reductions amid rising international arrivals (1.6 billion), with tourism contributing 5-8% of global greenhouse gases, underscoring the need for sustainable transport technologies.

Relevance

Transport technologies are central to achieving sustainability goals and maintaining global competitiveness. By enabling emission reductions through electrification and optimized logistics, these technologies support climate targets and resource efficiency. Integration with modern infrastructures such as ITS and charging network enhances operational efficiency and user experience, fostering economic growth and social connectivity. However, their development and deployment face uncertainties, including the pace of digital and physical infrastructure rollout, public acceptance of autonomous systems and regulatory framework.

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2.4 Infrastructures

Infrastructure refers to the fundamental physical, digital, and organizational frameworks that enable the operation of society and the economy. This includes transportation networks such as rail systems, streets, and harbours; energy infrastructure covering both conventional and renewable energy carriers; digital infrastructure supporting connectivity and innovation; strategic autonomy infrastructure including space and satellite management; and critical utilities like water and agricultural systems.

Aspects

- Transport infrastructure (rail systems, roads, ports)
- Energy infrastructure (renewables, smart grids, storage)
- Digital infrastructure (broadband, data centers, 5G)
- Space and satellite systems (navigation, observation, autonomy)
- Water supply and management systems
- Agricultural infrastructure (irrigation, storage, logistics)
- Waste management and circular economy systems
- Urban infrastructure (smart cities, public services, resilience)

Current developments

- Europe's e-mobility transition is hindered by high costs and fragmented charging infrastructure, risking a loss of competitiveness against China and the U.S., where faster EV adoption is driven by stronger policy support and investment.
- Asian dominance in E-mobility & EV battery production.
- Pressure on EU carmakers to transition from combustion engines.
- Trade disputes over battery material sourcing.
- Europe's e-mobility transition is hindered by high costs and fragmented charging infrastructure, risking a loss of competitiveness against China and the U.S., where faster EV adoption is driven by stronger policy support and investment.
- In Feb 2025 the EU released a work program prioritizing rail expansion, cross-border connectivity, and electrification to overcome regulatory fragmentation, funding gaps, and accelerate modernizing road and freight infrastructure.
- New forms of voluntary, tech-enabled mobility and their implications for taxation, regulation, and brain drain/gain.

Relevance

Infrastructure is a cornerstone of the EU's competitiveness and sustainability agenda. It directly influences innovation capacity by enabling digital transformation and supports decarbonization through renewable energy systems and sustainable transport networks. Strategic autonomy depends on resilient infrastructure in energy, digital services, and space, reducing dependency on external actors. Moreover, infrastructure underpins supply chain resilience and resource management, critical in a globalized economy facing geopolitical and environmental uncertainties.

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2.5 R&D spending and investment

Gross domestic spending on research and development (R&D) encompasses all expenditures by companies, research institutes, universities, and government laboratories within a country or region. These investments are essential for long-term economic growth, enabling organizations to anticipate and adapt to market trends and technological disruptions. Technology policies guide how these advancements serve societal goals while managing associated risks. Public-private partnerships (PPPs) are increasingly important, fostering

collaboration between academia, industry, and government to share costs and risks, accelerate innovation, and develop sustainable technologies.

Aspects

- Technology policy frameworks
- Environmental regulations and sustainability standards
- Public-private partnerships
- Start-up and spin-off support mechanisms
- Innovation culture and capacity building

Current development

- R&D investments continue to grow in OECD countries, reflecting the critical role of innovation in economic growth.
- Geopolitical tensions intensify strategic competition in emerging technologies, influencing R&D priorities and funding.
- The US has a clear dominance when it comes to cleantech VC investment in absolute terms (total Euros), while EU-27 countries combined only manage to compete with China for second place.
- 2023 recorded decline in R&D investments in support of the objectives of health and general advancement of knowledge, which had grown the fastest during the COVID-19 pandemic. In contrast, support for energy and the environment and defence increased.
- Public-private partnerships are increasingly recognized as vital for sharing R&D risks and accelerating sustainable innovation.

Relevance

R&D spending and investment are indispensable for driving innovation that supports both economic competitiveness and sustainability. By fostering technological advancements in clean energy, resource efficiency, and industrial transformation, R&D enables companies and regions to adapt to evolving market demands and regulatory environments. The integration of public-private partnerships enhances the capacity to share risks and pool expertise, accelerating the development and deployment of sustainable technologies.

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2.6 AI and Deep learning

This factor encompasses the future development of AI and related technological capabilities (including generative AI) for individuals, companies, ecosystems, and/or economies. AI offers many opportunities, such as improved healthcare, more efficient energy consumption, and longer-lasting products. However, AI also brings new risks.

Aspects

- Risk assessment
- Energy demand and requirements
- Societal adaptation
- Key players in AIS
- Strength in research & innovation

Current development

- A significant trend in the AI industry is the emergence of cost-effective, open-source models from startups like China's DeepSeek, which are challenging the dominance of major U.S. tech firms by delivering competitive performance at a fraction of the cost.
- Thinking models that go beyond traditional large language models by performing complex, lengthy tasks and summarizing insights, acting as virtual collaborators
- in the future and fundamentally transform the way companies work.
- AI will surpass humans in the development of new AI systems and the execution of most tasks by 2026-27, representing a critical "tipping point" in technological progress.
- Trend toward greater differentiation in models for specialized analyses with fewer parameters and for complementary search queries to reduce hallucinations.
- The global AI market is projected to reach $757.58 billion in 2025, with the U.S. and China leading advancements, while the European Union lags in R&D investment, potentially widening the economic gap.
- Globally, 75% of enterprises now use GenAI tools, marking a significant 36% increase from 2023.
- Research suggests that AI could double economic growth rates by 2035 and increase labour productivity by up to 40%.
- Dependency on non-EU tech supply chains and platforms.

Relevance

AI and deep learning play a pivotal role in advancing sustainability and enhancing competitiveness by optimizing processes, facilitating innovation, and enabling smarter resource management across various sectors.

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2.7 Quantum technology and Deep Tech

A key feature of key technologies is how they're all connected, which is happening more and more with digital platforms and in data rooms, like for building and using big data and applying AI in data analysis. Quantum technology is hyped as future key technology, but it is not yet clear when quantum will move past the research and development (R&D) stage.

Aspects

- Neurotechnology and brain-computer interfaces, biotechnology

- Geoengineering
- Quantum computing to improve efficiency in manufacturing, drug development, model climate change, simulate battery chemistry and nuclear fusion reaction for cleaner energy and optimize the supply chain
- Demand for large research infrastructures and research networks
- Quantum Computing industry & key players: Prominent companies in the quantum computing include IBM, Microsoft, Google, Rigetti Computing, Nvidia. RIKEN, NTT, D-Wave Quantum, QuEra, IonQ, Quantum Computing, SandboxAQ

Current development

- Global deep tech market size anticipated to be worth USD 3,857.1 million by 2034
- Quantum computing market size grows exponentially, from $2.57 billion in 2024 to $3.62 billion in 2025 at a compound annual growth rate (CAGR) of 40.9%.
- Investments in Quantum Computing are continually rising (currently exceeding $44.5 billion)
- Range of countries, led by Germany, the United Kingdom, and South Korea, US, China have announced significant funding for Quantum technology development
- Chemicals, life sciences, finance, and mobility—are likely to see the earliest impact from quantum computing and could gain up to $2 trillion by 2035
- Quantum computing poses significant threats to cybersecurity protocols. Emerging technologies can help mitigate these quantum threats.
- Quantum computing is expected to one day solve complex basic science problems that could lead to a huge reduction in global energy consumption and carbon footprint

Relevance

Deep tech, which encompasses advanced technologies such as artificial intelligence, machine learning, biotechnology, and advanced materials, plays a crucial role in promoting sustainability and enhancing competitiveness.

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2.8 Biotechnology

Biotechnology involves the use of living organisms, cells, and biological systems to develop products and technologies that improve human life and the environment. It combines principles from biology, chemistry, engineering, and computer science to manipulate biological systems for specific applications.

Aspects

- Innovations in bio-based chemicals and materials
- Strategic use of biomass for high-value applications
- Benefits e.g. on food security and climate adaptation

- Medical biotechnology
- Agricultural, food and environmental biotechnology, bioremediation
- Synthetic biology
- Biofuels

Current development

- Innovative and competitive biotech industry in EU
- AI is set to accelerate many biotech innovations and developments
- EU has strong domestic supply of renewable raw materials, such as wood
- Gross value added (GVA) from biotech activities reached €38.1 billion in 2022, nearly doubling since 2008. Industrial biotech is the fastest-growing subsector, with a growth rate of 5.3%, surpassing the EU's overall economy.
- Employment in biotech has grown six times faster than the overall EU economy, with industrial biotech leading at 7.5 times the EU average.
- Main use of biomass in the EU is for food and feed; woody biomass is increasingly used. Most of the EU's biomass supply is produced within the EU.
- Growing gap between biomass demand and supply for bioenergy and bio-based materials is expected for between now and 2050.
- Most EU MS have adopted or are developing national or macro-regional strategies dedicated or related to bioeconomy.

Relevance

Overall, biotechnology is a transformative field with applications across healthcare, agriculture, industry, and environmental management, contributing to advancements in sustainability, productivity, and quality of life.

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2.9 Carbon capture and storage (CCS) / usage (CCU)

Carbon Capture and Storage (CCS) involves capturing carbon dioxide emissions from industrial and power generation sources, transporting the CO2, and securely storing it underground in geological formations to prevent atmospheric release. CCS is essential for decarbonizing hard-to-abate sectors such as cement, steel, and chemicals. It also enables negative emissions when combined with bioenergy (BECCS). Additionally, Power-to-X technologies integrate with Carbon Capture and Utilization (CCU) by converting renewable electricity into chemical energy carriers, enhancing the circular carbon economy.

Aspects

- Capture technologies: chemical absorption (amine solvents), physical separation, membrane technologies, and advanced cycles (e.g., Allam cycle)
- CO2 transport and geological storage, focusing on offshore depleted fields and saline aquifers
- Risks of CO2 storage: leakage, induced seismicity, and long-term monitoring challenges
- Economic potential of captured CO2 utilization in synthetic fuels, chemicals, and enhanced oil recovery

- Environmental impact: net reduction of greenhouse gas emissions, lifecycle energy use considerations
- Integration with Power-to-X technologies for renewable energy conversion and CCU processes

Current developments

- Also found in emerging issue 10 (2024): geoengineering the global climate
- The European CCS market was valued at USD 1.2 billion in 2024, with a projected CAGR of 24% through 2034, potentially reaching over USD 10 billion [[Computing]]
- The EU Innovation Fund allocated approximately USD 1.5 billion to CCUS projects in its latest funding round, accelerating deployment [[Research]]
- Global CO2 capture capacity is on track to double to over 100 million tonnes per year by 2034, driven by advancements in capture and storage technologies [[Computing]]
- Technological progress includes improved amine solvents, innovative membrane materials (e.g., MOFs), chemical and calcium looping, and the implementation of the Allam cycle in clean energy plants [[Research]]
- North Sea storage projects in Denmark (Project Greensand), the Netherlands, and Norway (Sleipner, Northern Lights) are leading large-scale, cross-border CO2 storage initiatives [[Research]]
- Power-to-X technologies are increasingly integrated with CCU, enabling renewable hydrogen and synthetic fuel production from captured CO2

Relevance

CCS is a cornerstone of the EU's decarbonization strategy, crucial for achieving the European Green Deal's target of a 55% reduction in greenhouse gas emissions by 2030 and climate neutrality by 2050. It enables continued industrial activity while drastically reducing emissions, thus preserving economic competitiveness in energy-intensive sectors. The rapid market growth and substantial EU funding reflect CCS's strategic importance. However, uncertainties remain regarding public acceptance, long-term storage safety, and high costs.

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2.10 Space Technologies and Service

Space technologies encompass satellite infrastructure, launch systems, space exploration, and the commercialization of space economy, providing critical services such as telecommunications, Earth observation, navigation, disaster management, and scientific research. These technologies are increasingly integrated with artificial intelligence and miniaturized satellite constellations to enhance global connectivity and data services.

Aspects

- Satellite-based infrastructure ensuring EU strategic autonomy and security
- Space data applications for environmental monitoring, climate action, and sustainability
- Integration with the EU's three pillars of competitiveness: innovation, decarbonisation, and security
- Launch systems and accessibility improvements, including reusable rockets and commercial spaceports

- Space exploration missions and commercialization driving the expanding space economy
- Earth observation capabilities supporting agriculture, forestry, biodiversity, and resource management
- Governance, regulation, space debris management, and international collaboration frameworks

Current development

- Space technologies are integral to modern society, enhancing services like telecommunication, Earth observation, navigation, disaster management, environmental monitoring, and scientific research. Trends highlight the increasing integration of AI, miniaturization of satellites, and development of mega-constellations to enhance connectivity and data services.
- As of 2024, there are more than 14,000 satellites orbiting Earth, with over 10,400 still operational. More than 93% of these active satellites are in Low Earth Orbit (LEO). Major satellite networks (called mega-constellations), primarily launched by the United States, China, and Europe, are significantly boosting global satellite-based internet and communications services. This rapid growth will result in over 480 launches per year and support a total of over 43,000 active satellites by 2032
- The amount of space debris is steadily increasing, with over 35,000 tracked objects larger than 10 cm and an estimated over 1 million objects larger than 1 cm, posing significant risks to active satellites.
- The Global Earth Observation market project to exceed 8 Billion Dollars by 2033, driven by advancements in high resolution imaging and 3D capabilities

Relevance

Space technologies and services are critical enablers of the EU's competitiveness and sustainability ambitions. They drive innovation by advancing technological capabilities and research and development, underpinning the EU's leadership in space and related industries. Strategic autonomy is reinforced through secure satellite infrastructure and surveillance capabilities, reducing dependency on non-EU actors. However, uncertainties remain around space debris management, geopolitical competition in space, and the pace of technological integration, which require continued governance and innovation efforts to safeguard long-term benefits.

