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2021 Strategic Foresight Report

The EU's capacity and freedom to act

I. INTRODUCTION

The European Union is charting a strategic path to becoming the first climate-neutral continent by 2050, grasping the opportunities of the digital age, building an economy that works for people, promoting the European way of life, strengthening our unique brand of responsible global leadership, and nurturing, protecting and strengthening our democracy.

Openness, as well as rules-based international and multilateral cooperation, are strategic choices. They stimulate prosperity, fairness, stability, competitiveness and dynamism within the EU and beyond. The history of the European project demonstrates the benefits of **well-managed interdependence and open strategic autonomy** based on shared values, cohesion, strong multilateral governance and rules-based cooperation. The pandemic has only strengthened the case for international cooperation to address global challenges.

This 2021 Strategic Foresight Report presents a forward-looking and multi-disciplinary perspective on the EU's capacity and freedom to act in the coming decades. Based on an expert-led, cross-sectoral foresight process[1], it presents global trends, uncertainties and choices that will shape Europe's future. The report provides the context for possible policy responses. It builds on the 2020 Strategic Foresight Report[2], which introduced resilience as a new compass for EU policymaking.

Section II identifies important **structural global trends towards 2050 that will affect the EU's capacity and freedom to act**: climate change and other environmental challenges; digital hyperconnectivity and technological transformations; pressure on democracy and values; shifts in the global order and demography. Section III sets out **ten areas in which the EU could strengthen its open strategic autonomy and global leadership**. The report stresses that the EU's future capacity and freedom to act will depend on whether the EU is able to make ambitious choices today, guided by its values and interests, across the identified policy areas.

II. KEY GLOBAL TRENDS

1. CLIMATE CHANGE AND OTHER ENVIRONMENTAL CHALLENGES

Climate change has already impacted every region on Earth in unprecedented and irreversible ways[3]. On the current trajectory, global warming will likely surpass 1.5°C in the next two decades and head towards 2°C by 2050[4]. The first single year of global temperature at this level could already occur in the next five years. Every additional 0.5°C will increase the intensity and frequency of extreme weather events, droughts, wildfires or floods,

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1 The Communication builds on the Joint Research Centre (JRC)'s 'science for policy' report: JRC (2021), *Shaping & securing the EU's Open Strategic Autonomy by 2040 and beyond*. The foresight process included consultations with Member States and discussions with partners in the European Strategy and Policy Analysis System, a literature review, Delphi survey (involving Commission services, the European External Action Service and relevant stakeholders from academia, industry, civil society, public administration and international institutions) and scenario building. In addition, the ongoing work on the resilience dashboards, as well as other foresight activities helped inform the analysis of the EU's open strategic autonomy.

2 *2020 Strategic Foresight Report: Charting the course towards a more resilient Europe* (COM(2020) 493).

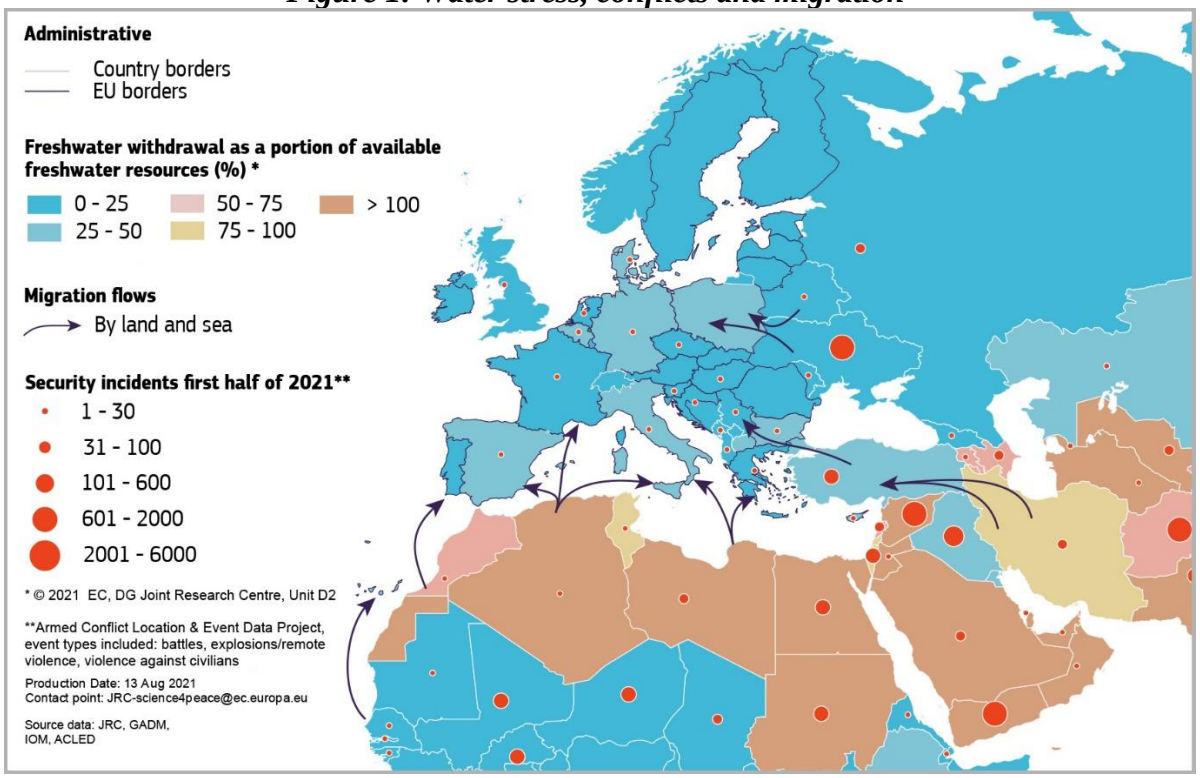
3 IPCC (2021), *Climate change 2021: The Physical Science Basis*. *Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*.

4 World Meteorological Organization (2021), *WMO global annual to decadal climate update*.

including in locations where this was uncommon in the past. Rising temperatures also mean more ice melting and higher sea levels. These changes will have significant consequences for the environment, health, food and water security, and human safety and development. Over the past decade, weather-related events have triggered an estimated displacement of around 23 million people on average each year, and the migration pressures will only increase. By 2050, over 200 million people could need humanitarian assistance every year partly due to climate-related disasters[5].

Pressure on water and food security will continue to grow. Parts of Europe are already under medium-to-high water stress levels (*Figure 1*), and this is set to increase over time. Water scarcity will become particularly problematic in the southern EU neighbourhood, potentially aggravating conflicts and pressure on migration. This issue can also affect the EU indirectly, through food insecurity and price shocks. Over 40% of the EU's agricultural imports could become highly vulnerable to drought by 2050[6], inducing competition for water and fertile land. Overall, the impact of droughts on EU's economy could reach over EUR 65 billion a year by 2100[7]. The agricultural activity zones will not move northwards, given that higher average temperatures in Northern Europe will be accompanied by the risk of increased cold waves caused by a weakened Gulf Stream.

Figure 1: Water stress, conflicts and migration[8]



5 International Committee of Red Cross and Red Crescent Societies (2019), *The Cost of Doing Nothing*.

6 Ercin, E., Veldkamp, T.I.E. & Hunink, J. (2021), *Cross-border climate vulnerabilities of the European Union to drought* (Nat Commun 12, 3322).

7 Naumann, G., Cammalleri, C., Mentaschi, L. et al. *Increased economic drought impacts in Europe with anthropogenic warming.* Nat. Clim. Chang. 11, 485–491 (2021).

8 European Commission (2021); *This indicator shows how much freshwater is withdrawn by economic activities, compared to the total renewable freshwater resources available. **Armed Conflict Location & Event Data Project, event types included: battles, explosions/remote violence, violence against civilians. Source data: JRC, GADM, IOM, ACLED.

Environmental challenges extend well beyond climate change, with a particularly alarming situation regarding biodiversity loss and change in the nitrogen cycle. The EU's natural ecosystems are under cumulative pressures not only from climate change, but also from pollution, land use, resource extraction, invasive species and the loss of pollinators. Moreover, human activities have substantially changed the nitrogen cycle, mainly due to its agricultural use. The scale of this change is far greater than the modification of the carbon cycle resulting from greenhouse gas emissions[9]. This affects freshwater, coastal areas and human health. Such environmental challenges have economic consequences often overlooked: an estimated EUR 3.5-18.5 trillion per year in ecosystem services from 1997 to 2011 were lost globally owing to land-cover change, and an estimated loss of EUR 5.5-10.5 trillion per year due to land degradation[10].

