A vision for the European industry until 2030

Final report of the Industry 2030
high level industrial roundtable

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Disclaimer

This report reflects collective views of the Industry 2030 high level industrial roundtable, and does not represent the official opinion of the European Commission.

About the Industry 2030 high level industrial roundtable

This expert group was established by the Commission Decision C(2017)8565 of 15/12/2017. Its members were selected following an open call for applications. Industry 2030 consists of experts appointed in a personal capacity: Bianca Dragomir, Sami Haddadin, Jerzy Hausner, Claudia Olsson, Cristina Oyón, Märtha Rehnberg, Antti Vasara, Adiari Vázquez; and members appointed to represent the interest of industrial enterprises or the interest of employees: Dochul Choi, Ineke Dezentjé Hamming-Bluemink, Krasimir Dachev, Saori Dubourg, Tomas Hedenborg, Emma Marcegaglia, Dámaso Molero, Ulrike Rabmer-Koller, Frédéric Saint-Geours, Peter Scherrer, Ariane Thomas and Luc Triangle. The European Committee of the Regions and the European Economic and Social Committee are permanent observers of the group.

More information on the European Union is available on the Internet (http://www.europa.eu).

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Executive summary

The Industry 2030 high level industrial roundtable was established by the European Commission in December 2017 to provide independent advice on future EU industrial policy action. It consists of 20 experts representing small and big businesses, traditional and disruptive industries, trade unions, innovation and research community, as well as finance and academia.

Following one and a half years of dedicated work, the group has now prepared a report with recommendations on the future of EU industrial policy strategy towards 2030.

The report sets out a vision of the European industry in 2030 as a global leader, responsibly delivering value for the society, the environment and the economy. Europe will build its competitive advantage on cutting-edge and breakthrough technologies, respect for our environment and biodiversity, investment in our people and smart European and global alliances. Based on collaboration and our common European values, this new industrial model will help to make Europe a role model for the rest of the world.

This industrial transformation is taking place in the context of long-term and structural global changes. We are facing a fast-changing geopolitical and economic situation, growing social and societal polarisation, an increasing role of digitisation and technology in all aspects of life, as well as climate change and other environmental challenges. To address these, our industrial transformation must take full account of the global Sustainable Development Goals, which provide a key global framework for fair and sustainable development.

In addition, Europe must respond to a series of specific and interconnected challenges facing our industries. A new European industrial model must ensure Europe remains a leader in technology, innovation and sustainability; support our citizens in developing the rights skills to embrace these changes and manage social fairness and wellbeing. At the same time, we must build a fair, agile and competitive business environment, while putting a particular focus on developing strategic value chains and value creating networks.

Turning the Industry 2030 vision into reality requires action and collaboration of policy makers at all levels, industry stakeholders and the broader civil society in Europe. The report identifies specific recommendations and game-changing actions that will help Europe better manage this fast and inclusive transformation, champion global competitiveness and address social inclusiveness and values.

These recommendations are geared to boost the transformation of European industry, by stimulating innovation and technology uptake. New policies are also needed to ensure Europe's industry becomes climate-neutral, circular and resource efficient, with reliable access to low carbon energy and raw materials. To ensure our global competitiveness, Europe must further strengthen the Single Market while putting a new focus on supporting strategic value chains. Open, fair and multilateral trading relations will further support Europe's global industrial leadership. Finally, Europe must also put into place policies and mechanisms that ensure fair and inclusive spread of the benefits of industrial transition.

1. Vision 2030

> **In 2030, European industry will be a global leader that will responsibly deliver value for society, the environment and the economy.** The future European industrial model will successfully connect economic progress with major environmental and societal challenges. Continuously progressing and benefiting from strong democratic principles, freedom, unity in our diversity and the rule of law, **by 2030, the European Union will successfully become an innovative, sustainable, competitive and human-centred collaborative economy in an increasingly populated, resource constrained and interconnected world.** We will invest heavily in cutting-edge and breakthrough technologies, respect planetary boundaries[1] and biodiversity, take leadership in smart European and global alliances, reinforce our global competitiveness and, last but not least, invest in current and future generations by addressing key societal challenges, providing innovative jobs in all regions and investing in new skills. This is how we, members of Industry 2030 high level industrial roundtable, envision Europe in 2030.

Our vision incorporates the following building blocks:

1.1. European industry will be transformed

Founded on sound ethical values and cutting-edge technologies, **the automation and digitisation of manufacturing, products and data-driven services** will successfully transform European industry, driving change at a pace never seen before. Progress in Artificial Intelligence, Internet of Things, robotics, automation, biotechnology or 3D printing **will bring about technology-led transformations** across all European industries. The online platform economy[2] will be more heterogeneous and decentralised than today, and will therefore help markets to operate in a more efficient and sustainable way. This will reinvigorate our economies and spread prosperity.

We will redefine our thinking about natural resources and re-organize industrial value chains towards a **circular economy that is "doing more with less".** This process will be underpinned by **substantially increased and focused R&D expenditures and private investment** fostering transformation. The United Nation's Sustainable Development Goals (SDGs) and the Paris Agreement[3] will be embedded in EU companies' strategies and business models, maximising value creation for human well-being, the environment and the economy, while supporting business competitiveness globally. The EU will become the world-leader in addressing climate change and respecting planetary boundaries and will pave the way for **global climate neutrality, leading the world away from fossil fuels**.