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2.11 Cyberphysical Systems - Digitalization

Cyberphysical systems (CPS) are the convergence of physical processes and digital mechanics, enabled by technologies such as the Internet of Things (IoT), RFID, embedded systems, and advanced communication networks like 5G. These systems create a symbiotic relationship where physical mechanisms are monitored, controlled, and optimised through computational algorithms and real-time data exchange.

Aspects

- Convergence of physical processes and digital mechanics as symbiotic integration
- 5G and beyond communication technologies contribute significantly to CPS by enabling ultra-fast networking with low latency, better control and monitoring of physical processes

- Components of CPS include RFID and IoT, embedded systems, WLAN and sensor technology, satellite networks, mobile networks, and the Internet.
- Increase in data spaces, which enable data to be shared while maintaining data sovereignty by providing the necessary data infrastructure (examples include Catena-X and Manufacturing-X)
- Size & structure of the European IT industry (compared to other regions)
- Adoption in business & industry
- Digital infrastructure and platform economy
- R&D and innovation dynamics
- Advanced Manufacturing and Industry 5.0
- E-Government & IT adoption in public administrations
- Regulatory, investment & governance framework
- Digital transformation changes the way people participate, focus their capacities and resources

2.11.1 Current development

- EU lagging behind in innovation and advanced technologies
- Dependencies on foreign technology providers and platforms
- Europe's IT services market is expected to grow steadily at an annual rate of 5.43% between 2025 and 2029, yet it still trails behind the U.S. and China
- Europe's Industry 4.0 becomes Industry 5.0 - 4.0 was just digital, 5.0 is also sustainable, human-centred and resilient, how the new directive of the EC shows
- Cyber Frauds /Cyberattacks are increasing

Relevance

Cyberphysical systems enhance industrial competitiveness by enabling smarter, more efficient, and innovative production processes. Their integration supports new business models that leverage data-driven insights and digital transformation, aligning with the European Union's goals for a sustainable and resilient industrial ecosystem. Rising cybersecurity threats pose significant risks to CPS reliability and data integrity.

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2.12 Robotisation and Automation

Robotization and automation refer to the growing integration of autonomous physical robots and software automation systems, often enhanced by artificial intelligence (AI), across industries, services, and households.

Aspects

- Rapid progress in AI integration enhances robot autonomy and adaptability, expanding applications from industrial to household settings.
- Automation boosts efficiency, reduces costs, and addresses labor shortages, significantly contributing to economic growth.
- Automation transforms job roles, creating demand for high-skilled workers while automating repetitive tasks.

- User-friendly and relatable robot designs, such as Apple's cartoon-inspired assistant robot, are key to widespread adoption.
- Ethics, Safety & Governance
- Cybersecurity & Risks
- Environmental & Social Impact
- Geopolitical leadership in robotization is crucial for maintaining strategic autonomy and global industrial competitiveness.

Current development

- In ten years, robots could take over a large part of our daily household chores.
- Apple has developed a new approach to increasing acceptance of robots in the home by taking inspiration from cartoon characters and creating an assistant robot in the form of a lamp.
- Robotics systems are incorporating AI to enhance Autonomy and Adaptability. Google DeepMind has Introduced AI models like Gemini Robotics and Gemini Robotics – ER, making robots to perform complex tasks such as folding Origami and organising workspaces.
- Logistics companies are using Humanoid Robots to streamline warehouse operations. For Instance, GXO Logistics has been testing Robots from Digit, Reflex and Apollo in various warehouse tasks.
- Industrial automation is expanding rapidly, with companies like Ocado and Unilever using AI-powered robotic systems to streamline processes and boost productivity.
- Educational and training programs are evolving to equip workers with skills necessary for managing and collaborating with automated systems.
- Cybersecurity frameworks are being developed to safeguard increasingly interconnected and AI-driven automation systems from cyber threats.

Relevance

Robotization and automation are central to the EU's ambition to enhance its global competitiveness and achieve sustainable economic growth. By driving productivity improvements and innovation, these technologies help address critical challenges such as labor shortages and demographic shifts. Their integration supports the EU's strategic autonomy by reducing dependency on external technology providers and securing industrial sovereignty. However, the pace of technological change introduces uncertainties related to workforce adaptation, ethical governance, social acceptance, and cybersecurity risks.

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2.13 Electrification & Energy System

Electrification and energy system transformation are central factors for the economy and wellbeing. The shift from nuclear and fossil energy carriers requires effective grid infrastructure to accommodate rising electricity demand and the integration of renewable energy sources. Energy storage and system flexibility are critical to balancing supply and demand amid variable renewables.

Aspects

- Transitioning transportation, industry, and residential uses to electricity to reduce carbon emissions leading to increased energy demand

- Upgrading and expanding electricity grids to handle increased loads and renewable integration.
- Energy Storage & Flexibility Solutions
- Electricity vs. Alternative Energy Carriers: Coordinating electricity use with hydrogen, battery systems and other carriers for a resilient energy mix.
- Cybersecurity & Infrastructure Resilience
- Economic Costs & Infrastructure Investments
- Environmental & Social Impacts: social equity and just transition principles.
- Shifts in global dependencies and power structures. (Future) role of oil-producing countries.
- Impacts on global emission trading.

Current development

- Global electricity demand increased by 4.0% in 2024, exceeding 30,000 TWh for the first time, expected to continue growing at an average rate of 3.4% annually through 2026
- Data centres expected to account for up to 5% of total European power consumption by 2030
- Slower than expected adoption of EVs and heat pumps in Europe
- European grid modernization market expected to reach USD 39,393.23 million by 2032
- Growing focus on Hybrid Energy Storage Systems (HESS)
- Global infrastructure gap of 2.08 million kilometres in grid infrastructure projected by 2050
- Electricity projected to account for 60% of final energy consumption by 2050 in Europe
- Implementation of EU Grid Policy Framework with over 80 action points
- Risk of reduced competitiveness due to high electricity costs in Europe

Relevance

The electrification and energy system transformation is critical for Europe's ability to maintain industrial competitiveness while achieving ambitious sustainability targets. Electrification drives innovation by fostering new technologies and business models in energy systems, enabling deep decarbonization aligned with climate goals. Strategic autonomy in energy supply enhances resilience against geopolitical risks and supply disruptions, which is vital for economic stability. However, the transition faces uncertainties including high electricity costs, infrastructure investment needs, and cybersecurity threats,

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2.14 Standardisation

Standardization is the process of establishing uniform technical specifications, criteria, and regulatory frameworks across industries and regions to ensure interoperability, safety, and quality. It encompasses a wide range of domains, from consumer electronics (e.g., USB-C charging cables) to advanced communication technologies (e.g., 5G and 6G networks) and environmental management standards.

Aspects

- Technical Standards: Includes USB-C charging, wireless charging (Qi2), 5G/6G communication protocols, IoT interoperability standards, and environmental management standards (e.g., ISO 14001).
- Institutional Framework: Involves global organizations such as ISO, ITU, IEEE, national standards bodies, industry consortiums, and regional standardization entities.
- Power Dynamics: Contrasts government-led approaches (notably China's centralized strategy) with market-driven models (common in Western countries), highlighting the role of economic and political influence in standard-setting. Standardization is a tool for economic and strategic influence
- Standards increasingly incorporate sustainability criteria, driving decarbonization, resource efficiency, and circular economy practices. Harmonized standards reduce fragmentation, enhance interoperability, lower costs, and improve consumer convenience.
- Innovation and Strategic Autonomy: Standards influence technological development trajectories and help regions secure control over critical technologies and supply chains.

Current development

- China is aggressively pursuing leadership in global standardization through its "China Standards 2035" initiative, focusing on emerging technologies like 5G, 6G, AI, and IoT, with strong government coordination and international promotion leading to competition between Western market-driven and Chinese government-led standardization
- The EU's USB-C mandate exemplifies regional standardization efforts that have global ripple effects, compelling multinational companies to adopt common charging interfaces to access the European market.
- Environmental and sustainability standards are gaining prominence, with updates to ISO standards (e.g., ISO 14001, ISO 20121) and EU regulations (e.g., Ecodesign for Sustainable Products Regulation) emphasizing climate goals and circularity.
- International bodies like ISO, ITU, and IEEE remain central to standard-setting but face challenges balancing transparency, inclusivity, and geopolitical pressures.

Relevance

Standardization is a cornerstone of global competitiveness and sustainability. By defining common technical and regulatory frameworks, standards enable interoperability, reduce market fragmentation, and lower costs for manufacturers and consumers. For the EU and other regions, active participation in standard-setting is vital to maintain technological leadership, secure strategic autonomy, and foster innovation ecosystems. However, the evolving geopolitical landscape introduces uncertainty, as competing standardization models—government-led versus market-driven—may fragment global markets or create parallel ecosystems. This competition influences access to critical technologies, supply chain resilience, and the global diffusion of sustainable practices.

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3 Economic factors

3.1 Global Economic Development

Global economic development encompasses the dynamic patterns of worldwide economic growth, structural transformations, and the complex interdependencies between regions and nations. It integrates the strategic and operational frameworks of business and management with the economic and financial policies that underpin investment, innovation, and stability. This factor reflects the evolution of global trade regimes, technological leadership, and financial systems, alongside challenges such as rising debt, income inequality, and geopolitical risks.

Aspects

- Worldwide economic growth patterns and structural changes shaping global markets and regional interdependencies
- Economic model: market driven vs. state driven, role of multinational companies and role of 1% of the richest persons
- Role of global oligopolistic structures
- Strategic business and management practices and role of CSR, ESG and due diligence mechanisms
- Technological and industrial leadership in AI, cloud computing, green energy, and digital infrastructure
- Trade regimes, foreign direct investment (FDI) flows, and risks of economic decoupling and regionalization
- Socioeconomic challenges such as income and wealth inequality, sovereign and corporate debt risks, and informal economies

Current developments

- Global economic output has grown approximately 35-fold since the early 20th century and is projected to double again by 2050, with Asia remaining a key growth driver despite China's slowdown. Advanced economies face stagnation and high debt burdens
- The U.S. leads in AI, cloud computing, and financial markets, while China advances in IT infrastructure and tech self-sufficiency; the EU is increasing strategic technology investments but faces funding and regulatory challenges limiting scale
- Rising income and wealth disparities, sovereign and corporate debt risks, and the informal economy's role in developing regions pose systemic risks to global stability
- Emerging digital currencies and blockchain-based financial systems, alongside geopolitical tensions and climate-related shocks, add layers of uncertainty to economic development trajectories

3.1.1 Relevance

Global economic development is critically relevant for the EU's competitiveness and sustainability as it shapes the external environment in which European industries and markets operate. The factor influences the EU's capacity to innovate, attract investment, and maintain leadership in strategic sectors such as green technologies and digital infrastructure.

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3.2 Structure of EU economy[6]

The structure of the EU economy is a multifaceted system balancing diverse sectors, regional disparities, innovation ecosystems, and resilience frameworks.

Aspects

- Development of Key Industries and Sectors: The EU economy is characterized by a mix of manufacturing, services, digital, and knowledge-based sectors.
- Significant economic disparities exist between and within member states, with wealthier regions like Germany and France contrasting with less developed areas. Cohesion policies aim to reduce these gaps and promote balanced regional growth.
- Industrial Diversification, Specialization, and Global Integration: The degree of industrial diversification and specialization varies across the EU, influencing resilience and adaptability.
- Integration into global value chains and economic interdependencies is vital for trade and competitiveness.
- Economic Resilience and Risk Management:
- Military spending also impacts economic resource allocation and security considerations.
- SMEs and startups are crucial innovation drivers and employment creators.
- Stability and resilience of financial markets, regulatory frameworks, and economic governance structures

Current developments

- Strategic autonomy is increasingly emphasized in key industrial sectors to reduce dependencies and enhance resilience.
- Post-pandemic, the EU has strengthened economic crisis response mechanisms, including the Single Market Emergency Instrument.
- Sustainable finance initiatives and green investments are growing rapidly, supporting the transition to a low-carbon economy.
- Venture capital markets are expanding, with increased focus on funding innovative SMEs and startups, particularly in digital and green sectors.
- Cohesion policies continue to target regional disparities, investing in infrastructure, innovation, and human capital in less developed regions.

Relevance

The structure of the EU economy is fundamental to its ability to compete globally while achieving sustainable development. By balancing diverse economic sectors and addressing regional disparities, the EU fosters inclusive growth and social cohesion. Its resilience frameworks and financial institutions enable effective management of economic shocks, ensuring stability in uncertain times. Innovation ecosystems, particularly the role of SMEs and startups, drive productivity and technological advancement, critical for maintaining competitiveness.

Sources
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[6] While this factor is key for shaping sustainability and competitiveness that will be addressed in more detail in after the scenario process, the dynamics are currently so high, to consider it already now, as there might be lock in effects or path dependencies.

3.3 Consumption patterns

Consumption patterns in Europe and elsewhere refer to the habits, preferences, and behaviours of individuals and households in acquiring and using goods and services, shaped by cultural, economic, and environmental factors. These patterns encompass shifts toward digital and sustainable consumption, differences across age groups and regions, and the impact of infrastructure, policy, and climate awareness on consumer choices.

Aspects

- Development of global consumption
- Comparison global consumption development vs. European consumption development
- Shift of global consumption preferences (across countries & within Europe e.g. food, ICT, etc.)
- Consumption infrastructure (stationary vs E-commerce, payment, delivery)
- Role of sustainable consumption
- Influences on consumption e.g. norms, culture, demographic change
- Climate and resource impact of consumption
- Waste generation and post-consumption patterns
- Consumer access and inclusion
- Level of affluence and income discrepancies; access to markets.
- Quality and standards of the products.

