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# FORESIGHT

## Futures of Big Tech in Europe

### Scenarios and Policy Implications



*Research and  
Innovation*

## **Futures of Big Tech in Europe Scenarios and Policy Implications**

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# **Futures of Big Tech in Europe**

## ***Scenarios and Policy Implications***

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# EXECUTIVE SUMMARY

Big Tech is rewiring the world. These very large private companies, rooted in research and development (R&D), now wield unprecedented and unparalleled influence on production and consumption relations. They command vast resources, attain granular reach and wield informational leadership in the expansive ecosystems and elite technologies they operate. They have established important positions as intermediaries in the socio-cultural, political, and science domains of regions like Europe. In just one year, the top 5 Big Tech invested in R&I more than twice the funding allocated by the EU-27 to the Horizon Europe 2021-2027 programme.

In this redefined world, Europe faces a number of agenda-setting questions. Will the regulatory framework deliver? Should Big Tech be broken up or standards relaxed? Should national and supra-national authorities foster alternative ventures capable of operating at global scale and scope thereby challenging the dominance of the USA (and China)? Alternatively, should policy makers prioritise an economic fabric full of smaller enterprises that are locally creative and dynamic?

This policy brief aims to anticipate the implications of 'Big Tech' for Europe's future by 2040. The in-depth exploration adopts the format of a scenario exercise, with a focus on R&I policy.

Four scenarios here presented serve as vessels to transport us into the future. We assume that *varieties of high-tech capitalism* are potential outcomes, and that the road to 2040 will be marked by *multiple tipping points* concerning demography and climate. These scenarios are presented without reference to desirability or likelihood but explicitly function as strategic habitats for deriving policy options.

Scenario 1 '*Winners Tech All*' might resonate with those who lived through the 2000s, now confronted with the power of Big Tech. In contrast, scenario 2 '*Pax Technologica*' could be seen as an extrapolation from the period around 2020 but in a more robust and negotiated multipolar environment. Scenario 3 '*Re-matching*' envisions the recovery of a mixed tech economy where alternatives to Big Tech are viable. Finally, Scenario 4 '*Closet Liberalism*', portrays a low-obstruction/wide-field environment where bottom-up self-organised economic action propels Europe back onto the world's competitive map.

Throughout this exercise, we depart from three foundational policy principles: the need to *protect pluralism* (for instance, economic and societal), to maintain a *cosmopolitan outlook* (in world affairs), and to safeguard *natural commons* (including Earth and orbital resources). Based on these assumptions and the scenario analysis, we draw three headline conclusions:

- The EU must consider the development of its own leading actors, it cannot rely solely on regulating those headquartered in other geographies;
- The EU Framework Programme and national R&I budgets should be benchmarked not only against their past performance but also compared to the spending and strategies of Big Tech;
- 'Big bet' investments are needed in Europe, coupled with more serendipity-inducing experimental approaches.

In addition to these overarching policy stances applicable to all scenarios, we outline scenario-specific policy prospects. For each of the scenarios mentioned above, Europe requires the following:

- 1) Consistent competition supervision and technology regulation enforcement on national and EU levels;
- 2) Exemption of education and research expenditures at Member State level from the 3% threshold of budget deficit rules;
- 3) A new generation of bilateral and multilateral agreements with the Global South to co-develop productive and infrastructural capacities;
- 4) Promotion of hot-spots of agglomeration and place-rooted innovation-related public goods to foster a continuous throughput of 'small bets'.

## SCENARIO ARCHITECTURE

Two scenario-building work is structured around two dimensions: *more or less open international interactions across the board (a 'Closuring'/'Openeering' continuum) versus more or less leaning towards large R&D-based scale, scope and network economies (a 'Hyperscaling'/'Smallerscaling' continuum).*

Table A. The four scenarios

<b>Scenarios</b>	<b>+Closuring</b>	<b>+Openeering</b>
<b>+Hyperscaling</b>	<b><i>Pax technologica</i></b>	<b><i>Winners tech all</i></b>
<b>+Smallerscaling</b>	<b><i>Re-matching</i></b>	<b><i>Closet liberalism</i></b>

Scenario 1 is a world in which Big Tech replace markets. In Scenario 2 Europe becomes an arsenal of regulation, while protecting its own champions. In the mirror of Scenario 3 there is a super-cycle of productive investment. Scenario 4 represents a large yard with small, but moveable, fences.

Table B. The scenarios in perspective

<b>Scenarios</b>	<b>Winners tech all (Scenario 1)</b>	<b>Pax technologica (Scenario 2)</b>	<b>Re-matching (Scenario 3)</b>	<b>Closet liberalism (Scenario 4)</b>
<b>Core driver</b>	Global oligopolistic competition	Regulated competition	Coordinated development	Emergent competitiveness
<b>Economy &amp; technology</b>	High-tech is hegemonic	Negotiations prevail	Active public players' policy leads the way	Edging through
<b>EU agency</b>	Going by the rules of the game	Living in cooperative clubs	The first base for investment	A minimalist arena
<b>Research focus</b>	Market-failures	Incentives for talent	Industrial strategy	Promoting trials
<b>Motto</b>	Driven by fear, driven by hope	Government-corporate arms wrestling	Shaping the championship	Fighting for survival
<b>Emotions</b>	Resignation, anxiety	Adaptability, apprehension	Voluntarism, trust	Cynicism, self-help

## POLICY RECOMMENDATIONS

### What constitutes a robust policy framework towards Big Tech across the various scenarios?

- The EU should consider nurturing its own leading actors in the technology sector.
- Increase transparency in technology lobbying. Employ innovative approaches to counter extreme information asymmetries. Actions by public authorities should be stakeholder-aware.
- Prioritise efforts to safeguard societal integrity (and economic pluralism) in this evolving era. Emphasize the importance of democratisation, participation, and experimentation in the policymaking process as key elements for legitimacy.
- Incorporate anticipatory capabilities into policy activities dealing with dynamic competition, including sectoral, technology, and product market supervision.



- Clarify the extent to which supply-chains are dependent on Big Tech and establish cooperation among different authorities, such as telecoms and mobility regulators, cybersecurity, and science & technology institutions.
- Benchmark EU and Member States R&I budgets and bets against those of Big Tech.
- Direct investment towards 'ecosystem infrastructures' as a structural logic. Revive R&I diplomacy.

#### **Options for Scenario 1: *Winners tech all***

- Alignment of the national & EU policies related to competition law and market regulation.
- Adoption of a robust rights-based approach to the pursuit of global guardrails in disruptive tech.
- Strengthened competition law and market regulation measures to safeguard democratic processes from potential negative impacts of Big Tech.
- Investment in a skilled and entrepreneurial population. Recognition of migration as a source of talent.

#### **Options for Scenario 2: *Pax technologica***

- R&I and industrial policy are crucial for ensuring prosperity, within and outside cooperative clubs.
- Use of EU R&I policy and adaptation of State Aid rules enabling national governments to apply more ambitious R&I policies, with the goal of enhancing the competitiveness of EU-anchored Big Tech.
- Encouragement of higher risk research and startups in disruptive tech, while ensuring that measures will be in place to block/discourage interferences by external interested parties.
- Exemption of education and research expenditure at Member State level from the 3% deficit rules.

#### **Options for Scenario 3: *Re-matching***

- Priority is to create and support a new wave of high-tech companies to compete with USA and Chinese corporations in emerging sectors.
- Establishing new-generation bilateral and multilateral agreements on trade, investment, and R&I.
- Central role of education and training in European public policies.
- The EU promotes education and cultural collaboration with the Global South.

#### **Options for Scenario 4: *Closest liberalism***

- Promotion of agglomeration hotspots of and place-rooted innovation strategies. Support business associations to generate public goods for their respective sectors.
- Establishment of a minimalist framework for an enhanced transactional but serendipity-prone economy, facilitating the prosperity of civil society. Stimulate 'small bets' with the help of sectoral regulatory agencies.
- Development of regulatory networks beyond 'like-minded' countries through the adoption of a pragmatic approach.
- The EU fosters educational collaboration with the Global South.

# 1. INTRODUCTION

Large R&D-based companies, commonly known as Big Tech, have emerged as major institutions driving technology, defining networks, shaping markets, and influencing various aspects of our lives. These companies, mainly concentrated within the West Coast of the United States of America (USA), along with challengers in Mainland China, Taiwan and elsewhere, hold significant informational leadership. Societies have come to rely on Big Tech for work, consumption, communications, logistics, and self-expression. Decision-makers, regulators, and stakeholders grapple with breakthrough innovations, enhanced connectivity, lopsided competition, and a number of ethical and political implications for how communities and countries govern themselves.

In facing these challenges, organised societies face difficult choices. Should Big Tech be allowed to continue unimpeded? Should governments consider breaking them up or attempt to tame them by imposing detailed standards of conduct? Should national and supra-national authorities strive to foster new and alternative undertakings capable of operating at global scale and scope? Or should policy actors prioritise an economic fabric filled with smaller-sized enterprises that are creative and dynamic at the local level?

**This policy brief explores what ‘Big Tech’ could imply for the future of Europe. In our in-depth analysis, we project towards 2040 and draws implications for Europe, emphasising research and innovation policy.**

Could large, tech-driven companies serve as effective instruments for the European Union (EU) to navigate the challenges of the future economy? Is this avenue viable and feasible? Conversely, have foreign-owned Big Tech companies already established overwhelming dominance, leaving the EU vulnerable to the influence of these sprawling giants? Can the EU adapt through bottom-up economic action? Addressing these critical questions, we believe it is timely to tackle these pressing issues.

The scenario work at the core of this report frames potential strategic habitats with high-tech activities as the overarching theme. From each scenario we derive policy implications – ideas and options that, if followed now, would better position Europe within each strategic habitat. Additionally, we draw cross-cutting implications – ideas that will assist Europe in positioning itself more effectively for the future across all strategic habitats.

## **Scope of the exercise**

European companies not only face under-representation among leading high-tech enterprises but also heavily depend on foreign Big Tech. In this in-depth exploration, we project towards 2040, directing attention to Big Tech and examining their future implications for Europe. Our focus revolves around oligopolistic Big Tech and their impact on research and innovation (R&I), questioning whether this influence is beneficial for society. Moreover, we ponder the prospect of Europe developing its own Big Tech companies and, if so, consider the pros and cons of such a move. Can Europe afford to lack its own headquartered Big Tech players in the global competitive landscape? These critical questions merit thorough analysis, and four scenarios are drawn to explore them.

## 2. OVERVIEW OF BIG TECH

### 2.1. Overview of tech bigness

The influence of Big Tech has fundamentally reshaped the world. When we refer to Big Tech, we loosely **encompass the largest corporations that prioritise high technological intensity as a key pillar of their business development**. In this brief, we intentionally avoid being confined by commonly used labels such as ‘tech titans’ or ‘tech giants’, which have gained popularity in the press and everyday language. While we acknowledge the connotations associated with these terms, we go beyond these conventional references.

Recently, the term ‘Big Tech’ has become linked to significant players in information and communication technology (ICT), specifically the dominant digital platforms headquartered in the USA, recognised by the acronym GAFAM (Google/Alphabet, Apple, Facebook/Meta, Amazon, and Microsoft). In China, a similar grouping is known as BAT (Baidu, Alibaba, Tencent). Sometimes other companies, like Tesla or Xiaomi, are also lumped together under the same umbrella. The use of the term ‘Big Tech’ gained traction in the early part of the 2010s and experienced widespread currency in the later of the decade (Figure 1).

Figure 1: Frequency of use of the term ‘Big Tech’ over time



Source: Google ngrams viewer

Note: Y-axis refers to the weight of the character string in the total corpus of digitised text; the scale is not presented, since the weight is usually very small

While most of the leading Big Tech combine software and hardware and utilise platform business models, these are only some of the technologies and approaches we look at in this brief; we also consider strategic sectors like automotive, energy, retail, aviation and space, defence and pharma. In many of these sectors, which are based on elite technologies (i.e. complex, difficult to replicate, and expensive knowledge-bases), and which display significant network externalities, the signs are that Europe is being squeezed out and that the edge of the ‘Global West’ (the USA and the EU, but also increasingly close associates like Australia and New Zealand) being blunted by the Asia-Pacific region as a whole.

In the context of our study with the term ‘big’ we refer loosely to market capitalisation, users and/or revenues. Overall, in terms of valuation, **60 out of the 100 largest companies of the world have their headquarters in the US, 19 in the European continent, and the remainder in Asia** (see Appendix I). Five out of the six **trillion-dollar companies** are based

in the US and all of them are 'tech'.<sup>1</sup> Among the largest 100 tech companies the picture is similar (based on market capitalisation, see Appendix II), the first 7 are American, the following 2 are from Asia – the first European headquartered tech companies are found on 13th (ASML, Netherlands), 20th (SAP, Germany), and 35th (Schneider Electronics, France) place; in total only 11 European companies in the top 100. If the metric is the top 500 world ranking by *sales revenues*, the three large **US-based ICT usual suspects** make it to the top 10 (Amazon #2, Apple #4, Google #8) and the other 2 are comfortably in the top 50 (Microsoft #13, Meta #31).<sup>2</sup> The under-representation of European companies is visible moreover in the Digital Services Act classification of *very large online platforms* (VLOPs), with only Booking.com and Zalando listed as EU based VLOPS and very large online search engines (VLOSEs), with no EU based companies, defined by attracting more than 45 million users per month in the EU. Sectoral change is a key part of the story but, overall, innovation performance in North America (US, Canada) and the Far East (South Korea, China) is pulling ahead at a higher rhythm than Europe since at least the mid-2010s (European Commission, 2023a, p. 37).

## 2.2. Appreciating tech bigness in R&I

Government agencies, independent authorities, and private think-tanks are among those actors that have issued warnings regarding market power and growing concentration in Big Tech. Questions are motivated by **concerns that lesser competitive intensity penalises economic efficiency, hampers innovation, leads to growing inequality and presents risks to the health of political processes:**

- The US Council of Economic Advisers (2016) pointed to 'a decline of competition' and 'increasing industry concentration', namely by offering evidence that the majority of sectors witnessing increases in the revenue share enjoyed by the largest firms from the 1990s to the 2010s;
- In the UK an analysis of the biggest 100 firms found increasing concentration from the 2000s to the 2010s, a phenomenon resistant to crises and compounded by the observation that highly concentrated industries have grown in size (Resolution Foundation, 2018);
- An in-depth analysis of the Canadian economy from 2000 to 2020 found that concentration further increased already in the most concentrated industries, rank stability solidified, top firms were less challenged, fewer firms entered industries, profits and mark-ups increased overall both becoming greater for those firms already earning higher economic and financial gains (Competition Bureau Canada, 2023).

**The contrast of outsized highly profitable undertakings with the anaemic performance across the rest of the economy** has been also the focus of worries of the specialised press and investment banks. Some examples:

- Exploitative behaviours of very large undertakings impose a tax upon others. Signs have been read in the 'the existence of firms more adept at siphoning wealth off than creating it afresh, such as those that exploit monopolies' (*The Economist*, 2016);

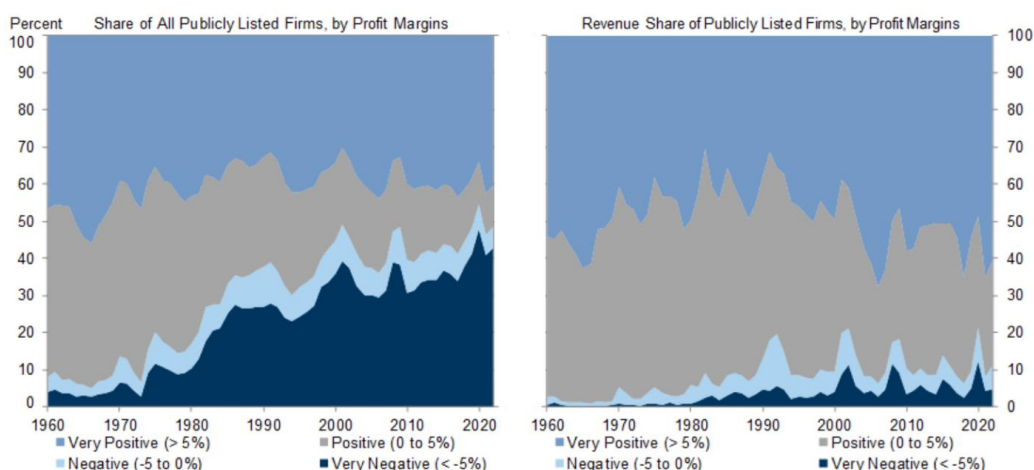
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<sup>1</sup> <https://www.ft.com/content/d3373bc2-e5f3-487d-8c72-10c4b921cb4d>

<sup>2</sup> <https://www.zyxware.com/articles/4344/list-of-fortune-500-companies-and-their-websites>

- Inequality is rising. Fortunes concentrate in some geographies and business areas as American tech dominates the 2023 top billionaire ranks, indeed US tycoons take 17 of the top 25 spots and those among the top 25 mostly made their money in technology (8 list members) (*Forbes*, 2023);
- Evidence points to ultra-big business as the only economically healthy game in town. As Figure 2 shows, the proportion of unprofitable US publicly listed companies is on the rise at least since the turn of the 1980s reaching almost 50% in 2022 (left-hand side), while that of very profitable ones has kept steady. Moreover, the share of business activity that 'hyper-profitable' corporations account for is much larger and in 2022 surpassed an economically overwhelming 60% of total business revenues (right).

Figure 2. Economic health of the US listed corporate sector, 1960-2022



Source: Goldman Sachs & Co. (2023)

Big Tech, especially from the ICT sector, integrate technologies prone to dynamic economies of scale and scope that allow them to operate a network of interconnected businesses that will encapsulate a sizeable portion of the world economy by the 2030s (US House of Representatives 2020, p. 11). However, their **ubiquity in our lives did not only emerge organically**: many of the take-overs of emergent innovative players remained under the threshold of triggering antitrust reviews and were too small to be announced (Congressional Research Service 2023, p. 33). Although being a phenomenon that went underreported for much time, it is generally recognised that many of these acquisitions may have targeted 'nascent competitors' (a subset of a tactic known as 'copy, acquire, kill') and established positions outside their original business and into new sectors (*Washington Post*, 2023) (see Appendix III).

Big business runs already a significant portion of the economy and has a disproportionate impact on reported performance indicators. For instance, the 'rising profits of Multinational Enterprises (MNEs) point to the key role of **large corporations dominating international activities**' (UNCTAD 2023, p. 48). Today, moreover, non-R&D-driven and non-platform economic activities appear increasingly under-powered. '**Older tech** large companies are **losing ground**, like the formerly dominant fossil fuels industry, which have steadily slid down the ranks of the world's largest companies (Fortune, 2021).

In terms of making their voices heard Big Tech also dominates, having trumped Big Oil and even Big Pharma. European Transparency Register Data for 2023 reveals that the top 5 lobby spenders in the EU are Meta (€8 million), Apple (€7m), Bayer (€6m), Alphabet (€5.5m) and Shell (€5.5m) (Corporate Europe Observatory, 2023). **Big Tech's lobbying power is on the way up**, having risen an aggregate of 97 to €113m from 2021 to 2023 – a 16.5% increase. These numbers underestimate their political clout and their footprint in public debate as Big Tech are among the firms not systematically declaring their funding of think tanks, NGOs, business associations and start-up organisations (Corporate Europe Observatory, 2021).

**Big Tech companies continue to pursue strategic high-priority growth areas** (J.P. Morgan 2022). A leading indicator of their sustained seeking of long-term opportunities is investment in R&D. The significant resources allocated to knowledge building activities can be assessed in relation to other large firms from more mature industries. In benchmarking exercises, the EU is often compared to other regions, but it is enlightening also to see how it stands in contrast to Big Tech themselves.