There is an important interlinkage between climate change, biodiversity loss, environmental degradation and public health. Loss of biodiversity, pressure on animal habitats, the excessive use of antibiotics, risks relating to biological research of highly pathogenic microbes, unhealthy lifestyles – all these factors make future pandemics or diseases more likely. The results will affect humans, major food crops and animal health. Challenges include infectious diseases, advanced antimicrobial resistance, non-communicable diseases (cancer, diabetes or obesity), and mental health problems. In addition, with climate change certain diseases (malaria or dengue) will become more prevalent further north[11].

2. DIGITAL HYPERCONNECTIVITY AND TECHNOLOGICAL TRANSFORMATIONS

To be technologically and digitally sovereign, the EU will need to support the development and uptake of human-centred knowledge and technologies. The EU is a strong player in terms of knowledge and innovation: it accounts for almost 20% of the world's total research and development, publications and patenting activity[12]. However, it lags behind global competitors in private investment into research and other indicators. The EU has a performance gap with Australia, Canada, Japan, South Korea and the United States. Since 2014, its position improved to Australia, Canada, Brazil, India, Russia and South Africa but worsened to Japan, South Korea, the USA and China.

Despite the uncertainty accompanying emerging technologies, it is clear that a number of breakthrough innovations can be key for the twin transitions and competitiveness[13]. The EU is a technological champion in advanced manufacturing and materials, with its firms delivering many critical enablers to global production lines. It is a leader in future smart and sustainable mobility and low-carbon technologies. The EU's capabilities in artificial intelligence, big data and robotics are similar to Japan's, but it needs to catch up with leaders: the USA and China. In key quantum technologies, the USA, Japan and China are currently in

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9 European Environment Agency (2019), *The European environment - state and outlook 2020*.

10 COM(2021) 380.

11 Kyle J. Foreman *et al.* (2018), *Forecasting life expectancy, years of life and all-cause and cause-specific formality for 250 causes of death: reference and alternative scenarios for 2016-2040 for 195 countries and territories* (The Lancet).

12 The EU is responsible for the biggest share of worldwide patent applications in advanced manufacturing technologies and the Internet of Things for mobility. European Commission (2020), *Science, research and innovation performance of the EU 2020*.

13 SWD(2021) 352.

the lead[14]. By 2025, the EU will have its first computer with quantum acceleration and if matched with investment, it could be at the cutting edge of quantum capabilities by 2030[15].

Other promising technologies include microelectronics, new materials for bio-degradable electronics, flexible and printed electronics, and 2D material based technologies such as graphene. Moreover, many pilot technologies have high decarbonisation potential. These include clean hydrogen, low carbon fuels, carbon capture and storage/usage, next-generation sustainable batteries, bio-based technologies and materials, methane[16] cracking, high temperature superconductivity, advanced geothermal and ocean energy, high altitude wind energy generation, and advanced fusion-based nuclear reactors[17]. Various nature-based solutions, like large-scale reforestation, also have major potential in this context.

Beyond specific technologies, hyperconnectivity is driving the transformation. It results in an increased convergence of industries, products, technologies and services. The number of connected devices globally might increase from 30.4 billion in 2020 to 200 billion in 2030. Increased connectivity of objects, places and people will result in new products, services, business models, life and work patterns. At the same time, it results in the increased risk of cyber-attacks and network outages, in both digital and physical world, e.g. essential infrastructures like pipelines and hospitals. It might also increase the threat of intellectual property and data loss and theft. Hyperconnectivity has only accelerated with the pandemic and its social impact needs to be carefully monitored.

However, new technologies and hyperconnectivity do not come without challenges. Certain jobs will be lost with automation[18]. Just in the EU in 2018, about 14% of adult workers were found to face a very high risks of automation[19]. In the future, 50% of current jobs globally could be automated[20], with significant differences across countries and sectors[21]. New jobs will appear, but will require new skills. If left unaddressed, these trends might lead to the erosion of fundamental social rights, and increased inequalities and dependencies within and between states. Moreover, digital transition can increase e-waste, and drive demands for energy or use of rare resources[22].

3. PRESSURE ON DEMOCRATIC MODELS OF GOVERNANCE AND VALUES

The EU is the largest group of democracies in the world, but democratic governance is declining globally. 2020 was the 15th consecutive year of a decline in political rights and civil liberties at a global level[23], exacerbated by the coronavirus pandemic in many regions. 34% of the world's population lives in countries where democratic governance is declining

[14] The USA is investing more than EUR 1 billion in the period 2019-2028 and China is building a EUR 9 billion National Laboratory for Quantum Information Sciences. JRC (2021), *Shaping and securing the EU's Open Strategic autonomy by 2040 and beyond*.

[15] COM(2021) 118.

[16] A greenhouse gas with greenhouse effect 25 times of that of carbon dioxide.

[17] World Economic Forum (2015), *Scaling technologies to decarbonise energy*. Fusion-based nuclear energy generation can help solve the problem of radioactive waste resulting from fission-based nuclear energy.

[18] World Economic Forum (2020), *The future of jobs report 2020*.

[19] Pouliakas K. (2018), *Determinants of automation risks in the labour market, a skills-needs approach*, IZA Institute of Labour Economics.

[20] Source: European Commission.

[21] OECD (2021), *What happened to jobs at risk of automation, policy brief on the future of work*.

[22] European Parliament, *E-waste in the EU: facts and figures* (infographic).

[23] Freedom House, *Freedom in the World 2021*.

and only 4% lives in countries that are becoming more democratic[24]. Geopolitical contestation[25], inter-state polarisation and tensions are likely to persist in the coming decades. If the ongoing erosion of democratic governance continues, it will affect both established and emerging democracies. The long-term performance of democratic systems hinges on their capacities to adapt to new realities and to remain resilient to internal and external challenges.

Zones of instability and conflict close to the EU and beyond are likely to persist and may even grow. Both state and non-state actors are likely to strengthen their hybrid tools, including the use of disruptive technologies, spread of disinformation and misinformation, information operations and both military and non-military influence. Repression of freedoms and democratic reforms, as well as continued instability in countries and regions in near and further EU neighbourhood, like Afghanistan or Syria, will continue to have an impact on migratory pressure.

Large-scale disinformation, powered by new tools and online platforms, will pose increasing challenges to democratic systems and drive a new type of information warfare. Countries, organised crime groups, businesses or individuals use these solutions to spread disinformation globally or gain competitive advantages. This could threaten our democracies, polarise debates, and put health, security and the environment at risk.

4. SHIFTS IN THE GLOBAL ORDER AND DEMOGRAPHY

The world's population will reach 8.5 billion in 2030 and 9.7 billion in 2050. Population growth will be uneven. It will stagnate in many advanced economies. The EU's population is expected to fall to just over 420 million, a 4.3% share of the global population. In Asia, the 2040s could represent an inflection point, after which populations are expected first to level out and then begin decreasing around mid-century, with East Asia experiencing rapid demographic decline[26]. Africa's population is projected to expand from 1.2 billion to 1.8 billion between 2017 and 2035 – when about half of the population would be under the age of 21. In 2050, India, China, Nigeria, the USA and Pakistan will be the most populated countries (*Figure 2*). Demographic growth will influence geopolitical ambitions, but may also create sustainability or migration challenges. By 2050, the working age population will diminish by about 16% in Europe and 17% in China, while it will grow in North America and India[27]. The projected median age of the EU population will rise from 43.9 in 2020 to 48.2 years by 2050. Sharp rises in total-age dependency ratios[28] are projected for many EU areas. If this trend continues, by 2050 there may be 135 dependent non-workers for every 100 workers in the EU[29].

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[24] Alizada N., Cole R., Gastaldi L., Grahn S., Hellmeier S., Kolvani P., Lachapelle J., Lührmann A., Maerz S. F., Pillai S., Lindberg S. I.. 2021. *Autocratization Turns Viral. Democracy Report 2021*. University of Gothenburg: V-Dem Institute.

[25] See, for instance, Sharon Lecocq (2020), *EU foreign policy and hybrid actors in the Middle East: ready for geopolitical contestation?*, *Global Affairs*, 6:4-5, 363-380, DOI: 10.1080/23340460.2021.1872401.