Those transformations will be enabled by **breakthrough policies**. Industrial policy in 2030 will be on an equal footing with other policy areas, in a coordinated European effort at all governance levels, achieving ambitious EU economic, environmental and social targets. EU policy makers will consistently address the **competitiveness** of European industry for companies of all sizes, its value chains, and its industrial innovation ecosystems; competitiveness in the way we innovate, in the way we turn environmental challenges into opportunities, and in the way we shape European infrastructure.

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[1] See: "Global environmental impacts and planetary boundaries in LCA", JRC Technical Report 2016, http://publications.jrc.ec.europa.eu/repository/bitstream/JRC105141/lb-na-28371-en-n.pdf

[2] Online platforms come in various shapes and sizes and continue to evolve at a pace not seen in any other sector of the economy. Presently, they cover a wide-ranging set of activities including online advertising platforms, marketplaces, industrial Internet of Things platforms, search engines, social media and creative content outlets, application distribution platforms, communications services, payment systems, and platforms for the collaborative economy. They can be established for B2B or B2C purposes.

[3] The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change, dealing with greenhouse gas emissions mitigation, adaptation, and finance, signed in 2016.

1.2. Europe will be globally competitive

The **Single Market,** and the legislation on which it is based, will be at the core of industrial policy and will constantly evolve to keep Europe's internal and global competitive edge. The Single Market, successful policies that consistently allow for a global level playing field and our values will spread the costs and benefits of technology and business activities widely and fairly. They will also make the EU competitive.

Europe will be open for investments from any country in the world that complies with global market rules. The **world's major economies will acknowledge the EU as a key partner** to collaborate and trade with, based on reciprocal rules-based terms.

European technology-led transformation from volume to value driven economy, generating value for the people, the environment and business, will be seen as an **attractive economic model**. Countries coping with growing societal tensions and affected by climate change, both in the European neighbourhood and beyond, will increasingly look up to this type of approach.

1.3. Social inclusiveness and values will be at the core of EU industry

In 2030, the EU will not only be the most attractive place to innovate, run business and invest, but also to live and work in. EU citizens across all generations will play a central role in this development. They will be agile and able to achieve and maintain their **competences and skills relevant** through life-long learning. Digitisation and its responsible use will be an integral part of European education and training.

By 2030, **EU citizens will be further empowered by cutting-edge technologies and innovations** developed throughout industrial innovation ecosystems. Those technologies and innovations will tackle societal challenges and be developed in a transparent way, resulting in **wide societal acceptance**. The EU will also achieve to alleviate people's concerns related to globalisation. A new EU industrial strategy, closely coordinated with national and regional efforts and based on action plans, will help to **share the benefits of economic development more widely across the society and regions**. As a result, nationalism and populism in Europe will be on the decline.

Finally, the EU institutions and national governments will become more agile. Together with EU industry, they will be championing the new European economic model, both at home and abroad. This will help European citizens to regain trust in the public and private sectors. **Stakeholders, including industry, academia and civil society, will work collaboratively with policymakers** towards a prosperous and sustainable future of Europe with regained optimism.

To achieve this vision, we need three strategic imperatives for European industrial policy:

➜ **Manage a fast and inclusive transformation**

➜ **Champion global competitiveness**

➜ **Address social inclusiveness and our values**

> The transition towards 2030 vision presents a multitude of opportunities for Europe offered by globalisation, new technologies, as well as social and environmental sustainability. They require urgent action and the implementation of an ambitious industrial policy. Together, as industry, policy makers, trade unions, civil society and academics, let's use those opportunities to create value and prosperity for the people, the planet and European industry!

2. Trends towards 2030: challenges and opportunities for EU industry

To deliver on the vision 2030, Europe needs to be aware of the long-term and structural transformations (including the implementation of the Sustainable Development Goals) that are taking place and that are changing the world towards 2030. Only in this way we can successfully face the challenges they pose and seize the opportunities they offer. Detailed information about those trends can be found in the Annex.

2.1. Global geopolitical and economic developments

Traditional patterns of economic and social interaction are being challenged by global developments such as global power shifts, security threats by non-state actors and rogue states, the questioning of multilateralism by some international partners, rising protectionism and climate change. Now, more than ever, Europe should adopt a positive, forward-looking stance, act as a leader and role model, and seek ways to influence global development in the right direction.

Challenges:

- **Global economic power shifts**: China is increasing presence in global value chains and is expected to become the largest economy in the world by 2050, followed by the US and India. Globalisation is increasingly driven by new actors with different economic models and values, as well as increased political or state interference.

- **Weak trade and investment** due to protectionism, rising trade barriers, and tensions linked to the weakening and dismantling of the multilateral system. At the same time, the growth of the EU market is relatively limited.

- **Strong nationalistic and populistic sentiments** in many parts of the world.