When it comes to *investment in innovation*, the top 10 companies in 2022 in terms of R&D budget are Amazon, Meta, Alphabet, Apple, Microsoft, Tencent and Intel from the USA, Huawei from China, Samsung from South Korea and only Volkswagen from Europe.<sup>3</sup> The combined big five USA-based tech companies have invested **over \$bn200 in R&D** in 2022, representing 80% of their profits and 30% of all R&D spending by American listed companies (*The Economist* 2023, pp. 47-48). Seven of the top 25 companies in terms of European patent applications in 2022 are from Europe, 8 are from the US, and the rest are from the Far East (Appendix IV).

**Among the world's top 2500 corporate investors in R&D, the EU occupies the third place** in terms of companies' headquarters (European Commission, 2022). Data for 2021 shows that 822 are from the US, 678 from China and 361 from the EU. The rest of the world comprises Japan (233), UK (91), Taiwan (80), South Korea (52), Switzerland (54), and further 21 countries. In 2021 the number of EU-based companies fell by 40 (from previous year), total EU corporate spending was €192.8b (increase of 8.9% compared to 2020, while the US grew by 16.5% and China 24.9%), the global R&D share of EU companies was 17.6% (decrease from the 20.3%), and companies were headquartered in 16 of the 27 EU countries (17 in 2020).

**Technology-intensity is highest in ICT (services, equipment) and health (biotech, pharma)**, but rapid change also taking place in energy generation and also in mobility ecosystem usages (Appendix V). In the US top 10 the first 5 companies are from ICT, the next 4 from health industries and 10<sup>th</sup> from the automotive sector. Of the top 10 Chinese investors the first 4 are from ICT, another 4 from construction engineering (including railways and roadways), and another from the automotive sector. In the EU case, the first 5 are from the automotive sector, the next two are from health and the final 3 from ICT. Overall, the US exhibits a specialisation in ICT and health, China has increased ICT R&D considerably, and the EU continues to show its strength against the US in automotive and against China in health (European Commission, 2022, pp. 26-28).

**An image of structural shift emerges if we take a longer view.** The top 10 performer list went through momentous changes during the 2010s. Comparing the years 2015 and 2020 there is a steady concentration of R&D in the top 10 performers (from 14.1% to 16.4%) (Table

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<sup>3</sup> Data from company accounts. Source: <https://www.statista.com/statistics/265645/ranking-of-the-20-companies-with-the-highest-spending-on-research-and-development>

1). There were two new entries pointing to the relative increase of US ICT corporates as the most dynamic R&D performers. European-based industrial entities show much more modest, sometimes barely positive, increases of R&D overtime (European Commission 2021a, pp. 36-37). Stretching the time window back to 2010 the shift becomes even more apparent in the top 10: in that year the number 1 was Roche from Switzerland, of the US ICT companies only Microsoft figured, and no Chinese came even near as there are none in the top 50 (European Commission 2011, p. 21).

**It is also instructive to compare that with government budget allocations for R&D (GBARD) across the EU with other geographies.** In 2022, total public investment in the 27 EU countries stood at €117,368 million. This represented a 5.4% rise compared with 2021 (€111,393m) and a 49.2% rise compared with 2012 (€78,656.). In contrast, South Korea grew by 98.1%, Japan by 88.9%, and the US by 77.5% between 2012 and 2022.

Table 1. Top R&D corporate investors, 2015-2020

Rank-2020	Rank-2015	Company	Country	Sector	R&D-2020 € million	R&D-2015 € million	CAGR, %
1	4	ALPHABET	US	ICT services	22,470	11,050	15.3
2	8	HUAWEI	CN	ICT producers	17,460	9,467	13
3	5	MICROSOFT	US	ICT services	16,882	10,624	9.7
4	2	SAMSUNG	KR	ICT producers	15,895	11,080	7.5
5	11	APPLE	US	ICT producers	15,282	8,186	13.3
6	29	FACEBOOK	US	ICT services	15,033	4,824	25.5
7	1	VOLKSWAGEN AG	DE	Automobiles	13,885	13,672	0.3
8	7	ROCHE HOLDING AG	CH	Health	11,247	9,176	4.2
9	3	INTEL CORP	US	ICT producers	11,047	10,382	1.2
10	9	JOHNSON & JOHNSON	US	Health	9,909	7,412	6
18	6	NOVARTIS	CH	Health	7,114	7,335	-0.6
11	10	TOYOTA	JP	Automobiles	8,620	8,159	1.1
<b>Total Top 10</b>					<b>149,109</b>	<b>98,357</b>	<b>8.7</b>
Total top 2500					908,875	695,963	5.5
Share of Top 10 in Total Top 2500, %					16.4	14.1	

Note: CAGR - Compound Annual Growth Rate; data refer to own R&D funding data computed in accordance to Frascati guidelines.

Source: European Commission (2021a).

If the EU is directly compared with the largest tech companies some salient features stand out. The 5 US ICT companies spent an equivalent to €209,058m in 2022, an increase of 28.4% from previous year and an increase of 688% from 2012. At the current rhythm this will soon be the double of all the individual governments' gross expenditures on research and development (GBARD) by the 27 European countries put together (totalling €117,368m in 2022). **The Horizon Europe programme has a budget of €95,500m for the period from 2021-2027 (seven-year time span), hence less than half of the Big 5 for 2022 (a single year).**

**Amazon has a larger R&D commitment than any European Member State.** The largest national government budget is Germany's which is the only EU country that makes it to the top 5 when governments and private entities are put into direct comparison. Alphabet, which is the second largest Big Tech in terms of R&D spending, has more than double of the budget of the second largest country, France (Table 2).



Table 2. Public sector R&D budget allocations in 2022 (top EU countries) vs Big Tech

Rank	Entity	€m
1	<b>Amazon</b>	69,625.56
2	Germany	43,085.30
3	<b>Alphabet</b>	37,564.50
4	<b>Meta</b>	33,606.44
5	<b>Apple</b>	24,964.70
6	<b>Microsoft</b>	23,310.91
7	France	17,899.71
8	Italy	12,654.46
9	Spain	7,956.80
10	Netherlands	7,751.55

Source: Eurostat; <https://www.macrotrends.net>

Note: Country data refers to government budget allocations for R&D (GBARD)

Recent trends keep indicating a concentration of extreme growth in R&D investment at the very top of big business undertakings, that is, already frontier firms located at the right end of the corporate size distributions appear to be committing the largest resources for future breakthroughs. In 2023 the top 10 and the top 50 R&D spenders were also the top contributors to R&D growth in the global top 2,500 high-tech firms, again with special note to ICT services and ICT producers displaying “the most impressive changes” European Commission, 2023b, p. 15).

### Setting the scene for the scenarios

So, is it the case that the economy is dividing into two blocs: Big business, powered by high-tech, and the rest? As Big Tech outperform in R&I capabilities will there be room for the ‘average firm’ or for a ‘middle economy’? What happens if there are globalisation-friendly cooperative governments no more? Will there be limits to technology-driven productivity and global imbalances? Can Europe change its destiny?

## 3. SCENARIO BUILDING

### 3.1. Studying the future(s)

Foresight is about envisioning potential scenarios. It involves **stretching hypotheticals**, especially along lines related to the potential for *high impact* and associated *high uncertainty*. The value of foresight lies in illustrating implicit assumptions – things we often take for granted. The interest lies in the policy challenges and the underlying currents behind the challenges.

Embarking on a journey of exploring futures, we analytically admitted a landscape where **varieties of high-tech capitalism** are conceivable. Economic, technological, institutional, societal, and ecological factors of change can converge to shape different worlds. The pieces of the puzzle are undergoing transformation, and the final image is not predetermined. Megatrends and crises provide fertile ground for unexpected outcomes. Contingencies and choice play crucial roles in shaping the future.

Amidst the contradictory pressures characterising the economy, **big business from high-tech sectors have emerged to play a decisive organisational role** in countries, entire continents, and even world history. Exploring their impact is the linchpin of this brief, aimed at understanding how industrial patterns and economic order could evolve in the next decades. While we cannot disentangle ourselves from historical time, we need not be prisoners of it. As the authors embarked on this project, it became evident that several shocks were **accelerating change**. In 2020, the full-blown Covid crisis. In 2021, the disruption of global supply chains, epitomised by the obstruction of the Suez Canal trading route by one of the world's largest container ships – the Ever Given. In 2022, the Russo-Ukrainian war. In 2023, the Hamas-Israel war.

### Terms of engagement with the future

Geographically, we refer to Europe but institutionally to the EU. We look towards 2040. When we mention Big Tech, we are not exclusively referring to today's predominant giant digital platforms or other ICT-oriented ventures (mostly from the US and also from China), but also, in a broader sense, to those R&D-based corporations situated at the core of sectoral techno-economic systems such as biotech & pharma, mobility & aerospace, clean-tech & smart materials, etc. The emphasis of our exercise is on the leadership that these economic agents can attain and sustain, even as they succeed one another at the technological forefront. We will consider alternative future scenarios in the present tense (as if already existing), without analysing the trajectories from today until then. While the challenges are global, we specifically address them from the European (R&I) policy perspective.

## 3.2. Scenario scoping

The basic architecture for the tailor-costumed exercise is designed to facilitate explorations into how the Big Tech phenomenon and EU policy may interact in the future. The methodology is geared towards generating scenarios (Appendix VI) and relies critically on structured dialogue with external experts (Appendix VII). Based on **factors of change** influencing future developments (Appendix VIII), two contrasting dimensions were defined to provide a starting point for the scenario work (3), ensuring that scenarios are self-contained and distinctive. The **dimensions** represent dominant uncertainties, and their interplay can project into different future worlds. Thus, we have scenario narratives for **four alternative futures** (Figure 3). In this exercise, we did not ponder the myriad of interlocking steps and unfathomable bifurcations that could help materialise the scenarios or that can switch one for the other (Appendix XIX). We simply consider their nature. Then, in linking scenarios to policy, we understand them as a set of **strategic habitats** and appreciate how they are (im)pertinent and inspirational for actionable advice (Appendix X).

Table 3. Key dimensions for the scenarios

**Dimension 1: Global governance**

+ *Openeering (open international interactions across the board)*

There remains a singular global economy chessboard where pragmatic interests dictate the moves. The economy revolves around hedging and transactions, and sectors more adapted to this business model triumph. GDP stands out as the predominant criterion for success. Interventions in the common market are largely performative and marginal, leaving EU member states to attempt to transpose that pattern internally by establishing a coherent division of labour among member states or by competing each other to attract investment in a perceived ever diminishing opportunity pool.

+ *Closing (international integration is asymmetric but managed)*

Countries self-organise into cooperative clubs, and partially overlap in doing so. The breakdown of globalisation as we knew it does not signal the end of commerce. This is more similar to networked isolationism, as meso-lateralism plays a role in the post-globalisation era. Instability is contained and borders matter. The European continent is connected to a narrower number of foreign partner economic spaces or strategically develops diversified ties to a select number of mega-regions.

**Dimension 2. Techno-economic profile**

+ *Hyperscaling (bias towards large R&D-based scale, scope and network economies)*

High-tech factors of production wield the greatest influence. These elite technologies (based on high-R&D investment and on expensive, difficult to replicate infrastructures) are exceedingly expensive and challenging to replicate. Those in control of them are determining (either directly or indirectly, through competition or cooperating) among themselves how the economic game is shaped. Quasi-monopolies drive progress; a significant orchestration status provides centrality. Smaller firms, lower-tech sectors, and smaller countries are dependent on the core inputs of central knowledge-based players and struggle to maintain their share of value added in the economy.

+ *Smallerscaling (smaller and lower tech flexible specialisation initiatives)*

Economic power is less asymmetric among sectors. Technologies are absorbed and allow for a degree of appropriation. Activity can be deep-tech, not simply high-tech. Bigness is not the sole determining factor, and certain industrial segments are crucial; profit may spike in a few key intersections. The economic ecosystem is fairly decentralised in terms of initiative and surplus capture. Independent undertakings, rooted in local assets (both tangible and intangible), can develop unique capabilities with significant demand. Diversity is networked, and specialised meso-sized champions prove robust, even in non-core industries and peripheral niche markets.

The two dimensions constitute the scaffolding that helps providing structure to scenario-canvasing. While a simplification, their strength lies in the rich nuances that they allow to be revealed in the substantive descriptions of scenarios. Suggestive names are provided for the sake of illustration (**Error! Reference source not found.**).

Table 3. The four scenarios

	+Closing	+Opening
+Hyperscaling	<i>Pax technologica</i>	<i>Winners tech all</i>
+Smallerscaling	<i>Re-matching</i>	<i>Closet liberalism</i>

We may also call them Scenario 1 (WTA), 2 (PT), 3 (RM), and 4 (CL). The following sketches provide the essence of the scenarios:

**Scenario 1: *Winners tech all* (Big Tech replace markets)**

This is a tale of modernisation orchestrated around digital high-tech. The economy is not governed by Big Tech but rather by the infrastructures these private companies own and continuously refine. Growing dependencies can be tolerated because benefits are shared, and businesses are empowered to pursue their plans. The operating framework inherited from globalisation ensures a modicum of stability, namely informal institutions like the G7 or the G20 and formal institutions like the IMF and the World Bank. The US remains the sole superpower and maintains its role as agenda-setter. The room for manoeuvre for the EU is limited, and it takes its place in the international division of labour.

**Scenario 2: *Pax technologica* (Europe as an arsenal of regulation)**

The economy represents a negotiated tension between pro-global business interests and pro-local (local here referring to groups of countries with aligned interests cooperating and competing with each other, forming cooperative clubs) political constraints. The drive to take advantage of economies of scale and scope has been restrained by enhanced regulation and reinforced borders. Supply chains are fragmented and directed towards suppliers within the mega-regions composed of preferential partners, increasing costs but reducing uncertainty. Existing large tech firms must accommodate each other. Existing platform models are entrenched but are compelled to grant access to their digital and logistic facilities, leading newcomers to not invest in their own subversive infrastructure. Stability is valued, not so much efficiency. The US retains its role as an economic-financial and political-military switchboard, but for a diminishing part of the globe. China is still challenging the dominance of the US both politically and economically. Other regional powers emerge. In accommodating and redistributing external and internal pressures, the EU functions among Member States and stakeholders, and this is the ‘Brussels Consensus’.

**Scenario 3: *Re-matching* (a super-cycle of productive investment)**

What shapes the development of individual nations and regions is their own path in a pluralist international scene. Proactive and productive policy makes sense, especially if

coordinated among players. After years of blitz-scaling, the tide turned, and Big Tech went into a fizzdown. Cross-regional/trans-sectoral innovative players gain mass and find expansive growth niches at key intersections of a complex (mix) economy with an active role of the public sector associated with national governments and international organisations. Club commons generate citizen engagement, and global fragmentation is controlled. An overstretched, self-consumed US has to share protagonism with other world powers. The EU is a network builder, it supports the catalysing and protection of the new core inputs of the modernising economy.

**Scenario 4: *Closet liberalism* (large yard with small, but moveable, fences)**

In this world, commercial and financial integration proceeds, and power continues to trespass national borders, overwhelming states. Large multinationals are seen to have a significant impact on public governance, but tech monopolies have matured, becoming expensive and of poor quality. There is a mesh of networks, and competing authorities create an opportunity for decentralisation, especially at the local and city levels. The US serves its own interests and is more reluctant to assume responsibilities in global public goods. The EU preaches the superiority of the market order, but inside the EU, everyone tries to reinterpret the rules of the game to their benefit (fiscal responsibility is for the population, not for businesses).

The main features and differences of the scenarios are summarised in Table 4. Scenario 1 is a world in which Big Tech replaces markets. In Scenario 2, Europe becomes an arsenal of regulation. In the mirror of Scenario 3, there is a super-cycle of productive investment. Scenario 4 is a large yard with small, but moveable, fences.

Table 4. Key dimensions for the scenarios

<i>Scenarios</i>	<i>Winners tech all</i> (Scenario 1)	<i>Pax technologica</i> (Scenario 2)	<i>Re-matching</i> (Scenario 3)	<i>Closet liberalism</i> (Scenario 4)
<b>Core driver</b>	Global oligopolistic competition	Regulated competition	Coordinated development	Emergent competitiveness
<b>Economy &amp; technology</b>	High-tech is hegemonic	Negotiations prevail	Active public players’ policy leads the way	Edging through
<b>EU agency</b>	Going by the rules of the game	Living in cooperative clubs	The first base for investment	A minimalist arena
<b>Research focus</b>	Market-failures	Incentives for talent	Industrial strategy	Promoting trials
<b>Motto</b>	Driven by fear, driven by hope	Government-corporate arms wrestling	Shaping the championship	Fighting for survival
<b>Emotions</b>	Resignation anxiety	Adaptability apprehension	Voluntarism trust	Cynicism self-help

## 4. SCENARIOS

### 4.1. Scenario 1: Winners tech all

In this scenario, the trend towards scaling up has continued. The existing economic drivers of economies of scale and scope, network effects, vertical integration, and both endogenous and exogenous innovation (by mergers or acquisitions) have persisted for the Big Technology companies that existed in 2023. Many sectors of the economy have become platformised and have undergone similar developments (pharma, agro-tech, biotech, transport, insurance & finance etc.). The direction of governance has been – as much as possible in light of ongoing geopolitical tensions – to protect the open global economy: the leading framework has continued to be that of the liberal economic framework of open global trade, competitiveness, deepening market integration, and high returns through efficiencies, underpinned by classic international economic institutions (such as WTO, IMF and World Bank).

#### *Key dimensions*

- Moderate openness
- Intense hyperscaling

#### *In brief*

In this scenario, digital high-tech continues to lead the direction of modernisation of society. In 2040, the digital economy, and much of society, is operated on the infrastructures (including the cloud) provided, owned, and honed by very few Big Tech companies. However, these asset (inter)dependencies are mostly tolerated because some of the benefits of these companies bring are shared: other businesses are empowered to pursue their own entrepreneurial plans when it comes to applications and services by making use of the infrastructures and business-to-business services of the platform giants. Also, for most citizens and consumers, the platforms are 'just there': convenient, ubiquitous, always on, always available, and unthinkable to do without.

As for international economic governance, globalisation still holds as formal and informal institutions like the G7 or the G20 (although countries have dropped out and others have been added), the IMF, and the World Bank assure a sense of economic stability, while the WTO manages to reduce trade barriers. However, the USA remains the sole superpower (it 'holds the world together' in terms of security and innovation templates), China continues to benefit from being a solid second (it is the factory of the world but also provides international infrastructures). The USA maintains its role as agenda-setter for the global economy (backed up by its role as continued military giant).

As the **platform-infrastructures also serve as the backbone for the 'agora'**- the global public sphere of debate – in which the USA-based Big Tech companies dominate through (social) media seamlessly integrated with all-encompassing, AI-mediated personalised assistants within and beyond Virtual Reality / Augmented Reality (VR/AR) in-home and on-the-road systems, these companies significantly shape discourse and social interactions in the EU. The EU's scope for manoeuvre on the global level is constrained. **The once-termed 'Brussels-effect' has proven transient**, coinciding with the diminishing significance of the EU as a global economic market. Why adhere to the EU's value-driven standards when lucrative markets await globally? As the EU recognises the importance of an open global

economy without borders, it also acknowledges its limitations as a primary exporter of regulatory innovation for technology, aiming to sustain economic welfare - a new form of 'Realpolitik' in global economic governance for the EU.