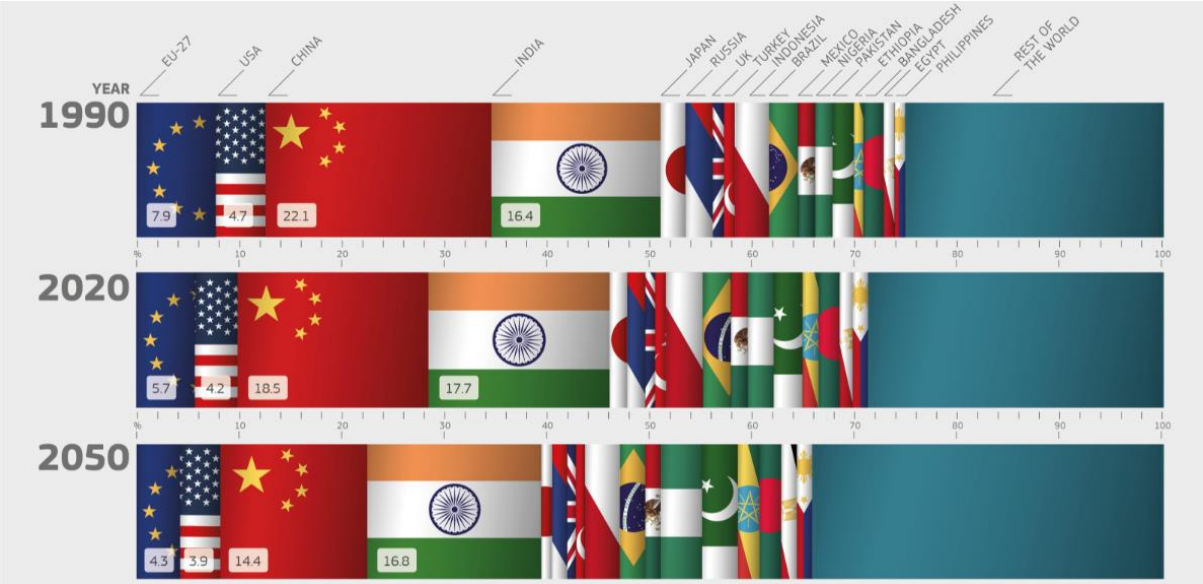
[26] UN (2019), *World population prospects*.

[27] JRC (2021), *Shaping & securing the EU's Open Strategic Autonomy by 2040 and beyond*.

[28] The total age dependency ratio relates the number of individuals who are likely to be dependent on the support of others for their daily living – the young and the elderly – to the number of those individuals who are capable of providing this support (Eurostat).

[29] JRC (2019), *Demographic scenarios for the EU: migration, population and education*.

Figure 2: Projected shares of global population[30]



The coming decades will be marked by an increasing redistribution of global power, with its geo-economic centre of gravity shifting eastwards[31]. The G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom, the USA) currently represent around 40% of global GDP, down from over 60% in 1975[32]. The economic weight of the 'emerging 7' (Brazil China, India, Indonesia, Mexico, Russia, Turkey) equates around two-thirds of the G7's. This ratio will reverse in the period to 2050. China is set to become the biggest economy before the end of this decade, with India possibly surpassing the EU in the next 20 years (*Figure 3*). At the same time, GDP growth in emerging and developing countries does not necessarily translate into a better quality of life for their citizens, including for countries with high GDP per capita[33]. Increased inequalities, lower environmental and labour standards remain key challenges for emerging economies.

Global rivalry and fragility are likely to increase. The USA-China competition could become a defining feature of the geopolitical landscape. The energy transition will further contribute to the redistribution of power. Fossil fuel exporters with the least diversified economies and/or the weakest institutions stand to be the most affected. On the other hand, countries with a large capacity to generate and export renewable energy will gain influence. The EU can expect continued tensions and adverse competition (including from China and Russia), requiring robust policies to project stability and prosperity, particularly in its neighbourhood. New tensions could arise from competition in contested areas, such as space or the Arctic. Increasing threats from organised crime, corruption, extremism, terrorism, and hybrid threats, including the instrumentalisation of migration for political purposes, could increasingly threaten EU security.

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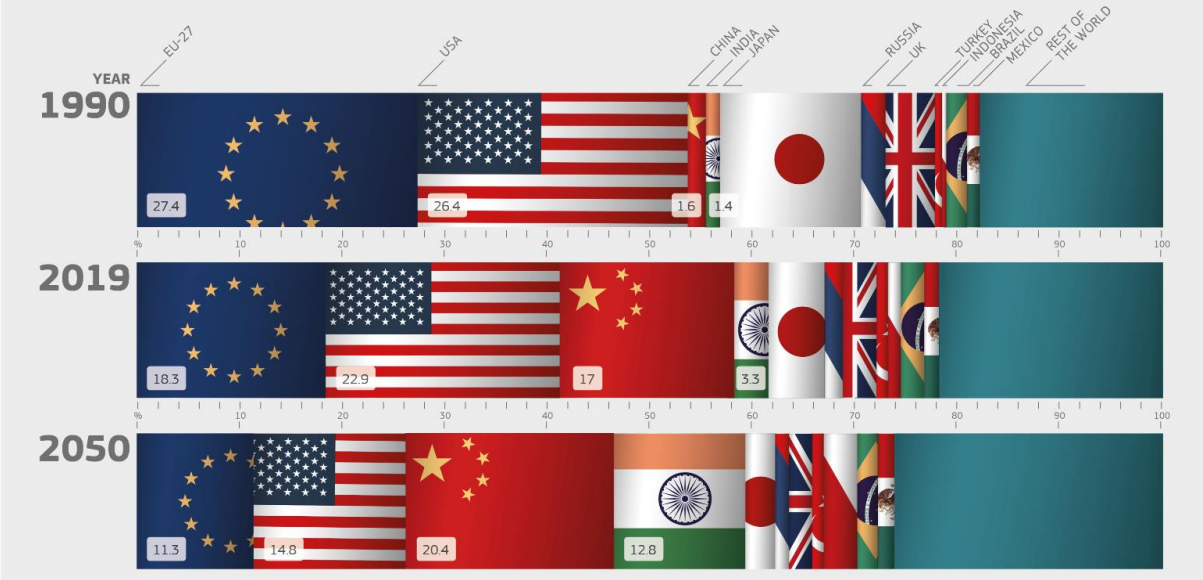
30 UN (2019), *World population prospects*.

31 This is already felt in international organisations, with emerging economies increasingly shaping policy.

32 The EU is also a 'non-enumerated' member of G7. As it participates in this cooperation as a supranational organisation, it is not taken into account in this comparison.

33 The Human Development Index was created to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone.

Figure 3: Projected shares of global GDP[34]



Multi-dimensional competition and deep interdependences are likely to be defining features of an increasingly multipolar global order. Global governance and infrastructure is at risk of fragmentation due to intensified rivalries in a range of areas. More diverse and assertive actors with increasing capacities and aspirations are likely to appear. This includes non- and intra-state actors, as well as transnational movements. While no single player will be in a position to dominate all regions and policy domains[35], strategic dependencies and capacities will continue emerging and evolving.

III. FACING CHALLENGES AND SEIZING OPPORTUNITIES FOR THE EU'S GLOBAL LEADERSHIP

1. ENSURING SUSTAINABLE AND RESILIENT HEALTH AND FOOD SYSTEMS

The EU's healthcare systems are among the most advanced in the world[36], but their sustainability and resilience need to increase. This includes investments in innovative care models (e.g. integrated care, telemedicine), strengthening the healthcare workforce, focusing on preventive measures and addressing comorbidity. To ensure healthier ageing, healthier lifestyles and physical activity will have to be combined with smart alternatives to long-term care, such as remote medicine solutions and home-based care robotics. New technologies matched with social and health policies might mitigate the additional costs associated with an ageing population, while enabling older people and persons with disabilities to live more

[34] The figures correspond to shares of nominal GDP, measured in current US dollars. They are obtained from the OECD's latest long-term projections (*Economic Outlook 103*, July 2018). With PPP adjustment, the rise of China and India is faster. China's adjusted GDP is already higher than that of the USA or the EU and India will overtake them by 2040. This is due to the fact that economic convergence tends to imply an increase of local prices (of services, for example), so PPP adjustment increases the GDP of emerging economies relative to developed economies. Real GDP comparisons among these four examples are similar to the ones based on nominal GDP.

[35] US National Intelligence Council (2021), *Global trends 2040*. Published every four years since 1997, the report assesses the key trends and uncertainties that will shape the USA's strategic environment in the next 20 years. The European Policy and Analysis System was consulted in the preparation of the latest edition.

[36] European Commission (2020), *Report on the impact of demographic change*.

autonomously. Online interaction, monitoring, and appropriate patient self-care could generate annual savings of up to EUR 120 billion in public healthcare spending across the EU[37]. A common European data space for health could support the rapid development and deployment of personalised medicine through data-driven decisions, thereby improving the effectiveness and accessibility of healthcare.