Current developments

- While some emerging economies continue to experience consumption growth, others—such as China—struggle with low consumption levels. In Europe and industrialized nations, preferences are shifting towards experience-based and sustainable consumption.
- E-commerce continues to outpace traditional retail, with mobile payments, subscription models, and instant delivery becoming standard. The shift towards cashless transactions and AI-driven personalization is transforming consumer experiences.
- While demand for eco-friendly products is rising, economic uncertainties make affordability a key factor in sustainable choices. Governments and corporations are pushing for greener supply chains and circular economy models, but large-scale adoption remains uneven across regions and income groups.
- Age structure, household size, education, and income distribution significantly impact consumption trends globally. Older populations, in particular, contribute to higher emissions and are less willing to change their consumption behaviors.

Relevance

Consumption patterns influence both companies and policymakers to adapt to evolving consumer needs and to drive innovation aligned with specific preferences. As consumer demand increases, so does economic growth, making consumption a key driver of competitiveness. Current patterns are shaped by major trends such as digitalization, environmentally conscious consumption, and, in some cases, hyper-consumption. The more effectively European industries respond to these shifts, the stronger their position in global markets. However, consumer behavior across Europe is far from uniform—it varies significantly by country, region, social group, income level, and personal preferences.

Sources

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3.4 Global Price Levels and Inflation

Global price levels and inflation refer to the general rise in prices of goods and services over time, influenced by factors such as energy costs, raw materials, and currency volatility. In Europe, inflation trends and price levels are shaped by production costs, carbon pricing, labour, regulatory burdens, and the region's specific market structures.

Aspects

- Price development in Europe compared to other countries, here as price level, production costs, cost competitiveness
- Price drivers e.g. energy, raw materials, supply chain costs, carbon pricing, labour, regulation etc.
- Inflation
- Insurance and risk pricing
- Pricing power and market concentration
- Currency volatility and exchange rates
- Technology costs
- Stock markets and financial regulation / role of world banks and regional markets

Current developments

- European industries, particularly those that are energy-intensive, face higher production costs compared to global competitors, primarily due to elevated energy prices and regulatory expenses. This disparity challenges Europe's cost competitiveness, especially in sectors like chemicals, steel, and aluminum production.
- While inflation in the euro area has decreased to near the European Central Bank's target of 2%, manufacturing sectors continue to grapple with high energy costs. Additionally, rising labor expenses and regulatory burdens contribute to sustained production costs. Relevance
- The insurance industry is experiencing increased premiums due to heightened climate risks, cyber threats, and geopolitical instability. These factors are reshaping risk assessments and pricing strategies within the sector.
- Dominant entities, such as OPEC+ and major rare earth suppliers, exert significant influence over global prices and supply chains. For instance, China's control over approximately 69% of rare earth production impacts global value chains and pricing dynamics.
- As of April 2025, the U.S. dollar has weakened by nearly 10% since January due to new tariffs and rising inflation concerns. This volatility impacts trade and investment, prompting companies to extend currency hedging to manage financial risk.

Relevance

Europe's price levels are crucial to its global competitiveness, as higher production costs can undermine its ability to compete with lower-cost regions. This affects exports, investment attractiveness, and industrial resilience.

Sources

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3.5 European Single Market (inner-European Trade)

The Single Market in Europe constitutes the integrated economic space within the European Union, enabling the free movement of goods, services, capital, and people. It encompasses internal trade dynamics and external trade relationships, supported by physical, digital, and financial infrastructures. This factor addresses a broad spectrum of aspects including inner-European trade volumes, trade alliances, global tariffs, and trade governance. It also incorporates strategic autonomy concerns such as energy self-sufficiency, supply chain resilience, and technological independence.

Aspects

- Inner-European trade volumes, trade alliances and agreements, global tariffs, trade barriers, and institutional reforms ensuring market efficiency and cohesion.
- Strategic Autonomy and Security: Energy self-sufficiency, reduced dependence on critical raw materials, supply chain resilience
- Trade Flows and Innovation: Movement of manufactured goods, information, natural resources, agriculture, services, R&D, finance, patents, and intellectual property rights.
- Implementation of CBAM, ETS coordination with third countries, and adherence to stringent environmental and sustainability standards.
- Digital and Technological Sovereignty: Development of digital infrastructure, technological independence, cybersecurity, and digitalisation autonomy.
- Financial Infrastructure Autonomy: European payment systems and financial networks reducing reliance on external providers and enhancing economic sovereignty.

Current developments

- The Carbon Border Adjustment Mechanism (CBAM) is in its transitional phase, requiring importers to report carbon emissions, with full implementation expected by 2026.
- The EU is advancing digital sovereignty through legislative frameworks alongside initiatives like Gaia-X for sovereign cloud infrastructure.
- The development of autonomous European payment systems and financial infrastructure is underway to reduce dependency on non-EU financial networks.
- Strengthening of supply chain resilience measures is ongoing, driven by recent global disruptions and geopolitical tensions.
- Increased focus on energy self-sufficiency through investments in renewable energy and diversification of energy sources.
- Enhanced military spending and defence cooperation aim to bolster strategic autonomy and economic security.

Relevance

The Single Market in Europe is pivotal for the EU's economic competitiveness and sustainability ambitions. By facilitating seamless trade and innovation across member states, it drives productivity growth and industrial transformation. Its strategic autonomy components reduce vulnerabilities related to energy, raw materials, and technology dependencies, thereby enhancing resilience against external shocks. The integration of green trade policies like CBAM ensures that economic growth aligns with climate goals, preventing carbon leakage and fostering global environmental standards.

Sources

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3.6 Investment and Financing Europe

Investment and financing in Europe refer to the structures, mechanisms, and conditions through which public and private capital is mobilized, allocated, and regulated across sectors and regions. Key influencing factors include public budgets, financial institutions, regulatory frameworks, private capital sources, cost structures, fiscal policies, technological developments, and market dynamics.

Aspects

- Public Budget Development
- Role of Financial Institutions
- Regulatory and Disclosure Requirements
- Availability and Sources of Private Capital
- Cost Structures and Production Conditions
- Fiscal Policy and Tax Incentives
- Technological Developments in Finance
- Market Structures and Capital Allocation

Current development

- The EU's 2025 budget increased by 1.78%, prioritizing innovation, disaster management, and cohesion projects.
- The European Investment Bank (EIB) now allocates over 50% of its financing to climate and environmental sustainability projects.
- Europe's venture capital sector faces structural fundraising challenges, particularly due to a lack of domestic limited partners (LPs).
- Green transition demands substantial infrastructure investment, increasing pressure on production costs and requiring new financing models.
- Investment is increasingly directed toward AI and industrial automation, particularly in B2B applications.
- The InvestEU Programme, backed by a €26.2 billion EU guarantee, plays a central role in channelling capital into public-private partnerships.

Relevance

Investment and finance in Europe are key to shaping the continent's future competitiveness by enabling innovation, green transformation and technological leadership. Strategic allocation of capital - through public finance, private investment and supportive regulatory frameworks - drives productivity, industrial modernisation and resilience in global markets. As global competition intensifies, Europe's ability to attract and deploy investment efficiently will determine its ability to lead in sectors such as AI, clean tech and sustainable infrastructure.

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3.7 Global Trade and Supply Chains

Global trade and supply chains encompass the complex networks and systems through which goods, services, data, and intellectual property move across borders. This factor reflects the dynamic interplay of geopolitical realignments, technological advancements such as AI and digital trade corridors, and the role of sustainability demands.

Aspects

- Trade Structure and Geography: Shifts in global trade routes and supply chain configurations
- Vulnerabilities in transport, digital networks, finance, and health infrastructure against geopolitical tensions, cyber threats, and natural disasters.
- Integration of AI, digital trade corridors, and advanced logistics to enhance efficiency, transparency, and adaptability of supply chains.
- Role of green trade standards, CBAM, ETS, waste management, and circular economy principles
- Trade Governance and Institutional Reform.
- Intellectual Property and Intangible Assets
- Role of Global South

Current developments

- The WTO faces pressure for reform or replacement by plurilateral and translateral trade frameworks to better address contemporary trade challenges.
- China's Belt and Road Initiative continue to expand infrastructure connectivity, reshaping trade flows but raising geopolitical and debt sustainability concerns.
- Digital trade corridors and AI-driven logistics are becoming mainstream, enabling real-time supply chain visibility and predictive risk management.
- Sustainability measures like the EU's CBAM and ETS are influencing global trade policies, pushing companies to adopt greener practices.
- Supply chain resilience is prioritized through diversification, nearshoring, and enhanced cybersecurity to counteract disruptions from geopolitical conflicts and pandemics.
- The rise of intangible assets in trade necessitates stronger IP protection and new regulatory approaches to safeguard innovation and competitiveness.
- More developing countries and emerging economies are seeking to maintain stations of the value chain in their region.
- The U.S. has adopted an "America First" trade policy, imposing 25% tariffs on imports from Canada and Mexico, and 10% on Chinese goods, aiming to reduce dependence on foreign products. The EU is reassessing its trade relationship.
- Trends toward regional blocs, friendshoring, or decoupling (e.g. US–China, EU–Russia), and their impact on trade flows and dependencies.

Relevance

Global trade and supply chains are foundational to economic growth, innovation, and the delivery of goods and services worldwide. Their evolving nature presents both opportunities and uncertainties for competitiveness and sustainability. On one hand, technological advancements and new trade corridors can

unlock efficiency gains and market access. On the other, geopolitical fragmentation, rising protectionism, and environmental imperatives challenge the stability and inclusiveness of trade systems.

Sources

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3.8 Attitude of Businesses towards sustainability

The attitude of businesses towards sustainability reflects their evolving commitment to integrating environmental, social, and governance (ESG) principles into core operations. Initially motivated by regulatory compliance and reputational concerns, sustainability has become a fundamental strategic priority for many companies. This transformation is propelled by increasing consumer demand for responsible products, investor pressure emphasizing ESG performance, and recognition of sustainability's long-term benefits such as cost savings, innovation, and risk mitigation.

Aspects

- Embedding sustainability into core business strategies and setting ambitious goals aligned with global frameworks (e.g., SDGs, net-zero targets). Or do the contrary as USP.
- Regulatory Compliance: Adhering to evolving laws and directives such as the EU Corporate Sustainability Reporting Directive (CSRD).
- Consumer preferences for sustainable and ethically produced goods and services.
- Incorporating ESG criteria into investment decisions and sustainability-linked financing.
- Role of transparency and Reporting schemes
- Role of oligopolistic and other power structures influencing sustainability criteria

Current developments

- In April 2025, the European Parliament voted to delay the implementation of certain business actors' attitudes towards sustainability reporting rules, providing time to renegotiate exemptions, particularly those that are shifting.
- Companies increasingly embrace ESG initiatives and sustainability embedded in business strategies as a competitive advantage.
- More consumers are factoring a product's sustainability attributes into their purchasing behaviour, and 73% of global consumers say they're willing to change their consumption habits to reduce their environmental impact.
- Companies are increasingly implementing strategies beyond sustainability, focusing on actively restoring natural ecosystems and social systems.
- There are reports of a retreat from climate-related investments by asset managers, driven by shifting political landscapes - several European asset managers had said they had received letters from US Republican states threatening legal challenges to their focus on ESG issues, including any potential exclusion of fossil-fuel investments.

Relevance

The evolving attitude of businesses towards sustainability is critical for maintaining and enhancing competitiveness in today's market. Companies that proactively integrate sustainability into their strategies

might unlock innovation, reduce operational costs through efficiency gains, and strengthen brand loyalty among increasingly conscious consumers. Moreover, robust sustainability practices improve access to capital by attracting ESG-focused investors and mitigating regulatory risks. However, current “economy–first” attitudes might undermine the reporting schemes.

The complexity of sustainability reporting, supply chain management, and balancing short-term costs with long-term benefits presents ongoing challenges.

Sources

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Sustainability and due diligence: MEPs agree to delay application of new rules | News | European Parliament

3.9 Work and Employment

The factor "Work and Employment" encompasses the dynamic interactions between workforce characteristics, labor market conditions, and evolving employment practices, including education and skills. It also reflects the nature of work, which is increasingly influenced by technological advancements such as AI and automation, shifting workforce demographics, and new organizational models like remote and hybrid work.

Aspects

- Technological Impact: Automation, AI, digital transformation, and their effects on job creation, displacement, and task automation and skill building.
- Skills and Education Alignment: Continuous vocational training, upskilling, reskilling, and integration of work-based learning models to meet evolving job requirements.
- Work Models and Organizational Practices: Remote, hybrid work, workplace culture, employee experience, and flexible work arrangements.
- Workforce Demographics and Diversity: Aging populations, gender employment gaps, inclusion, and diversity policies.
- Employee Well-being: Mental health, work-life balance, and supportive workplace initiatives.
- Economic and Policy Context: Labor market regulations, active labour market policies, and social safety nets.

Current developments

- Several European countries are experimenting with four-day work weeks. Belgium became the first country in Europe to legislate for a four-day week. The emergence of generative AI tools, with their potential to support worktime reduction strategies, are also refuelling interest in a shorter working week
- The European Union is investing €1.3 billion in artificial intelligence, cybersecurity, and digital skills as part of the Digital Europe Programme for 2025 to 2027 to equip the workforce with necessary competencies to adapt to increasing automation and digital transformation.
- The European Training Foundation reports that NEET (Not in Employment, Education or Training) rates remain above the EU average in many ETF partner countries, and disadvantaged young people often struggle to access equitable learning opportunities.

- Skill gaps in the labour market are the primary barrier to business transformation perceived by Future of Jobs Survey respondents for the 2025- 2030 period, cited by 63% of surveyed employers. Globally, the Future of Jobs Survey finds increased emphasis by employers on diversity, equity and inclusion in the workplace, connected to a growing perception of its potential to increase talent availability.
- Demand for employees with 'green' skills is surging, in Europe rose by an average of 5% annually from 2021 to 2024. Supply will continue to lag demand, with a gap of 18.7% by 2030.