### *Key drivers*

In 2040 the future is driven by the following elements:

- Generative AI systems of the 4<sup>th</sup> generation (personalised, integrated, AR & VR based) continue to become ever more sophisticated, seamlessly entwining profit-making (for the platform giants) into all aspects of life. These 4<sup>th</sup> generation systems are expected to become integrated in all **public service systems**, including in healthcare and education. Transparency concerns have not abated in policy circles, though many citizens are not terribly interested in the topic.
- **Powerful AI systems**, which are now ubiquitous, have fundamentally changed how people work and continue to shape **future work**. In the EU, there is an understanding of the fine line to be threaded by the MS and EU governments in protecting workers' rights, continued investing in re-skilling the labour force, continued reaping but better redistribution of the economic benefits from the resulting increased productivity growth, and preventing – or managing – the social unrest that too-quick labour-force changes will continue to bring.
- It is expected that the EU, together with national (and local) governments, companies, and civil society organisations, will start providing a **basic income for tech-displaced workers** in 2041.
- Some countries are experimenting with Big Tech companies **running democratic elections via their platforms**. This has increased voter turnout. 'Platformised democracy' is expected to bring continuous direct polling of the citizenry. The EU's institutions are hesitant to follow, referring to European values and pointing to concerns about the discourse-shaping powers of the same platforms, which have incentives to steer voters towards certain outcomes. Part of the citizenry of the EU, confident that they have become increasingly more sophisticated in recognising manipulation, but ironically not recognising that this point of view might have been manipulated by the platforms in increasingly individual-targeting ways, are mostly apathetic towards this topic. However, there is a growing 'Digital Xtinction' and 'touch-grass' movement to counteract technological determinism.
- There have been major **biotech and neuro-tech developments**, leading to new technologies for generic treatment capacities: mRNA-based, gene therapy, immune therapy approaches, genetic editing (relevant for humans, animals, and plants), Brain-Machine interfaces, etc. Rice plants, wheat, maize have been developed to thrive in brackish water, providing a staple food in low-lying deltas globally to withstand rising sea-levels. The EU recognised the need for large-scale investments in innovation in these sectors has secured a fairly robust position in global developments, particularly in sectors less dependent on infrastructures offered by USA-based tech companies.
- **Digitalised and robotised healthcare** is expected to continue growing: essential for maintaining a baseline of healthcare for the ageing baby-boomer population, the majority of whom are now over 85 years old. Although there are promising developments for treating Alzheimer's disease through personalised medicine, these advancements come too late for the boomer-generation.

- Continuous and ubiquitous **data-collection, both** in public and the private spheres, is a result of developments: Gen Y, Z, and subsequent generations do not value '**privacy**' as much as previous generations. The acceptance of 'surveillance' and 'safety' measures to protect citizens remains a hot topic in the EU. The AI-Act and the GDPR have, in this sense, fallen short, as supervisory agencies struggle to keep pace with the increasing waves of innovation in data-based applications and services. There is ongoing reflection on what 'privacy' and 'high-risk AI' mean, as we move past the 2040s and onto the 2060s.
- There is an expectation that, in 2050, 'real' **AGI (artificial general intelligence)** will be in place, developed by dominant Big Technology companies. The EU is uncertain about how to respond, given past regulatory failures (the AI Act and GDPR, as mentioned earlier).
- Surprisingly, the re-enacted-for-VR novels of Iain M. Banks in '*The Culture*'-series, now 50 years old, are an unexpected hit among the younger generation. These novels provide a hopeful glimpse of a future where humanity lives with superintelligent artificial intelligence. Concurrently, modern-day 'created just for you' dystopian science fiction remains highly popular. In a notable move, the UK's Queen Charlotte has posthumously knighted Alan Turing, showing resolve and recognition.
- The future of **global governance** will grapple with two main geopolitical lines of potential friction. The first is between the USA as the hegemonic global *economic* power (especially in tech) versus the Chinese tech-governance model (China has regained economic and geopolitical strength after the slump in the 2030-2035 turmoil related to changing Party leadership). India's growing presence, especially in high-tech services, is expected to impact the Chinese – USA relationship. The second line of friction is between 'old' powers and the upcoming economic and innovation-focused powerhouses from the African continent.
- The **relative position of the USA** is expected to decline after 2040 due to internal disparities growing beyond containment in unstructured slums and an ever-growing theocratic-focused political contingent. The **EU remains vigilant** in preventing a similar spiral from happening. Nonetheless, the EU's institutions realistically expect its global importance to continue to wane. Influence is now more dependent on individual leadership capabilities such as political savviness, integrity, awareness, and openness than on economic strength. Only solid and uncontested leadership will enable the EU to continue punching above its economic weight. Meanwhile, **China** is poised to take over as the leading tech-based economy, successfully implementing its Digital Silk Road initiative across the globe and heavily investing in creating its tech-giants, including in quantum computing and space exploration (similarly to India, a solid space and biotech power now).
- Both the existing global institutions, the global great powers, and the EU will persist in grappling with **immigration**. The catastrophic consequences of droughts, wildfires, torrential rains, and other **climate disasters** have deeply affected the conscience of people in recent decades. This period has witnessed a profound crisis of callousness and depression, juxtaposed with a deeply felt connection to global humanity. Expectations include a continued disconnect between humanitarian relief efforts and the unabated political polarisation on the issue of **migration**. However, within the EU, the stalemate among Member States during the massive refugee crises of 2028 and 2032 have somewhat eased, mostly driven by self-interest. It has become increasingly clear to many in the EU that demographic developments necessitate migration to attract skilled workers.



The future is **driven by fear**: fear of fully autonomous weapons of mass destruction amidst ongoing geopolitical tensions, fear of unforeseen consequences of AGI, and fear for a diminishing private sphere in the face of ubiquitous surveillance. There is also anxiety about having reached numerous major ecological tipping points; the societal destabilisation resulting from continual ecological disasters presents a significant challenge for global governance institutions.

However, the future is also **driven by hope**: optimism for cures of diseases that seemed incurable even at the turn of the 2030s, aspirations for a complete transition to renewable energy resources in the EU and elsewhere, and the hope to eradicate hunger through precision data-driven agro-tech. Hope emerges from the younger generation's increasing desire to shift focus away from tech-mediated realities as seen in the growing 'get-off-the-internet'/'touch grass' movement, and their critical approach to information warfare.

There is also hope in the inherent capacity for human adaptability and resilience, as global, EU, and local institutions persist in their functionality. Furthermore, there is hope that humanity will not only reach the stars, as demonstrated by missions in 2031 and 2035, but will also responsibly share, rather than exploit and deplete, the bounties of these commons. India's initiative led to the conclusion of a new 'Treaty to protect the Commons of Space' at the end of 2039.

#### *Key actors and their strategies/activities*

In 2040, the **global landscape is shaped by key players**, with the USA the leading economic and military global power, particularly following Russia's collapse in the long war with Ukraine. China sustained its growth trajectory and maintains strong ties to the global (political) economy, recognizing the imperative to counter its demographic challenges and prevent an economic downturn. Notably, the China National Space Administration is leading in the space-tech field.

Many countries of the Global South have ascended in economic and political power. While some grapple with tribalism and civil wars, the more robust countries have fostered democracy and economic growth, leading to a highly skilled (and relatively young) workforce, driving innovation and economic growth.

The **technological sphere** is dominated by a handful of **technology companies**, surpassing their 2023 scale. The **platform conglomerates**, integrating (physical) infrastructures, cloud, AI, AR and VR capabilities, along with social media-services, are dominant. Three US-based companies MM (formerly: Meta-Microsoft-Siemens-Nvidia), Gamazon (Amazon including Intel, Adobe and Oracle), and the Apple-conglomerate wield dominance. China's Huawei+ (now with strong interest in semiconductors and electrical mobility) emerges as a strong contender for fourth place.

Despite growing inequality within the USA and simmering civil unrest, these platform companies, have quelled discontent by influencing the discourse. Antitrust laws in the USA have proven ineffective against monopolisation, with political, electoral, and judicial actors aligning with capitalism and supporting platform giants. Antitrust cases of the late 2020s, including those against the Google-Amazon and the Meta-Microsoft mergers, have all failed. While EU competition law perseveres in challenging these companies, its impact has been limited, merely scratching the surface of these mergers.

Though the **EU has some large and important tech companies** – ASML and Spotify that have continued to reinvent themselves – yet they operate in different league. There are many

smaller (modular) complementors too. Notably large manufacturing and engineering firms have transitioned into 'tech companies', focusing on digital tooling for industrial clients and adopting platform models.

Maintaining a robust bilateral relationship with the USA and solid economic connections, has forestalled the emergence of a 'splinternet'. Nonetheless, within the EU, reactions are mixed. It is expected that a growing part of the electorate may advocate for 'sectioning off' the EU's technological sphere, possibly supporting an EU exit from the global governance systems. Conversely, many economists and others caution against such a move, citing potential disastrous effects on the European economy and the resulting destabilization of society.

Despite these challenges, the EU is expected to retain prominence in certain niches, such as luxury goods, where it maintains a leading edge. Additionally, in the fields of bio-, neuro-, and agro-tech, the EU has solidified its position as a specialised player in the global economy.

#### *European perspective (and DG RTD focus)*

In terms of policy-making powers, the EU experienced a hiatus after an intense regulatory intervention through the Digital Package (2024). The expectation at that time was to reap the benefits of this regulatory model, positioning it as an export product. Despite sustained good intentions in the second and third decades of the 21st century, the EU has no alternatives to the USA-based ecosystem-spanning platforms.

Moreover, in 2040 the EU continues to lose in the '**talent war**'. It invested in fundamental science (the EU remains at top level in this field), but there is still no robust entrepreneurial innovation ecosystem. Though its investments led to success at the 'modular' services layer level, but insufficient emphasis on innovation eco-systems, scale-ups, and higher Technology Readiness Levels (TRLs) became apparent. The EU still lacks investments in creating viable and recognizable public-domain alternatives for services (as the failure of the distrusted E(U)-identity initiative shows).

Recognizing the need for more flexibility in venture capital, and more flexible legal systems for bankruptcy (couples with the protection of workers through the basic income schemes), the EU responded. However, the acknowledgment of the significance of attracting talent from the Global South has come late, prompting a belated refocusing of 'talent-attraction' schemes.

In the current situation, where the economic and regulatory power of the EU has diminished compared to its position in 2023, the EU maintains a focus on its values, despite nominal support from its electorate, particularly the youngest voter-generations, who exhibit apathy in this regard. Clearly, the roles of the **privacy and market regulators** have been marginalised in the face of rapid AI-developments stemming from a lack of investment in capacities and belated recognition of the need for greater EU-level supervision (GDPR, DSA and AI Act).

Economic and USA-led technological developments, embraced in the technological-globalised sphere by users, including governments – keep unfolding too quickly for supervisors to keep pace. The EU realises that its concept of 'privacy as a fundamental right' has somewhat lost its depth and is now in the process of recalibrating its focus.

In hindsight, it has become evident that the EU, along with its member states, failed to swiftly invest time and effort to strengthen its **internal market**. The persistence of diverse jurisdictional regimes within the EU created hurdles for companies aiming to scale, prompting many promising companies to relocate to the USA, India, China, or emerging markets like

Kenya, Nigeria, Brazil, or Colombia. This lack of investment is also reflected in the **social pillar**, with meaningful initiatives only gaining momentum in recent years, starting from 2035.

The EU has pushed towards investing both in skilled (and re-skilled) labour, social innovation, experimenting with a basic income, and facilitating the integration of immigrants into the labour market through immediate access to work, training, or higher education. Continued investment in regional cohesion has streamlined the relocation process for inter-EU displaced persons.

Despite a diminished influence on the global sphere, the EU remains a formidable force, for example in **(data-driven) green agro-tech and water-management innovations, as well as in one or two other key enabling technologies)**. It has also successfully found its position in the **bio- and neurotech fields**. Having only started a decade ago, these efforts have a great potential for success.

## 4.2. Scenario 2: Pax technologica

In the 'Pax technologica' scenario, the once-prevailing doctrine of global free markets at any cost is discarded. The alignment of interests between companies and governments in international trade becomes fractured. Driven by both political and economic reasons, politicians focus on protecting internal markets, which, though larger than national, are confined to groups of countries sharing geographical, political, or cultural affinities. Multilateral trade agreements establish stable boundaries, fostering political and economic cooperation within these groups, creating a mixture of cooperation and competition known as 'coopetitive clubs', shaped by their individual political agendas, interests, and values (that is to say, they have mostly crystallised as geopolitical blocs). Companies within these groups cooperate and compete in a 'coopetition' paradigm.

There are large dominant firms within each bloc, so Big Tech is not as big and as influential as under ubiquitous globalisation. The post-globalisation international landscape is governed by evolving rules of the game, with actors (government and companies) in each club concentrating on short-term advantages within their respective club. Inter-club trade continues, and in certain highly concentrated sectors as AI, e-commerce, pharma, and critical raw materials, oligopolies successfully form global cartels. Foreign direct investment continues and, in these fragmented markets, governments actively support national champions who gain more and more power over the state, influencing economic growth.

### *Key dimensions*

- Moderate closure
- Moderate hyperscaling

### *In brief*

In this scenario, market forces operate within the confines of cooperating groups of countries. Within these clubs, in all high-tech areas, a few dominant market players determine prices and the progress of technology. Globally, there are few large players competing, but politics determine the rules of how free trade will be. Companies try to influence governments in favour of free trade (which diminishes global political tensions). This creates uncertainty and precarious equilibria. Large companies dominate the scene, but start-ups continue to emerge

based on efforts to disrupt technologies. Successful start-ups are absorbed by big-tech companies. Intra-bloc mergers and acquisitions are incentivised – if pan-European, this happens under the rhetoric of making the most out of the ‘internal market’, and if transatlantic under the cloak of ‘like-minded’ values enabling a tougher stance against competing blocs. Cross-bloc mergers and acquisitions are more difficult than in the past and in certain cases made impossible. Productivity growth is slower but there is diminishing inequality between blocs, as parts of the Global South (Arab countries mainly) succeed in nurturing national and intra-Group champions.

#### *Key drivers*

**Global Governance and Trade.** Globalisation forces, as evolved until the Trump era, have receded so that the current situation is characterised by new features:

- Countries self-organise into cooperative clubs, and partially overlappingly so;
- Reshoring, and ‘build-back-better’ type plans have taken place in all blocs replicating the ‘America first’ policies;
- Friendshoring leads to higher interdependencies within blocs internally determined by competition; at national level there are still industrial policies, but trade is free within the cooperative clubs;
- Strategic autonomy and assurance of smoothly functioning value chains influences trade decisions;
- The European continent is cooperating with the USA, Canada and Australia but European companies are struggling to get a share of Big Tech and are supported by national and EU industrial policies in this effort;
- There is restricted trade between the mega-regions, it is determined by both political and techno-economic agendas;
- Critical raw materials and rare earths are a determining factor of the power of specific regions (China being the champion for its own subsoil and African investments) while other regions (USA and Europe) invest heavily in an effort to reduce this dependency.

#### **Techno-economic profile:**

- The structure of the economy within each bloc is meant to be determined by market forces but large companies have significant power over governments through their importance for economic growth, employment and taxes. The EU pushes for corporate consolidation, in an attempt to realise the economies of scale afforded by the ‘single market’ and as a ‘non-protectionist’ strategy for enabling competitiveness against the USA and Asia. Technologies are proprietary in the EU and travel well within its cooperative clubs.
- While enforcement of competition law has not intervened to break down quasi-monopolies within any bloc. There are no powerful international economic institutions able to control collusive behaviour and concerted practices within or between cooperative clubs. Inside countries regulatory authorities combine guidelines (*ex ante* regulation) with guidance strategy (*ex post* interventions) so as to maintain the flow of the economic game. Market and product supervision authorities increasingly use ‘regtech’ which allow real-time data

from regulated entities with minimal intrusion and administrative burdens but with great accuracy and responsiveness gains.

- High-tech factors of production command the biggest influence. These elite technologies are very expensive and hard to replicate. Those who command them are settling (either directly or indirectly, quarrying or cooperating) among themselves how the economic game is shaped. Quasi-monopolies with access to technologies dominate, while smaller firms, lower-tech sectors and smaller countries are dependent from the core inputs of central knowledge-based players and struggle to keep their share of value added in the economy. High-tech start-ups are important for technological progress and productivity growth. Large companies limit their investments in technology towards the necessary resources for maintaining absorptive capacities and externalise applied research to universities and public research centres for higher TRLs. They obtain disruptive technologies through the acquisition of high-tech start-ups, which they systematically scrutinise to access those that fit their portfolio best. Large dominant companies may invest only in technologies where they have a monopolistic position not only within their own bloc but even beyond it.

**A government-corporate arms wrestling regarding inter-bloc trade**, despite their strong ties within their countries, because some actors consider global free trade is dangerous while others wish to return to the ubiquitous globalisation era.

- The middle class (low and middle skills, small shops and traditional SMEs) feels threatened because imports from low-cost countries threaten jobs; this is accompanied by a strong anti-immigrant sentiment.
- Governments have experienced intended embargos (Russian oil) and unintended trade restrictions (COVID) in the past and have become defensive and acting to 'de-risk' supply chains often by moving production closer to home.
- Conversely large deep tech and academia wish to open all markets/collaboration potential and ensure maximum economies of scale, hence they continue urging for global free trade and conflict reduction.

**The Global South is also partly suspicious and views the terms of foreign direct investment as neo-colonialism.**

**The world becomes multipolar**, with the US and China maintaining technological leadership in AI, e-commerce and other high-tech services but more and partly variable geometry alliances are built: Russia with Belarus and former Soviet Republics; East Asia with Korea and Japan, Latin America, Africa, rich Arab countries form alliances mostly based on their religious factions. Under competitive pressures, the EU has deepened its economic integration with the UK, Switzerland and all developed European countries and has also strong links to the USA, Canada and to a smaller extent Australia and New Zealand. EU leads in wind and solar energy as solar investments have re-shored from China. It has not yet accepted the Western Balkan and Ukraine as full member states. Israel (and its highly competitive start-up ecosystem) aligns in terms of economic cooperation to both Europe and the US, and while tensions with Palestine have receded. the main problem of Jerusalem is not yet resolved, maintaining political tensions. Turkey is still ambivalent between Europe and the Arab world. Certain groups from the Global South start closing the productivity gap with the OECD countries.

The combination of fragile supply chains, growing threats to national security, the energy transition and the cost-of-living crisis have led the USA and the EU to reshoring. They protect and subsidise national champions, who are gradually becoming more powerful than the state itself.

Deep tech, AI in particular, penetrates most economic activities and shapes labour markets. **Economies of scale and scope give large companies in each area a quasi-monopoly power within each major bloc while appropriability and tacit knowledge hamper competition.**

**Countries within and between blocs compete for talent**, which is less volatile than in the era of steadily increasing globalisation. The free movement of labour is restricted and there is high global competition for highly skilled people.

**Migration pressures increase**, probably mostly illegal or asylum seeking, in certain blocs. People in the OECD are more xenophobic so governments exercise more authoritarian policies than in the past.

**Developed countries are much less dependent on fossil fuels; however, they are still dependent in the case of critical raw materials and rare earths.** This gives China a very strong advantage in international negotiations and drives investments in exploration and exploitation for raw materials in all blocs.

**National policies become more powerful** in terms of creating the rules for the international 'free' movement of goods, services, capital, labour and technology but their willingness and power to affect global competition is diminished. Organisations like the World Trade Organisation exist but their power is minimal.

**National budget deficits increase** to make up for the lost productivity gains emanating from the reduced productivity growth imposed by diminished competition and scale.

Income inequality is diminished because tax heavens are better controlled and by higher tax revenues governments are in a position to increase welfare policies despite slower productivity growth. Extreme political parties and anti-European movements are losing momentum because of (slightly) reduced inequality and declining immigration.