Early in the pandemic, the EU's strategic dependencies on third countries for critical goods, like pharmaceutics, have become obvious. Of 5200 imported products, the EU is highly import-dependent in relation to 137 in 'sensitive ecosystems'[38], with 14 products belonging to the health ecosystem. An important part of the active ingredients used for generic medicines comes from India and China, as well as the majority of raw materials and intermediates used in pharmaceutics. Both countries are bolstering their environmental and safety measures for the chemical sector, and China is closing some manufacturing plants. This could have implications for the availability and pricing of medicines[39]. While the EU has strong capabilities to produce innovative medicines, it needs to ensure supply security for critical off patent products with particularly consolidated supply chains through alternative sources. However, pharmaceutical supply chains are highly complex and require the highest quality. They are therefore particularly vulnerable to supply disruptions. In case of a public health crisis or supply disruptions, it is not possible to establish alternative manufacturers of certain key components in the short term. Yet, the availability of certain products at all times is key for public health[40]. Establishing or re-establishing the production of some critical medicines and medical countermeasures in the EU might be supported by innovation in manufacturing processes to compensate for possibly higher production costs in the EU and to strengthen leadership in green and digital pharmaceutical manufacturing.

A European Health Union would strengthen EU's ability to tackle new health crises. The pandemic has shown the need for a full review of EU structures and mechanisms relevant for the prevention and response to cross-border health threats. A stronger European Health Union could reinforce the collective preparedness of the EU against health threats as well as enhance coordination in times of crisis. The EU Health Emergency Preparedness and Response Authority (HERA) will help anticipate cross-border threats to health and underpin preparedness and response by focusing on anticipatory threat assessments, foresight, market intelligence and horizon scanning of emerging pathogens and technologies. This knowledge will also help HERA steer the development of an annual State of Preparedness report. On a global scale, it remains important to reinforce the international preparedness and response to future pandemics, notably by reforming the World Health Organization and strengthening its capacity to address health emergencies. This also includes working towards an international

[37] COM(2021) 118.

[38] SWD(2021) 352. The updated New Industrial Strategy identifies a number of areas where the EU's dependence on a limited number of suppliers is most prominent, which are defined as 'sensitive ecosystems' (e.g. aerospace and defence, electronics, health etc.). The SWD announced a second stage of review of potential dependencies and periodic monitoring of the EU's current and future dependencies.

[39] European Commission (2020), *Foresight ON health* newsletter.

[40] For example, the EU's heavy dependency on plasma from the USA, in particular where no other suppliers are available, undermines its health capacities and ability to react in the event of new public health crises.

treaty on pandemics[41] and boosting local manufacturing capacities. Multilateralism is the only way to prevent the reoccurrence of similar crises in the future.

While the EU's food systems are increasingly challenged, new technologies could strengthen their sustainability and resilience. During the pandemic, EU action to facilitate the movement of food across the single market and keeping global trade open was crucial. However, climate change and nature degradation may distort supply, demand and trade in the major food-producing regions, including the EU, inducing price variability and spikes[42] that could have serious socio-economic impacts. Changes in demand and diets will also have an influence. For example, advances in nutrigenomics (which connects the human genome to nutrition and health) will lead to more personalised diets and new health needs[43]. The adoption of a legislative framework for sustainable food systems will accelerate and facilitate the transition and increase the food sustainability. Disruptive innovations, such as insect- and algae-based food, cellular agriculture, or indoor farming[44], could lower the ecological footprint of food production. Biotechnology, including new genomic techniques, could play a key role in developing innovative and sustainable ways to protect harvests from pests, diseases and the climate change effects. A coherent and sustainable approach to the whole food system, from food production to reducing food waste will be crucial.

2. SECURING DECARBONISED AND AFFORDABLE ENERGY

Securing a sufficient supply of decarbonised and affordable energy is key on the path to a greener and more digital Europe. Implementing the EU's green objectives would mean that by 2050 more than 80% of gross inland energy consumption would come from low-carbon sources, mostly from renewables, while fossil fuel for energy purposes would drop to less than 10%[45]. Reducing the EU's fossil fuel dependency requires increasing the use of renewable energy and rapidly diversifying the EU's energy supply. It also entails developing energy infrastructure, smart grids, and new low-carbon and environment-friendly technologies and solutions in the EU and with key third country partners. Lastly, it calls for preventing carbon leakage. Greater energy efficiency will be crucial to avoiding possible rebound effect as renewable energy becomes cheaper and humanity consumes more of it. To meet the Paris Agreement and European Green Deal targets, energy intensity in the EU will need to fall steeply, to about half of today's levels[46], by 2050.

Reaching the climate neutrality objective by 2050 could help the EU to reduce its energy dependency from around 60% today to 15%[47]**.** This should be supported by significant progress on the circular economy. A deeper energy union will support decarbonisation, improve energy efficiency, strengthen the internal energy market and increase security of supply. Transition pathways and a strong agenda for sustainable and low-carbon

[41] The EU and a group of countries from all WHO regions have built a coalition ahead of the 74th session of the World Health Assembly in May 2021 to establish a process towards a WHO convention, agreement or other international instrument on Pandemic Preparedness and Response.

[42] European Commission (2021), *Foresight ON synergies between civil, defence and space industries* newsletter.

[43] Fraunhofer Institute for Systems and Innovation Research (2019), *50 trends influencing Europe's food sector by 2035*.

[44] European Commission (2020), *Foresight On health* newsletter.

[45] *Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people*, SWD(2020)176.

[46] International Renewable Energy Agency (2018), *Global energy transformation: a roadmap to 2050*.

[47] Source: Eurostat.

infrastructure investment in the EU and beyond would create investment opportunities for EU businesses. It would also help ensure the coherence of public support and sustained research and innovation in new clean energy technologies and sources, where the private sector does not deliver in market failure areas. It will be important to scale up emerging technologies and make them affordable and accessible to developing economies to ensure their large-scale uptake. In parallel, a more circular economy and realistic pricing of externalities would decrease energy consumption in the EU.

The decarbonisation of energy will have long-term effects on geopolitical dynamics, with new strategic dependencies emerging and others fading away. It will impact both oil and gas producing economies and leaders in renewable power. Efforts will be needed to ease this transition and manage the decline of revenue in vulnerable producing states. Significant progress in reducing associated emissions from production (such as methane from fossil gas) will presage an orderly transition. New technologies will be key in this context. Making them available and affordable will benefit the EU, and could help emerging economies leap-frog fossil-based infrastructure and adopt less carbon intensive alternatives. This type of cooperation also offers economic and connectivity opportunities for the EU. Moreover, the decentralised nature of future energy networks, coupled with high cyber defence capacities, will support the EU's resilience, with power generation distributed much more widely than in today's centralised, more vulnerable energy systems.

3. STRENGTHENING CAPACITY IN DATA MANAGEMENT, ARTIFICIAL INTELLIGENCE AND CUTTING EDGE TECHNOLOGIES

The EU's digital sovereignty will depend on capacity to store, extract and process data, while satisfying the requirements of trust, security and fundamental rights. The digital economy, especially data processing, high-performance cloud and edge computing, may have a positive effect on the EU's economy and competitiveness[48]. EU companies and public administration authorities will increasingly adopt user and entity data analytics, Internet of Things, and artificial intelligence. Such technologies have wide and varied applications[49]. The EU has introduced significant investment objectives and funding instruments to promote the development and deployment of next-generation and disruptive cloud and edge technologies. With the increasing use of data for industrial and business applications, a strategic approach to the development and deployment of industrial Internet of Things systems, 5G/6G, and edge computing with the ability to manage and quickly analyse big data will be crucial for achieving the objectives of the twin transitions.

Big data and advanced analytics are evolving rapidly, with the USA and China in the lead. They provide real-time early indicators of possible crises, early detection of illnesses and long-range detection of military activity. Use of such analytics in decision-making is likely to increase. From an EU perspective, it is important that these technologies are developed respecting fundamental rights and EU values, especially where their development and uptake

[48] The effect of the digital economy on GDP and productivity is still debated. According to recent macroeconomic simulations, the cumulative additional GDP contribution of new digital technologies by 2030 could amount to EUR 2.2 trillion in the EU, a 14.1% increase from 2017 (DG CNECT (2020), *Shaping the digital transformation in Europe*). At the same time, some economists point out that new technologies have little effect on GDP and productivity.

[49] For instance, multimodal connected and automated mobility and seamless data sharing could support the more sustainable move of people and goods, greatly reduce road fatalities and injuries, and enhance quality of life and the efficiency of transport systems.

relies on massive data volumes, including personal data. The development and uptake of critical technologies relies on massive data volumes. Currently, data produced in the EU is largely stored and processed in cloud storage operated by non-EU providers, which makes it subject to third country jurisdictions. This creates strategic dependencies and risks for cybersecurity, data protection, access and security. It also implies that non-EU providers benefit commercially from processing this data. The EU should build capacities to store data and ensure access to open, secure and transparent data and high data-rated connection availability. It should also safeguard its leading edge in the development and deployment of trustworthy artificial intelligence. It should promote standards and values with trusted partners around the world.