- **Fragmentation of the Single Market,** which is an obstacle for Europe to fully operate as a continental player.

- **Insufficient R&D and innovation expenditure** in Europe to finance disruptive and incremental innovation and to capitalize on our knowledge leadership by producing innovative and sustainable products and services.

- Ensuring that all economic actors, irrespective of their size and location, pay their **fair share of taxes, while ensuring a global level playing field**.

Opportunities for Europe:

- **New and fast growing world markets** as an opportunity for Europe's businesses, including SMEs, for **gains through globalization.** By building on its excellence in scientific research, position as the world's largest exporter of manufactured goods and services, and one of the biggest global markets, Europe could reinforce its position as a leader in world-class innovative and sustainable products and services.

- **A growing middle class** in China and other regions of the world is creating new markets for European products and services.

- Europe is a global leader in multilateralism. It can build on its own internal and international experience to **take global leadership and partner with like-minded countries** in international organizations (e.g. G20, World Trade Organisation, United Nations) and to promote a global level playing field for EU business based on progressive trade policy and strong enforcement of international trade rules.

- **Increasing demand for our new industrial model** from other countries and parts of the world.

2.2. Scientific and technological developments

Innovation is an essential driver and precondition of productivity and economic progress that benefits consumers, businesses, the economy and the society as a whole. Innovation often starts on a small scale, e.g. when a new technology is first applied within the company where it has been developed. However, the larger benefits occur when innovation is diffused to other companies and larger communities throughout the value chain, eventually spreading across the broader economy.

Servitisation[4] and the blurring of borders between sectors are signs of the new industrial revolution, fuelled by major crosscutting enablers – Big Data and digital technologies, such as Artificial Intelligence and robotics, as well as hardware and materials technology breakthroughs based on advanced materials, photonics and manufacturing processes.

Challenges:

- **Slow rollout of new technologies to the large majority of SMEs** and other companies and **insufficient translation of European R&D and knowledge base into marketable goods and services** that are competitive at a global level, especially in the area of Key Enabling Technologies (KETs). This is often due to a lack of public confidence and hazard-based approach instead of responsible risk management and a balanced regulatory approach and policy measures that supports active innovation, while at the same time protecting the environment and public health.

- The level of digitisation and the uptake of other new technologies among the Member States still varies considerably, which creates the **risk of innovation gap in Europe**, leaving some territories and communities behind.

- **Carbon footprint[5] from digitisation,** related to the production and delivery of digital content as well as the devices on which it is accessed, needs to be properly addressed.

- **General security awareness, education, and understanding** of the related vulnerabilities for industry and for the society (diffusion of fake news, strong concern about possible negative impacts on employment, wages and career development, etc.). The development and implementation of new technologies should be accompanied by social reflection and regular communication with the public related to accountability and transparency. The **ethical, legal liability and data-ownership issues raised by new technologies need to be clarified,** while establishing a framework that is flexible enough to allow for experimentation.

- The valuation methods for **intangible assets[6]** are not always well known or easy to use which hampers their better economic use. In this context, Europe should also strengthen **proper Intellectual Property protection and management,** and to streamline and simplify the patent process and facilitate the balanced use of patents.

- **Insufficient investment in infrastructure.** Energy infrastructure and grids need to be adapted to drive the fossil-free electrification, while at the same time balancing the volatility of renewable energy supply. European industry also needs an EU-wide "high performance" digital industrial

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[4] The process of adding 1 or more services to a product.

[5] Weighted sum of greenhouse gas emissions and greenhouse gas removals of a process, a system of processes or a product system.

[6] According to OECD, "intangible assets (also referred to as knowledge assets or intellectual capital) are assets that do not have a physical or financial embodiment. Much of the focus on intangibles has been on R&D, key personnel and software. But the range of intangible assets is considerably broader. One classification groups intangibles into three types: computerised information (such as software and databases); innovative property (such as scientific and non-scientific R&D, copyrights, designs, trademarks); and economic competencies (including brand equity, firm-specific human capital, networks joining people and institutions, organisational know-how that increases enterprise efficiency, and aspects of advertising and marketing)." http://www.oecd.org/sti/inno/46349020.pdf

infrastructure (fixed and mobile broadband) that is ubiquitously available, including in rural areas, cross-border, high-speed, highly secured and of high quality, while respecting EU health and safety standards. This should take into account the needs of both big and small companies.

- There is a risk of retaining **unsustainable consumption patterns**, in contradiction with circular economy objectives.

Opportunities for Europe:

➔ **Building on our recognised leadership** in low carbon, energy, resources, and waste management technologies, as well as Key Enabling technologies, matched with our experience in the dialogue between citizens, business and research. That will help EU industry design more competitive products and services built around market, societal and environmental needs.

➔ Fostering the research and development of components to **gain strategic independence** from foreign suppliers.

➔ **Modernising more traditional sectors**, especially manufacturing, and **creating new opportunities** for the whole economy by enabling all enterprises, especially SMEs, to access new technologies and Big Data (by providing the necessary physical and digital infrastructure) and supporting their adoption and use.

➔ Developing the **demand side** for the deployment of technologies, throughout policies, awareness-raising (both among industry and society) and appropriate support measures.