Relevance

Work and Employment is a cornerstone factor for national and organizational competitiveness, as the quality, adaptability, and inclusiveness of the workforce directly influence productivity, innovation, and economic resilience. The rapid pace of technological change and shifting societal expectations create uncertainty, requiring agile responses in skills development, labour policies, and organizational culture.

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4 Environmental factors

4.1 Global pollution

Global pollution refers to the widespread contamination of air, water, soil, and ecosystems that transcends national borders, driven by industrial activities, trade, waste management practices, and emerging technologies.

Aspects

- Transboundary pollution flows via air, water, and trade routes, spreading contaminants beyond borders.
- Pollution-intensive trade patterns and industrial relocation that shift environmental burdens
- Global waste redistribution, including plastic and microplastic pollution, often impacting less regulated regions.
- Persistent organic pollutants (POPs), soil degradation, and cumulative legacy pollution
- Uneven regulatory capacity and enforcement across countries, leading to environmental dumping and governance challenges.
- Emerging pollution risks from new technologies and demographic shifts influencing pollution dynamics.
- the role of insurance, cost, responsibilities, precautionary and polluter pays principle.
- Pollution and loss of water due to industrial agricultural production
- Bio-contamination (genetically modified organisms)

Current developments

- Relocation of high-emission industries to regions with weaker climate regulations.
- Global redistribution of waste to developing nations with lax environmental policies.
- Cross-border effects of agrochemical runoff (e.g., fertilizer-induced dead zones).
- E-waste, battery disposal, AI/data centre emissions, and the environmental footprint of digital infrastructure.

- Long-term build-up of pollutants (e.g. heavy metals, PFAS, radioactive waste) with persistent global health and ecological effects.
- Driven by overuse of agrochemicals, mining, landfills, and industrial waste, affecting global food security and biodiversity

Relevance

Global pollution is a critical factor influencing the European Union's competitiveness and sustainability trajectory. Pollution flows and trade patterns can undermine the EU's environmental standards and economic goals by externalising environmental costs to less-regulated regions, risking reputational damage and supply chain vulnerabilities. Additionally, crossing tipping points and irreversible loss of ecosystem services has enormous potential to affect strategic autonomy and self-sufficiency aims of the EU.

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4.2 Biodiversity and Ecosystems

Biodiversity and ecosystems encompass the variety of life forms and their complex interactions within natural habitats, providing vital services such as pollination, water purification, climate regulation, and soil fertility.

Aspects

- State of Biodiversity & Ecosystem Health: Rapid global decline in species populations and ecosystem integrity, with significant habitat degradation and species extinction rates far exceeding natural background levels.
- Habitat destruction (agriculture, urbanization), climate change, pollution, overexploitation of resources, invasive species.
- Ecosystem services underpin over $50 trillion of global GDP
- Link of Climate Change and Biodiversity loss
- Nature-Based Solutions & Restoration
- Role of agroecology,
- Balance protected and "usable" areas
- Governance, Policy & International Agreements
- Capacities of Productive Soils / Loss of Productive Areas: Soil degradation and desertification threaten agricultural productivity and ecosystem functions, requiring sustainable soil management and land restoration.
- Tipping Points and Irreversible Ecosystem Changes:
- Biopatents and Commercialisation

Current development

- EU countries are not on track to hit the EU's targets to halt the degradation of ecosystems and their restoration by 2030
- Progress has been made in promoting organic farming, protecting pollinators and reducing pesticide use, however there is weakening by the Common Agricultural Policy.
- Th Biodiversity Strategy's commitments to restoring nature in agricultural areas are far from being achieved.

- Marine ecosystems in Europe are also deteriorating, with 93% of seas impacted by human activities such as overfishing and pollution.
- Nature-based solutions are increasingly recognized as essential for addressing both the climate and biodiversity crises.
- Desertification is intensifying worldwide, with an average of 12 million hectares of land lost each year due to desertification and drought.

4.2.1 Relevance

Biodiversity and ecosystems are indispensable for sustaining economic activities and human well-being, making them critical to competitiveness and sustainability. The degradation of natural systems threatens supply chains, agricultural productivity, and resilience to climate impacts, potentially undermining long-term economic growth and social stability. Uncertainties remain regarding the pace of biodiversity loss, tipping points, and the effectiveness of policy measures, necessitating adaptive governance and integrated approaches.

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4.3 Vulnerability to climate change

Vulnerability to climate change is the degree to which systems—ranging from ecosystems and infrastructure to communities and industries—are susceptible to harm from climate-related hazards such as heatwaves, droughts, floods, and storms. It reflects both exposure to climate impacts and the capacity to adapt or cope with these changes.

Aspects

- Exposure to climate hazards such as extreme heat, drought, flooding, and wildfires.
- Sensitivity of natural ecosystems, agriculture, infrastructure, and human health to climate impacts.
- Adaptive capacity, including socioeconomic resilience, governance, and technological readiness.
- Regional disparities in vulnerability, with southern Europe facing higher risks of drought and wildfires, and northern Europe more prone to flooding.
- Interdependencies between climate, biodiversity, and economic sectors like energy, agriculture, and industry.
- Social vulnerability factors, including age, income, and health status, which affect the ability to cope with climate stress.

Current development

- Europe experienced its warmest year on record in 2024, intensifying extreme weather events such as heatwaves, floods, and droughts
- The European Climate Risk Assessment (EUCRA) identifies 36 critical climate risks threatening energy, food security, infrastructure, and public health, many already at critical levels
- New vulnerability indicators incorporate socioeconomic and demographic data to better target adaptation efforts, such as the EU Joint Research Centre's Atlas of Demography
- Economic sectors like agriculture, forestry, and industry face increasing risks from climate impacts, threatening productivity, supply chains, and energy security

- Extreme weather events result in the disruption or destruction of communication and supply infrastructures and can also lead to more climate-related migration.
- Climate change has already been impacting the biomass supply from the European agriculture and forestry sectors in both positive and negative ways and this impact has regional differences.
- Climate change disproportionately affects vulnerable populations, increasing health risks and social inequalities

Relevance

Vulnerability to climate change is a pivotal factor influencing the EU's long-term competitiveness and sustainability. Climate-related disruptions can cause significant economic losses, damage critical infrastructure, and undermine social cohesion. Regions and sectors with high vulnerability may experience reduced productivity, increased costs, and diminished innovation capacity, threatening the EU's global economic position. Moreover, failure to address vulnerability risks exacerbating inequalities and environmental degradation, undermining sustainability goals.

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5 Political

5.1 Global political power landscape

Wars such as those in Ukraine, the economic growth of individual states, growing inequality, and climate change are acting as catalysts for power conflicts within the established world order. Global power relations and cooperation through global governance by state and non-state institutions could be completely reorganized and restructured in the future. The global realignment of major powers with geopolitical zones of influence is determined by many factors, such as access to natural resources including land and water or raw materials. This already entail a high degree of uncertainty but also harbour further potential for disruption regarding the stability of longstanding alliances and global governance institutions (e.g. UN, NATO, WHO). US alliances and stability of power are uncertain, especially under Trump's influence, while the geopolitical landscape could shift toward interest-driven multiple alliances ("translaterism") or many regional small alliances ("minilateralism").

Aspects

- Geopolitical actors
- Geopolitical zones of influence
- Political model (e.g. democracy vs autocracy)
- Global collaboration (e.g. multilaterialism vs. Multipolarity)
- Military strength
- Shifting alliances and blocs
- Soft power and global influence
- Technological sovereignty and standards-setting
- Global governance institutions

Current developments

- Autocratic political forces are growing stronger worldwide, becoming increasingly networked and pursuing values that differ from those established to date.
- More private, non-governmental actors are gaining power in state discourse and taking on state functions.
- Established cooperation and reliability, particularly regarding relations between Europe, the US, Russia, and China, are changing dramatically. The d
- Demonstration of military strength between these powers is increasing, as is their courting of supporters and expansion of their own power by making others, especially the Global South, dependent on them.
- Authoritarian regimes expand control through digital surveillance and economic leverage, while democracies struggle with internal fragmentation and tendencies of polarization.
- Europe is significantly increasing its military investments.

Relevance

Wars and power conflicts lead to instability, which can affect investment and economic planning. Competition for resources such as water and raw materials will be decisive for economic stability. Growing inequality can exacerbate social tensions and hamper economic development. Changes in global institutions can influence the rules for international trade and cooperation. Uncertainty in alliances can influence the strategic orientation of companies and states.

Sources
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5.2 Governance of digital transformation

Governance of digital transformation refers to the structures, policies, and processes that guide and regulate the development, implementation, and impact of digital technologies across society, economy, and government. It ensures that digital change aligns with public interest, safeguards rights, promotes innovation, and supports economic competitiveness.

Aspects

- Development of Europe's digital industries (e.g., platforms, fintech, cybersecurity, ai) in a global context
- Regulatory frameworks and digital market governance
- Digital infrastructure, security and resilience
- R&D and innovation investment
- Governance of the data economy and digital sovereignty
- Ethics, human rights, and trust in digital transformation
- Digitalization of public administration and e-government
- Digital skills and inclusion for workforce and society-wide participation
- Innovation ecosystems e.g. public-private partnerships

Current trends

- Europe is intensifying efforts to bolster its digital industries, with initiatives like the AI Continent Action Plan aiming to position the EU as a global leader in trustworthy AI technologies.
- Europe is falling behind the US and China in digital competitiveness, with significantly lower per capita investment in digital infrastructure and slower 5G deployment, underscoring the need for increased investment and market consolidation.
- The EU is enforcing the Digital Markets Act (DMA) to curb monopolistic practices of major tech companies, exemplified by recent fines imposed on Apple and Meta for antitrust violations.
- The EU's strategy for data aims to create a single market for data, enhancing data sovereignty and competitiveness by establishing common European data spaces.
- The EU is advancing digital rights frameworks to ensure that digital transformation aligns with fundamental rights and builds public trust.
- European public administrations are increasingly adopting co-creation approaches and leveraging GovTech solutions to enhance service delivery and citizen engagement.
- The EU aims for 80% of its population to have at least basic digital skills by 2030, addressing current gaps in digital competence across member states.

Relevance

Governance of digital transformation is key to Europe's competitiveness by enabling innovation, digital sovereignty, and resilient infrastructure. Coordinated regulation, investment, and skills development help Europe compete globally while upholding ethical and fair market standards.

Sources

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5.3 Global Security and Conflicts

Global Security and Conflicts encompass a broad and interconnected set of challenges that impact international stability and peace. This factor includes traditional geopolitical and military security concerns such as ongoing conflicts and wars (e.g., Russia-Ukraine, Israel-Hamas, China-Taiwan), defence capabilities, and strategic autonomy. It also covers emerging threats like cyberattacks and hybrid warfare targeting critical infrastructure and democratic institutions, internal threats from terrorism and radicalization, and migration and border pressures driven by conflicts, climate change, and economic crises. Additionally, the weaponization of economic interdependence, nuclear proliferation, space security vulnerabilities, climate-driven security threats, and Arctic geopolitical competition are increasingly significant.

Aspects

- Geopolitical and military security landscape (conflicts, wars, regional tensions)
- Cyberattacks and hybrid threats
- Internal European security challenges: terrorism, radicalisation, societal polarization, migration
- Global comparison of military and defence capability development

- Strategic autonomy and its implications for EU security policy
- Nuclear proliferation and evolving WMD threats
- Space security and satellite vulnerability
- Climate-driven security threats
- Arctic geopolitics
- Security resilience: infrastructure, energy, health systems, food supply, and societal preparedness

Current developments

- The Russia-Ukraine conflict remains a central security challenge in Europe, with ongoing territorial disputes, high military aid flows to Ukraine, and significant humanitarian impacts.
- NATO faces pressure due to an uncertain US-EU relationship, affecting collective defence strategies and European security architecture.
- State-sponsored cyberattacks and hybrid threats, including disinformation campaigns by actors like Russia and China, increasingly target critical infrastructure and democratic processes.
- The EU is actively securing alternative energy suppliers (e.g., LNG from the U.S., Norway, Qatar) and expanding renewables to reduce fossil fuel dependency and enhance energy stability.
- Climate change drives security risks such as resource conflicts, migration flows, and Arctic geopolitical competition,

Relevance

Global security and conflicts have profound implications for both economic competitiveness and sustainability. Security disruptions can severely impact trade routes, supply chains, and market stability, directly affecting business operations and industrial competitiveness. Cybersecurity threats jeopardize intellectual property and critical infrastructure, while defence sector innovation drives technological progress and economic growth. Through diversification and renewables, energy security influences operational costs and long-term sustainability. Geopolitical tensions and conflicts create uncertainty in international markets and political alliances, complicating strategic planning for businesses and governments alike.

Sources

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https://www.eeas.europa.eu/eeas/joint-communication-climate-security-nexus_en

5.4 Fragmentation and trust in policy

"Fragmentation and Trust in Policy" refers to the actual or perceived ideological, cultural, and institutional divisions both within societies and across political entities, notably within the EU.

Aspects

- Capacity of institutions to adapt, implement participatory governance, and use deliberative democracy formats (e.g., citizens' assemblies).
- Social Cohesion & Trust: Levels of trust in institutions, legitimacy of public engagement, polarization dynamics, and civic literacy.
- Engagement & Participation Patterns: Political engagement trends, voter turnout, depth and temporal sustainability of participation, and the role of key actors including youth and marginalized groups.

- Inclusivity & Equity: Access to participation, inclusivity of policy processes, and the role of civil society in bridging divides.
- Public Influence on Innovation & Policy
- Erosion of trust in traditional political institutions, contrasted with rising trust in private companies.
- The digital transformation reshapes political participation, introducing new forms of engagement but also risks such as online harassment and misinformation.