Faced with the exponential increase in demand for semiconductors, the EU needs to position itself more firmly in the development and production of next-generation technologies. Access to semiconductors could be compromised by limited production capacity, and shortages can heavily affect business continuity of different industries. The EU has notable strengths and is home to a crucial supplier of manufacturing equipment to all leading manufacturers, but it is lagging behind in the production of next-generation processors and advanced semiconductors. Taiwan, China, South Korea[50] and the USA are investing heavily in boosting their domestic production of semiconductors. Furthermore, chipmakers in Taiwan, South Korea, Japan and the USA have announced massive private investments in new production capacities. To stay in the race, the EU needs to invest in capabilities for the next generation of processors and semiconductor chips. This requires a tightened screening of foreign take-over of the European production capacities, investments in research and development, and setting favourable conditions across the value chain.

4. SECURING AND DIVERSIFYING SUPPLY OF CRITICAL RAW MATERIALS

Critical raw materials are essential for the EU's twin transitions. The expansion of green technologies, such as those underpinning wind and solar power, domestic energy storage, and the production of batteries for electric vehicles will drive up demand for raw materials such as cobalt, lithium, graphite, manganese and nickel in the next two decades[51]. However, the challenge goes beyond green technologies. For instance, the sector for small drones, for which China delivers more than a third of the raw materials, is expected to grow exponentially between now and the 2030s, with high potential for the civil and commercial sub-sectors, and sharply increasing demand for gallium, indium, scandium and titanium, among others. The defence industry relies heavily on critical raw materials, for example almost half of the materials needed in aircraft production[52] come from non-EU countries. The increase in demand for critical raw materials is expected to coincide with an upturn in the major suppliers' (*Figure 4*) readiness to impose export restrictions[53].

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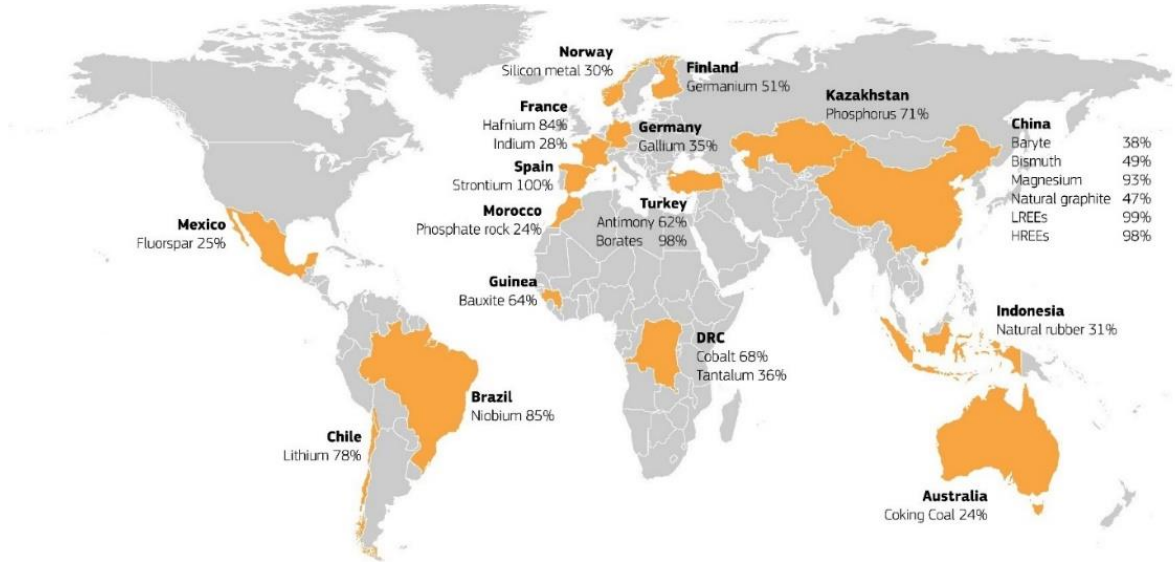
[50] China is investing over USD 200 billion under the 'Made in China 2025' plan, with the ambition of reaching 70% autonomy in chip-making by 2025. South Korea plans to invest USD 450 billion in semiconductors by 2030 with a focus on manufacturing technologies. Taiwan Semiconductor Manufacturing Company TSMC is investing over USD 100 billion in three years in expanding production capacity.

[51] European Commission (2020), *Critical raw materials for strategic technologies and sectors in the EU – a foresight study*.

[52] Critical raw materials such as magnesium, niobium, germanium, borates, cobalt and beryllium and the rare earth elements, such as dysprosium, samarium, neodymium, praseodymium, and yttrium.

[53] European Commission (2021), *Raw Materials Scoreboard, 3rd Edition.*

Figure 4: Main EU-suppliers for critical raw materials[54]



A smart mix of industrial, research and trade policies with international partnerships could ensure sustainable and diverse supply. The EU faces challenges relating to access, limited diversification, supply disruptions and insufficient processing, recycling, refining and separation capacities. The EU needs to prepare for a future erosion of critical supply security due to major factors shaping the geopolitical environment: state fragility, economic coercion, and climate change. In most cases, industry is best placed to reduce strategic dependencies by diversifying supply, making greater use of secondary raw materials, and substitution. However, the potential for supply diversification for many critical raw materials is rather limited due to geographically limited sources or *de facto* mono- or oligopolies. Industry's efforts to secure access to critical raw materials and reduce its demand (through efficiency, prolongation of product lifetimes and circular economy) require a clear long-term strategy. Finally, novel ways of sourcing, such as seabed and space mining need to be explored in accordance with internationally agreed principles and commitments.

5. ENSURING FIRST-MOVER GLOBAL POSITION IN STANDARD-SETTING

The EU is in competition for 'first mover' advantage in standard-setting. This is particularly relevant in emerging technologies (and related products and services), such as artificial intelligence, blockchain, quantum, cyber security, sensitive and specialised data (e.g. in the fields of health and space), digital currencies and chemicals. Other priority fields include green technologies such as hydrogen, energy storage, offshore wind and sustainable transport. Our trading partners are taking more assertive actions in terms of standard-setting, e.g. China is working on a 'China standards 2035' plan to identify next-generation technologies that it could impose on the 140 countries participating in the Belt and Road Initiative. However, Chinese state capitalism is not always compatible with open global regulation, human-centred standards and sustainable values.

The EU's track record in setting internal rules and *de facto* international standards provides a solid basis to address this challenge. The so called 'Brussels effect'[55], whereby

[54] JRC (2021), *Shaping and securing the EU's Open Strategic autonomy by 2040 and beyond*.
[55] Bradford A. (2020), *The Brussels effect – how the European Union rules the world*.

multinational corporations comply with EU-level regulation, is a by-product of the stringency of that regulation and the size of the single market. The EU's trade position is also a key driver in its regulatory and standard-setting power, including in future key markets and technologies. The EU is the biggest player in world trade and the number one trading partner for 74 countries, more than China (66) and the USA (31). It is the number one trading partner for Asia, Africa, the USA, the Western Balkans and the EU neighbourhood[56]. The international acceptance of EU standards is crucial for its influence in the global order and leadership on climate change, sustainability and protection of consumers, personal data and rights at work. To this end, the EU will further engage in active regulatory cooperation, ensuring a leading role in international norm setting organisations, such as the International Organization for Standardization.

6. BUILDING RESILIENT AND FUTURE-PROOF ECONOMIC AND FINANCIAL SYSTEMS

A resilient and stable economy is critical for addressing the EU's long-term challenges. The EU should further increase the resilience and growth potential of its economy by addressing the remaining vulnerabilities in order to facilitate the ongoing transitions and to withstand future shocks. Solid economic fundamentals, productivity, investments and reforms will determine the EU's future economic performance, linked with positive financing conditions for the public and private sector.

Europe's social market economy is also key to its democratic model, protecting people against social risks and their consequences. The single market gives a strong basis for a recovery and the resilience of the EU industry, and to facilitate the green and digital transitions. To be accepted, these transitions must be fair and accompanied by stronger economic and social convergence. The COVID-19 crisis has highlighted the importance of an open, competitive and fully functioning single market to enable businesses to grow to the scale needed to compete globally.

The EU's financial system will undergo profound shifts as a result of climate and technological changes and of Brexit. Sustained political determination to remove the remaining obstacles to market integration and to fully implement Capital Markets Union and Banking Union is therefore essential to diversify and deepen sources of funding for EU companies, improve saving opportunities for EU citizens, strengthen the EU's ability to absorb shocks and support stronger domestic financial markets. This can also address supervisory arbitrage between Member States and with neighbouring third countries. The withdrawal of the United Kingdom as a major financial hub from the EU strengthens the need to further deepen the Union's capital markets, and EU markets exhibited strong adaptability and resilience. Nevertheless, medium-term challenges to financial stability and resilience remain. Most importantly, EU market participants maintain excessive reliance on essential financial infrastructure outside the EU, which could amplify financial stability risks. Moreover, the supervisory capacity in the EU needs to be adequately structured in view of the continuing reconfiguration of value chains and relocation of businesses to the EU following Brexit.