➔ **Better connecting technology infrastructures and ecosystems** to ensure better diffusion of knowledge and technologies.

➔ **Gene-editing** technology offers the potential for the further development of climate-resilient, sustainable agriculture, and a bio-based economy. A proportionate, science-based, and non-discriminatory regulatory framework, balanced with a continued dialogue of the ethical, societal and environmental dimensions of this technology, could allow Europe to realize the potential benefits of gene-edited innovations.

➔ **Building on our current strong position in medical biotechnology**, improve transfer from research to production, increase manufacturing capacities, and work on the combination of digitisation, Big Data analysis, automation and AI with biotech to generate new high added value processes, products, and services which would benefit the society.[7]

➔ **Further investing in quantum technologies,** including computing, communication, and sensor technologies, to make the results of quantum research available in commercial applications and disruptive technologies.

➔ Promoting **Additive Manufacturing** (**3D printing)** which allows for shorter supply chains, more efficient use of production materials, and reduced time and cost in developing, designing and testing new products or improving existing ones.

➔ **Carbon Capturing Storage and Utilization technologies**, that, combined in a system, convert otherwise industrially emitted or airborne CO_2 into fuels, chemicals, and materials. Those technologies, combined with other efforts of industry to reduce emissions, help transformation towards climate-neutral economy. Where process emissions cannot be reduced, Carbon Capture Storage technologies should be implemented.

➔ Demand for **batteries**, in particular with much higher energy density, and **hydrogen fuel cells,** is expected to grow very rapidly in the coming years, making this market increasingly strategic

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[7] By allowing for the development of more and better drugs, advanced therapies, and personalized medicine for the diseases that are poorly or not possible to be treated today.

globally. The European market potential for batteries only could be worth up to EUR 250 billion annually from 2025 onwards[8].

➔ Leveraging **technologies for Human-Cyber-Physical Interaction**. EU could explore and develop applications based on haptic technologies[9], affective computing[10] and vocal emotions technologies to provide better services to citizens (while respecting their integrity and the integrity of their data).

➔ **Public sharing of and access to Big Data for all companies**, including SMEs to boost data-based products and services. That should be matched with assuring data security and enhancing security awareness. The sharing of data in B2B relationships should be driven by a self-regulatory approach and promotion of soft-law measures[11].

➔ **Using the logic and methods of digital platforms in public services**, e.g. administration, transport, education and health.

➔ **Strengthening Open Data efforts in other countries** (including neighbouring ones) **and cooperation with them** on **the** systematic collection, analysis and use of data, as well as for the creation of a Single Market for data.

➔ The development of **blockchain technology** and other distributed ledger technologies that have potential applications in numerous sectors[12]. This requires openness to all users and EU-wide uniform (safety) standards for verification.

➔ **Developing a strategic Deep Tech AI plan** by building on the work of the High Level Group on AI, the experience of the European first-movers in this area and our expertise in AI B2B. It should fully take into account the needs of its entrepreneurs, industry leaders, and society. It should include simplifying and constantly updating AI regulation and legislative overhead to avoid overregulation, foster competitiveness and enable Europe to develop new global Deep Tech AI champions.

2.3. Social and societal developments

Europe is home to the most advanced welfare systems in the world and to a wealth of best practices and social innovations, but it needs to confront and adapt to unprecedented societal challenges. Both the EU and Member State are facing rapid changes taking place in our societies and the world of work.

Challenges:

▪ The world population is aging and **in 2030 Europe will be the oldest region** in the world[13].

▪ While investment in robotics, automation and other new technologies offers the opportunity to re-shore manufacturing in Europe, **a lack of skilled individuals and talents will create a bottleneck in this process.**

▪ The high share of young people "**neither in employment nor in education**" (NEETs) in the EU [14] constitutes a loss of talent and potential for the overall economy and society. At the same time, a

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[8] Implementation of the Strategic Action Plan on Batteries: Building a Strategic Battery Value Chain in Europe (COM/2019/176 final).

[9] Haptic devices allow the user to interact with the virtual environment using their sense of touch.

[10] The ability of machines to detect, interpret, and foresee human reactions.

[11] Such as guidelines, good practice guides, and sectoral standard conditions of contracts.

[12] For example, health and pharmaceuticals industry, Internet of Things, energy sector, public administration, and e-government or the management of the intellectual property.

[13] Source: Global Trends to 2030: Can the EU meet the challenges ahead? The European Strategy and Policy Analysis System Report.

[14] 10,5% in 2018, source: Eurostat.

high share of teenagers and adults have **insufficient levels of basic skills**[15]. Almost half of the population of the EU has **low or no digital skills**[16]**.**

- **The demand for 21st-century skills will rise by 2030.** They cover STEM (science, technology, engineering, and mathematics) subjects,[17] basic skills (literacy, numeracy or digital), data literacy, as well a mix of cognitive and socio-emotional skills (problem-solving, creativity, communication, collaboration, active learning, learning strategies). The combination of developing technical and soft skills is a challenge across the board.