Current developments

- The Edelman Trust Barometer 2025 shows a decline in trust in government and politics worldwide, however, companies enjoy the highest level of trust.
- There is currently a profound shift towards the acceptance of aggressive measures to achieve political goals, especially among younger people.
- Digital transformation changes the way people participate
- The idea of Commons plays a growing role in civic engagement
- The perceived fairness, transparency, and effectiveness of public engagement efforts, is key to fostering participation and avoiding disillusionment.
- Opportunities for cross-border civic participation and democratic innovation at the EU
- Use and impact of citizens' assemblies, mini-publics, and other deliberative formats that go beyond traditional voting or consultation.

Relevance

Fragmentation and trust in policy are critical determinants of the EU's ability to implement coherent, effective policies that underpin competitiveness and sustainability. Fragmentation—both within member states and across the EU—can stall decision-making on key challenges such as climate change, digital transformation, and security, undermining collective action. Trust in institutions and participatory processes is essential to mobilize public support for ambitious sustainability transitions and innovation agendas. Conversely, declining trust and rising polarization threaten social stability and economic resilience.

Sources

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5.5 European cohesion and ability to act

European cohesion refers to the unity and solidarity among European Union member states. At the same time, the ability to act describes the EU's capacity to implement effective policies and respond promptly to challenges. These twin concepts are fundamental to the European project and directly impact the Commission's effectiveness. The interplay between national interests and supranational governance creates a complex decision-making environment that influences Europe's position in global affairs and its internal stability.

Aspects

- Role of nationalistic tendencies: Single countries within EU have / had strong nationalistic tendencies, partly blocking decisions of EU (Hungary, Poland)

- Role of Turkey and EU accession candidates
- Speed of decision-making processes between commission and member states (Role of subsidiary principle)
- Common defence policies, role of NATO
- Migration Management: The New Pact on Migration and Asylum faces implementation challenges due to disagreements over burden-sharing

Current developments

- The new Pact on Migration and Asylum faces significant implementation difficulties due to fundamental disagreements among member states over burden-sharing mechanisms.
- Several member states, notably Hungary and Poland, have demonstrated strong nationalistic positions occasionally blocking EU-wide decisions, complicating the governance process. This dynamic is further influenced by the growing division between nationalist and progressive camps across the continent.
- The EU is currently managing multiple simultaneous crises—a "polycrisis" situation—ranging from security concerns to economic challenges. Eastern member states remain preoccupied with the conflict with Russia and potential NATO involvement, while Mediterranean countries focus on distinct regional concerns, creating different priorities within the union.
- Record-high trust levels in EU institutions suggest public recognition of the value of European cooperation. The implementation of a new fiscal framework represents an important step towards addressing economic governance concerns that have previously undermined cohesion.

Relevance

European cohesion significantly impacts the EU's competitive position and sustainability goals. The marked economic disparities have led to disagreements on debt policies, creating tensions undermining the bloc's unified economic approach. The speed of decision-making processes between the Commission and member states, heavily influenced by the subsidiary principle, directly affects Europe's ability to respond to global economic challenges.

Sources

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Annex 2: Raw documentation of the Delphi-Results

Question 1.1.

Question	In 2040, the EU's competitiveness is resilient against cascading climate, social, and environmental risks.
Description	Do you agree that this is possible by 2040?
Number of participants (n)	28

	Relative	Absolute
Yes, this will be true by 2040.	10.71%	3
No, it will take longer.	46.43%	13
No, this will never be possible to achieve.	28.57%	8
I don't know.	14.29%	4

Question 1.2.

Question	In 2040, the EU's competitiveness is resilient against cascading climate, social, and environmental risks.
Description	What are the key success factors or barriers to achieving this target?
Number of participants (n)	21

Participant	Value
Anonymous 38	The full consequences of climate change are not foreseeable currently. We are on a +3-degree pathway, creating huge uncertainty, including sea-level rise, droughts and flooding. The full consequences of a disruption of AMOC is not clear. In addition, tipping points make the full system unstable. The goal cannot be competitiveness but increasing resilience in general and wellbeing of the population. If competitiveness (which implies against others) is the right means to achieve this resilience, i doubt.
Anonymous 57	success factors: actual climate change consequences, maybe scarcity of certain agricultural products, brain drain from China / US (Europe as a hub for free thinking and researching) barriers: Europe will be able to pay for losses for a longer time, that might block fast adaptation, trade wars, wars in general
Anonymous 17	EU has the power to be prepared and avoiding cascading effects by acting and adopting certain and effective legislative measures
Anonymous 107	Sustainability needs to be linked with EU competitiveness
Anonymous 90	I believe that externally, resilience will depend on the EU's ability to act decisively and navigate in a new geopolitical environment—particularly in containing threats like Russia, which is trying to destabilize EU. Internally, resilience will require sustained political commitment to certain (adaptation and resilience) policies, backed by strong, stable institutions. Barriers: decrease in trust; rise of far-right and hyper-neoliberalism.
Anonymous 106	key factor: Understanding all-risks' Interdependence in all times. Barrier: Geopolitical tensions are rapidly shifting needs and priorities.
Anonymous 4	The EU is far from sustainability at broad sense. This incorporates climate, social and environmental conditions and competitiveness relies on global playing field too. Lack of a level global situation regarding sustainability in a broad sense will jeopardize the efforts of EU.
Anonymous 9	Current economic system & short-term, non-systemic thinking

Anonymous 102	I think we are behind in social resilience firstly and environmental resilience secondly
Anonymous 52	faster implementation of European policies towards sustainability
Anonymous 47	Being prepared to change EUs attitude to migration. Being prepared to spend large amounts of money to change infrastructures to enable economies and society to function when large scale climate impacts are continuous.
Anonymous 83	more economic equality is probably the important driver for social resilience. Social resilience is a prerequisite for tracking the measures against cascading environmental and climate risks
Anonymous 5	Key success factors: implementation of the EU sustainability policies, financing, raising public awareness/engagement Barriers: insufficient financing, prioritizing of other topics, lobbying causing delays, impact of wars and conflicts that require reprioritizing
Anonymous 97	world embeddedness of the EU, unknown unknowns, divergent EU-internal interests
Anonymous 72	adaptation is going too slow compared to the pace of the increasing risks
Anonymous 19	short sightedness and looking for quick wins in policy and business, lack of policies that hinder unsustainable behaviour
Anonymous 14	depending on the goals Europe sets in relation to the rest of the world;
Anonymous 124	Freedom (basic human rights), stability, fairness and solidarity, responsibility, braveness, open mind interest and learning, co-operation
Anonymous 56	Orchestrated long-term vision and transition strategy Bold investments in resiliency measures, particularly for network-infrastructures
Anonymous 81	Emergence of concrete environmental damages force to take cascading risks more seriously. Anticipation of new kinds of risks remain a challenge.
Anonymous 148	Regressive politics Security priorities creating trade-offs with industrial transformation

List of identified elements

Success factors:

- Fast and coherent implementation of EU sustainability policies at all governance levels, supported by strong legislative action, sustained political commitment and institutional resilience.
- An orchestrated long-term vision and transition strategy to guide systemic change. A holistic and systemic approach to anticipating and mitigating interconnected environmental, social, and economic risks.

- Large-scale investments in resilience measures, particularly in critical and network infrastructures.
- Stability and trust within the EU to maintain collective action and public support.
- Greater economic equality across member states to strengthen social resilience and public buy-in.
- Freedom, basic human rights, fairness, solidarity, responsibility, and cooperation as fundamental societal values supporting resilience.
- Increased public awareness and engagement in sustainability and resilience efforts.
- Europe's ability to navigate a rapidly evolving global landscape and act decisively in times of crisis.
- Strategic use of the EU's global embeddedness to foster international cooperation, partnerships, and innovation. Leveraging Europe's potential as a global hub for free thinking and research, benefiting from talent shifts from other global powers.
- Revising EU migration policies to address climate-driven displacement and demographic change.
- Emergence of visible, concrete environmental damages as a catalyst for urgent action on cascading risks.

Barriers:

- Insufficient or poorly allocated financing for sustainability and adaptation measures.
- Lack of policies, or weak enforcement of existing policies, to prevent unsustainable behaviour.
- Adaptation efforts progressing too slowly relative to the accelerating pace of climate and environmental risks.
- Political and business short-termism focused on immediate wins rather than long-term planning. Lobbying and vested interests delaying regulatory action and systemic reforms.
- The current economic model reinforces unsustainable practices and resists transformative change.
- Domestic political instability and declining public trust in institutions undermine implementation. Regressive politics and populism weaken collective EU action.
- Conflicts, wars, and crises divert resources and attention away from long-term resilience building. Security priorities may compete with, or delay, industrial transformation and sustainability measures.
- Anticipating new and emerging types of risks remains a challenge, making planning difficult.

Rethinking competitiveness:

- Competitiveness should not be the main goal but a means to increase resilience, well-being, and sustainability
- The EU is still far from achieving a truly sustainable development model, which remains essential for long-term resilience

Uncertainties:

- The full consequences of climate change, including tipping points, are not currently foreseeable and may destabilize entire systems.
- Geopolitical developments may unpredictably shift priorities and disrupt resilience-building efforts.
- Diverging interests within EU member states could hinder coordinated action.
- The EU's goals and role in relation to the rest of the world remain uncertain and may evolve.
- "Unknown unknowns" and systemic complexity make long-term strategic planning inherently fragile and uncertain.

Question 2.1.

Question	In 2040, the EU has achieved its intermediate emission reduction target of 90%, while reducing excessive dependencies and enhancing security through strategic trade agreements.
Description	Do you agree with this statement?
Number of participants (n)	25

	Relative	Absolute
Yes, this will be true by 2040	12.00%	3
No, it will take longer	68.00%	17
No, this will never be possible to achieve.	0.00%	0
I don't know	20.00%	5

Question 2.2.

Question	In 2040, the EU has achieved its intermediate emission reduction target of 90%, while reducing excessive dependencies and enhancing security through strategic trade agreements.
Description	What are the key success factors or barriers to achieving this target?
Number of participants (n)	22

Participant	Value
Anonymous 57	I am not sure what the role of strategic trade agreements will be in the longer term and what the effects of the current disruptions will be. Europe would probably only be in a good position if it harnesses the scientific and innovation potential properly and makes this an asset for other nations. In case a food crisis would arise (due to extensive drought for example), Europe's standing might be different. (I have no deeper economic expertise)
Anonymous 38	Emission reduction might work with renewable energies and by applying large-scale nature-based solutions. However, tipping points, loss of forest, might counteract this. Strategic trade agreements are important but require the partner's will to have this agreement, too. The principal problem is that critical raw materials will not be enough for all countries worldwide to go 100% renewable. Energy consumption needs to be lower. In addition, we cannot afford losing materials due to lack of recycling.
Anonymous 17	I am afraid that there will be so many unexpected incidents up to 2040 that will render any effort of long-term evaluation very ambiguous
Anonymous 107	Need more commitment at EU and outside EU
Anonymous 90	Trade agreements and strategic partnerships to secure raw materials. At the same time, large-scale investments in clean technology and stable policies are needed to speed up innovation and deployment. Main barriers are global supply disruptions, slow technology rollout, and political or public resistance to change.
Anonymous 106	This is a Commission's recommendation based on a science-based estimate of the relevant Advisory board. This estimate for 2040 could go wrong or extend, if unexpected and rapidly developing complexities of systems were/are not completely understood.
Anonymous 74	War, financial barriers
Anonymous 9	Current economic system

Anonymous 4	If the conditions cover also sustainability coherence with the trade partners and competitors, then there is a chance.
Anonymous 116	climate change as barrier trade barriers
Anonymous 102	excessive dependencies
Anonymous 47	Drastic measures to massively reduce GHG emissions. Much higher levels of economic engagement with countries apart from the US
Anonymous 83	we cannot achieve these goals without radical changes in the economic system, lifestyle and the underlying cultures and paradigms around which society is organised.
Anonymous 5	Success factors: implementation of regulations, monitoring and control of emission reduction, state support /incentives for emission reduction, political will of different stakeholders. Barriers: wars, conflicts, lack of political will, lack of solutions for emission reduction, cost of solutions
Anonymous 97	while excessive dependencies and some security issues can be tackled effectively by trade agreements, the emission reduction target of 90 % appears to be too ambitious given the likelihood of war expansion in Europe and exacerbating competition from other world regions
Anonymous 72	carbon certificates; e-mobility; economic downturns due to global instability
Anonymous 19	willingness of countries to work together
Anonymous 14	to achieve that target competitiveness in other areas will suffer
Anonymous 124	change of the management mind setting in nearby all institutions and companies (priorities; LCA thinking; net-zero front-runner competition; much more benefits for individuals and entities for carbon free acting, effective and fair carbon taxes, which are used for ST only.
Anonymous 56	Success factors: orchestrated long-term visions and strategies of viable transformation pathways; new Social Contract on sharing costs and benefits of ongoing transformations, with fair distribution of rights and responsibilities of economic actors, citizens and the state; bold action Barriers: Fundamental uncertainties for economic actors not dealt with by legitimate democratic institutions; incrementalist strategies paired with short-termism of influential actors; believing in technological fix; fear of uncompensated sunken costs; lack of financial instruments for bold long-term investment
Anonymous 81	Technological development will allow surprisingly fast emission reductions (but the role of strategic trade agreements is likely to be less important)
Anonymous 148	Dependencies will be hard to reduce in critical areas

List of identified elements

Success factors:

- Effective implementation of policies and regulations, including robust monitoring and control mechanisms.
- Drastic and sustained measures to massively reduce greenhouse gas emissions across all stakeholder levels (EU institutions, member states, industries), supported by tools like carbon certificates, e-mobility, and large-scale nature-based solutions. Large-scale, sustained investments in clean technologies.
- Orchestrated long-term visions and strategies outlining viable transformation pathways that align stakeholders and set clear priorities.
- Establishment of a new Social Contract that fairly distributes the costs and benefits of transformation among economic actors, citizens, and the state, ensuring equitable participation. Implementation of effective and fair carbon taxation, with revenues used strategically to support sustainable transition.
- Transformation of management mindsets across institutions and companies, including life-cycle assessment thinking, net-zero competition, and incentives for carbon-free actions.
- Strengthened recycling and circular systems to reduce dependency on virgin resources and secure material flows.
- Greater economic and diplomatic engagement with a broad range of global partners beyond traditional allies like the US, diversifying partnerships. Strategic trade agreements used carefully to reduce excessive dependencies and enhance supply security, with sustainability coherence as a core condition.
- Harnessing Europe's scientific, research, and innovation capacity as a strategic asset.