#### *Key actors and their strategies/activities*

- Countries/national governments play a dominant role because they negotiate global trade deals and financial interventions. They decide on the terms and types of multilateral trade agreements and the extent to which they are respected (or not). However, they succumb to local champions pressure to open up, even if selectively. The US and China, because of their role in Big Tech still have a paramount influence on global trade. Taiwan joins forces with Japan and Korea in the microchips arena.
- Large Big Tech Companies dominate their internal markets and compete globally, to the extent determined by political power games. They invest less in R&D because they have a 'security blanket' in their national markets.
- SMEs in traditional sectors are investing in AI applications.
- Tech start-ups continue to flourish in the US, and are also encountered in all blocs. Venture capital is less mobile, compared to what it was towards the end of the ubiquitous

globalisation. The EU continues to massively subsidise with Funds of Funds. Acquisitions take place more within blocs.

- Regulators play the same role as in the past, limited to assessing dominant position and competition rules within the EU; In the US there is no effort to break up monopolies.
- Political parties: extreme parties are losing momentum.

#### *European perspective (and DG RTD focus)*

The growing gap between EU and the US continues because companies with global leads maintain their global leadership. China and other emerging cooperative clubs are also challenging the EU in certain areas.

However, the Internal Market is large enough allowing for some national champions to emerge in areas where the EU already had some competitive advantage (green technologies, chemicals, and technological niches like photoengraving). There is active industrial policy (including R&D support) which also takes the form of protectionism, since globalisation and the power of global institutions are receding.

Europe is a moral leader, recognised by the Global South as a bloc respecting democratic values and human rights, but is unable to negotiate, let alone impose, standards to countries in other blocs. The de-civilisation (problem with democratic values) within Europe has been avoided, at least for some time. As it did with greenhouse emissions it is in certain areas (AI) creating its own standards deriving from its democratic values.

This **mix of protection and public investment in infrastructures** for the dual transition (not yet completed) is pursued at a heavy cost for the national budgets. The Stability Pact is under threat and is revised: R&D and education spending is excluded from the deficit calculations, the 3% remains for the rest of public expenditure.

There are opportunities which are partly grasped: The Member States agree to more integration in educational policies, experiment more with new types of higher education and invest significantly in talent, paying more rather than thinly spreading funds. The EU has significantly reduced bureaucracy in the case of competitive funding, the Framework Programmes in particular. Innovation policy is highly supportive, funding has increased and there is increasing emphasis on supporting large companies that have a leading edge in the club, while international scientific collaboration is limited within the bloc. The EU has also adopted a **more high-risk/high-reward policy** in its Framework Programmes. In areas emerging from the current missions, in new missions or in areas where economies of scale lead towards the idea of supporting national champions to export beyond the bloc is gaining momentum (Airbus-type consortia model) and foster European competitiveness in future high tech. The weakening of the WTO makes such endeavours much easier compared to the ubiquitous globalisation.

### **4.3. Scenario 3: Re-matching**

After several decades in which many nations and entire geographical areas have been marginalized from the main economic and technological regions being confined to some traditional production, radical change has occurred since the 2020s. The urgency to act has united peripheral areas and emerging forces, leading to the making of the famous rainbow coalitions between governments, businesses, and civil society. The impact of these changes is clearly visible in 2040. The fact that many parts of the world were forced to pay increasing

prices to a small number of companies triggered new national priorities under the label: 'we can do better'. Rather than awaiting that the dominant companies would provide some subsidiary economic activity, a new generation of small and medium sized companies have started to explore new technological developments and created innovation, often supported by their national governments and in collaboration with universities. A few of these companies managed to become much larger, and to contest the market shares acquired by the Big Tech in the first decades of the 21st century. Other companies directed their efforts to what they believed could be the developing areas, and which are currently dominating the market and technological opportunities introduced in the 2020s and 2030s. Citizens have been actively involved in public affairs: there is a general feeling that in the most innovative fields, all nations and regions should be considered as partners and not as duty payers.

#### *Key dimensions*

- Moderate closure
- Moderate smallerscaling

#### *In brief*

In this scenario there is a **change from a market-led order to multilateral trade/investment agreements**. Through a stronger involvement of national governments and international organizations, these agreements help to support economic activities in less developed areas and regions. We also witness the concertation of technological and innovation policies between governments and SMEs to open up new fields and compete with the Big Tech companies. It is also a fact that a **coordinated industrial policy is designed to open up new markets for products, processes, and services**. Strong investment in creating renewed resources, starting from human resources, to respond to social priorities can be seen.

#### *Key drivers*

The strong discontent of the two first decades of the 21st Century was due to the fact that too many geographical areas were left outside the main routes of scientific, technological, and productive activities. This motivated, under the rainbow coalition, strong support for new leadership in business and in politics. The main aim was to reduce the power of the gigantic high-tech corporations and to be able to ride new waves of innovation. The fact that these corporations were fostered and protected by national political power was perceived more and more as predatory. The scene is not so much as growing champions, although this is held as legitimate, but the real drive is truly about **shaping the championship**. In order to protect the economic, social, and political life in other nations, an economic and cultural revolution has taken place and in 2040 it is possible to see how this has shaped the outcomes. New alliances among the companies which are left outside the main directions start to be built, in a race where newcomers challenge incumbent firms and try to enter into the most dynamic and profitable industries. South-South agreements in trade, technology transfer, and mobility of scientists and engineers are common, often involving also marginalised areas in Europe and Japan.

A typical example is represented by the cinema industry: while in the 2020s Hollywood dominated the globe, there are now four industrial poles of audio visual production which compete on a par: Hollywood, Bollywood, Rio de la Plata, and Cinecittà are attracting more and more talents and investment from all over the world.



The fact, that a few players took all the economic advantages associated with new technological developments, generated a major social and political concern that those, who risk to be relegated, have addressed. The dominance of a few gigantic corporations has mobilised forces leading to a coalition of would-be-losers, aiming to survive. A few Big Tech corporations were considered not only a major economic threat, but also a danger to the privacy, information systems, and democracy at large in Europe and elsewhere. This has led to the **creation of broad alliances (named 'rainbow coalitions') which involved capital and labour, strongly supported by national political power**. In the competitive electoral process, this has led to the growth of political forces, which prioritise industrial and technological policies to support production and consumption at the national and European levels. New leaders with a dynamic vision are now in government in most of the European nations. Traditional and new international organisations aim to coordinate and support the efforts carried out within nations.

In trade, rather than an overall reduction of tariffs, there are more and more bilateral and multilateral agreements which allow to maintain production in peripheral areas. The basic difference is that trade is not left any longer entirely to market forces. The new trade agreements allow high and increasing levels of exchange across countries, but imports and exports are supervised by political decisions rather than left to unaccountable market forces. These trade agreements reflect stronger political ties between business, local governments, and civil society. They have become known as **areas of trade complementarity often associated to co-investments**. As suggested by Lord Keynes almost a century ago at Bretton Woods, trade agreements are an attempt to avoid that areas with stronger capacity get permanent surpluses in their balance of payments.

Likewise, there is a greater political and societal control over inward and outward flows of foreign direct investment. Third-party monitors from academic institutions and civil society enforce transparency. This allows to apply expansionary economic policies in each nation to increase production and employment while maintaining corruption in check. Sustainability criteria are included in trade agreements to minimise transport costs and, when appropriate, schemes such as **'KM 0 production and consumption circles'**. When there are ecological concerns, the possibility to have short value-chains, are widely applied.

The differences among the demographic trends across nations has forced ageing areas (including the EU and Japan) to 'import' workforce and talent from areas with high birth rates. The so-called 'war for talents' which dominated in the 2010s and 2020s, in which companies tried to attract the best brains worldwide, has been replaced by more constructive forms of collaboration. The catchphrase has become **'brain circulation' among continents**. This implies that countries with ageing populations and low birth rates but high education levels provide a substantial contribution to educate and train work force overseas. New schemes called Marco Polo are implemented which replicate the **EU Erasmus programme at the global level**, expanding the opportunity to educate and train foreigners in the EU. New schemes are also introduced to create global universities in the South and Universidad de Mexico and University of Shanghai are competing on a par with Harvard and Stanford. Continental European Universities are today the most popular, also for their programmes with terms in different locations. It has been noted that no USA-based scientist has won the 2040 Nobel Prizes while most of them have been awarded to European and Asians, and for the first time more than half of them have been received by women. Nations with a lower rate of innovation substantially increase their investment, choosing to prioritise the fields with higher technological opportunities.

One important driver is associated to demographic trends. Europe, Japan, and China realised that their very low fertility level was a serious threat to their existence. The past demographic structure induced these nations to act energetically to avoid that an ageing population is left

abandoned without proper economic and welfare protection. Radical social policies to increase fertility rate have been applied and their effects are visible in 2040, with what has been labelled a **baby boom revival meant to stabilize population growth**. These social policies have introduced gender equality, larger parental leaves with benefits when they are shared between fathers and mothers, free and improved childcare, social housing. The scientific research showing that senior citizens participating in parental caring and mentoring of children and youth are more likely to have longer, healthy lives, has inspired policies to enhance Healthy Working Life Expectancy. Several schemes have been designed for the involvement of senior citizens in parental caring and education. Senior volunteers' associations are active in almost all neighbourhoods and schools to facilitate parenting.

To address the demographic trends of the 2010s and 2020s, many countries have opted opening up to migration from the Global South with its opposite demographic trends, and which perceive it as advantageous to use the social facilities available in nations with population decline. However, there is a clear perception that it is insufficient to host migrants. They need to be motivated to contribute to the well-being of their host countries through social, political, and cultural integration. A major engagement by governments and, above all, local communities, is devoted to **properly educate and train migrants to allow them to start successful carriers in the new digital and creative economy**.

Educational facilities in nations affected by population decline have also been drastically restructured. To combat the fact that the numbers of enrolled students aged 5 to 24 were declining, two major changes have occurred. The first was to open schools and universities to foreign students, introducing courses which fit their preferences in terms of timetables and subjects to be studied. The second was to reform educational institutions in order to accommodate adult migrants as well as senior citizens. High schools and universities are now open around the clock, providing permanent education and training, attended by large number of migrants which did not have the opportunity to obtain degrees. To the traditional courses for students aged 5-24, are complemented with courses for migrants and mature students (including unemployed, retired persons, and others) which need to update and upgrade their professional skills. Senior citizens have now the opportunity to work part-time because of the new skills, they manage to acquire.

Schools have also become a crucial place for integration, becoming social and cultural centres in each neighbourhood. On the fringes of educational programmes, schools also host events such as book launches, film clubs, theatre, and choir groups. Many of these programmes are also devoted to acquire a better knowledge of other ethnic traditions and contribute to better integration.

In cultural terms, Europe is now called '**the multi-flower continent**' for the successful integration of different ethnic and social groups, which is often compared to the 'melting pot' achieved in North America in the 1970s and 1980s. The census in all countries indicate that mixed families have increased exponentially.

Another important driver is connected with the need of European nations to preserve their own economic market and space against more and more challenging monopolies. During the 1950s and 1960s many nations perceived the need to develop their own national oil companies to prevent that the market shares were totally controlled by a restricted oligopoly. Despite the geo-political tensions, this has led to a market where several European and Latin-American corporations created and supported national corporations in the oil industry which have managed to compete with the incumbent US corporations. Likewise, the aircraft industry was dominated by a small number of US corporations. But two European governments launched a new corporation, Airbus, which after decades of economic rivalry with American competitors, became, at the beginning of the 2020s, the largest world manufacturer.

On the ground of these experiences, there have been attempts to create new public and transnational corporations targeting the areas where the EU was lagging behind: they have been launched in industries like quantum phones, self-writing software, holographic networks, 7G equipment, AI translators. The state deploys its coordination power to orchestrate a few strategic high-tech underlying ecosystems such as semiconductors or mobility. After several geo-political tensions, these EU-sponsored corporations are in 2040 leading new sectors and competing on a par with their American, Chinese, and Indian rivals.

A third driver is associated to the widespread feeling by European leaders and the citizens that their nations and culture may become irrelevant in the future world. To combat this trend, the **EU has accelerated its political union and it has promoted vast actions to diffuse its culture and ideals**. It has established greater economic, social, and cultural ties with nations in the vicinity and in the Global South. This has led to a renaissance of cultural activities applied to media, cinema, and music.

#### *Key actors and their strategies/activities*

The European Union member states have regained authority and prestige in the world by becoming more and more a non-military but rather a civilian and cultural super-power. Ties with emerging countries are stronger. New political forms are experimented in emerging countries and they finally find appropriate inspirations in Western human rights and democracy, which are shaped and enhanced through Asian values.

In this landscape, the new crucial actors is represented by **new state-owned companies active in the emerging industries**. They are often supported by transnational agreements brokered by governments and international organisations. There is also a cluster of new SMEs active in the high-tech and in creative fields. Large and small objectives are made compatible and synergistic.

There is also an increasing role of non-governmental organisations to monitor, which have partnered with governments and parliaments to receive mandates to steer the activities of the new generation of commonly (state-)owned companies. Citizen's activism has also created original forms of civic participation in which corporate behaviour is under scrutiny to guarantee that they serve the public interest. Guidelines about Corporate Social Responsibility are now discussed and applied in the economic and business life.

#### *European perspective (and DG RTD focus)*

**The EU has successfully managed to have its own European champions in the emerging fields associated to the new creative economy**. These firms dominate in new fields and compete on a par with American and Chinese and Indian competitors. The increased competition does not exclude the existence of strong interactions among global corporations.

A new form of regulation of economic activity has been implemented to ensure that **the knowledge generated by companies is shared for the benefit of society at large**. Open-source knowledge is explicitly encouraged and all public sponsored programmes, in companies and in the public sector, are requested to make the results available to the public at large. This helps to reduce the importance of IPRs. IPRs have become a method which allows a larger diffusion of knowledge. For companies it is more important to contribute to set standards than to acquire revenues and recognition from the innovations introduced in the past. The business sector is directly involved in collaboration with governments and local authorities to introduce appropriate standards and to deliver public goods.

**The EU has also reinforced its joint research centres (JRCs)** which are open to worldwide collaboration for basic research in a variety of fields. The JRCs have been reinforced and now the EU could count not just on CERN, but on a handful of science and technology centres of excellence. All these Centres have substantially increased their interaction with the business community and are often instrumental to transform their scientific and technological knowledge, as well as their inventions, into new products, processes, and services.

*Internal dynamics in the European Union (e.g. the role of the EU and MSs)*

A much larger share of administrative activities are now in the hands of a new generation of public servants within the EU, equipped with managerial and technical skills. This new creative class is often compared to the class which led the Japanese Meiji Restoration in the 1860s when some Japanese leaders realised that, without a social, economic and cultural change, their country would not be able to survive against the mounting Western powers.

The political governance of the European Union has been substantially transformed: the European Commission has been directly elected by citizens for the first time in 2031 and soon there will be a third European General Election. This has allowed **a direct access of citizens to decision-making**. New forms of consultation of epistemic communities in areas of their concern (health, local services, education) have become more and more common, also exploiting the potentials provided by ICTs. This has substantially modified policy implementation, which has become much faster than in the past, also because leaders can quickly obtain political legitimacy for their strategies.

#### **4.4. Scenario 4: Closet liberalism**

The scenario on 'Closet liberalism' brings into focus a world, in which the immediate pressures of competition are combined with a pluralistic economic structure. The international playing field is wide and broadly governed by a set of globalised rules of the game, but the atmosphere is tense as actors and authorities scramble to stay competitive by fostering R&I. Long-term investment is constrained by a lack of resource commitments, while organic growth in established companies and locally-led initiatives face better conditions. The emphasis of this scenario is on the struggle for individual agency, on the dynamics of bottom-up innovation, and on the capabilities to make better use of technology.

*Key dimensions*

- Moderate openness
- Intense smallerscaling

*In brief*

The world markets continue to be open, and a minimalist governance framework provides room for trade and specialisation. This is a low-trust environment, as actors and institutions actively compete along self-serving objectives. As creeping crises (public finances, social security, migration pressures, etc.) and unexpected disruptions (pandemics, cybersecurity events, secessions in European countries, etc.) are increasingly poorly managed, hope for solutions within central governance structures such as the State is diminishing. Following a growing atmosphere of cynicism, social contracts are on the brink of collapse and governments have little legitimacy to plan, coordinate, and make long-run commitments, while agreements on global societal goals are not holding. Nevertheless, market relationships prevail, and liberalism is revered as the leading doctrine (though more broken than followed

in reality). While governments are constrained, they intervene, especially through indirect state institutions and in a 'market-friendly' manner, which is actually often criticised as business-friendly or protectionist. International organisations such as the WTO and the IMF serve as arbitration chambers for interstate agreements but do not exert their own leadership. Most activities develop bottom-up, particularly concerning innovation. Digital technologies supporting decentralised peer-to-peer activities enable an economic system that is flat, flexible, intelligent, and automatic. There is turbulence and room for innovation as the redistribution of resources through private contracts advances rapidly. However, there is also stability and path-dependence as firms and workers gather around proven trajectories on which they can build and find economic security.

### *Key drivers*

This scenario is a combination of technology and tradition, in an environment of intense rivalry between workers, firms, regions, governments, and groups of countries. Proficient technology adoption of data technologies in open/agnostic/interoperable networks assure that the economic structure is pluralistic, and frayed at the edges with many SMEs and self-employed individuals. However, some private locally rooted/sectoral-specific system organisers are able to capitalise on the 'hot-spot' type of economy that characterises the year 2040. Civil society demonstrates skill in finding new solidarities and providing communal public goods, largely facilitated by ledger and cryptographic solutions as institutional arrangements. Digital money is the standard currency, but tokenised payment systems prevail.

In this **highly transactional economy**, there are limited benefits from economies of scale and scope. The backlash against Big Tech does not come from public-led global governance schemes, but from private-actors leveraging deregulated blockchains and other disruptive technologies (including digital identities) that empower decentralised dealing, and facilitate coordination beyond the traditional contractual governance mechanisms. Along with enforcement and licencing applications, self-executing software ('smart contracts') became ubiquitous and unleashed bottom-up dynamism.

The economic system is **volatile, uncertain, and rapidly mutating**. Indeed, jobs come and go, there are fast reallocations of workers across contracting employers, firms start and shut down. Fluidity prevails as the remnants of the old social-democratic apparatus (e.g., social welfare systems, collective bargaining, pensions) were restructured, watered down, or abolished over time. Unions are virtually extinct. Bankruptcy laws were changed to enable swift shutdowns of companies. The expectations of the actors are not anchored in given certainties; the emphasis is on adaptability, agility, and entrepreneurial action.

The markets are contestable, while **states are run like businesses, and functions are treated more like projects**. The public sector is lean and constrained by tight budgets. New Public Management is the norm since there was a wave of 'agencysation'. This has sometimes led to a lack of coherence in the public sector, as national agencies tend to compete among themselves for budget, influence, and prestige. In the haze of significant tax intolerance (and avoidance), agencies survive with renewed vigour by maintaining financial flows through producing services to the private sector. Polarisation and entrenched positions have made it impossible to reinvent politics, rendering central politics powerless against decentralised initiatives.

**The EU is less a shared task for all, but rather a space where interests interact** (i.e., it is essentially a marketplace). The EU is an institutional multipurpose arrangement in which member states have smaller increasingly fewer commonalities, using them to drive specific

initiatives in smaller ad-hoc coalitions. The social pillar of the EU integration ideal has crumbled due to a lack of a clear vision. Judicial review by the European Court of Justice has become powerless in preventing the delegitimation of social protection and thwarting a shift towards the dictate that labour is entirely subject to market forces. Radical political reforms are not feasible and often result in friction and impasses. The external geographical scope of the EU is larger, but internally the number of countries is much greater, as some have broken along regional lines. A number of surviving international institutions such as the WTO or the IMF ensure that markets remain active across different geographical locations. The financial sector adapted to the wave of digitalisation of the 2020s and has returned to its influential standing of the past.