- Companies often rank supply and cost of technically skilled employees as the most important factor for localising their manufacturing, while the pace of **change in the skills needed by industry and the shift of tasks is accelerating**. That requires major changes in the current approach to anticipating and upgrade of the education & training system, and life-long learning.

- There is strong global competition for highly skilled individuals, e.g. ICT specialists, and it is crucial to **make working for European companies attractive for both European and global talents**.

- All European regions should benefit from the industrial transition, but they also have to **address adjustment costs and risk of economic and social polarisation**.

- In the field of **sharing economy** Europe is too hesitant compared to other parts of the world with regards to the regulatory and legal framework.

Opportunities for Europe:

→ **Automation and digitisation offer new opportunities for employment and growth**, new European companies can be created by the innovators with global experience and the will to realize their success stories in Europe.

→ Using new technologies and Big Data to help **consumers make more sustainable choices**.

→ Due to its **cultural diversity and good quality educational systems,** Europe is well placed to meet the need for a variety of skills that will be in high demand by 2030.

→ Europe has more experience in social dialogue than other regions in the world and can use that **to shape industrial transformation to achieve co-ownership**. It can build on this expertise to co-create future industrial policy and adapt it to the needs of a changing world and society.

→ **The human-centred design of technology**, while breaking down the silos between technology and society and democratizing technology development with more bottom-up initiatives, could stimulate responsible disruptive innovation, e.g. the European way of creating intelligent machines based on collective human-machine dynamism provides an opportunity to enhance human labour with new robot and AI tools instead of substituting human labour with robots.

2.4. Climate change and other environmental developments

Tackling the threat of climate change is high on the international, European and national political agendas. The commitments laid down in the Paris Agreement are the formal baseline for comprehensive and cost-efficient reductions of greenhouse gas emissions in all sectors of the economy and society. The 2018 United Nations Intergovernmental Panel on Climate Change (IPCC) report[18]

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[15] European Commission (2016), Education and Training Monitor 2016.

[16] European Commission's Digital Scoreboard 2017.

[17] In view of the high demand for a qualified workforce in technology- and research-intensive sectors (see previous sections), those should be a priority area for education. See Council Recommendation of 22 May 2018 on key competences for lifelong learning (2018/C 189/01).

[18] http://www.ipcc.ch/report/sr15/

shows the urgency of the Paris ambition to limit global warming to 1.5°C, by stressing that we have only 11 years left until 2030 to limit the consequences of climate change. Finally, in 2018, the Commission presented its strategic long-term vision on how Europe can lead the way to climate neutrality towards 2050.[19]

Challenges:

- **Decarbonisation of industry**, while at the same time increasing its competitiveness. Industry must make its technologies products, services, and processes climate-neutral and sector coupling and power-to-x technologies are important drivers of this process. That is also the case for other sectors of the economy. This long-term transition requires strong economic, societal, and political commitment and huge investments

- Enabling by appropriate measures the **transition of sectors that face carbon leakage risks,** particularly energy-intensive industries,[20] which have to reduce their greenhouse gas emissions within the EU Emissions Trading System (EU ETS), as long as other key global emitters do not have comparable regulation in place for their industries and there is **no global carbon price**.

- **Decarbonisation of the energy sector**, which is an important precondition for the decarbonisation of industry.

- Maintaining **or achieving global leadership in renewable energy, energy efficiency and new climate-neutral technologies**, while other economies speed up their investments.

- **Competitive energy pricing and energy supply** in Europe in comparison to its main competitors will continue to be a decisive aspect for EU industry's competitiveness. In this regard, the completion of a harmonized EU internal energy market is of utmost importance as well as steps towards global carbon pricing.

- **Low carbon energy availability and energy price increases** due to regulatory interventions. Low greenhouse gas technologies in the energy-intensive industries depend on huge amounts of electricity at competitive prices, which may conflict with availability when taking decarbonisation of other sectors into account.

- **Fair, transparent and barrier-free access to sustainable private and public finance** to speed up investments in transition (also in energy-intensive industries).

- Need for a **predictable, consistent and stable regulatory framework as well as fair, proportionate science-based regulation** to lead a sustainable and successful transformation of European industry in the context of delivering on the EU's contribution under the Paris Agreement to reduce emissions by at least 40% by 2030 compared to 1990[21], and getting a climate-neutral economy by

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[19] COM(2018) 773 final.

[20] Steel, paper, glass, chemicals, fuels, cement, etc.

[21] "In fact, when the agreed EU legislation is fully implemented, total greenhouse gas emission reductions are estimated to reach around 45% by 2030. The policies put in place today will have a continued impact after 2030 and will therefore already go a long way, with projected emissions reductions of around 60% by 2050. This is, however, not sufficient for the EU to contribute to the Paris Agreement's temperature goals. The IPCC report confirms that the world needs to limit climate change to 1.5°C to reduce the likelihood of extreme weather events. It also emphasises that emissions need to be reduced with far more urgency than previously anticipated. In order to limit temperature increase to 1.5°C, net-zero CO2 emissions at global level needs to be achieved around 2050 and neutrality for all other greenhouse gases somewhat later in the century. At this point, any remaining greenhouse gas emissions in certain sectors need to be compensated for by absorption in other sectors, with a specific role for the land use sector, agriculture and forests. This provides an opportunity for the EU to step up its action to show leadership and reap the benefits of first mover advantage. This would require

2050**.** It should address concerns about international competitiveness and efficient incentives to stimulate investment.