Barriers:

- Uncertainties for economic actors, particularly when not addressed by legitimate democratic institutions. Fear of uncompensated sunk costs leading to resistance from industries and sectors that face disruption.
- Short-termism and incremental strategies pursued by influential stakeholders instead of bold, systemic action.
- Belief in purely technological fixes without addressing underlying systemic and social changes needed for deep transformation.
- Political resistance, lack of coordination, and uneven political will across member states and sectors.
- Dependencies on critical raw materials and strategic resources that are difficult to substitute or reduce.
- Persistent global competition over critical raw materials and recurring supply chain disruptions slowing the rollout of essential technologies.
- Insufficient or unavailable technological solutions for full-scale emission reduction in certain sectors.
- High costs of implementation and limited resources, especially during economic downturns caused by global instability.
- Structural limitations within the current economic model that hinder deep, systemic transformation.
- Radical changes in the economic system, lifestyles, and underlying cultural paradigms may face strong resistance.

- Climate tipping points, biodiversity loss, and extreme weather events that could reverse progress and create cascading setbacks.

Uncertainties:

- The long-term role and effectiveness of strategic trade agreements in achieving emission reduction and autonomy goals.
- The impact of current and future global disruptions (e.g. economic shocks, climate events).
- Wars, armed conflicts, and geopolitical tensions can derail strategic focus and funding.
- The 90% emission reduction target may prove too ambitious given the likelihood of war expansion and intensified global competition.
- The willingness of countries within and beyond the EU to collaborate consistently remains uncertain.
- Rapid technological development could enable surprisingly fast emission reductions.

Question 3.1.

Question	In 2040, the EU's competitiveness model prioritises environmental restoration and innovation while ensuring equitable social and economic benefits.
Description	Do you agree that this model will be feasible and effective by 2040?
Number of participants (n)	24

	Relative	Absolute
Yes, this will be feasible and effective by 2040.	25.00%	6
No, it will take longer.	37.50%	9
No, this will never be possible to achieve	33.33%	8
I don't know.	4.17%	1

Question 3.2.

Question	In 2040, the EU's competitiveness model prioritises environmental restoration and innovation while ensuring equitable social and economic benefits.
Description	What policies or investments are most critical to achieving this balance?
Number of participants (n)	19

Participant	Value
Anonymous 57	investment and policies that foster social innovation, community-based projects and local solutions. (probably something like the main strategies that are in place in development aid programs for the global South?) What is needed are good mechanisms to support many, but smaller and local projects, where a community is in charge. For technical innovation, there are existing models, but they lack for social innovation, which is in my view crucial, especially when facing a mayor shift due to AI possibilities
Anonymous 38	Competitiveness "requires" someone to compete with. This is a mindset of the stronger and powerful. If priority is this, all weaker elements in the chain will be set behind this. Priorities must be: - Innovation in recycling and material science - culture, arts, education, science in general - nature restoration and nature-based techniques - technology only where it is useful - Europe must be bold enough to withstand the global led discourse of power
Anonymous 17	EU is committed to this scope since its formation as European Coal and Steel Community. Now EU much more than previous years has the competence, the determination and the means to work more intensively towards this scope. First a multi-pronged policy and investment strategy is required driven by evidence based and adaptive governance.
Anonymous 107	The link of environmental restoration with competitiveness needs to be better explored and demonstrated
Anonymous 90	Building a sustainable food system, ensuring access to affordable and "clean" housing and energy, and addressing inequality and well-being. Targeted investments should focus on education and repairing inefficiencies in current social support systems, ensuring they not only protect the most vulnerable, but also encourage people to actively participate in the green transition.

Anonymous 106	I can see "environmental restoration/ innovation“ and "ensuring equitable social and economic benefits" side by side, but I'm afraid I cannot see the former in true priority.
Anonymous 9	Current economic system & decision-making distribution
Anonymous 4	Re-definition of our relations with nature and improving justice in terms of benefitting resources and sharing the burden. Transformative change of the industry and technologies. Beware spill-over effects
Anonymous 102	timescale of environmental restoration actions
Anonymous 47	A change in the economic system to set economic goals to recognise the negative impacts of environmental disasters and prioritise environmental impacts above the current GDP growth measure
Anonymous 83	Making the private/market logic in innovation much less dominant. Bringing innovation back into the public and civic sphere
Anonymous 5	policies on justice (or incorporating justice considerations in other policies) investments available for start-ups, venture capital, investments for environmental restoration projects which are economically unviable
Anonymous 97	mitigation of internal conflicts and trade-offs between competitiveness and environment protection
Anonymous 72	major forces inside the EU blockade effective restoration policy; the principle of subsidiarity makes effective EU wide implementation almost impossible
Anonymous 19	business models for restoration, ensuring ability to get a livelihood (e.g. to landowners) from nature restoration (vs. business as usual such as conducting forest harvesting)
Anonymous 14	if giant companies operate and need to satisfy the wishes of their investors, it will be impossible to achieve social benefits and environmental restoration
Anonymous 124	very important factors/priorities are not included to reach competitiveness on institutional and global level and most important on individual level.
Anonymous 81	Societal change is likely to be slower because of path-dependencies; innovations will be prioritised but it's difficult to guarantee truly equitable distribution of benefits
Anonymous 148	I don't know in detail. Nature Restoration Law, Social Climate Fund and the Industrial Deal mostly.

List of identified elements

Critical policies and investments:

- Implementation of Nature Restoration Law, Social Climate Fund, and the Industrial Deal and other policies that explicitly incorporate justice considerations or integrate justice principles into other sectoral policies.
- Large-scale investments in innovation across recycling, material science, nature-based techniques, and in cultural, educational, and scientific institutions.
- Significant investments in start-ups, venture capital, and environmental restoration projects that are not economically viable under current market conditions.
- Support for social innovation and community-based solutions, including mechanisms that empower smaller-scale, local initiatives to contribute to systemic transformation.
- Development of business models for restoration that create viable livelihoods from nature restoration activities, offering sustainable alternatives to extractive and destructive practices such as intensive logging or mining.
- Building resilient social systems through affordable housing, universal access to clean energy, sustainable food system, targeted education programs, and effective social support mechanisms that enable vulnerable and marginalized groups to participate in the green transition.
- Evidence-based and adaptive governance, supported by long-term, inclusive strategies that can adjust to emerging challenges.
- Establishing clear institutional priorities to strengthen competitiveness not only at the EU or global level, but also at the level of individual citizens and communities.

Barriers:

- Prevailing economic paradigms centred on growth and global power competition are misaligned with long-term sustainability and justice.
- The dominant logic of large corporations focused on shareholder profit maximization undermines efforts to achieve social benefits and environmental restoration.
- Major internal political and institutional forces within the EU can block ambitious restoration policies, with the principle of subsidiarity limiting EU-wide coordinated action.
- Lack of adequate support for social innovation, despite its importance in addressing disruptive changes (e.g. AI-driven transformation).
- Persistent inefficiencies and inequities in social systems, preventing vulnerable groups from participating fully in the transition.
- Resistance from entrenched mindsets, ideological frameworks, and vested interests that obstruct transformative change.

Rethinking competitiveness:

- Very important priorities and factors for competitiveness are missing at institutional, global, and especially individual levels, weakening overall effectiveness. We need to redefine competitiveness in terms of resilience, equity, and well-being, rather than purely economic performance. A fundamental shift in the economic system to ensure economic goals reflect and account for the negative impacts of environmental disasters, prioritizing ecological outcomes over GDP growth.
- Addressing internal conflicts and trade-offs between competitiveness and environmental protection to prevent one from undermining the other.
- Reducing the dominance of private/market logic in innovation and shifting innovation back into the public and civic sphere.

- Ensuring the equitable distribution of benefits across all social groups remains a challenge.
- Addressing structural political barriers and vested interests that currently block ambitious environmental action.

Question 4.1.

Question	In 2040, the EU has strengthened its strategic autonomy by establishing strong trade partnerships with third countries (enhancing supply chain resilience) and by reducing internal demand for critical raw materials.
Description	Do you agree that the EU will achieve this level of strategic autonomy by 2040
Number of participants (n)	24

	Relative	Absolute
Yes, this will be true by 2040.	37.50%	9
No, it will take longer.	20.83%	5
No, this will never be possible to achieve.	16.67%	4
I don't know.	25.00%	6

Question 4.2.

Question	In 2040, the EU has strengthened its strategic autonomy by establishing strong trade partnerships with third countries (enhancing supply chain resilience) and by reducing internal demand for critical raw materials.
Description	What are the most important measures the EU should take today to help realise this vision?
Number of participants (n)	19

Participant	Value
Anonymous 57	the definition of "strategic autonomy" is key here. I cannot respond to this question as I also lack relevant economic expertise
Anonymous 38	The best chance to become autonomous is to install as many renewable energies as quickly as possible and to establish technology to recycle solar panels, windmills, etc. That means in shorthand, demand must and will increase. The strategy must be get the most in shortest time possible and then keep in a loop.
Anonymous 17	EU has devoted much effort since many years ago in establishing strong trade partnerships with third countries especially for agricultural and fisheries products. However, CRMs are very supply-risk prone and difficult to be substitute, therefore such a long-term extrapolation up to 2040 is a very difficult task and many times unrealistic.
Anonymous 107	External negotiations and circular economy efforts need to be put in place and enhanced
Anonymous 90	Investing in strategic, long-term diplomatic partnerships—including through cultural diplomacy. Internally, it needs to ensure political stability, strengthen institutional capacity, and increase its capacity to project influence and protect critical infrastructure globally. In parallel, reduce raw material demand through innovation and regulation - circularity and substitution policies.
Anonymous 106	definition of Strategic autonomy is unclear to me
Anonymous 9	expand Circular economy, enhance Bioeconomy, change current economic system
Anonymous 4	Circular material use rate is critical. But too low. Slow improvement for alternatives
Anonymous 116	success might be limited by availability of partners who are not already engaged in other partnerships or deals with USA or China.

Anonymous 47	Consistent policies that are designed to decrease demand instead of increasing economic growth. A change in the measure of economic success away from GDP growth
Anonymous 83	what will happen geopolitically is too hard to predict
Anonymous 5	identify and work on the advantages of the EU as the contractor (for enhancing supply chain resilience) invest in R&D focused on reducing EU demand for the CRM
Anonymous 97	as in question 2 the conjunction <and> in the Delphi statement does not allow for a clear answer as it is two statements. while third country trade partnerships are very likely, they reduce the pressure to reduce demand
Anonymous 72	strengthening of strategic autonomy with strong trade partnerships with third countries seems like an oxymoron
Anonymous 19	foresight
Anonymous 14	a big change must be made to reduce this dependency, not possible so fast
Anonymous 124	Reducing internal demand for critical raw materials should be the priority but is not taken seriously at all. One reason is maybe the process of policy decision finding for national and European and international legislation/agreements, execution and administration. A fundamental change forward and not backwards is very needed.
Anonymous 81	It's possible to "strengthen" strategic autonomy and "reduce" demand of materials but achieving truly sustainable levels may not be feasible under this timeframe. Justness of trade partnerships with third countries remains a key concern
Anonymous 148	NZIA

List of identified elements

Most important measures:

- Reducing internal demand for critical raw materials (CRMs) should be the top priority. Implement consistent policies focused on decreasing demand, rather than prioritizing traditional economic growth objectives.
- Implementation of key legislative frameworks such as the Net-Zero Industry Act (NZIA).
- Expand circular economy practices and further develop bioeconomy to reduce dependence on virgin material extraction.
- Invest in research and development focused on innovation in recycling, substitution materials, and process efficiency.
- Accelerate deployment of renewable energy and develop advanced recycling technologies for renewable infrastructure such as solar panels and wind turbines.

- Shift measures of economic success away from GDP growth toward indicators that reflect sustainability, resilience, and social well-being.
- Strengthen political stability, institutional capacity, and the EU's ability to project influence and protect critical infrastructure globally.
- Establish and maintain long-term strategic diplomatic partnerships, including cultural diplomacy, to diversify supply sources and enhance cooperation.
- Align external trade negotiations with sustainability objectives to ensure that supply chain resilience is not achieved at the expense of environmental or social justice.
- Promote a fundamental change in the policymaking process at national, EU, and international levels to make decision-making, execution, and administration more effective and forward-looking rather than reactive or regressive.

Barriers:

- Difficulty substituting CRMs, as many are technologically or economically challenging to replace.
- The circular material use rate and development of alternative materials remains low, with limited progress.
- Limited availability of willing trade partners, especially as many are already aligned with major global powers like the US or China.
- Strong trade partnerships with third countries may conflict with the goal of strategic autonomy.
- These partnerships may also reduce incentives to cut raw material demand, undermining long-term sustainability goals.
- Achieving truly sustainable levels of CRM use within the given timeframe may not be feasible, given systemic inertia and current consumption trends.
- Insufficient prioritization of reducing internal demand for CRMs, with policies and actions not taken seriously or implemented at the necessary scale.
- Slow and complex policymaking processes at national, EU, and international levels.
- The current economic system and decision-making structures reinforce linear, growth-driven models.
- Geopolitical volatility and unpredictability create uncertainty for long-term planning and strategic resilience.

Question 5.1.

Question	In 2040, a fully operational circular economy is established in the EU, based on digitally optimised resource allocation technologies, advanced recycling systems and regenerative, nature-positive business models.
Description	Do you agree with this statement?
Number of participants (n)	24

	Relative	Absolute
Yes, this will be true by 2040.	16.67%	4
No, it will take longer.	66.67%	16
No, this will never be possible to achieve.	16.67%	4
I don't know.	0.00%	0

Question 5.2.