The EU financial system also has a key role to play in financing the transition to a climate-neutral economy and resilience against environmental degradation. The EU will

[56] COM(2021) 66.

need EUR 470 billion in additional investment per year to reach its 2030 climate and environmental targets, which will require a massive mobilisation of private capital. Institutional and retail investors are showing a growing interest in sustainable investment, as witnessed by the five-fold increase of net capital flows attracted by equity funds adopting environmental, social and governance (ESG) strategies in the 10 months after such adoption, compared to 10 months before[57]. Greater transparency of the ecological footprint of financial products and ratings, as well as access to reliable sustainability-relevant data, will be essential for financing an orderly transition and to prevent 'green-washing'.

Climate change and environmental degradation can also affect financial stability directly because of more frequent and more severe extreme weather events. Only 30% of all economic losses are currently insured. Investments in unsustainable activities and assets are increasingly likely to become stranded and financial stability could be compromised in case of a disorderly and sudden reaction to the transition. The EU financial system needs to systematically integrate sustainability risks and impacts in financial decision-making, and integrate long-term risk management and disaster risk financing strategies.

The digital age will also influence payment means and capital markets, with a growing role of crypto-assets and the development of digital currencies. Digital finance can create new opportunities for citizens and businesses, but consumer protection needs to be ensured. A strong, competitive, properly regulated and supervised EU digital finance sector is needed.

The establishment of the Chinese digital *renminbi* is rapidly progressing and other countries are also working on their own digital currencies. The central bank digital currencies would also impact the current model of central banks, the conduct of monetary policy, and consumer protection systems. The European Central Bank, together with the Commission, is actively engaged in work on the concept of a digital euro, which can bring significant benefits to EU citizens and businesses. Yet, to reap the benefits of a public digital euro, it is key to address potential challenges for EU policies, such as those related to financial intermediation and stability.

A wider use of the euro in international trade and services, including in energy markets, and EU-wide solutions for instant payments would strengthen the strategic clout of the EU. It would strengthen the EU's resilience, including to the extra-territorial application of sanctions by third countries. It would enable the EU to further benefit from international financial markets, while managing external risks and avoiding strategic dependencies. At the same time, weaknesses in the integrity of third country service providers, markets and infrastructures might create risks.

The EU needs to continue to be on the global forefront in the fight against money laundering and terrorist financing and ensure appropriate safeguards against these illicit purposes.

7. DEVELOPING AND RETAINING SKILLS AND TALENTS MATCHING EU AMBITIONS

Clear responses will be needed to successfully face demographic trends and close existing skills gaps in the context of the twin transitions. While greater labour force participation is needed, labour market and social policies will need to be adjusted to avoid increase in socio-economic inequalities and ensure fair working conditions, decent income

[57] European Financial Stability and Integration Review (EFSIR), SWD(2021) 113.

and access to social security. Close cooperation with social partners is crucial to respond to this new reality. While ensuring good working conditions and embedding these within active ageing policies, prolonging the effective retirement age by one year could add four million people to the labour market[58]. Women's greater labour force participation, through targeted measures that ensure gender equality and work-life balance, would also support employment rates. This is particularly the case in Member States with women's participation rates below the EU average[59]. Greater labour force participation would bring economic and social benefits across the EU, e.g. a lower ratio of dependent non-workers to workers and higher labour force participation. In addition, new approaches to working patterns would help mitigate the downsides of population ageing. Well-managed legal migration that addresses the skills needs and gaps, matched with effective integration policies, would make an important contribution to the EU's labour market.

Young people deserve better access to quality jobs. Continued support for youth employment through targeted support schemes will be needed. The next generation is increasingly ready for the digital transition[60], although the challenge of bridging the digital skills gap and getting more young women to study STEAM (science, technology, engineering, arts and mathematics) subjects remains. Easing the transition from education to employment, creating quality entry-level jobs and engaging youth in policy dialogue will also be key for young people entering the labour market.

Harnessing the job opportunities of the twin transformations will require policy action supporting the transition to new types of jobs. This includes support to regions and workers in sectors that will undergo transition and the right mix of support, incentives and framework conditions for companies from traditional and new sectors. Adjustments in education and training systems will also be needed, as skills requirements and education levels are increasing fast in the green and digital economy, faster than in the economy overall[61]. The EU's future labour force will likely be better educated and more capable of adapting to the changing nature of work and augmented intelligence. By 2050, 54% of all job market participants are projected to have post-secondary education[62]. STEAM competencies, digital skills and literacy, together with sector-specific expertise to achieve the green transition (e.g. in renewable energy, circular economy, new green technologies or nature-based solutions) will be indispensable for successful labour market and social integration. To ensure access to the skills of tomorrow, the EU's education and training systems will need to remain on the global cutting edge. The EU should also incentivise more of its talents (at universities, in research institutions or businesses) to stay in Europe[63] and mitigate brain drain between Member States and regions.

8. STRENGTHENING SECURITY AND DEFENCE CAPACITIES AND ACCESS TO SPACE

[58] European Commission (2020), *Employment and social developments in Europe*.

[59] Current levels range from 47.5% to 79.3%, see COM(2020) 152.

[60] The proportion of young adults with above-basic digital skills is over 50% and rising; see the JRC's ongoing work on the 'digital resilience' dashboard, based on Eurostat data (digital skills) and PREDICT CORE data (available places in advanced technologies).

[61] European Commission (2019), *Employment and social developments in Europe*.

[62] JRC (2019), *Demographic scenarios for the EU: migration, population and education*.

[63] PPMI, IDEA Consult and WIFO (2020), MORE4 study, Support data collection and analysis concerning mobility patterns and career paths of researchers.

Action is needed to mitigate the increased risk of conflict, internal instability and disruption of critical infrastructures. The EU needs to continue to play an essential role in preventive diplomacy and support, adapting and upgrading its tools to ensure effectiveness of its actions. Building trust and coordination amongst Member States, as well as the capacity to better anticipate risks, while learning from experience, could provide the EU with greater influence and the ability to act jointly on defence and security matters. The EU should continue to support Member States to develop adequate tools, including to build resilience and respond to hybrid threats in full respect of the EU's legal and ethical framework. The increased likelihood of extreme weather events, future pandemics or other natural and manmade disasters reaffirms the need for a stronger EU response and cooperation on civil protection, including to improve prevention, preparedness and response to disasters such as floods, wildfires and infectious diseases[64].

In order to enhance its defence capabilities and operations, the EU should commit to joining forces and strengthening the coherence of recently established cooperation instruments and initiatives. The EU needs to ensure its capacity to defend - autonomously if needed - its essential security interests in a challenging international environment marked by great power competition and a race to technological leadership. The EU has recently made progress on defence through the launch of several important initiatives. The remaining vulnerabilities include a relatively low level of expenditure, fragmentation of demand and supply, and research, innovation and manufacturing gaps[65]. At the international level, while promoting a rules-based international order and strongly cooperating with NATO, the EU will have to enhance its preparedness for a more conflictual world. The development of indigenous defence capabilities will increase the capacity of the EU to promote such a rule-based international order, while strengthening the role of EU Member States in NATO.

It is essential that the EU supports autonomous, reliable and cost-effective access to space. Space technologies, together with artificial intelligence, are strategic means of countering threats and anticipating future risks, such as hybrid threats including cyber espionage[66]. They are important for the future of the EU's communications, Earth observation, manufacturing, security, and an essential ingredient of the twin transitions. They help monitor climate change, transportation, security and defence and are key to the functioning of critical infrastructure and technology. Moreover, the weaponisation of space by EU rivals is increasingly supported by new technologies such as anti-satellite weapons. The space sector contributes EUR 46-54 billion to the EU economy[67] and is expected to grow globally to EUR 1 trillion by 2040[68]. The EU is currently a world leader in some areas (e.g. satellite services), while other areas (e.g. space launchers and space missions) are dominated by the USA, China and Russia, and increasingly by private actors. Other space-faring nations have a very strong domestic market – effectively an anchor customer for a considerable

[64] Under the current EU Civil Protection Mechanism the EU Member States and Iceland, Norway, Serbia, North Macedonia, Montenegro, and Turkey cooperate on civil protection to improve prevention, preparedness and response to disasters. Constant monitoring by the Emergency Response Coordination Centre ensures rapid deployment of emergency support through a direct link with national civil protection authorities. Specialised teams and equipment, such as forest fire-fighting planes, search, rescue, and medical teams can be mobilised at short notice for deployments inside and outside the EU to support the response efforts of countries affected by disasters.

[65] European Defence Agency (2020), CARD report.