- **Climate, energy, raw materials, and bio-economy policies** are key areas considered essential for the future of EU industry in terms of challenges and opportunities. They need to go hand in hand with industrial policy and a societal dialogue on what emission reduction and other environmental policies mean in terms of costs, benefits and behavioural changes for everyone.

- While the circular economy is promoted as the European model to reconcile economic imperatives of development with resource efficiency, **the EU is still far from optimal resource efficiency**, where technology and innovation can play an increased and decisive role for doing more with less.

- **Securing a sustainable supply of raw materials** from Europe and global markets. The **resource security** (supply of primary raw materials and the circular economy to provide quality secondary raw materials) will put constraints on economic and technological developments. Therefore new resource-efficient methods, including innovative substitute material and supply concepts, have to be developed. This needs to be balanced with environmental requirements.

- The long-term objective for climate-neutral and circular economies in the EU will prompt **changes in the industrial fabric of some European regions** (e.g. coal mining ones). This might increase the regional imbalances and would require support to regions and sectors for managing the transition.

Opportunities for Europe:

- **Europe is a global leader in the circular economy and resource efficiency and it has taken important steps to implement the Circular Economy Action Plan.** Sectors that enable the transformation to a low-carbon economy, like technology, machinery, materials, electronics, etc., can benefit from well-designed political targets and appropriate accompanying measures if embedded in systemic change in the whole economy. Given a predictable and consistent legal framework and efficient incentives, they will develop existing and create new (sustainable) business models and strengthen or open up new markets, also outside Europe.

- Given a predictable legal framework securing Europe's competitiveness, **industry**, including energy-intensive industries, **can build on its achievements and further benefit from the early mover advantage and sustainable innovative technologies**, showing good results with relevant Key Performance Indicators and gaining production efficiency leadership against its competitors.

- **New technologies**[22] and **new sustainable industrial systems** developed in Europe can substantially **accelerate the global mitigation path**.

- European industry can build on its leadership and **further strengthen its role in the field of** to stay ahead of global competitors and remain a frontrunner in **eco-innovation and eco-efficiency of manufacturing and society**. Europe should also build on its experience and continue **investing in, technologies and business models.**

- EU has to provide the **enabling framework conditions for developing sustainable mobility concepts,** which do not focus on one single technology, sector or industry. They should be technology-neutral when ensuring sustainability and support sector coupling.

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the EU to achieve greenhouse gas emissions neutrality by 2050." A Clean Planet for all. A European strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy, COM(2018) 773 final.

[22] E.g. low carbon processes for the steel and chemical industry have the potential to decrease global emissions in the magnitude of the total emissions of the EU today.

3. Key drivers of success

Success in achieving the 2030 vision requires not only facing challenges and seizing opportunities mentioned in the previous chapter. The structural transformation of EU industry should also be powered by five interdependent drivers, which require an integrated approach in addressing all of them to implement the future European industrial model.

Figure: Five key drivers to achieve the Industry 2030 vision

3.1. Leadership in technology, innovation and sustainability

Both the industry and the society require transition to sustainable and climate-neutral production and consumption patterns. The 2018 IPCC report emphasized the need to accelerate measures to urgently curb climate change. The Commission proposal for the 2021-2027 Multiannual Financial Framework has already set an overall target of 25% of EU expenditure contributing to climate objectives. But the scale of this task requires further large-scale investments, as well as deep changes in the workforce and consumer behaviour, which needs to be anticipated and managed in a responsible way. While this is a challenge, it also opens significant business opportunities for companies able to address the worldwide demand for resource wisdom, energy efficiency, energy storage and sustainable solutions for the circular economy. This opportunity is expected to give a net economic boost of USD 26 trillion to the worldwide economy.[23] Therefore, Europe's opportunity for differentiation and leadership lies at the heart of three symbiotic ingredients: **technology**, **innovation** *and* **sustainability**.

Technology-powered companies that innovate for sustainability will prosper on the global arena, replacing those less willing to change. **Exponential technologies[24] fuelled by digitisation**, such as AI, 3D printing, blockchain or robotics, **drive an unprecedented wave of innovation** through all European industries. At the same time, the shift to **sustainable consumption and production** is a major driving force for change. Increasing consumer demand for transparency and traceability changes the way we design, produce, commercialize, maintain and generate value from products and services. Customer

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[23] https://newclimateeconomy.report/2018/wp-content/uploads/sites/6/2018/09/NCE_2018_FULL-REPORT.pdf

[24] Technologies that thrive from advancements in computation (related to Moore's Law) and growth of data and digital interconnectivity, e.g. AI, 3D printing, blockchain or robotics, that are re-shaping industries and all aspects of our lives, not by their siloed development, but by how they are creatively crossed with one another to create new disruptive business models.

needs are fulfilled in new and better ways and business is increasingly done **sustainably** and **responsibly**. However, the need for correct and detailed data availability at the final consumer product level needs to be balanced with additional bureaucracy, costs, Intellectual Property Rights and confidential business information and solutions should be applicable globally.