Question	In 2040, a fully operational circular economy is established in the EU, based on digitally optimised resource allocation technologies, advanced recycling systems and regenerative, nature-positive business models.
Description	What is the key blind spots or risks that could hinder the EU's transition to a circular economy?
Number of participants (n)	21

Participant	Value
Anonymous 57	For once, I am optimistic here. I am sure that AI has a huge potential to optimise a lot of aspects. fully circular is probably not achievable, but I believe that overall waste management and recycling are also economically beneficial practices that will trigger the necessary innovation
Anonymous 38	This requires design for recyclability. The more complex the materials, the harder they are to separate. Materials with a certain degree of quality are often needed, especially in digitalisation. As far as I can see, recycling often comes with a downgrading of the material quality. In addition, the material streams leaving Europe are too high - there is a net loss of resources. The risk for rebound effects is extremely high. History tells that gains in efficiency are used to produce more. Digitalization will in this regard lead to more.
Anonymous 17	Circular economy has been developed sharply in EU the recent years. Therefore, by the year of 2040 the transition to a fully operational circular economy could be possible. The rapid application of new technologies like the digitally optimised resource allocation, advanced recycling systems and regenerative, nature-positive business models would contribute strongly to attaining this scope.
Anonymous 107	Need more regulation and financial schemes with incentives (e.g. taxes) to be achieved completely
Anonymous 90	CE technologies may remain economically unfeasible or fail to scale due to weak market incentives. There are existing lock-ins in linear business models and lack of infrastructure. In terms of product design, there has been little progress so far and it is still most profitable to have new "models" of products than repairable or modular design. AI might help a lot in terms of efficiency, but the speed of adoption across value chains will depend on skills and incentives.
Anonymous 106	Inadequate consumer knowledge and engagement to CE. It needs more time for awareness. On the other hand, there is a lot of progress in innovation/technologies support

Anonymous 129	more expensive
Anonymous 9	Current economic system & decision-making distribution
Anonymous 4	Global material flow and its security Establishment of a circularity market Nature-based solutions
Anonymous 116	system complexity is too high
Anonymous 102	waste management
Anonymous 47	There are no established business models that will operate on the scale necessary to achieve this by 2030
Anonymous 83	the cost of labour. it really needs a change in how and what we tax, to create an economy of repair and maintenance
Anonymous 5	sufficient financing, developing a common approach to CE financing reduction of virgin materials use Changing mindsets: CE shall become the priority choice
Anonymous 97	there are economic and ecological break even points that impede recycling. the suggested solution in the statement does not address specific recycling barriers exactly.
Anonymous 72	lack of market for circular goods; conflicting consumption patterns of public and overall logic of the capitalist market economy block against circular economy
Anonymous 14	100% circular is not possible, look at the prospects from the plastic industry to increase their production in the coming years, if we do not even get a stable situation, it is very far from getting better
Anonymous 124	Bind Spot: MOTIVATION Industry, economy and consumers will change very slowly or move back, if there are no strong benefits and widely accepted clear rules and strict execution (Singapore would reach it). Risks: See answer in Topic 1 as well as in 2 and 6 and 8
Anonymous 56	In the early phase of transition towards a circular economy, currently announced strategies of optimisation and efficiency are counterproductive, risking backlash and loosing speed. Until 2040 the focus must be on implementing a digitally enhanced real-economy (based on effective resource allocation technologies, advanced circularity and regenerative, nature-positive business models) that works on decarbonised energy and significantly reduced material extraction. After 2040, and only once a fully operational system of circular economy has been implemented, the currently pertaining management approaches of optimisation and efficiency, might become the best approach once again to.

Anonymous 81	A full breakdown of global supply chains may force implement this kind of circular economy, but it's likely that availability of new natural resources keeps the linear economy alive for a longer time.
Anonymous 148	The business case for CE is not yet strong enough. The regulatory framework must punish waste production much stronger.

List of identified elements

Opportunities:

- AI and digital technologies can optimize resource use, improve system efficiency, and enable real-time resource allocation.
- Economic benefits of improved waste management, recycling, and resource recovery can drive innovation and investment.
- Rapid progress in circular economy policies and technology adoption in the EU creates a favourable environment for scaling solutions.
- Digitally optimized resource allocation, advanced recycling systems, and regenerative, nature-positive business models have strong transformative potential.
- Growing innovation and technological support within the EU can accelerate adoption of circular practices.
- A full breakdown of global supply chains could force the EU to accelerate circular economy implementation as a resilience strategy.

Barriers:

- Lack of motivation and incentives for industry, economy, and consumers. Without clear, strong benefits, strict enforcement, and widely accepted rules, progress will be slow or may regress.
- Full circularity may not be realistically achievable due to technical, economic, and ecological constraints. Economic and ecological break-even points can make some recycling processes unviable.
- The business case for the circular economy remains weak, with insufficient financial incentives and limited profitability compared to linear models. High labour costs make repair, maintenance, and reuse less competitive compared to new production.
- Product design still does not prioritize modularity, repairability, or recyclability.
- Lack of market demand for circular goods due to low consumer awareness, combined with conflicting public consumption patterns and continued growth in high-impact industries such as plastics.
- The capitalist market economy’s linear growth logic conflicts with circularity objectives.
- Rebound effects, in which efficiency gains lead to overall increases in consumption.
- Lock-ins in linear business models and a lack of adequate supporting infrastructure.
- Complex materials that are difficult to recycle, often leading to quality downgrading during processing.
- Significant net loss of resources through exports and material outflows from Europe.
- Inadequate waste management systems, especially in certain regions.

Needs:

- Strong, clear policy frameworks with long-term targets, strict enforcement, and accountability mechanisms.
- A fundamental tax reform to incentivize repair, maintenance, and reuse over linear production and disposal.
- Sufficient and sustained financing for circular economy initiatives, with a common EU-wide approach to CE funding.
- Skills development and incentives across entire value chains.
- Better product design prioritizing durability, modularity, repairability, and recyclability.
- Creation and expansion of circularity markets, ensuring demand for circular products and services.
- Nature-based solutions to complement technological and industrial strategies.
- Transparency, public awareness campaigns, and stakeholder engagement to build societal support.
- Penalties for waste production and pollution, making businesses accountable under a polluter-pays principle.
- Focus on building a digitally enhanced economy by 2040, powered by decarbonized energy and significantly reduced material extraction, with advanced circularity and regenerative, nature-positive business models. After 2040, once a fully operational circular economy is established, optimization and efficiency strategies can again become the primary management approach.
- Changing societal mindsets so that circular economy principles become the default choice for businesses and consumers.

Question 6.1.

Question	In 2040, the EU's hard-to-abate industries are zero-pollution, fully decarbonised and supported by a competitive energy market that provides affordable and clean energy to all citizens and businesses.
Description	Do you agree that the EU's hard-to-abate industries will achieve zero-pollution and full decarbonization by 2040?
Number of participants (n)	24

	Relative	Absolute
Yes, this will be realised by 2040.	16.67%	4
No, it will take longer.	50.00%	12
No, this will never be possible to achieve.	25.00%	6
I don't know.	8.33%	2

Question 6.2.

Question	In 2040, the EU's hard-to-abate industries are zero-pollution, fully decarbonised and supported by a competitive energy market that provides affordable and clean energy to all citizens and businesses.
Description	What are the most critical technologies or policies needed to enable this transformation?
Number of participants (n)	19

Participant	Value
Anonymous 57	Probably, the logics of industrialization and large-scale manufacturing per se is contradicting a fully decarbonised and clean energy world. I am not sure; this vision can be scaled up. More positive about energy - I believe that there is potential to get it done.
Anonymous 38	There are many concepts to get there. It must be realised, quickly.
Anonymous 17	The EU has been well prepared for this transition. The recent (Feb. 2025) Clean Industrial Deal or Industrial Decarbonisation Accelerator Act provides all the necessary tools for the decarbonization road map for the hard-to-abate industries. Among others it stimulates the demand for EU made clean products, introduces sustainability and resilience criteria and mobilises over €100 billion in funding for clean manufacturing and infrastructure. Moreover, the Budapest Declaration is strengthening Europe's competitiveness with the Innovation Fund and is launching a dedicated industrial decarbonisation bank. It also provides for anticipatory investments in infrastructure with state guarantees to reduce risk and ensure timely deployment for achieving climate neutrality
Anonymous 107	Policies that enforce regulation in place and provide incentives (taxes) for more ambition zero-pollution
Anonymous 90	I would say that the EU is generally headed this way, but the success is highly uncertain. Keep strong carbon pricing, targeted public investment, and stable long-term regulation.
Anonymous 106	brave policy making and less energy demand
Anonymous 74	General geopolitical situation
Anonymous 129	- stricter chemical(s) legislation - grid interconnection ...
Anonymous 9	Current economic system & decision-making distribution

Anonymous 4	Nature-friendly innovation Population growth Consumption paradigms Equality concerns
Anonymous 102	I think emissions neutrality has a better chance compared with decarbonisation, so maybe promote technologies towards that.
Anonymous 47	Stringent requirements to completely decarbonise. The EU ETS and green growth policies are completely inadequate to achieve this goal.
Anonymous 5	decarbonization technologies for hard-to-abate industries waste management technologies for hard-to-abate industries and pollution prevention technologies once the technologies are developed, policies and state support shall be used for scaling up and accelerating the result
Anonymous 97	I do not see sufficient efforts to make energy affordable. The social transition needs to be first as polarized societies in terms of wealth are not capable to absorb the impacts of large transitions without creating too much internal tensions
Anonymous 19	renewable energy, hydrogen energy, optimism
Anonymous 14	still the use of resources for green energy is critical and the reuse of these materials/recycling is very complex and not proven to work from today's perspective
Anonymous 124	steel and metal production, cement and bricks, and some other chemical industries
Anonymous 56	Clear long-term commitments creating trust in viable transition pathways and translating fundamental uncertainties in manageable, insurable and bankable risk
Anonymous 81	Technological development may be surprisingly fast in industries, especially if adequate economic incentives are in place and strong environmental/industrial policies are implemented in consistent way

List of identified elements

Needs

- Clear long-term commitments and predictable policies that create trust in transition pathways, helping to turn fundamental uncertainties into manageable, insurable, and bankable risks for industries and investors.
- Stringent requirements to achieve complete decarbonization, including enforceable timelines and strong governance structures.
- Policy flexibility to recognize sectoral limitations, promoting emissions neutrality in industries where full decarbonization is not technically or economically feasible.

- Financial incentives to accelerate scaling and market adoption of clean technologies. Strong carbon pricing mechanisms.
- Focused attention on hard-to-abate sectors such as steel and metal production, cement and bricks, and certain chemical industries, with sector-specific strategies and roadmaps.
- Continued expansion of renewable energy and hydrogen energy, including the development of associated infrastructure. Improved grid interconnection to support a stable, clean energy supply.
- Stricter legislation on harmful chemicals.
- Prioritization of social transition, ensuring that polarized societies can manage the impacts of large-scale changes without triggering internal tensions and resistance.

Barriers:

- The fundamental logic of industrialization and large-scale manufacturing may conflict with the vision of a fully decarbonized, zero-pollution future.
- Reuse and recycling of materials for green energy infrastructure is complex and, from today's perspective, not proven to work at scale.
- The overall success of the transition is uncertain due to technological, economic, and social constraints.
- The EU ETS and current green growth policies are inadequate to achieve full decarbonization.
- Geopolitical instability could undermine coordinated energy and decarbonization efforts.
- The current economic system and decision-making structures may resist deep structural transformation.
- Lack of sufficient efforts to make energy affordable for all. Social challenges such as demography, unequal wealth distribution, and high consumption patterns risk obstructing progress.
- Full decarbonization may be unrealistic in some sectors, making emissions neutrality a more feasible target.

Opportunities:

- Technological development in hard-to-abate industries could progress surprisingly fast if supported by adequate economic incentives and consistent, strong environmental and industrial policies.
- Deployment of renewable energy and hydrogen energy solutions.
- Emerging innovations in nature-friendly technologies offers a path to decarbonization aligned with ecological goals.
- The Clean Industrial Deal and the Industrial Decarbonization Accelerator Act (2025) offer concrete tools, including demand stimulation, sustainability criteria, and over €100 billion in targeted funding.
- The Budapest Declaration boosts industrial decarbonization through the Innovation Fund and anticipatory investments with state guarantees.

Question 7.1.

Question	In 2040, the EU has implemented a smart and coherent regulatory environment that significantly reduces the administrative burden on businesses, while fostering a culture of innovation and competitiveness.
Description	Do you agree that the EU will be able to achieve this regulatory environment by 2040?
Number of participants (n)	24

	Relative	Absolute
Yes, this will be true by 2040.	62.50%	15
No, it will take longer.	16.67%	4
No, this will never be possible to achieve.	12.50%	3
I don't know.	8.33%	2

Question 7.2.