The economic landscape is characterised by **hot-spots of agglomeration**. This means, that the free-flow economy is not simply atomistic. Economic actors organise around key assets such as tacit know-how, hard-to-reproduce location-bound goods (from intangibles like collective trademarks to critical minerals), and local networks. As a consequence, the hinterland of countries becomes more attractive. In fact, cities are heavily congested and have thus evolved from attractions to repulsions. Multinational companies are adept users of technology, but they are not conglomerates and therefore have less influence outside their sectoral markets. The number of hotspots and competence clusters is roughly the same as in 2020 (with marginal changes on the European continent overall, although some industries in some countries have experienced significant impacts on national GDP and the areas that where they are located).

Swarming is the order of the day. Small firms and projects behave as **fruit-flies of entrepreneurship** accumulating innovative lessons from experience. However, at the core of the clusters, there are sectoral orchestrators which captured and re-distribute the surplus. Unlike a world in which 'killer acquisitions' (like those startup purchases intended to nib future competition in the bud) are very important, here Venture Capital is not steering the start-ups to be bought up by the Big Tech: Even though money for innovation is limited, the entrepreneurial initiatives are actually able to be converted into companies that independently scale-up. This trend allowed corporate forms that evolved from banks (which adapted to the digital payment systems revolution to collect more and more information about all other producer and consumer agents) to stay on top of the real economy and therefore assuming an important role in allocating capital and resources.

### *Key actors*

The macro-economy is nothing; micro-managing is everything. At the country level regulatory bodies like **competition authorities have become as powerful as central banks**. They have independent management and financial autonomy and they collect their funds from other agencies. Agencies in general are perceived as 'independent' from government, and they follow 'pro-competition' strategies and increasingly go to the point of organising themselves in associative fronts so to gain leverage within states. For example, sectoral regulatory agencies assemble around 'reg-cooperative fronts' to claim more powers from governments and less interference from the judicial bodies.

Central governments do not intervene in visible ways, as confidence by the public eroded. It is not 'big government' or 'small government', it is 'different government'. In this context, the mission of national regulators is updated so that they become more active in national systems of innovation, and more focused on reducing bureaucratic burden. It is common now that regulators have 'chief innovation officers'. For instance, radiospectrum management agencies make sure to keep open enough free radiofrequency resources, for which they welcome **unlicensed innovation** for the industrial internet, hyperconnected health, holographic media, and many other burgeoning projects using airwaves to create

decentralised private networks of devices and sensors which now have more than 50% market share compared to the incumbent telecom services.

Central Banks are now also very active in payment system curation activities, which became the main business ecosystem they supervise. This different (entrepreneurial, experimental) governments can foster light-touch trial-and-error policies having in mind generating massive serendipity gains. What concerns antitrust, the EU's competition authority has become more entwined with member states authorities, and acts in close alignment with more general policies like climate transition, social policy, etc.

The large US-led information-intensive R&D-based companies that defined the corporate landscape, went into diminishing returns and became lethargic. They are in the background, like **utilities 2.0**. Tough questions by authorities concerning these corporate actors are not pressing anymore, but a plethora of 'smaller' open issues means that still **many need to be nudged**. Enhanced competition agencies have teeth, but also behave strategically. In fact, it can be said that they conduct industrial policy 'by other means' (selectively authorising some mergers and not others, allowing for some conducts and not others, deepening the deregulation of professions, while sometimes allowing sectoral systems orchestrators to grow and other times partially devolving decisions to industry associations in ways that are not always predictable and explainable). That is to say, they effectively manage competition and creatively keep breaking new grounds in re-interpreting anti-monopoly laws.

Enhancing SME access to knowledge and markets is an accepted policy goal, and among the means to achieve it are the promotion of product test-beds, pilot lines, proof-of-concept incentives, demonstration prizes, free-trade zones, etc. They complement algorithmic private ordering that now is pervasive in the markets by injecting **a degree of (top-down, unelected, technocratic) discretion in economic evolutionary dynamics**. That is, competitive decentralised economic action is the default (the purest case is the labour market), but it is so in concentric circles (there are degrees of liberalism, and exceptions are always rationalised as pro-competitive).

**Business associations have a stronger role as learning enablers** and providers of capabilities in regional innovation systems. These issue-driven 'not-for-profit' organisations act at the inter-firm level and contribute to filling gaps in inventive and absorptive capacities. They act in representing, defending, promoting, and supporting existing companies but they have evolved to provide knowledge-based services which also allow for the appearance of new innovative firms. They now function very much as intermediaries between communities of researchers and communities of practitioners. They have sophisticated their logic as a mid-level mode of governance in a variety of industries. In a world of continuous actor recombination, they have become a focusing collective actor that channels the productive powers of locally-rooted sectors to the external economic stage.

Given that the state has withdrawn its direct influence over the economy (market framing is the overriding rationale, but economic security justifies one-off interventions to deal with public bads like waste, and wicked problems such as water scarcity), there has been a **rise of civil countervailing powers**. Philanthropy is abundant, NGO's are much more active, grassroots movements are pervasive. This is not exactly a neo-tribalist world, but more a situation in which new types of pragmatic collective action and self-organised communitarian practices come to centre stage. Collectively-owned, blockchain-empowered social organisations working towards a shared mission are alive in this story. **Technology-enhanced social capital is important to tackle local challenges** and make the most of new socio-economic opportunities. Innovation-based places attract nomads and migrants. There is a relative flattening of economic outcomes and a decrease of inequality.

### *International scene*

**The US is overstretched**, shirks leading societal agendas and cuts its support for global efforts. It continues to strive for nominal global protagonism but its global giants teeter, also because the largest part of their employees are outside the country and therefore it is more difficult to coordinate and organise intra-firm activities. The US became consumed with inner disputes and has become a largely unreliable international partner. Most of its external policies are basically neo-mercantilist, but still under the disguise of human rights and security interests. The large Big Tech firms of the early part of the 21st century use the US as their 'captive market'.

**No company is permanently big, and no country is permanently great.** Other countries and regions became frontrunners in high-tech areas, as we can see in the Arab Peninsula. Large countries from the Far East like Malaysia and Indonesia moved up the value chain and directly compete with many countries in the EU. Brazil was able to put together some large high-tech firms and is also gaining market shares. African countries continue to globalise and are not friendly turf for the companies of its former colonial powers. Chinese multinationals are mostly from the clean manufacturing and the financial services sectors; Chinese Big Tech from the ICT sector found it hard to dominate markets abroad.

A collective economic space like **the expanded EU-50** (but by now it is just 10% of the world economy, and internally its workings are watered down so it resembles EFTA) has kept steady in importance but the **BRICS++** (now in its fifth wave of integration, and it includes 30 countries, accounts for 60% of the world GDP, and internally resembles the EEC of the 1980s) has been a driver of many global agendas, including sustainability.

Inside the newly enlarged EU, and in the spirit of the times, politics is mostly a transactional affair. It has become so large that countries organise into competing factions. Many times we witness bitter recriminations, for instance related to the digital euro, and the **EU is on the brink of collapse on a continuous basis**. Regulatory fatigue led to diminishing legislative production. However, never before was civil society as active and entrepreneurial; for the first time some cross-border parties are elected to the European Parliament.

### *European perspective (and DG RTD focus)*

Europe has been largely deregulated and the demise of large foreign-owned Big Tech has left room for the **renewal and rise of home-grown sizeable undertakings that capture 5% of the world mid-tech product market share in a number of segments**. The continent lives in a state of internal tension, but is actually attractive to disruptive ideas that are complemented by a fairly vibrant neo-communitarian life-style. The lack of domestic centralised R&D policy has meant that the continent is **not the protagonist of expensive disruptive innovation** in areas like AI or quantum computing. The competitive advantage is brought about by agile small-scale ventures, many of them fed by migrants and digital nomads.

**After years of painful sectoral restructuring**, the decrease of European influence on the world stage has stabilised. Due to the lacking ability to marshal significant resources for an assertive innovation policy, radical place-base experimentation that tries to maximise an endless stream of 'small bets' was chosen. In other words, the positioning of the EU in the global context evolved into a **continent-sized sand-box**. Some small peripheral countries show themselves to be able to prosper in this situation, they never had many very large companies anyway.



In the 'Closet liberalism' scenario the prospects for innovation policy are diminished. However, at the EU level the role of **hot-spot community-based innovation processes** is emphasised. Universities that are closer to productive clusters are given more chances in terms of funding. PhDs are increasingly developed in a corporate context. Business associations became innovation promoters and brokers of RTD funding. They increasingly deliver research and intelligence services to their firms. Local communities play the role of screeners and evaluators of research priorities. They work as prediction markets for the needs to be supported by R&I support.

## 5. FROM SCENARIOS TO STRATEGY

### 5.1. Policy principles for the future

In drawing policy implications within the future imaginaries canvased in this exercise, three **higher level principles** frame our normative standpoint towards Big Tech in Europe by 2040. This framework relies on three basic pillars that have to do with *existence* (economic means), *co-existence* (social and international relations) and *commons* (ecology and climate). These principles are threaded into the various concrete policies that are proposed. They are as follows:

- **Protecting pluralism:** Big Tech go far and wide, bringing benefits to many, but they also represent the replacement of markets by a widening corporate perimeter in large parts of the economy. Big Tech power poses risks to political systems everywhere, including democracies based on the rule of law. Overwhelming tech bigness can be an evolutionary drag for the developmental potential of the economy as a whole and raising hazards for societal progress. Moreover, as Big Tech tends to be foreign-based, a comprehensive economic diversity approach would value the importance of countervailing European-headquartered (i.e. dissimilar) bigness. This general guideline opens the possibility to a different kind of socio-economic/techno-institutional system.
- **Cosmopolitan outlook:** There is a mounting number of world problems related to inequality and exclusion, demography and migration, education and general wellbeing, culture and 'fakeness', conflict and instability. One basic stance is the concern with human dignity and the acknowledgement of the 'other' and the 'affected'. International institutions are channels for dealing with interdependencies. They constitute a check over 'bubbles' which can set processes in motion that can lead to break-downs.
- **Natural commons:** Preserving and restoring 'habitat earth' is necessarily a shared effort, but not necessarily equally distributed. It all starts with needs such as water or the safeguard for the human species to have shelter. But then there is the management of forests and oceans, along with the responsibility for the sustainable curation of biodiversity and geodiversity without failing to recognise that nature itself should be entitled to its own freedom ('wildness', since the environment cannot be taken solely as a resource for the sake of only one species). The scope of sustainability must be widened, to encompass outer space.

## 5.2. Developing policy implications

In this early decades of the 21<sup>st</sup> century, Big Tech emerged directly as well as indirectly as the most powerful 'influencer' of production and consumption relations. It embodies a new techno-economic solution with massive outreach in an unfolding number of domains and geographies. **The world is now rewired by Big Tech.** This section is about what policies can be envisioned after this development.

In the two first two decades of the 21st century, policies were developed in light of liberalisation, privatisation, and deregulation. Considering the four scenarios developed above, the question is whether a new policy framework should be developed. The scenarios show how some current trends could develop and thus show how (EU) policies might have to be changed if the EU aims to prevent some of the outcomes entailed in the scenarios. However, as the scenarios are just scenarios visions of alternative futures – there is the danger of unintended consequences. Thus, **reflexive management of R&I is necessary; R&I must anticipate its own long-range consequences.** So, what to do, if anything? And how, by whom, and when? Scenarios sketch an anticipation of the possible by envisioning multiple end-states. These end-states are here conceived as '**strategic habitats**'. We do not know whether one of them will materialise, none of them will materialise or whether a combination of them will materialise. Under this veil of uncertainty at the least two stances may be developed:

1. coming up with '**all-terrain**' **proposals** that allow systematic robustness in a wide variety of circumstances while facilitating or hindering the materialisation of given scenarios (sub-section 5.3);
2. elaborating more **specific policy menus** that fit a particular scenario configuration and that make the most of any given scenario (sub-section 5.4).

## 5.3. Cross-cutting scenario implications

This first layer of policy implications starts with a number of **general guidelines**, that are consistent with the higher-level framework mentioned above. These guidelines are systematic statements that account for major uncertainties and should work across all scenario-specific, policy-making initiatives. These general-purpose proposals are:

- The direction of technological development is difficult to predict, therefore, flexibility, adaptability, and resilience of ecosystems are important focus points;
- Since time horizons are perceived differently in different ecosystems, perceived varying urgencies need to be acknowledged;
- Social goods and societal goals including personal autonomy and equality are paramount to be considered;
- Creativity of the social fabric is also pre-conditioned in well-being (e.g. employment) and culture (e.g. heritage);
- Ecosystem-oriented strategies can help in economic development, but their focusing on 'anchors' in elite technologies and within critical growth sectors is vital - such 'leverage points' can be used to develop presence and relevance at the global level;

- Ecosystem strategies have to take into account specific factors, namely geopolitical reorganisation, asymmetrical access to natural resources and human talent, and the burden of climate change;
- When managing trade-offs, regulation should be geared towards obtaining net gains in light of larger societal challenges from an extended regulatory impact assessment perspective - generating synergies and network effects are often the largest and longer-lasting contributions of regulation, i.e. they have emergent consequences;
- The EU should adopt a consistent multilateral approach also in technical and R&I issues (for instance in contexts for expert-to-expert exchange and high-tech standard development like the 3GPP forum and the International Telecommunications Union), this is in line with a vision of Europe as an international broker with historical responsibilities in an increasingly volatile world.

From an **R&I policy perspective**, big R&D-based companies have become decisive for economic dynamics. Given the importance of private R&D budgets and the relatively meagre public R&D budgets, the EU seems to have settled for striving to give *market access to smaller players* (protecting and promoting competition) and emphasises *horizontal R&I* (market-failure science and technology policy). However, an enhanced and expanded R&I policy with new ways to intertwine *strategic research* (the space between basic and applied research) and *industrial strategy* (for a fast-moving competitive international chessboard), is an important option.

Whether the forces that have pushed Big Tech corporates to commanding heights will rise them to even higher levels of importance or, if for some reason, these undertakings are drawn to a background role, policy could have a role. Policy, including R&I policy, could also be robust to varying globalisation possibilities, namely if the world keeps at a fairly recognisable level (hyperscale and open) or if it recedes in a sharp way (smallscale and closed). The interplay between these fundamental uncertainties yields the four scenarios, and some policies may have meaning in whatever quadrant. What we do next, is to make the **R&I lessons learned across the scenarios** to talk to each other and to fuse into robust guidelines.

#### *What policy towards Big Tech?*

- The EU is not the only team in the pitch. Many players may be expected to intervene and have contradictory agendas. EU authorities cannot assume to make decisions in isolation or without pressure. Any movement by Europe will be up-hill, endurance is a precondition.
- The EU should consider developing its own leading actors, it cannot be satisfied only with regulating the actors of others. In this way it will also be contributing to the global diversity of available Big Tech.
- Existing Big Tech actors will be ever more involved in influencing policy developments. They may forcefully try to block regulatory initiatives, or capture others. Thus, awareness and monitoring of lobbying and pressure by these private players must be heightened. Any policy must be political economy conscious. Transparency, including in tech lobbying is concerned, should be increased and any policy-making activity of the EU should be aware especially when these activities are supported by foreign diplomacy.

- Big Tech are central in an informational era. They have unprecedentedly concentrated control and reach. Network externalities continue to determine their power. Their interests can be upheld through conventional or unconventional means and in lawful or unlawful ways. Digitalisation, cloudification, algorithmisation and inteligentification instrumentally alter economic relations but intrinsically and transversally alter social, political and cultural relations too. The power of Big Tech correlates with its economic importance, although without a political mandate. Big Tech project voice and exert influence in many international institutional circles, informal networks, and events. Efforts to safeguard societal integrity and economic pluralism in this new era must be move up as a priority.
- Policy in the domains of competition law, regulatory practice, and industrial strategy need to take into account that the economic process is characterised by dynamic competition. Essentially, and compared to previous generations of globalising big business (e.g. Big Oil), entities like dominant digital platforms or Big Pharma are much more important engines of R&D and technical change. Their role transcends the current markets they are active in any given point in time as well as outside national and even continental regulatory frameworks. Dynamic competition is exerting pressure on regulators, which have bounded financial and research resources. Foresight-prone governance needs to be mainstreamed in policy activities dealing with dynamic competition, including in anti-trust and sectoral supervision, as well as in technology and product market surveillance.
- The boundaries of Big Tech are not predetermined. There is an inherent recombinant power of diversification that is pre-product related, especially as data is a general purpose 'raw-material' at a fundamental level. Increasing capacity to learn across classic industry boundaries and a propensity to external technology acquisition represents a shift as the range for exploitation by those benefiting from intensive (and dynamic) economies of scale and scope expands. One implication is the need to clarify supply-chain models in which Big Tech are involved. There is also a need to establish cooperation and interoperability among different authorities (e.g. telecoms and mobility regulators, cybersecurity and science institutions, digital and environmental agencies), which will enable a better understanding of player operations and more effective policy approaches.
- Large high-tech undertakings muster combinations of giant physical and intangible assets. Sometimes their assets become infrastructures that become used by others (including the public sector) in a way that has been described as 'collaborative', 'sharing', 'as-a-service', 'open innovation', etc. Major regulatory interventions in Big Tech, especially those with platform business models, create impacts at a variety of levels and on a number of stakeholders. However, as enforcement mechanisms, the Big Tech remain sovereign within their realm. Innovation ensures that contracts are incomplete, so that tweaks are constant. This means Big Tech have managed to create spaces of interaction they themselves regulate, but in a discretionary way. Any action by public authorities should be stakeholder-aware and find new ways to countervail extreme information asymmetries.
- The public sector is an economic actor, also vis-à-vis Big Tech. It supplies framework conditions and inputs and is a major demand-side actor through public procurement of goods and services. There is room to leverage latent supplier-buyer power.
- Regulatory efforts overlap, sprawl and are often non-aligned. A purposive interpretation of the legislation should be applied, where regulation becomes a tool for growth and competitiveness on the supply side.

- Regulatory instruments should be streamlined, be straightforward and comprehensive. Efforts to ensure simplicity, consistency and coherence will be essential. This requires innovation in the regulatory activity itself, both in devising new normative frameworks (sandboxes, etc.) but in the implementation phases (using new data-driven approach for market monitoring). Coherent regulation is typically conducive to efficiency.

#### *Safeguards for sound R&I policy in a rugged landscape?*

- Since digital platform companies deploy power that spills into the science domain, the science-Big Tech interface should receive closer scrutiny. In order to obtain clear evidence on the scale and scope, an observatory on the interactions should be built. Relevant information such as on Big Tech involvement in science policy processes should be made transparent.
- Science officials and high-level research policy-makers have a crucial role to play in the economy and society in times of innovative transformation. At the same time, Big Tech companies are very active in the domains of science and knowledge. This raises questions regarding independence and protection against undue influence. This issue should be promoted in terms of public sector culture. While acknowledge the need to have inputs from businesses, well-established lessons acquired in the regulatory field, like rules regarding inappropriate interaction and cooling-off periods, can be useful.
- The Framework programme and national R&I budgets should not be benchmarked just against themselves but also against Big Tech spending. This policy learning approach does have a role to play in the process of comparing and assessing processes, procedures, and performance in the innovation-seeking economy. This should be done in terms of levels, growth rates, and directionality.