The industrial transformation requires a **proper policy mix and investment strategies addressing the interplay between technology, innovation and sustainability**. In this context, Europe offers a wide set of unique means and tools. It can pool together resources from the private and public sector to invest in ecosystems with networks of strong place-based testbeds and innovation hubs. It can also combine its investment strategy with the design of a policy mix (including innovation-friendly regulation of the Single Market) to speed up the adoption of exponential technologies for sustainability. This, coupled with skilled workforce, provides **the recipe for EU industry to realize its untapped technological potential.**

Industrial and commercial success, built on creating and applying new knowledge, requires **strong basic and applied research**. By further stimulating **market availability and demand for products and services based on Key Enabling Technologies** made in the EU, Europe could strengthen its **competitiveness** along entire global value chains. Ripple effects could also level the playing field for EU industry at large, necessary for skills upgrading and global competitiveness. To make that happen Europe needs to accelerate the diffusion of new technologies and skills to all companies, in all economic fields, and all regions.

3.2. Anticipating and developing skills

European industry has the opportunity to be equipped with the right set of skills, professional and transversal, for addressing the challenges posed by exponential technologies, digitisation and the shift to sustainable production and consumption. Those **skills should come from policies and systems that ease the generation and transfer of knowledge and place-based ecosystems that spread innovation.**

Our society requires knowledge concerning complex problems, like those at the nexus of technology, innovation and sustainability. Europe needs a **cross-disciplinary** approach to 21st-century skills and interoperability of the workforce to harness the enormous opportunities of the industrial transformation. Therefore, there is a need to support the adoption of digital technologies and to spread digital expertise in the workforce, with special measures to tackle the digital gender gap[25] and address the varying levels of digitisation among Member States.

People are our talents who can easily learn to create with new technologies, e.g. through vocational training programmes with work-based learning elements. Reskilling and up-skilling to keep up with technology is an important part of maintaining a valuable workforce of all ages.[26] The few labour market needs that are unmet with the domestic workforce could be addressed within a renewed EU migration policy framework, respecting national competences.

Our education and training systems need to take into account the fast-changing developments on labour markets, be capable of anticipating and providing needed knowledge and skills, while adaptable to change. We need policies that foster **recruiting and retaining brains.** Therefore, it is essential to be proactive, not reactive. It is necessary to keep world-class researchers and teachers in the EU to lead the education, research, development and training agenda of the future workforce and to enhance collaboration between education and training, research and the business sector. Moreover, career models and work environments should be more inducive to learning. All this should help to lower entry barriers to skills development and lead us **to fully implement for the first time life-long learning,** in which every adult continues to take part in education and training.

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[25] https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf
[26] https://www.thinkadvisor.com/2016/03/03/how-an-aging-work-force-can-thrive-in-the-digital/

Inclusivity and diversity in education are required for a new societal deal based on European values, which incorporates the social dimension of industrial policy as a tool for social-economic progress and addresses the social impact of the economic and technological shift to ensure nobody is left behind.

With these skills and assets at hand, European companies can improve their innovation capacity and competitiveness and gain the potential to become a key player within their value chains and the dynamically expanding value creation networks.

3.3. Focus on strategic value chains and value creation networks

Europe has the opportunity to **combine world-class capabilities with strategic value chain[27] positioning** to further gain distinctive competitive advantages in a deeply integrated global economy. This is true for a growing number of high-value, traded-sector industries and productions systems that are geographically fragmented[28]. Focusing on delivering value to achieve an SDG-driven growth will position European industries in areas where Europe is and can be at the forefront globally.

We observe fundamental changes in the role of local production networks, which arise from a new logic in which servitisation is becoming increasingly important in the economy[29] and global leading manufacturers transform to also become service providers. European industries need to shift from supply chain management, to demand and ecosystem management and to meet and strengthen each other around **problems they need to solve together** *for and with* **their customers**. This new shift from product to solution is facilitated by the digital economy, which enables the use of **virtual value chains** (e.g. internet-based platforms) to deliver services and products (solutions).

To respond to these opportunities, Europe needs to build on **regional ecosystems**[30] **that embrace their own smart specialisation, help to bridge regional disparities and provide the platform** where all the actors can combine their knowledge and co-create the content, context and learning experiences. Those ecosystems should bring together public administration, higher education institutions, scientists, civil society and industry, create focal points and act as a multiplier of EU efforts.[31] They should also create technological platforms or hubs to pull together resources for technical, digital and soft skills acquisition. Europe needs to move beyond traditional models, in which a linear and hierarchical relations between customers and suppliers in the value chain are driving the relational environment. We need fresh, bold, dynamic, and transformational networks where non-mainstream interactions are fostered and renewal is a continuous process. Our industrial innovation ecosystems should be integrated around new type of **smart clusters**, which actively support the transformation of industry as agents of change. They need to act at the speed and scale that Europe needs. They also need to work across boundaries and take part in the **interregional collaboration** leading to more critical mass, e.g. via the new interregional innovation investment instrument in ERDF.