[66] NATO (2020), *Science & technology trends 2020-2040: exploring the S&T edge*.

[67] European Commission (2020), *Foresight ON security* newsletter.

[68] Morgan Stanley (2016), *The space economy's next giant leap*.

launch volume (including launches for defence and national security). Lacking this, EU launcher companies are at a competitive disadvantage in the global market, and depend on the commercial market to a much higher degree than competitors from China, Russia, the USA, or Japan.

The EU should acknowledge the EU space infrastructure as strategic and maximise the benefits of new technologies, such as advanced launchers, nano-satellites, robotics, large constellations, on-orbit operations or quantum-based applications (e.g. for secure communications and Earth observation for secure connectivity). It should also prepare itself for new space activities and promote on-orbit services or space data centres, building on its expertise in areas where it has a competitive industrial capacity, such as telecommunications and Earth observation.

9. WORKING WITH GLOBAL PARTNERS TO PROMOTE PEACE, SECURITY AND PROSPERITY FOR ALL

Multilateralism must adapt to remain fit for purpose. The COVID-19 pandemic and the climate emergency are perfect illustrations of the need for multilateral solutions and a coordinated global cooperation on crisis preparedness and response. In both cases, support to the least developed or more fragile partner countries is essential to overcoming challenges ahead, leaving no one behind. A truly inclusive, networked multilateralism[69] is the only way forward. That is why the EU is committed to striving for a rules-based global order with the United Nations at its core. This will involve preserving what works well, reforming what needs to change, and extending effective global governance to new areas. The EU should trigger and facilitate discussions on the necessary reforms of global governance. It should support the ongoing reform of the UN on the basis of a clear set of rules and values. Restoring the dispute settlement system to full functionality is also a pressing priority in the necessary modernisation of all of the World Trade Organization's (WTO) functions to ensure it can deal with the challenges of global trade. The governance of international financial institutions, such as the World Bank, the International Monetary Fund and the New Development Bank[70], should better reflect emerging regional and global challenges. Global economic governance should address unwanted spill-overs of monetary, fiscal and macroeconomic policies on emerging markets.

Acting more assertively will be key in countering coercive action or extra-territorial sanctions imposed by third countries. Open trade and investment is one of the EU's fundamental strengths, but the EU will need to counter economic pressure and act where dispute settlement under WTO or bilateral agreements are blocked. Stronger trade defence instruments need to protect EU operators from unfair trade practices and avoid undermining the EU's strategic priorities. The potential security or public order risks arising from the acquisition or control of a particular business, infrastructure or technology call for a fully-fledged screening mechanism for foreign direct investment and measures to address potential distortive effects of foreign subsidies. EU export credits can ensure a level playing field in non-EU markets in which foreign competitors increasingly have financial backing from their governments.

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[69] See, for instance, https://www.un.org/sg/en/content/sg/speeches/2020-09-21/remarks-general-assembly-ceremony-marking-the-75th-anniversary-of-the-united-nations.

[70] The New Development Bank aims to mobilize resources for development projects in BRICS, emerging economies and developing countries.

The EU will also need to reinforce and develop strategic as well as issue-based coalitions and partnerships with specific countries and regions. The reinvigorated transatlantic alliance, the integration of the Western Balkans, closer cooperation with Turkey and the neighbourhood countries, the strategic partnership with Africa, connectivity in the Indo-Pacific and stability in Central Asia are all geopolitical priorities. China is simultaneously a cooperation partner for certain shared objectives, a negotiation partner, an economic competitor, and a systemic rival. China's increasing presence in the world, including in Europe, must be accompanied by assuming greater responsibilities for upholding the rules-based international order, as well as greater reciprocity, non-discrimination and openness of its domestic system[71]. With Russia, the EU needs to continue its principled approach of defending its interests and promoting values based on the implementation of the five agreed principles[72]. The EU must insist that the Russian leadership demonstrate a more constructive engagement and stop actions against the EU and its Member States and partner third countries. This is indispensable to turn the currently unproductive and potentially dangerous tide in this important relationship. Cooperation with the G7 and the G20 will also continue to be important.

The EU should strengthen its partnerships with the international organisations that are central to European and global stability. It has reached unprecedented levels in its cooperation with the North Atlantic Treaty Organization (NATO), the bulwark of European defence[73]. The EU-NATO partnership is an indispensable pillar of EU defence and it will be strengthened further[74]. The EU should also further strengthen cooperation with the Organization for Security and Co-operation in Europe on issues of common interest, and continue a close relationship with the Council of Europe that bolsters our common respect for human rights, democracy and the rule of law. Inter-regional cooperation with organisations such as the African Union, the Community of Latin American and Caribbean States and the Association of South East Asian Nations provides important levers for regional development and stability, and helps advance the EU's global agenda. The EU will also need to develop a coherent stance towards other international actors and actively pursue cooperation with partners ready to work on common solutions to global challenges, and peacefully and sustainably managing the global commons (e.g. oceans, space).

The EU stands ready to lead global coalitions on climate and environmental action. With the European Green Deal[75] and its key initiatives, such as the 'fit for 55' package[76], the EU is pursuing a transformation of the economy and comprehensive policies on climate, biodiversity and the environment[77]. The EU is committed to delivering on the Paris Agreement, the United Nations' 2030 Agenda and its Sustainable Development Goals and the Post-2020 Biodiversity Framework. Their achievement is increasingly challenged by the consequences of the COVID-19 crisis. For example, the pandemic could undo years of development progress in Africa, where countries are already spending on average 30% of

[71] European Commission, (2019), *EU-China: a strategic outlook*.
[72] See JOIN(2021) 20.
[73] Sixth progress report on the implementation of the common set of proposals endorsed by the EU and NATO Councils on 6 December 2016 and 5 December 2017 (June 2021).
[74] NATO (2021), Brussels Summit communiqué.
[75] COM(2020) 640.
[76] COM(2021) 550.
[77] EU greenhouse gas emissions were reduced by 24% between 1990 and 2019 while the economy grew by around 60% over the same period. European Commission (2019), *the EU's track record on climate action*.

their revenues on servicing debt (up from 20% before)[78]. As the EU accounts for just 8% of global greenhouse gas emissions, and with 85% of the world's GDP growth expected to come from elsewhere by 2024[79], the EU's ambitious internal agenda needs to be matched with equally ambitious global cooperation. The extent to which emerging economies and societies in particular can decouple human and economic development from resource intensive production and greenhouse gas emissions will be decisive. The EU should continue playing a key role in maximising support for the transition at global level, beyond succeeding in its own transformation. The EU should strengthen a comprehensive EU-led green diplomacy with a priority given to climate change and environmental action, particularly under the United Nations Climate Change Conferences framework and other relevant multilateral organisations.

'Connectivity agendas'[80] should be embedded in the EU's strategic partnerships. They are part of the geopolitical toolbox. The USA has the BUILD Act and Japan has the Partnership for Quality Infrastructure. Through its Belt and Road Initiative, China is advancing its economic, political and security interests across the world, including in Europe. In Africa, China has been by far the largest infrastructure developer over the last decade, with an estimated 10 000 Chinese companies operating on the continent. After launching the Blue Dot Network with Japan and Australia, the USA has put forward the 'Build Back Better World' initiative (B3W) in the context of the G7. China and the USA differ in their approaches, but both are ahead of the EU in their influence over internet infrastructures and those that depend on them. The EU has experience developing connectivity and can build on promising partnership experiences with Japan and India. However, while the EU has laid down the first building blocks of an EU connectivity strategy[81], it needs to be developed further and aligned with the rapidly evolving realities. In particular, the EU could focus on sustainable transportation, resilient and secure digital infrastructure networks, and pervasive information connectivity, which are also space-based. A Team Europe approach[82] will be key to achieve the necessary scale of implementation.

International ocean governance is an increasingly strategic area. Oceans are an essential regulator of the climate, producing half of the oxygen in the Earth's atmosphere and absorbing 25% of CO_2 emissions. They are home to a fragile ecosystem that is a source of nutritious food and 4.5 million direct jobs in the EU. The cumulative impacts of resource extraction and pollution have increased, with 31% of global fish stocks overfished and 4.8 to 12.7 million tonnes of plastic waste entering the ocean each year[83]. With the world's population expected to increase, human pressure on the ocean will intensify, calling for more effective, cross-cutting and integrated ocean governance built on strong cooperation.

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78 JRC (2021), *Shaping and securing the EU's Open Strategic autonomy by 2040 and beyond*.

79 COM(2021) 66.

80 Connectivity can be defined as bringing countries, societies and people closer together. It encompasses physical and institutional social-cultural linkages, sectorial agreements as well as regulatory and technical cooperation in concrete sectors such as transport, energy and digital.