#### *What is the scope for success of the EU in the world?*

- Investment in R&I must be a sustained commitment. It can be a **mix of 'big bets' and 'small bets'**. Some bets are 'competitive bets' (new projects rival to existing Big Tech) some 'complementary bets' (adjusted and adapted to the current Big Tech landscape). Bold and persistent funding will matter, especially for 'big bets', and must be emphasised.
- Since Big Tech's reach is pervasive, the portfolio of strategic initiatives must be multi-layered. It must contemplate trans-European infrastructure and display local integration. It will be necessary to take into account both national bottom-up initiatives as well as top-down EU initiatives. Democratization, participation and experimentation in the process of science and knowledge priority setting and ex-post oversight must be built-in. Legitimacy is key.
- Investment directed to 'ecosystem infrastructures' as structural logic should be considered. Those infrastructures are either physical (e.g. 'European Data Gateways') or intangible (e.g. tech governance mechanisms, including standard essential patents). Coordinating the required effort to provide public goods provides a role for the state. To implement it, a corporate form akin to an 'European state-owned enterprise' may be needed.
- It must moreover be kept in mind that EU-wide infrastructures can only be used to the full if their size of usage extends to a market outside the European frontiers. This means that innovation and internationalisation capabilities are critical and self-reinforcing. The projection of R&I presence abroad will require creativity (as example could be entrepreneurship sandboxes as outposts in universities of large promising markets, such

as in the Asia-Pacific, including Vietnam or Malaysia, but elsewhere like Kenya, Nigeria, Brazil or Colombia). Promotion of cross-border interface mechanisms should be high on the priority R&I policy list.

- Diversified science and technology diplomacy is a prudent and desirable approach. Europe must consider all continents as partners. This extended realm is also a chance to craft new creative linkages and build relative autonomy through complementary international networks. For Europe, international stakeholder engagement can be seen as a source of competitive advantage. This will create room for Europe's larger and smaller tech alike. Europe should position itself as a 'platform', a mediation place in which many international players can find reasons to embark into productive relationships. As Europe shrinks on the world stage, the importance of going beyond the internal market increases.

## 5.4. Scenario-specific R&I options

In light of the normative starting points (above, sub-section 5.1) and the general policy recommendations (previous subsection), there could be a package of **scenario-specific strategies that make sense (to make the most of opportunities and to cushion risks)**, identified through the scenario process. On top of the general-purpose recommendations that are robust across the different scenarios, there could be a complementary layer of forward-looking options, intended to help policy-makers in preventing or supporting specific aspects of a scenario. Building panoramic awareness through scenarios improves the capacity of relevant actors to bring about the desired futures to facilitate or to forestall undesired developments.

Each scenario describes Europe in a particular situation. Each can be considered a critique of the present situation. In every environment, there is room for search and selection of policy options that are most fitting towards Big Tech. So, which are those? The following policy options provide the key strategic insights and seem important for acting *now* (developed in more detail in Appendix X).

### Scenario 1: Winners tech all

- Align national & EU policies in competition law and market regulation and also invest in strengthening supervision and enforcement on national and EU levels and cohesion across regulatory instruments. Continue to apply EU competition rules stringently, fairly, and objectively consistent with rule of law requirements. Focus efforts on globalised convergence in competition rules for a globalised technology-economy (through instances as WTO, OECD, UNCTAD, ICN);
- Align, as much as possible, the global response to AI (and AGI) developments when it comes to safety, cybersecurity, warfare and space-exploration; continue to be a strong rights-based voice on the global level and advocate for global guardrails on AI and AGI;
- Use and/or create stronger competition law and (market) regulations to protect EU and Member States' democratic processes against negative impact and interference by (using infrastructures and services of) Big Tech corporations – such as microtargeting and misinformation campaigns - while continuing to protect EU constitutional values, including fundamental rights;
- Invest smartly, and swiftly coordinate and support industrial investments, in pivotal sectors in which the EU has or can create a global competitive edge, and for which innovation is

of utmost necessity in light of changing demographic realities; aim for a (EU) race-to-the-top, for example in biotech, neurotech, agro-tech, robotics, and healthcare technologies;

- Invest strongly in a skilled, resilient, entrepreneurial population, including by strengthening the social component of the internal market, recognizing migration as source of talent, and attracting global talent more generally.

### **Scenario 2: Pax technologica**

- R&I and industrial policy constitute the crucial elements for ensuring prosperity. Competition from within and outside the club, forces the EU and the member states to invest heavily in creating European Big Tech. At the same time, and despite controlled international trade, efforts are necessary to align the global response to AI (and AGI) developments as much as possible, in particular when it comes to safety, cybersecurity, and warfare.
- Use EU R&I policy and adapt State Aid rules for national governments to be able to apply more ambitious research, innovation, and industrial policies with the aim for EU-anchored Big Tech to become more competitive, and get in selected areas a dominant position in the cooperative club. Since global value chains are not reliable, coordinate investment across the EU to ensure strategic autonomy. Incentivise diversification and those technologies that de-leverage from components necessary for the digital and green transition and scarce strategic minerals, especially those that cause risk of chokepoints in international supply chains.
- Encourage higher risk research and the creation of start-ups aiming at disruptive technologies, while ensuring that they will be blocked/discouraged from being acquired by Big Tech within or outside the cooperative club.
- Nurture relations with the Global South with the aim to compete for talent and markets with competitors from both, inside and outside, the cooperative club.
- Exempt education and research expenditure at Member State level from the 3% rule of budget deficit, because they constitute a long-term investment with high return on investment.

### **Scenario 3: Re-matching**

- The EU priority is to create and support a new generation of high-tech companies able to compete with USA and Chinese corporations in the new emerging sectors. Some of these corporations are founded with the mandate to exploit new scientific and technological opportunities.
- Priority in trade policy is no longer to lower tariffs and non-tariff barriers, but to develop co-investment projects that create the conditions for fair trade. This implies a new generation of bi-lateral and multilateral agreements which allows peripheral areas to develop their own productive capacity.
- Education and training are at the core of the European public policies. This is taking into account the demographic trends, with a low birth rate and an ageing population. The notion of healthy working life expectancy is designed to help senior citizens to continue successfully their economic and social integration.

- The EU fosters education collaboration with the Global South. There should be more programmes devoted to educate and train people and the concept of brain circulation promotes the acquisition of human resources for EU.
- Migration policy must be strongly transformed and the need to train migrants in Europe needs to be a priority.

#### **Scenario 4: Closet liberalism**

- Promote hot-spots of agglomeration and place-based innovation strategy. Support business associations to produce public goods to their sectors. Enhance the economic role of local communities and local universities. This can include a special eye towards rural development as alternative to crowded and expensive cities.
- Ensure a minimalist framework that an enhanced transactional but serendipity-prone economy in which civil society can prosper. Examples are streamlined bankruptcy laws, facilitate tokenised payment systems, smart contracting and smart procurement, training private-actors to leverage deregulated blockchains, etc. Create conditions for the adoption of data technologies in open infrastructures and agnostic/interoperable networks; build a sandbox-economy by installing a new experimental innovation framework for product test-beds, launch proof-of-concept incentives and a wave of demonstration prizes. Favour all kinds of market trials coming from grassroot innovation. Finance endless streams of 'small bets'.
- Update the mandate of sectoral regulators to make them contribute to an experimental economic policy and enhance a hot-spot economic structure. Independent sectoral regulators may be entrepreneurial in ways that further shake markets, make room for entrants, nudge industries, and unlock the potential of disruptive technologies.
- Reinforce science & technology diplomacy. Develop regulatory networks beyond 'like-minded' countries by adopting a humbler, more pragmatic approach. Create agreements with 'sister' regional or national innovation systems in other continents. Invest in free science/entrepreneurship interface zones in foreign university campuses.



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# APPENDIXES

## APPENDIX I. WORLD'S LARGEST COMPANIES

### The 100 largest companies by market capitalisation, September 1, 2023

(European firms underlined)

Rank	Name	Market capitalisation	Country
1	Apple	USD 2,962,055,495,680	United States
2	Microsoft	USD 2,441,865,068,544	United States
3	Saudi Aramco	USD 2,252,397,753,896	Saudi Arabia
4	Alphabet (Google)	USD 1,717,770,256,384	United States
5	Amazon	USD 1,425,094,606,848	United States
6	NVIDIA	USD 1,198,172,405,760	United States
7	Berkshire Hathaway	USD 790,246,129,664	United States
8	Tesla	USD 777,659,219,968	United States
9	Meta Platforms (Facebook)	USD 762,633,125,888	United States
10	Eli Lilly	USD 528,861,724,672	United States
11	Visa	USD 516,019,191,808	United States
12	TSMC	USD 483,321,544,704	Taiwan
13	Exxon Mobil	USD 452,547,477,504	United States
14	UnitedHealth	USD 443,394,654,208	United States
15	Walmart	USD 435,082,166,272	United States
16	<u>LVMH</u>	<u>USD 431,711,496,084</u>	<u>France</u>
17	JPMorgan Chase	USD 426,673,602,560	United States
18	<u>Novo Nordisk</u>	<u>USD 423,645,446,144</u>	<u>Denmark</u>
19	Tencent	USD 403,333,283,840	China
20	Mastercard	USD 391,555,022,848	United States
21	Johnson & Johnson	USD 386,437,447,680	United States
22	Procter & Gamble	USD 364,227,952,640	United States
23	Broadcom	USD 360,075,919,360	United States
24	Samsung	USD 357,497,732,154	South Korea
25	Home Depot	USD 333,103,300,608	United States
26	Oracle	USD 328,235,450,368	United States
27	Kweichow Moutai	USD 320,283,308,124	China
28	<u>Nestlé</u>	<u>USD 317,976,983,795</u>	<u>Switzerland</u>
29	Chevron	USD 313,418,678,272	United States
30	Merck	USD 278,721,200,128	United States
31	AbbVie	USD 261,580,406,784	United States



32	<u>ASML</u>	<u>USD 260,635,377,664</u>	<u>Netherlands</u>
33	Adobe	USD 256,711,131,136	United States
34	Coca-Cola	USD 256,476,626,944	United States
35	International Holding Company	USD 243,089,564,122	United Arab Emirates
36	Alibaba	USD 241,969,561,600	China
37	Pepsico	USD 241,342,005,248	United States
38	Costco	USD 241,183,293,440	United States
39	<u>Roche</u>	<u>USD 236,265,167,427</u>	<u>Switzerland</u>
40	Cisco	USD 235,701,469,184	United States
41	<u>L'Oreal</u>	<u>USD 234,059,662,774</u>	<u>France</u>
42	Toyota	USD 233,477,668,864	Japan
43	Bank of America	USD 230,285,803,520	United States
44	Salesforce	USD 215,770,218,496	United States
45	Thermo Fisher Scientific	USD 215,059,054,592	United States
46	<u>Hermès</u>	<u>USD 213,004,554,180</u>	<u>France</u>
47	<u>AstraZeneca</u>	<u>USD 211,218,333,696</u>	<u>United Kingdom</u>
48	<u>Shell</u>	<u>USD 209,550,065,664</u>	<u>United Kingdom</u>
49	ICBC	USD 209,515,688,126	China
50	<u>Novartis</u>	<u>USD 209,081,630,720</u>	<u>Switzerland</u>
51	<u>Accenture</u>	<u>USD 206,903,230,464</u>	<u>Ireland</u>
52	McDonald	USD 205,112,606,720	United States
53	Pfizer	USD 202,012,442,624	United States
54	Reliance Industries	USD 197,465,258,836	India
55	Danaher	USD 196,098,899,968	United States
56	Netflix	USD 194,931,507,200	United States
57	<u>Linde</u>	<u>USD 189,767,073,792</u>	<u>United Kingdom</u>
58	Comcast	USD 188,642,197,504	United States
59	PetroChina	USD 188,364,479,123	China
60	China Mobile	USD 187,171,427,518	China
61	Abbott Laboratories	USD 178,481,774,592	United States
62	AMD	USD 176,835,084,288	United States
63	<u>SAP</u>	<u>USD 161,640,841,216</u>	<u>Germany</u>
64	Agricultural Bank of China	USD 161,596,280,470	China
65	T-Mobile US	USD 161,563,262,976	United States
66	HDFC Bank	USD 158,543,626,240	India
67	Nike	USD 156,607,741,952	United States
68	Texas Instruments	USD 154,199,867,392	United States
69	Intuit	USD 153,920,962,560	United States
70	<u>Total Energies</u>	<u>USD 153,839,026,176</u>	<u>France</u>
71	Intel	USD 153,322,684,416	United States
72	Wells Fargo	USD 152,388,190,208	United States

73	<u>Dior</u>	<u>USD 150,387,162,755</u>	<u>France</u>
74	Tata Consultancy Services	USD 149,568,296,954	India
75	Walt Disney	USD 149,383,233,536	United States
76	Philip Morris	USD 148,528,840,704	United States
77	Caterpillar	USD 147,804,045,312	United States
78	<u>HSBC</u>	<u>USD 147,608,305,664</u>	<u>United Kingdom</u>
79	BHP Group	USD 147,426,930,000	Australia
80	Verizon	USD 146,552,832,000	United States
81	ConocoPhillips	USD 146,261,426,176	United States
82	United Parcel Service	USD 143,547,596,800	United States
83	CATL	USD 143,149,946,924	China
84	Morgan Stanley	USD 142,259,257,344	United States
85	<u>Prosus</u>	<u>USD 139,648,135,380</u>	<u>Netherlands</u>
86	Amgen	USD 137,314,426,880	United States
87	Pinduoduo	USD 137,230,057,472	China
88	China Construction Bank	USD 137,074,969,779	China
89	Bank of China	USD 136,179,142,912	China
90	Nextera Energy	USD 135,325,491,200	United States
91	Lowe's Companies	USD 135,320,813,568	United States
92	IBM	USD 134,774,235,136	United States
93	Boeing	USD 134,755,762,176	United States
94	Union Pacific Corporation	USD 134,708,060,160	United States
95	<u>Sanofi</u>	<u>USD 133,209,128,960</u>	<u>France</u>
96	Bristol-Myers Squibb	USD 129,565,982,720	United States
97	<u>Unilever</u>	<u>USD 129,291,083,776</u>	<u>United Kingdom</u>
98	Applied Materials	USD 128,817,881,088	United States
99	QUALCOMM	USD 128,769,662,976	United States
100	Royal Bank of Canada	USD 126,020,788,224	Canada

Source: <https://companiesmarketcap.com/>

## APPENDIX II. THE WORLD'S LARGEST TECHNOLOGY COMPANIES

### The world's 100 largest tech companies by market cap, September 1, 2023

(list of 'tech' firms; European firms underlined)

Rank	Name	market capitalisation	country
1	Apple	£2,962,055,495,680	United States
2	Microsoft	£2,441,865,068,544	United States
3	Alphabet (Google)	£1,717,770,256,384	United States
4	Amazon	£1,425,094,606,848	United States
5	NVIDIA	£1,198,172,405,760	United States
6	Tesla	£777,659,219,968	United States
7	Meta Platforms (Facebook)	£762,633,125,888	United States
8	TSMC	£483,321,544,704	Taiwan
9	Tencent	£403,333,283,840	China
10	Broadcom	£360,075,919,360	United States
11	Samsung	£357,497,732,154	South Korea
12	Oracle	£328,235,450,368	United States
13	<u>ASML</u>	<u>£260,635,377,664</u>	<u>Netherlands</u>
14	Adobe	£256,711,131,136	United States
15	Alibaba	£241,969,561,600	China
16	Cisco	£235,701,469,184	United States
17	Salesforce	£215,770,218,496	United States
18	Netflix	£194,931,507,200	United States
19	AMD	£176,835,084,288	United States
20	<u>SAP</u>	<u>£161,640,841,216</u>	<u>Germany</u>
21	Texas Instruments	£154,199,867,392	United States
22	Intuit	£153,920,962,560	United States
23	Intel	£153,322,684,416	United States
24	Pinduoduo	£137,230,057,472	China
25	IBM	£134,774,235,136	United States
26	Applied Materials	£128,817,881,088	United States
27	QUALCOMM	£128,769,662,976	United States
28	ServiceNow	£120,539,521,024	United States
29	Booking Holdings (Booking.com)	£115,044,409,344	United States
30	Automatic Data Processing	£105,394,577,408	United States
31	Sony	£105,263,710,208	Japan
32	Meituan	£102,247,989,362	China

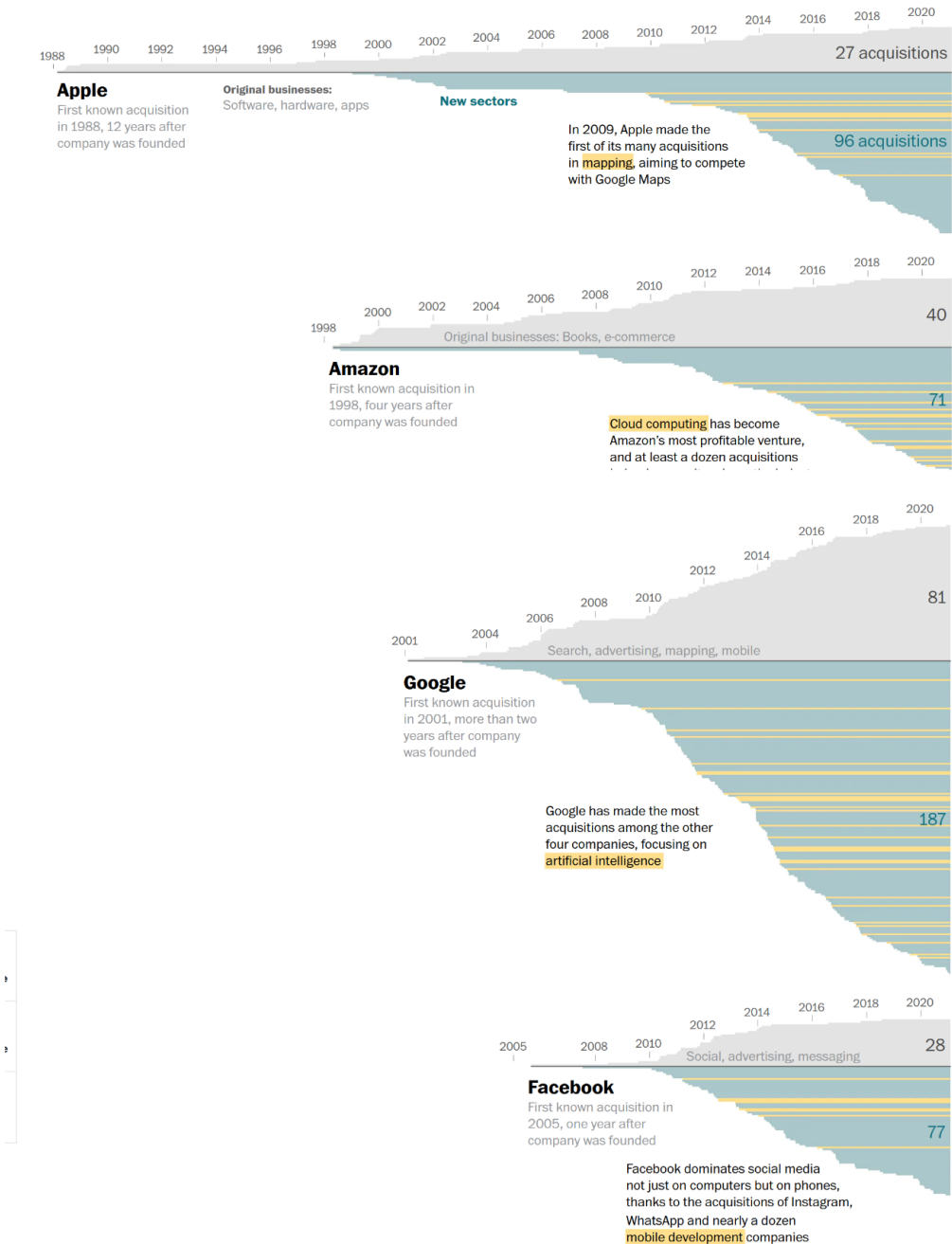
33	Keyence	£100,532,014,534	Japan
34	Uber	£96,127,180,800	United States
35	<u>Schneider Electric</u>	<u>£95,162,718,052</u>	<u>France</u>
36	Lam Research	£93,018,128,384	United States
37	Analog Devices	£90,907,418,624	United States
38	Shopify	£85,573,591,040	Canada
39	Airbnb	£84,667,359,232	United States
40	Micron Technology	£77,098,164,224	United States
41	Fiserv	£74,866,810,880	United States
42	Palo Alto Networks	£74,237,124,608	United States
43	Equinix	£72,748,580,864	United States
44	Activision Blizzard	£72,416,886,784	United States
45	MercadoLibre	£71,377,133,568	Argentina
46	PayPal	£70,925,680,640	United States
47	Vmware	£70,621,421,568	United States
48	Synopsys	£70,045,958,144	United States
49	KLA	£69,319,770,112	United States
50	Tokyo Electron	£68,240,903,011	Japan
51	NetEase	£67,365,232,640	China
52	Cadence Design Systems	£66,197,176,320	United States
53	Workday	£65,104,379,904	United States
54	SK Hynix	£64,506,428,632	South Korea
55	Arista Networks	£61,098,905,600	United States
56	<u>NXP Semiconductors</u>	<u>£54,128,111,616</u>	<u>Netherlands</u>
57	Jingdong Mall	£53,639,294,976	China
58	Roper Technologies	£53,306,413,056	United States
59	Atlassian	£52,621,541,376	Australia
60	<u>Dassault Systems</u>	<u>£51,651,098,541</u>	<u>France</u>
61	Baidu	£51,205,472,256	China
62	Snowflake	£51,192,373,248	United States
63	Nintendo	£50,079,792,575	Japan
64	Marvell Technology Group	£49,999,261,696	United States
65	Dell	£49,590,702,080	United States
66	Adyen	£49,222,672,443	Netherlands
67	Fortinet	£47,803,465,728	United States
68	Autodesk	£47,032,356,864	United States
69	Foxconn (Hon Hai Precision Industry)	£46,770,598,017	Taiwan
70	<u>Infineon</u>	<u>£46,154,671,771</u>	<u>Germany</u>
71	Microchip Technology	£44,793,245,696	United States
72	Constellation Software	£44,393,479,835	Canada
73	ON Semiconductor	£42,928,177,152	United States