Question	In 2040, the EU has implemented a smart and coherent regulatory environment that significantly reduces the administrative burden on businesses, while fostering a culture of innovation and competitiveness.
Description	What safeguards should be in place to ensure that reducing administrative burdens does not undermine environmental or social protections?
Number of participants (n)	19

Participant	Value
Anonymous 57	This just must happen! The review of the (organically grown) policy set-up must be done, and if the option is included that regulations, that proved to be ineffiicient can be removed, there is a chance for coherence. In my view, this is the only aspect, that is within full "human control" - smart use of AI could support this coherence process considerably as well.
Anonymous 38	This is feasible, but not for the good. Currently, the discourse seems to be led by profit orientation, growth, and expansion. Deregulation increases the risk of inequity and imbalances. A social market economy needs to counteract the strong economisation discourse to safeguard social well-being and equity. This would be the essence of environmental liberalism. However, the current discourse led by libertarian protagonists (Trump, Musk, Thiel, etc.) is capitalistic and power-oriented. The EU needs a clear position on the fairness and well-being of citizens.
Anonymous 107	This being put in place but some MS will face some challenges
Anonymous 17	The EU has indeed rolled out various initiatives to cut red tape, such as the Better Regulation Agenda and the REFIT program (Regulatory Fitness and Performance). These aim to simplify laws, improve consultation with stakeholders, and make legislation more future-proof with a clear direction toward innovation, transparency, and competitiveness especially important in fast-moving sectors like digital tech and sustainability. Reducing further administrative burden needs more and excessive preparation as EU is struggling towards this scope over many decades.
Anonymous 90	Safeguards should include clear minimum for environmental and social standards with robust impact assessments, transparency, and stakeholder participation, particularly from civil society. Digital tools should be used to reduce burdens while maintaining accountability.
Anonymous 106	I sincerely don't know, maybe too ambitious also due to important national cultural/businesses differences, inequity/imbalances are expected on the way

Anonymous 129	- permitting does not need to be faster, but more resilient + ensure different EU legislations are not contradicting - more clarity on how to deal with innovation vs permitting ...
Anonymous 9	Current economic system & decision-making distribution
Anonymous 4	Transparency at policy making Avoid watering down the improvement efforts Clear terms and conditions
Anonymous 102	specific capacity building
Anonymous 47	Policies that prioritise environmental and social protections over GDP growth
Anonymous 5	regular monitoring or audit penalties in case of undermining environmental or social protections (polluter pays principle) - businesses shall feel accountable transparency - information on environmental and social dimensions shall be public
Anonymous 97	There are no strange safeguards that could guarantee this as there is always a co-evolution between regulations, breaching of regulations and escape strategies.
Anonymous 72	effective participation of all stakeholders in the process of formulating reporting requirements
Anonymous 14	as we see it today there is no movement to reduce the administrative burden, even more burden
Anonymous 124	more focus on European long-term research capacities and targets; less funding of singular research projects with widely spread thematics and without continuity essential for sustainable knowledge progress and to reach a level of competitive demonstration; more national co-operation at R&D programs; better data transparency; more free space for innovation within companies and institutions; more support for start-ups and rolling out of innovations, ... much more realistic and pragmatic legislation for prosumers and SMEs on national and European level; a very positive atmosphere for innovator teams and pioneers – because they are the real heroes :-) on innovation competitiveness
Anonymous 56	Focus on the benefits of trusted institutions and trust-capital still exploitable in Europe, instead of seeing public administration a burden for a single enterprise.
Anonymous 81	Current political turmoil will eventually motivate for smart & coherent env policy that serves also the long-term economic prosperity. Safeguards perhaps can come from the private sector, from coalitions of forerunner companies
Anonymous 148	I think the Omnibus aims for exactly that - the need for economic autonomy from US and China will remain a strong pressure to this end.

List of identified elements

Needs:

- Review and streamline the current (organically grown) regulatory setup, remove inefficient regulations.
- Develop more realistic and pragmatic legislation for prosumers and SMEs at both national and EU levels.
- Ensure coherence across EU legislation and better define how to regulate innovation versus permitting. Build resilient permitting systems rather than simply speeding them up.
- Make legislation more future-proof, especially in fast-changing sectors such as technology and sustainability.
- Use AI and digital tools to support simplification and coherence.
- Ensure transparency in policymaking, with clear terms and conditions, robust impact assessments, stakeholder participation, including civil society.
- Introduce regular monitoring and auditing systems. Ensure effective participation of all stakeholders in the process of formulating reporting requirements. Improve data transparency across EU and national levels.
- Invest in capacity building, especially for national administrations, with a focus on specific capacity building for sustainability.
- Strengthen the social market economy to counterbalance profit-oriented deregulation. Establish a clear EU position on fairness, equity, and citizen well-being. Set clear minimum environmental and social standards.
- Adopt policies that prioritize environmental and social protection over GDP growth.
- Apply penalties in cases of undermining environmental or social protections, with polluter pays principles to make businesses accountable.
- Focus more on European long-term research capacities and targets, with less funding of singular short-term projects and more continuity to ensure sustainable knowledge progress. Promote stronger national co-operation in R&D programmes
- Support start-ups and roll-out of innovations with financing and policy incentives.

Risks:

- Deregulation driven by profit-orientation, growth, and expansion may erode social and environmental protections. Risk of increased inequities and imbalances if safeguards are not in place.
- Influence of libertarian and hyper-neoliberal narratives (e.g. Trump, Musk, Thiel) pushing for minimal regulation.
- Existing economic system and governance models may hinder reform efforts.
- There are no strong safeguards that can guarantee lasting protection, since regulations co-evolve with breaches and escape strategies.
- Member States may face implementation challenges due to differences in capacity or political will. The overall ambition may be too high, given national cultural and business differences.

Current discourse:

- Simplification is already underway, but more preparation and work are needed. Existing EU efforts include the Better Regulation Agenda and the REFIT (Regulatory Fitness and Performance)

Programme. The Omnibus initiative is seen as an effort in this direction, with strong pressure coming from the EU's need for economic autonomy from the US and China.

- A tension persists between economic liberalisation and the need for safeguards to protect environmental and social goals.
- Currently, there is no clear movement to reduce the administrative burden, and in fact, additional burden is being created.
- Political turmoil may motivate the creation of smart and coherent environmental policies that also serve long-term economic prosperity.
- Safeguards may emerge from the private sector, with coalitions of forerunner companies taking the lead.

Question 8.1.

Question	In 2040, the EU is the global leader in biomaterials, bio-manufacturing, biochemistry, and agri-biotechnology, with these sectors contributing significantly to its competitiveness.
Description	Do you agree that the EU will attain this level of leadership in biotech innovations by 2040?
Number of participants (n)	24

	Relative	Absolute
Yes, this will be true by 2040.	16.67%	4
No, it will take longer.	20.83%	5
No, this will never be possible to achieve.	4.17%	1
I don't kow.	58.33%	14

Question 8.2.

Question	In 2040, the EU is the global leader in biomaterials, bio-manufacturing, biochemistry, and agri-biotechnology, with these sectors contributing significantly to its competitiveness.
Description	What are the most significant risks or opportunities for the EU in achieving and sustaining this leadership?
Number of participants (n)	16

Participant	Value
Anonymous 57	No expertise on this market segment
Anonymous 38	I think this is a wrong pathway. We need clever improvements but mainly we should aim for nature bases solutions. Otherwise, the risk is so high from pandemics to irreversible damages to gene pools.
Anonymous 107	There are different developments in the EU for these areas...more efforts and funding schemes are needed to support research and innovation
Anonymous 17	The EU has already strengthened her position in playing a significant role in biomaterials, bio-manufacturing, biochemistry, and agri-biotechnology. There are three main opportunities intact that can position EU to play a significant role in its competitiveness and strategic autonomy, namely the recent EU Biotech Act, the strategic financial instrument of the Circular Bio-based Europe Joint Undertaking (CBE JU) and the newly developed EU Bioeconomy Strategy (2025). All these three initiatives make us consider that in 2024 would contribute greatly to making the EU global leader in this sector.
Anonymous 90	The EU has a strong foundation in science, research, and innovation capacity, but faces a significant investment gap in scaling up and commercialising biotechnologies. To realise the full potential of this sector, regulatory frameworks may need to evolve—particularly around emerging technologies such as gene editing—while still safeguarding environmental and health standards. Key risks include public opposition and global competition from regions with mare agile regulation and higher risk tolerance.
Anonymous 106	EU has a well-established market for biomaterials and significantly progressed in science and research. Aging population is a driver for advancing in biomaterials though maybe Asia has a faster rate and that is more motivation to lead the market.
Anonymous 9	Current economic system & decision-making distribution

Anonymous 4	Cost of boosting innovation Global cooperation in RND for nature-based solutions Re-discover traditional and indigenous knowledge
Anonymous 102	cost allocation
Anonymous 83	we must be careful putting too much emphasis on the bio-economy, as we also need to bring back our bio-footprint to have in within acceptable limits
Anonymous 5	opportunities in bringing the EU vision for agriculture and food into realization and leading by examples opportunities in further growing of organic agriculture risks of soil pollution (especially given the war in Ukraine)
Anonymous 97	accountability of bio-innovation in Europe ("not in my backyard") is a severe obstacle to development of the EU's bioeconomy compared to other world regions
Anonymous 19	Other countries moving faster ahead
Anonymous 14	the first part yes, but I am not sure if this contributes to the overall competitiveness, as this depends on if this is asked for by others as well
Anonymous 124	common research initiatives and building-up excellent research capacities; open date policy and synergy with research on artificial intelligence
Anonymous 81	Difficulties to truly renew CAP will slow down the positive development in agro-sector. Biotech sector remains to be behind US and Asian competitors

List of identified elements

Opportunities:

- Existing EU strategies and instruments such as the EU Biotech Act, Circular Bio-based Europe Joint Undertaking (CBE JU), and the EU Bioeconomy Strategy (2025) provide a strong framework to strengthen EU leadership.
- The EU already benefits from a strong research and science base, as well as a well-established biomaterials market.
- The ageing population could drive demand for biotechnologies, particularly in health and care.
- Strategic leadership in biotech and bioeconomy could enhance EU competitiveness and strategic autonomy.
- Opportunities to realize the EU’s vision for sustainable agriculture and food, leading by example globally. Further expansion and support of organic agriculture.

Needs:

- More funding schemes and policy support for research, innovation, and industrial scaling.
- Common research initiatives and building up excellent research capacities.

- Bridging the investment gap in commercialization of biotechnologies.
- Adaptation of regulatory frameworks, particularly for emerging technologies such as gene editing, while maintaining strong environmental and health protections.
- Global cooperation in R&D, especially for nature-based solutions.
- Recognition and integration of traditional and indigenous knowledge.
- Open data policy and stronger synergies with research on artificial intelligence.

Risks:

- Overreliance on technological solutions may pose environmental and biological risks, including pandemics or gene pool disruption.
- Too much emphasis on bioeconomy without reducing the EU's bio-footprint could undermine sustainability goals.
- Stronger global competition from countries with more agile regulations and higher risk tolerance.
- The EU biotech sector risks remaining behind US and Asian competitors.
- Public opposition to biotechnology, particularly around sensitive areas like gene editing.
- Accountability of bio-innovation in Europe ("not in my backyard") could severely slow development compared to other world regions.
- Structural economic constraints, including the current economic system, cost allocation, and high costs of innovation.
- Risk of soil pollution.
- Difficulties in truly renewing the Common Agricultural Policy (CAP), slowing positive development in the agro-sector.

Question 9.1.

Question	In 2040, the EU has a single capital market system dedicated to biotech innovations, enabling biotech startups to scale up effectively within the EU and compete successfully.
Description	Do you think achieving this will be possible by 2040?
Number of participants (n)	25

	Relative	Absolute
Yes, this will be true by 2040.	36.00%	9
No, it will take longer.	4.00%	1
No, this will never be possible to achieve.	0.00%	0
I don't know.	60.00%	15

Question 9.2.

Question	In 2040, the EU has a single capital market system dedicated to biotech innovations, enabling biotech startups to scale up effectively within the EU and compete successfully.
Description	What are the key enablers or barriers to creating such a capital market system?
Number of participants (n)	12

Participant	Value
Anonymous 57	mindsets and scepticism within the population might be a barrier
Anonymous 38	not sure, where this should lead. I don't see any need for prioritization in this segment. This might be the biggest obstacle: Why should we focus on this segment, when priorities should be in adaptation, mitigation and wellbeing of the people.
Anonymous 17	Although, the EU does not yet have a single, fully unified capital market system exclusively dedicated to biotech innovations, it is actively working toward creating a more integrated and supportive environment for biotech startups and scaleups through several key initiatives. Mainly through Savings and Investment Union (SIU) initiative along with the newly in development Biotech Act, the E. Commission has laid the foundations for the development of biotech innovations that are capital intensive and require long-term investment horizons. Moreover, the recent EU Startup and Scaleup Strategy could create the right environment for improving financial mechanisms and market access for innovation.
Anonymous 90	Potential barriers include differing national interests, risk tolerances, hesitation to cede control and national funding priorities. Biotech firms may be drawn to more agile markets outside the EU.
Anonymous 106	No expertise or ideas on that
Anonymous 9	Current economic system & decision-making distribution
Anonymous 4	Ability to lead the global cooperation and achieve a level playing field.
Anonymous 102	being surpassed by other markets
Anonymous 5	establishing common rules from the capital market system in the EU directing citizens' savings to support of biotech innovations (raising awareness for the support needed, creating incentives, e.g. tax reduction in case of savings is directed to biotech innovations) barriers are in the variety of national regulations

Anonymous 97	usually, start-ups are subject to mergers and acquisitions of large, capital rich companies to prevent innovations from cannibalizing their profitable markets.
Anonymous 14	yes, if we talk about competitiveness within the EU
Anonymous 81	Not sure what "single capital market system" would entail

List of identified elements

Enablers:

- Ongoing EU initiatives such as the Savings and Investment Union (SIU), the EU Biotech Act, and the Startup and Scaleup Strategy, which aim to integrate capital markets and support biotech development.
- Improvement of financial mechanisms, better market access, and attraction of long-term investment for capital-intensive biotech innovations.
- Establishing common rules for the EU capital market system to create a level playing field across Member States.
- Directing citizens' savings toward biotech innovations through awareness-raising, tax incentives, and savings schemes that channel private capital into innovation.

Barriers:

- Diverging national interests, risk tolerances, and reluctance to share control over national funding mechanisms.
- Public scepticism and lack of societal consensus on prioritizing biotech over other urgent areas such as climate adaptation or well-being.
- Strong competition from more agile and attractive non-EU markets, which may divert both talent and investment away from the EU.
- Structural challenges in the economic model and limited EU capacity to guarantee a globally competitive level playing field.
- Mergers and acquisitions by large, capital-rich companies that can suppress innovation by absorbing or sidelining startups to protect their existing market.