81 The EU's approach to connectivity has been set out in the Joint Communication "*Connecting Europe and Asia - Building blocks for an EU Strategy*", JOIN(2018) 31.

82 Team Europe consists of the EU, Member States and their diplomatic networks, finance institutions including national development banks and implementing agencies, as well as the European Investment Bank and the European Bank for Reconstruction and Development.

83 European Environment Agency (2019), *The European environment - state and outlook 2020*.

To consolidate the EU's role as a leading global actor on human rights, partnerships with countries and organisations that share democratic values are key. Defending human rights requires using all available tools, including the EU Global Human Rights Sanctions Regime, political and human rights dialogues, strategic partnerships with international and regional organisations and proactive engagement in international fora. It also calls for stronger engagement with the private sector to promote responsible business conduct. To globally promote democracy and prosperity, education should also be a core international policy pursued by the EU together with its partners.

10. STRENGTHENING THE RESILIENCE OF INSTITUTIONS

Public institutions and administrations need to be responsive to societal concerns and effective in delivering policies. Increased polarisation shows the need for participatory and inclusive governance to enhance trust and legitimacy at all levels. Institutions and processes need to increase their resilience, adapt and innovate to cope with new challenges and deliver results for citizens. New forms of participatory democracy, new technologies, civic participation and grassroots innovations, as in the context of the Conference on the Future of Europe[84], can enhance political participation and strengthen the resilience of our democratic systems.

Countering disinformation and ensuring freedom of expression, pluralistic and inclusive democratic debates and media freedom in the EU and beyond will depend on the continued development of common frameworks and practices. Partnerships with other global public and private players will be vital in ensuring a more robust and effective response. This must go hand in hand with the promotion of free and fair elections and the protection of media freedom and pluralism.

The implications of current and future trends will require agile policy responses. Uncertainty, volatility, complexity and ambiguity will need to be embraced and managed. Developing strategic foresight capabilities can help assess the impending risks and better prepare to deal with crises and emerging opportunities. The EU Foresight Network of Ministers for the Future, and the related development of foresight capacities at national level, will be contributing to this.

Greater preparedness also means better monitoring of resilience to withstand challenges and undergo transitions in a sustainable, fair and democratic manner. The resilience dashboards[85] developed by the Commission (in cooperation with Member States and stakeholders), as announced in the 2020 Strategic Foresight Report, are an important step towards a more integrated approach for measuring wellbeing beyond GDP. Their multidimensional approach sheds light on challenges and opportunities ahead, and helps to navigate societal transformation towards a more sustainable development path. The resilience dashboards will also contribute to the *ex-post* assessment of Europe's recovery and resilience strategy, including vis-à-vis other key global players.

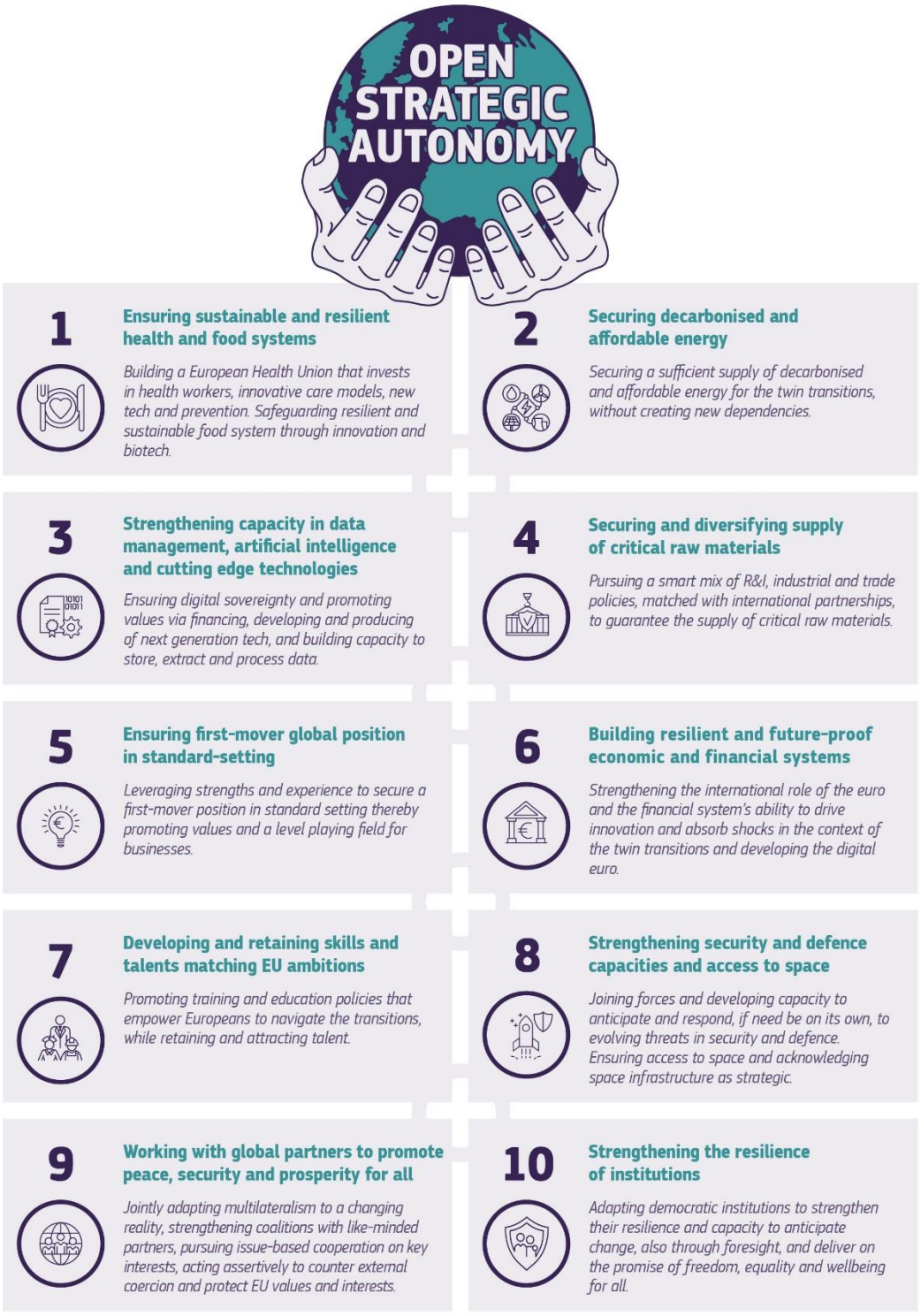
IV. SETTING THE STAGE FOR TOMORROW'S POLICIES

[84] https://futureu.europa.eu/

[85] https://ec.europa.eu/info/strategy/strategic-planning/strategic-foresight/2020-strategic-foresight-report/resilience-dashboards_en; resilience dashboards are monitoring tools for assessing the EU's and Member States' vulnerabilities and capacities across four dimensions: social and economic, green, digital and geopolitical.

The emerging global order is increasingly multipolar and contested. While we cannot be certain as to what the future holds, it is up to us to work towards the most favourable scenario to preserve and enhance the EU's capacity and freedom to act, based on a clear understanding of megatrends, uncertainties and opportunities. This Communication underpins a shared long-term vision of the EU's open strategic autonomy on the path towards 2050, highlighting the need for increased coherence across time horizons and between the domestic and external policy agenda across ten areas of action (*Figure 5*).

Figure 5: Key implications for the EU's capacity and freedom to act



Inter alia, the EU will resolutely pursue climate neutrality by 2050 and step up its global leadership in this respect. A more circular economy will be powered by decarbonised energy, green and digital technologies, and world-class talent. The twin transitions will strengthen competitiveness, generate economic and social opportunities, and contribute to the global order, while reducing strategic dependencies. A digitally hyperconnected future, driven by big data, artificial intelligence and the quantum jump will be non-linear and fraught with uncertainties. Given its profound and diverse impacts across sectors, territories and society, technological progress needs to be backed by a strong social market economy and competitive single market. It also requires an anticipatory and inclusive approach to education and training, empowering people to confidently navigate change. Encouraging and facilitating participation will also invigorate democracies.

In pursuing global leadership towards 2050, the EU will not turn inwards but will remain firm on its principles and values and agile in its conduct. As an interconnected global pole in a multipolar world, it will continuously leverage its close international partnerships to promote peace, stability and prosperity, presenting a united front against hostile actors and common challenges. It will take the lead in effective multilateral cooperation, while protecting EU citizens and the economy from unfair and abusive practices. The EU will uphold the promise of achieving the twin transitions in a fair and democratic way in order to provide the next generation of Europeans with the ability and freedom to chart their own course.

The next Strategic Foresight Report will focus on a better understanding of the twinning between the green and the digital transitions, i.e. how they can mutually reinforce each other, including through the use of emerging technologies.