74	<u>STMicroelectronics</u>	<u>£42,565,562,368</u>	<u>Switzerland</u>
75	<u>TE Connectivity</u>	<u>£41,838,653,440</u>	<u>Switzerland</u>
76	IQVIA	£41,079,758,848	United States
77	Xiaomi	£40,387,493,888	China
78	The Trade Desk	£39,181,529,088	United States
79	Delta Electronics (Thailand)	£39,169,796,319	Thailand
80	CrowdStrike	£38,228,922,368	United States
81	Kuaishou Technology	£35,639,640,188	China
82	Block	£35,488,120,832	United States
83	MediaTek	£35,471,249,866	Taiwan
84	Murata Manuft. (Murata Seisakusho)	£35,131,784,110	Japan
85	Veeva Systems	£34,699,714,560	United States
86	Coupang	£34,158,620,672	South Korea
87	CoStar Group	£33,716,385,792	United States
88	Global Payments	£33,622,425,600	United States
89	Fidelity National Information Services	£33,580,916,736	United States
90	DoorDash	£33,052,762,112	United States
91	Palantir	£32,664,780,800	United States
92	Electronic Arts	£32,655,732,736	United States
93	Datadog	£31,762,153,472	United States
94	<u>Spotify</u>	<u>£30,673,149,952</u>	<u>Sweden</u>
95	GlobalFoundries	£30,640,191,488	United States
96	<u>Amadeus IT Group</u>	<u>£30,322,380,325</u>	<u>Spain</u>
97	HP	£29,943,484,416	United States
98	Renesas Electronics	£29,763,518,785	Japan
99	SMIC	£29,565,319,388	China
100	Mobileye	£29,519,456,256	Israel

Source: <https://companiesmarketcap.com/tech/largest-tech-companies-by-market-cap/>

# APPENDIX III. BIG TECH AQUISITIONS

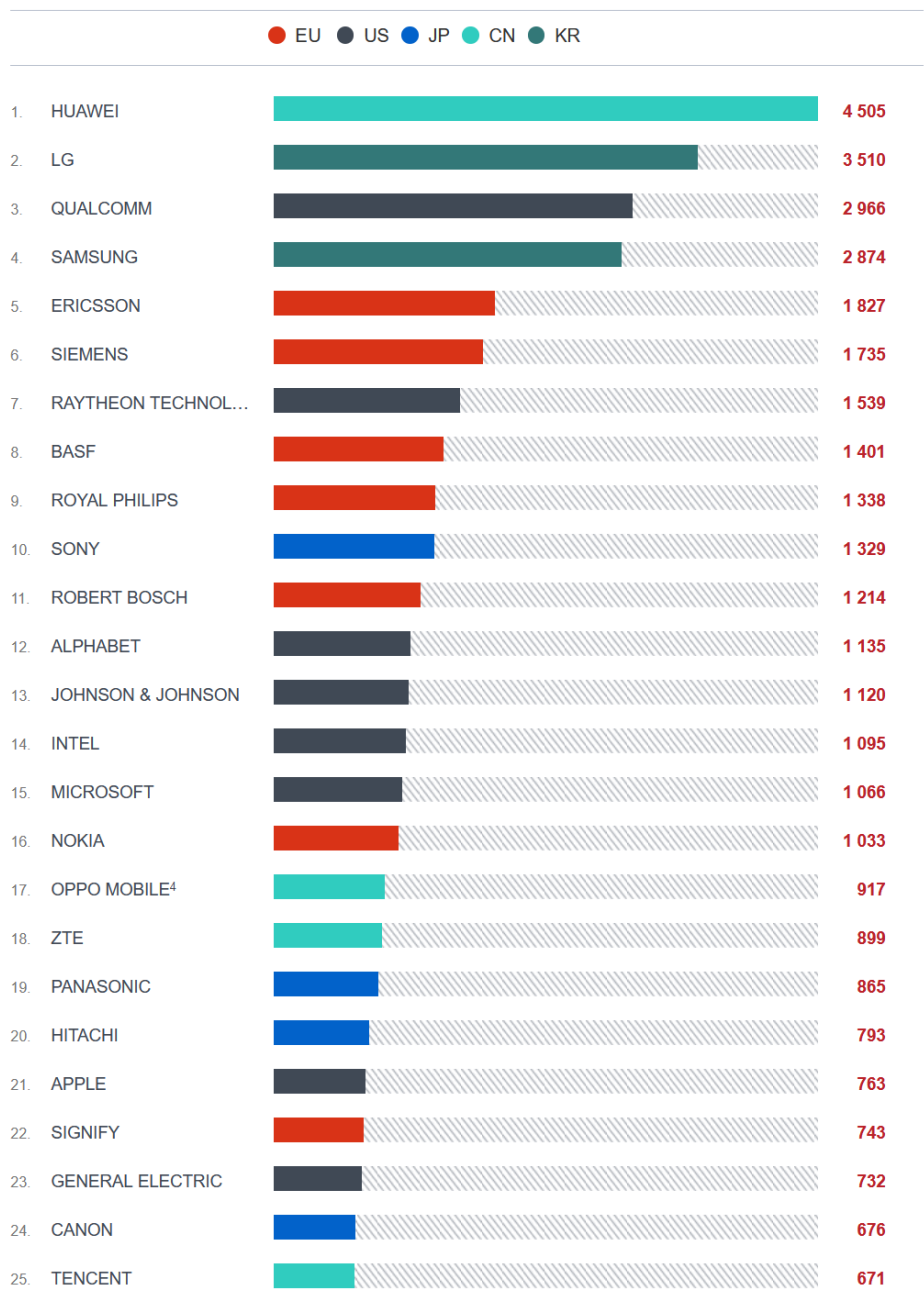
## History of external acquisitions by some Big Tech companies



Source: *Washington Post* (2023), updated September, <https://www.washingtonpost.com/technology/interactive/2021/amazon-apple-facebook-google-acquisitions/>

# APPENDIX IV. TOP INVENTORS IN EUROPE

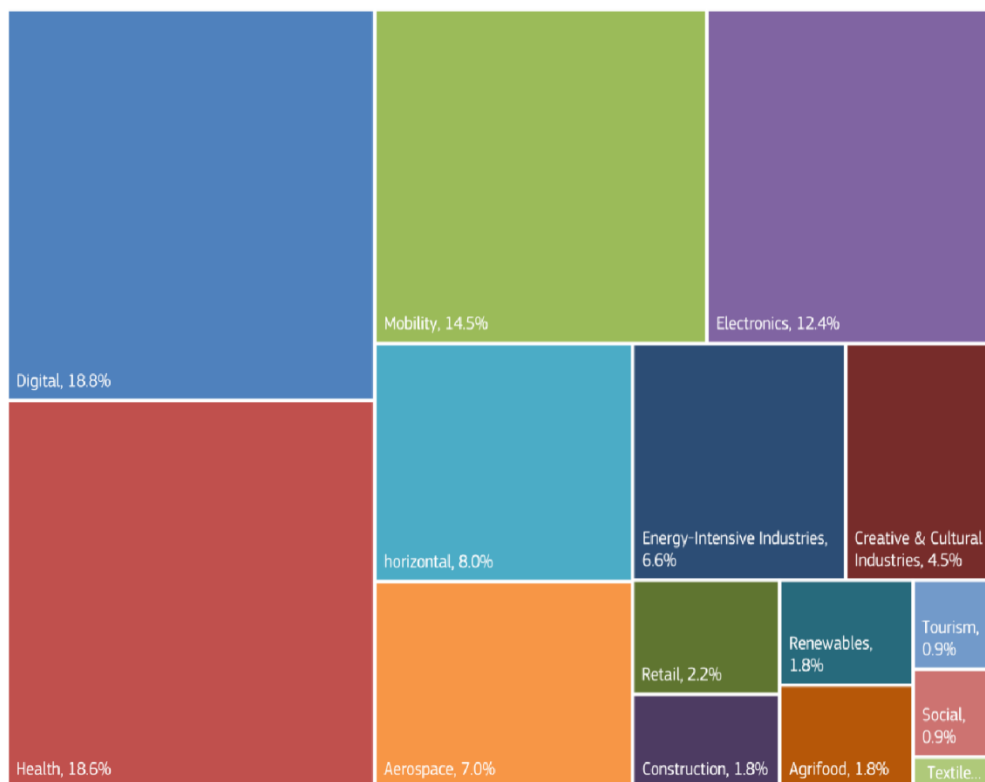
The 25 top patent applicants at the European Patent Office, 2022



Source: European Patent Office, <https://report-archive.epo.org/about-us/annual-reports-statistics/statistics/2022.html>

# APPENDIX V. CORPORATE R&D ECOSYSTEMS

Share of corporate R&D investment by technology-industry ecosystems, 2021



Source: European Commission (2022, p. 13)



## APPENDIX VI. METHODOLOGICAL NOTE

Scenarios are provocative stories of possible futures, not forecasts of likely end-states. They are charged with conceptual and normative baggage, but they do not have to be thought from the outset to represent utopias or dystopias (they are not prescriptive). If the methodology is at its best, the actual future would be a combination of features that we can anticipate today. The process of developing scenarios is an interactive learning process that draws on explicit evidence and expert tacit knowledge.

### *Foresight process*

The design of the scenario set-up was based on original work and scenario sketches were distributed to external experts so as to get them acquainted with their generic traits previous to workshops in which each of them was discussed in depth.

### *Scenario dimensions*

Dimensions lead to mutually-contrasting states of the future, thanks to the 2x2 opposition axes. The methodological decision to simplify is one way to handle complexity

### *Expert selection*

As usual, there is a significant difference between the stakeholders (in the sense of representatives of bodies of expertise, sectors, etc.) contacted and those willing to participate. In our case, the number of contacted stakeholders was three times higher than those that in the end were able to participate.

### *Scenario building*

Workshops were organised as 'scenario sprints' (speed-dating with the future). A high-pressure method to generate and collect insight created focus and allowed for creativity.

### *Wind-tunnelling*

Scenarios were sent to yet another group of experts (with specific foresight expertise) in order to debug and test them.

### *Policy debates*

Scenario drafts were sent in advance to another batch of experts. In a dedicated workshop each of the scenarios was explored from a policy perspective.

### *Qualifications*

Our focus implied less explicit attention than might be expected to issues like environmental changes. The global impact of these, e.g. when climate goals are not met and global warming critical thresholds, are easily squared with the scenario dimensions. The same is true for the impact of migration pressures. We have not meant to disregard these developments but accepted that in futuring-analysis, only a few factors can be highlighted. Nevertheless, such factors surface in the scenarios.

## APPENDIX VII. EXTERNAL EXPERTS

While the goal was to have a balanced representation of diverse views that would tap into a range of stakeholder perspectives, in practice the process depends on the context and the subsequent ready-ness of experts to engage. Then, even if efforts are made to cover diverse perspectives, the results build on the contributions of those involved in the process. Using a structured dialogue, the process offers opportunities for reciprocal learning among participants to explore together possible futures and reflect on related policy implications. A number of external experts were engaged in the exercise and helped in several ways. We would like to acknowledge their contribution:

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Cher Li  
Conor Kirwan  
Constantinos Stylianou  
Despoina Mantzari  
Eduardo Longo  
Eric Iversen  
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## APPENDIX VIII. FACTORS OF CHANGE

While the main scenario dimensions provide the basic planks for the scenario work, factors of change provide specific ideas (impelling factors, buffering factors, etc.) on possible future developments. The mix of these moving issues provide texture and need to be taken into account in terms of scenario development (for stakeholders and analysts).

In the scenario workshops, participants were invited to relate and adapt the factors to the dimensions of each scenario and propose new factors and issues to be addressed in a given scenario. The team prepared in advance a non-exhaustive collection of factors of change by drawing on the literature about recent developments and earlier foresight research.

The factors can be categorised as follows:

- Economy and production
- Technology and engineering
- Society and human behaviour
- Geopolitics and cross-border affairs
- Climate and resources

### Economy and production

Descriptor	Projections	Sources
<b>Secular stagnation</b>	Prolonged period of anaemic economic growth. Unlike the previous phase, called 'The Great Moderation', the macroeconomic trend displays low-growth but large amplitude of fluctuations. Underemployment is sticky. Policies have little impact and seem counter-productive. The debt-to-GDP ratio is stiff. Bond-holders are kings.	<a href="https://cepr.org/voxeu/columns/secular-stagnation-facts-causes-and-cures-new-vox-ebook">https://cepr.org/voxeu/columns/secular-stagnation-facts-causes-and-cures-new-vox-ebook</a>
<b>Creeping concentration</b>	The economic system has shifted towards being more concentrated and less competitive. Big business is an ever increasing part of personal lives and of productive life. Large corporations from a few sectors, and large corporations in any given sector, are explaining larger shares of revenue and of total employment. Corporate profits are an ever increasing proportion of the aggregate economy. New entrants face high barriers to entry while incumbents seem to absorb challenges. The industrial demography is of corporate ageing, This is a 'megalodon' and a 'gerontodon' economy.	<a href="https://www.resolutionfoundation.org/publications/is-everybody-concentrating-recent-trends-in-product-and-labour-market-concentration-in-the-uk/">https://www.resolutionfoundation.org/publications/is-everybody-concentrating-recent-trends-in-product-and-labour-market-concentration-in-the-uk/</a>

<b>Zero-cost welfare</b>	The importance of non-priced digital goods continues to climb in the consumer basket. By the year 2020 the money equivalent of these conveniences amounted to 10% of family income, but with the continuous digitization of the economy, by 2040 'free stuff' reaches one third of the average income. Benefits for low-incomes are even higher, as well as for less developed countries. GDP accounts now assign explicit amounts of what these services are worth. This is an e-Gift Economy.	<a href="https://www.nber.org/system/files/working_papers/w31670/w31670.pdf">https://www.nber.org/system/files/working_papers/w31670/w31670.pdf</a>
<b>High-growth from regional hot-spots</b>	Vibrant regional economic dynamics as pathway to innovation-led development. Entrepreneurial ecosystems provide springboards for growth even in peripheral territories. Persistent prosperity is place-based.	<a href="https://publications.jrc.ec.europa.eu/repository/handle/JRC134577">https://publications.jrc.ec.europa.eu/repository/handle/JRC134577</a>

## Technology and engineering

Descriptor	Projections	Sources
<b>Limits to innovation</b>	The cost of R&D is on the increase. Scientific productivity stutters. Only a few poles of innovative investment are able to keep up with the requirements of modern high-end research. Open science and intellectual property are only partial responses, often with perverse effects.	<a href="https://press.princeton.edu/books/paperback/9780691175805/the-rise-and-fall-of-american-growth">https://press.princeton.edu/books/paperback/9780691175805/the-rise-and-fall-of-american-growth</a>
<b>Critical and exponential knowledge bases</b>	A constellation of new science and technology fields have a large potential for causing innovations in the market space. However, like nuclear power in its business models are not always clear. Examples are robotics, 6G, metaverse, quantum and biotech.	<a href="https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf">https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf</a>
<b>AI-powered platforms</b>	AI systems capitalise on platform-based business models and distributed cloud-architectures. In this way they have scalability, flexibility and data depth. Digital platforms are entrenching their position as organisers of external players, like final customers and industry partners.	<a href="https://ide.mit.edu/insights/now-available-2023-platform-strategy-summit-report/">https://ide.mit.edu/insights/now-available-2023-platform-strategy-summit-report/</a>
<b>Eyes and muscle everywhere</b>	Sensors (and connectivity) are cheap and can be deployed everywhere in the built environment and in nature. Robotics is democratised through drones, which are creatively reconfigured by users. Autonomous systems	<a href="https://www.lifo-undation.org.uk/en/publications/foresight-review-of-">https://www.lifo-undation.org.uk/en/publications/foresight-review-of-</a>

	seem to seep into the cracks of every situation or policy puzzle.	<a href="#">robotics-and-autonomous-systems-ras/</a>

## Society and human behaviour

Descriptor	Projections	Sources
<b>Social fractures</b>	The Web 2.0 accelerated the social conversation. Increasingly income inequality created resentment. There are no proper countervailing powers of offset disequilibria. This combination is combustible and channels its blast through nationalism, regionalism, communitarism, wokeness, and other identity-driven issues. These are dynamics of disparity.	<a href="https://www.amazon.es/dp/0300244177?linkCode=gs2&amp;tag=uuid0f-21">https://www.amazon.es/dp/0300244177?linkCode=gs2&amp;tag=uuid0f-21</a>
<b>Deep Davos</b>	World leaders increasingly see each other in venues like the G7/G20/etc. and make pacts outside the UN. Technocratic circles known as 'deep state' are stable mandarins in a scene of democratic volatility. But business leaders also meet and coordinate discourses like in Davos or Bilderberg. Since the economic system is capitalist, the importance of these convergent networks should not be underestimated.	<a href="https://yalebooks.yale.edu/book/9780300261448/trade-wars-are-class-wars/">https://yalebooks.yale.edu/book/9780300261448/trade-wars-are-class-wars/</a>
<b>Telemigration</b>	The relative costs of moving physical objects and immaterial items shifts due to strategic trade policies, non-tariff barriers, geopolitical risks and sluggish data transfer regulation. The costs of in-shoring and friend-shoring go down allowing for permanent ability to telework of broader varieties of jobs.	<a href="https://www.nbcr.org/papers/w29387">https://www.nbcr.org/papers/w29387</a>
<b>Changing demographics</b>	Higher life-expectancy in prosperous geographies and younger cohort replenishment in poorer continents (Africa, Central and South America). Pressures become higher given different preferences and easier information circulation and transport alternatives.	<a href="https://worldmanufacturing.org/societal-megatrends-shaping-the-future-of-manufacturing/">https://worldmanufacturing.org/societal-megatrends-shaping-the-future-of-manufacturing/</a>

## Geopolitics and cross-border affairs

Descriptor	Projections	Sources
<b>Slowbalization</b>	Hyperglobalisation peaked with the 'Sub-prime crises' and the ensuing 'Great Recession'. The ratio of world trade to global GDP will keep sliding downwards. Competition will be become harder and more rooted in politics.	<a href="https://www.imf.org/en/Blogs/Articles/2023/02/08/charting-globalizations-turn-to-slowbalization-after-global-financial-crisis">https://www.imf.org/en/Blogs/Articles/2023/02/08/charting-globalizations-turn-to-slowbalization-after-global-financial-crisis</a>
<b>Meso-lateral regionalism</b>	A pattern economic relations that reconciles place and prosperity, providing both resilience and sustainability. The world is not 'flat', but an archipelago. Neo-liberal accords have failed, but negotiated commercial accommodation with strategic partners is sought after. This is neither deglobalisation nor fragmentation. Relational security is the issue.	<a href="https://www.penguinrandomhouse.com/books/688161/homecoming-by-rana-foroohar/">https://www.penguinrandomhouse.com/books/688161/homecoming-by-rana-foroohar/</a>
<b>Post-Americanization</b>	Non-Western countries display more agenda-setting powers. Western ideals and values are not taken as universal. Non-Western countries actively try to do away with US-based institutions, like the dollar or finance.	<a href="https://link.springer.com/book/10.1057/9781137493217">https://link.springer.com/book/10.1057/9781137493217</a>
<b>West vs West</b>	A package of policy commitments by the US have promoted own competitiveness against that of allies. The Infrastructure Investment and Jobs Act (IIJA) of 2021, the CHIPS and Science Act of 2022, and Inflation Reduction Act (IRA) of 2022 have transformed the trade chessboard by prioritising what 'like-minded' countries can portray as a predatory approach.	<a href="https://books.google.pt/books?id=N1HDEAAAQBAJ&amp;hl=pt-PT&amp;source=gbs_book_other_versions">https://books.google.pt/books?id=N1HDEAAAQBAJ&amp;hl=pt-PT&amp;source=gbs_book_other_versions</a>
<b>Big lobbying</b>	High-tech industries, especially foreign-based digital giants, invest in the hearts and minds of decision-makers and the population at large. Big Tech remains at the top as the big spenders. The semiconductor and big pharma are also active. Moreover, their influence is felt as funders of 'NGOs' but also, and increasingly so, of universities.	<a href="https://corporateeurope.org/en/2023/09/lobbying-power-amazon-google-and-co-continues-grow">https://corporateeurope.org/en/2023/09/lobbying-power-amazon-google-and-co-continues-grow</a>

## Climate and resources

Descriptor	Projections	Sources
<b>Climate changing</b>	Global boiling.	<a href="https://www.ipcc.ch/report/sixth-assessment-report-cycle/">https://www.ipcc.ch/report/sixth-assessment-report-cycle/</a>
<b>Geodiversity matters</b>	Transition of techno-economic paradigm impacts the locales that are more valuable to support the clean reconfiguration of the economic system.	<a href="https://ig.ft.com/rare-earths/">https://ig.ft.com/rare-earths/</a>
<b>The liquid nature</b>	Ocean warming, polar ice melting, acidification of seawater, sea level rising, coastal stress, sweet water scarcity.	<a href="https://www.weforum.org/agenda/2012/09/how-sick-are-the-oceans/">https://www.weforum.org/agenda/2012/09/how-sick-are-the-oceans/</a>
<b>Land stress</b>	Accelerated erosion, usable soil scarcity. Dietary impacts.	<a href="https://www.sciencedirect.com/science/article/pii/S2211467X20300985">https://www.sciencedirect.com/science/article/pii/S2211467X20300985</a>
<b>Circular economy</b>	Industrial products and consumer goods grow the recycled component of total material incorporation. Sharing models are favoured.	<a href="https://www.capgemini.com/wp-content/uploads/2021/11/Circular-Economy_1112021_v10_web-2.pdf">https://www.capgemini.com/wp-content/uploads/2021/11/Circular-Economy_1112021_v10_web-2.pdf</a>

## APPENDIX XIX. SCENARIO SIGNALS AND SWITCHES

Scenarios are frames that help developing a panoramic awareness of human-ecological systems of possible futures. They give decision-makers and stakeholders a wide-angle lens. However, they may have a drawback: they are *static* pictures of futures.

A more dynamic, evolutionary aware perspective can be brought about by concepts such as 'weak signals' and 'wild cards'. These concepts may be articulated in connection to scenarios as a way to developing anticipatory capabilities regarding future *creeping* and *sudden* future changes.

We can understand scenario signals as evidence that points to the materialisation of a given scenario. Some facts or gradual build-ups may mean that one direction gains force instead of another, chaining the perception of what is a consistent representation of the world that is taking shape. Early detection of developments that could lead to scenarios is a continuous, but often ambiguous, effort.

We may define wild cards as those surprising single events that have the power to be turning points in the history of the relevant context. Shocks may have the effect of producing a jump in the status quo. Embracing the notion of wild cards, creates an alertness to those unforeseen discrete extreme change phenomena, that take us out from one scenario and place us into another one, thereby switching the future.

In the context of this study the following 'weak signals' and 'wild cards' may be considered. Since meaning and impacts are open to interpretation, these will be articulated as questions:

### *Scenario signals*

- Yuan-designated and rupee-designated oil transactions between Global South trading partners as a signal that the world's major commodity exporters and importers can try to reduce their dependence on the dollar?
- Increasing interacting within G7 and within BRICS as a pointer of renewed multilateral cooperation?
- Both USA and China facing increasing domestic economic and political challenges instability that could disrupt their capacity to lead over regional trade and technology blocs?
- Loss of influence of the EU's large companies in the Global South creates room for greater split in technological standards?

### *Scenario switchers*

- Reserves of critical minerals deplete fast, creating impulses for local innovative solutions how to recycle the waste?
- USA splits into hinterland conservative and coastal ultra-liberal parts, with the former rapidly sinking into neo-communitarism and the latter collapsing in chaos in the midst



'defund the state' movement, so the USA is out of play? By coincidence there are internal revolts in China, which make the country to turn inwards?

- In the aftermath of a number of high-profile scandals related to massive surveillance practices, Western tech-giants collapse, and China takes over the new hyperpower status?
- Maverick billionaires wielding control over Big Tech infrastructures with global span, single-handedly curb the power over sovereign states, create momentum for Big Tech firms to enter the UN security council?
- Singularity of a combination between quantum computing and Artificial General Intelligence with unravelling of biblical proportions?

# APPENDIX X. SCENARIO-SPECIFIC POLICY MENUS

What is to be done in each strategic habitat?

Scenario 1	National	EU	International
<b>Competition &amp; Regulation</b>	<ul style="list-style-type: none"> <li>Align national policies in regulation &amp; competition with those of the EU;</li> <li>State Aid should be granted in line with EU industrial policies;</li> <li>It is of utmost important to implement market policies in light of increasing the effectiveness of the internal market policies, including its social pillar policies;</li> <li>Prevent race-to-the-bottom when it comes to EU regulation implementation;</li> <li>Protect democratic processes against misinformation and micro-targeting practices.</li> </ul>	<ul style="list-style-type: none"> <li>Continue to apply existing competition and regulatory rules stringently, fairly and objectively; step-up enforcement of the digital package, both in line with rule of law requirements;</li> <li>Align supervision and enforcement: prevent fragmentation of each MS having its own national regulatory agency for each new regulatory initiative, each with different EU mandates.</li> </ul>	<ul style="list-style-type: none"> <li>Efforts should focus on globalised convergence in competition rules for a globalised technology-economy (through instances as WTO, OECD, UNCTAD, ICN);</li> <li>Strengthen advocacy and invest in capacity building for regulatory oversight for developing countries;</li> <li>Align, in as much is possible, the global response to AI (and AGI) developments when it comes to safety, cybersecurity, and warfare;</li> <li>Integrate sustainability as major concern in all competition and regulatory frameworks.</li> </ul>
<b>Industrial strategy</b>	<ul style="list-style-type: none"> <li>Support tech-displaced workers by: investing in reskilling, continuous education, and experimenting with general basic income for tech replaced workers;</li> <li>Invest decisively in social innovation;</li> <li>In coordination with EU policies: strengthen the public services and create public or public-private alternatives or top-up's for information services.</li> </ul>	<ul style="list-style-type: none"> <li>Invest in areas necessary in light of demographic developments (e.g. robotization and digital health care);</li> <li>Support industrial policy with social innovation policies; Invest strongly in (anchors within) industries that rely less on infrastructures of the USA based tech companies, such as biotech, neurotech and agro-tech, building on EU-strengths.</li> </ul>	<ul style="list-style-type: none"> <li>Focus on creating a level playing field by 'race to the top';</li> <li>Greater schemes for Technology Transfer</li> <li>Create a robust and fair system for climate-displaced by focusing on skills and learning;</li> <li>Keep focusing on lowering geo-political tensions;</li> <li>Start negotiating for a 'Treaty to protect the commons of Space' to protect its resources and to prevent a spiralling space war.</li> </ul>

<b>Research &amp; Innovation</b>	<ul style="list-style-type: none"> <li>▪ Focus on 'national strengths' by creating targeted R&amp;D investments;</li> <li>▪ Create attractive work-life balance conditions for attracting talent;</li> <li>▪ Support industrial innovation through knowledge-sharing centres;</li> <li>▪ Create stronger ties among universities public research centres and the business community</li> </ul>	<ul style="list-style-type: none"> <li>▪ Make innovation within the EU simpler by striking down regulatory burdens (create a central 'allowed in the EU' system, including for pharma);</li> <li>▪ Become a player in attracting global talent and do not 'waste' talent by overlooking migration;</li> <li>▪ Support of big science in emerging areas in collaboration with external players on the CERN model.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Collaborate with the Big Tech industries of the USA to connect to local talent and cultures;</li> <li>▪ Fostering global infrastructures for R&amp;D; but also create access to high-investment costs technologies between the EU and the USA;</li> <li>▪ Focus on delimitation of R&amp;D and innovation in cyber-warfare technologies; focus instead of enhancing participation and democratisation globally.</li> </ul>
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Scenario 2	National	EU	International
<b>Competition &amp; Regulation</b>	<ul style="list-style-type: none"> <li>▪ Align national policies in regulation &amp; competition with those of the EU, so as to stand stronger as an EU-entity in light of powerful non-EU companies;</li> <li>▪ State Aid should be granted in line with EU industrial policies.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Step-up enforcement of the digital package, both in line with rule of law requirements</li> <li>▪ Be realistic about global markets, also in competition law assessments, make room for innovative complementors to grow;</li> <li>▪ Consider providing the European Commission with the tool to break up large companies under well-considered circumstances;</li> <li>▪ State Aid should be reformulated to serve better the targets of industrial policy.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Focus on regulation and EU values, strengthening data protection and personal autonomy;</li> <li>▪ Try to export product market surveillance techniques and templates;</li> <li>▪ Block the derailing of disruptive technologies emergence through the acquisition of high-tech start-ups by Big Tech;</li> <li>▪ Streamline the role of leading big business in the trade between major regions.</li> </ul>
<b>Industrial strategy</b>	<ul style="list-style-type: none"> <li>▪ In coordination with EU policies: strengthen the public services and create public or public-private alternatives or top-up's for information services;</li> <li>▪ Accommodate skill-shifting effects by re-</li> </ul>	<ul style="list-style-type: none"> <li>▪ Make regulatory room for businesses that can act as complementors to the Big Tech companies;</li> <li>▪ Invest in key technologies that EU has strength (e.g. Ag-tech and precision farming)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Friendshore, allyshore, nearshore but be careful of who are the so-called 'friends' or 'allies';</li> <li>▪ Create partnerships in key ecosystems;</li> <li>▪ Get active in patent essential standards;</li> </ul>

	<ul style="list-style-type: none"> <li>investing in the middle-classes;</li> <li>▪ Encouragement of defence-related technologies and explicit multi-use R&amp;I financing;</li> <li>▪ Demand-side innovation policy;</li> <li>▪ Economic security as a key policy rationale.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Create infrastructural alternatives (for the Big Tech offerings) in key areas in public-private or public initiatives: cloud computing, networks, etc.</li> <li>▪ Create policies that attract talent from the Global South.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Enhance industrial capacity in the Global South and create cooperation schemes;</li> <li>▪ Support of EU to cherish existing 'anchors' in technology ecosystems is needed;</li> <li>▪ Substitute monopolistic sources of critical materials:</li> </ul>
<b>Research &amp; Innovation</b>	<ul style="list-style-type: none"> <li>▪ Aim at nurturing complementors;</li> <li>▪ Nudge to establish anchors in ecosystems in line with EU policies;</li> <li>▪ Take out education and R&amp;I from the EU budgetary deficit rules;</li> <li>▪ high-risk/high reward bets in R&amp;I policy.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Focus on creating a co-supporting EU ecosystem of research and innovation by creating circumstances that do not pit national investments against each other, but strengthen each member states' strongest opportunities;</li> <li>▪ Make innovation within the EU simpler by striking down regulatory burdens (create a central 'allowed in the EU' system, including for pharma);</li> <li>▪ Create an attractive funding system for talent in R&amp;I;</li> <li>▪ high-risk/high reward bets in the Framework Programmes.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Incentivise technologies that deleverage from scarce strategic minerals, especially those that cause risk of choke-points in international supply chains;</li> <li>▪ Work out key programmes within cooperative clubs, but avoid parasitical relationships and stress the need for the sharing of benefits;</li> <li>▪ Learn how to play the R&amp;I multi-polar game.</li> </ul>

Scenario 3	National	EU	International
<b>Competition &amp; Regulation</b>	<ul style="list-style-type: none"> <li>▪ In crucial industries, mixed oligopolies in which foreign Big Tech companies are complemented by national firms;</li> <li>▪ Stronger regulations about data protection;</li> <li>▪ Balancing IPRs with knowledge sharing and dissemination.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Support of EU to industrial champions;</li> <li>▪ Political control on Mergers &amp; Acquisitions to protect EU start-ups in innovative fields;</li> <li>▪ Strong regulations about data protection.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Multilateral trade is more and more associated to political control rather than to market forces;</li> <li>▪ WTO activities is complemented by bilateral, multilateral and regional trade agreements;</li> <li>▪ Regulation to enhance the green transitions.</li> </ul>

<b>Industrial strategy</b>	<ul style="list-style-type: none"> <li>▪ National states work as ecosystem orchestrators in strategic business areas, like semiconductors or mobility;</li> <li>▪ Capacity building, especially in the emerging industries;</li> <li>▪ Renewed support for education and training infrastructures;</li> <li>▪ Support to civilian rather than to defence industry.</li> </ul>	<ul style="list-style-type: none"> <li>▪ New programmes for the creation of European companies in emerging fields;</li> <li>▪ Stronger anti-trust policies to prevent abuses of dominant positions in the internal market, but flexibility to allow the players to extend beyond the EU;</li> <li>▪ Creation of a data sharing centre to control, store and disseminate information under the control of political authorities and civil society.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Dynamic competition among Big Tech companies directed to the diffusion of knowledge;</li> <li>▪ Enhanced industrial capacity in the Global South;</li> <li>▪ Greater schemes for technology transfer;</li> <li>▪ Disarmament agreements lead to the reduction of military expenditure and in increase in investment in civilian infrastructures;</li> <li>▪ Sustainability criteria are included in trade agreements to minimize transport costs and, when appropriate, schemes such as 'KM 0 production and consumption circles';</li> <li>▪ Strategic bilateralism in research funding with key geographies of the 'Global South'.</li> </ul>
<b>Research &amp; Innovation</b>	<ul style="list-style-type: none"> <li>▪ Increase of public R&amp;D in emerging areas;</li> <li>▪ Support to industrial innovation through knowledge-sharing centres;</li> <li>▪ Stronger ties among universities public research centres and the business community.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Support of big science in emerging areas in collaboration with external players on the CERN model;</li> <li>▪ Integration of R&amp;D activities and facilities at the EU level;</li> <li>▪ Enhance students' mobility with Erasmus programmes and similar programmes targeting non-European students.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Fostering global infrastructures for R&amp;D;</li> <li>▪ Creating a global IPR system to favour the sharing of scientific and technical information;</li> <li>▪ Generation of global exchange of students to facilitate brain-circulation rather than brain-drain.</li> </ul>

Scenario 4	National	EU	International
<b>Competition &amp; Regulation</b>	<ul style="list-style-type: none"> <li>▪ Entrepreneurial regulators propose new services and nudge sectors;</li> <li>▪ Bankruptcy laws streamlined.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Facilitate tokenised payment systems;</li> <li>▪ Framework for smart contracts and smart procurement;</li> <li>▪ Minimalist frameworks for civil society to find new for itself;</li> </ul>	<ul style="list-style-type: none"> <li>▪ Develop regulatory networks beyond 'like-minded' countries, but not only (humbler, 'values-agnostic' approach).</li> </ul>

		<ul style="list-style-type: none"> <li>Regulation is mostly defined as standard-stewardship and experimentation-promotion.</li> </ul>	
<b>Industrial strategy</b>	<ul style="list-style-type: none"> <li>Regional policy is at the core of growth government strategies;</li> <li>Promote hot-spots of agglomeration and place-based innovation strategy;</li> <li>Training for private-actors to leverage deregulated blockchains;</li> <li>Sectoral regulators are lean organisations and incentivise unlicensed innovation running on top of unlocked public domain assets (like radiospectrum);</li> <li>Foster grassroots innovation and all things bottom-up.</li> </ul>	<ul style="list-style-type: none"> <li>Focus on diffusion, technology usage capabilities and on industry PhDs;</li> <li>Create conditions for the adoption of data technologies in open/agnostic/interoperable networks;</li> <li>Focus on rural development as alternative to crowded and expensive cities.</li> </ul>	<ul style="list-style-type: none"> <li>Connect different regional innovation systems.</li> <li>Create 'sister' regional innovation systems with other regional systems in other continents.</li> </ul>
<b>Research &amp; Innovation</b>	<ul style="list-style-type: none"> <li>Incentives for technological trials;</li> <li>Foster grassroots innovation and all things bottom-up</li> <li>Supporting business associations to produce public goods to their sectors.</li> </ul>	<ul style="list-style-type: none"> <li>New experimental innovation framework for product test-beds, factory pilot lines, proof-of-concept incentives, and a wave of demonstration prizes;</li> <li>Finance endless stream of 'small bets';</li> <li>Develop brand of the European innovation sandbox</li> </ul>	<ul style="list-style-type: none"> <li>Free science entrepreneurship interface zones in foreign university campuses;</li> <li>Reinforce science &amp; technology diplomacy.</li> </ul>

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## **Background**

This policy brief is the outcome of one of the eight 'Deep Dive' Foresight Studies conducted within the framework of the 'European R&I Foresight and Public Engagement for Horizon Europe' project. The study was carried out by the 'Foresight on Demand' consortium for the European Commission. Throughout September and October 2023, a core team of authors identified the factors of change and key uncertainties that shaped the scenarios. External experts were consulted and actively participated in three workshops, providing valuable inputs that contributed to the development of scenario narratives and their policy implications. Additionally, experts from national and EU public administration have made various contributions to this report. The process was further enriched by discussions within the Commission's internal Horizon Europe Foresight Network.

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Big Tech wield unprecedented influence on production and consumption relations. Europe faces a number of epoch-making questions. Will the regulatory frameworks deliver? Should Big Tech be broken up or standards relaxed? Should national and supra-national authorities foster alternative ventures capable of operating at global scale and scope? Or should policy makers prioritise an economic fabric full of smaller enterprises that are locally creative and dynamic? This policy brief uses a scenario approach to sketch the implications of Big Tech for Europe's future by 2040.

*Research and Innovation policy*