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[27] The Strategic Forum on IPCEIs associates the term "value chain" with both a set of interdependent economic activities creating added value around a product, process or service, and a group of interlinked economic actors, operating in a strategic network across firms of different sizes, including SMEs, sectors and borders.

[28] The competitive edge: A policymaker's guide to developing a national strategy, ITIF, Robert D. Atkinson, December 2017, http://www2.itif.org/2017-competitive-edge.pdf

[29] Evolving to a new dominant logic for marketing, Journal of Marketing, Stephan L. Vargo, Robert F.Lusch, 2004

[30] E.g. the ones developed by the Knowledge and Innovation Communities (KICs) supported by the European Institute of Innovation and Technology (EIT), clusters, Research and Technology Organisations (for applied research, testing and demonstration facilities for accompanying measures to scale-up), Digital Innovation Hubs (as one-stop-shops where companies can get access to digital technology-testing, financing advice, market intelligence and skilling the workforce).

[31] Towards a new approach for upgrading Europe´s competitiveness, Harvard Business Review Working paper 19-033, Christian Ketels, Michael E. Porter, September 2018 https://hbswk.hbs.edu/item/towards-a-new-approach-for-upgrading-europe-s-competitiveness?cid=wk-rss

In this context, **strategic value chains[32] are essential**. They can be supported by several EU instruments including legislation, regulation, funding (Horizon 2020/Horizon Europe, InvestEU) and – if conditions require it – the support of Important Projects of Common European Interest (IPCEIs). The combination of existing value chains through interregional and international collaboration, with matching smart specialisation assets linking industrial clusters, can **support Europe to move from linear value chains to networks that create value**. Such value goes beyond seeking profit and takes into account the social and environmental impacts of industrial activity. If we want to strengthen Europe's engine of growth, business, education, research and innovation ecosystems should be more tightly interconnected and this interconnection be financially backed up.

Focusing on strategic value chains and their connection to value creation networks is essential to foster the transformation of European industry. **Policy must be inherently designed for value creation networks rather than for individual sectors, and for companies of all sizes**. We need to have enough actors across sectors that join forces and reach critical mass around industrial transformation through sustainability, technology and innovation. It is important to get industry on board as early as possible, notably by mobilising forerunner companies, but also supporting new players. European value creation networks will potentially give the highest collective return on invested efforts as they provide the platforms through which transformation happens in areas strategic for Europe, e.g. smart energy systems including renewable energies, sustainable mobility, smart buildings, resource efficiency and circular economy, smart manufacturing, ageing society, decarbonisation, digitised economy. A public-private collaborative effort to build European value creation networks would better embed globally leading companies in the regional ecosystem and foster the global competitiveness of smaller suppliers of value-added products and services. This would increase the global competitiveness and the autonomy of European industry and maintain a high share of value creation in Europe. Finally, it would also ensure that individual and collective transitions to the new industrial model are inclusive, smooth and just.

3.4. Fair, competitive and agile business environment

For Europe to thrive from globalization, digitisation and sustainability, industrial policy needs to be predictable, stable, reliable, coherent and apt to adapt to and with its environment. **Policy must be inherently designed to ease the cost of doing business responsibly in Europe**.

Exponential technologies and new business models supporting decarbonisation and dematerialization, entail several policy challenges. They are still emergent and any **inappropriate or unnecessarily burdensome regulation could be detrimental to their development and the rise of European champions**. Thus, agile governance, such as light touch legislation combined with the promotion of an experimental regulatory 'sandbox' approach, is required until those technologies have reached their full potential. Policy makers should also systematically consider the potential impact of legislation on innovation when designing it. It is necessary to use the **"innovation principle",** ensuring that the choice, design and regulatory tools foster innovation, rather than hamper it. The innovation principle, understood as a positive obligation to facilitate innovation, offers guidance on the process and content of regulation and can be implemented through both. The two, the process and the content, are of equal importance to achieve a qualitative change in the way that regulation can fuel innovation.

In a highly competitive environment, value offering renewal is very quick and innovation is copied or imitated at a fast pace. At the same time, new risks should be addressed such as access to data and cybersecurity for connected products. In this context, it is essential that new products and services can quickly find their consumers for manufacturers to recoup their investment and work on improving and developing new products. Therefore, **self-certification for products or services** should be systematically favoured. This requires a much simpler European administrative procedures to enable

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[32] See also work of the Strategic Forum on IPCEIs.

the timely availability of regulatory requirements and harmonised standards for manufacturers to benefit from the scale of the Single Market for their products and services. In some industries intelligent and dynamic setting of **EU regulatory requirements and European-wide standards**, if possible in line with international UN rules, the International Organization for Standardization and the International Electrotechnical Commission standards, can reduce risks for both innovators and purchasers by aggregating demand in fields that might otherwise be spread too widely over multiple solutions. Regulatory requirements and standards, next to Intellectual Property Rights, provide support to innovators and can encourage innovation if they are set at a demanding level of functionality without specifying which solution must be followed.

The Single Market is key for the transformation to a climate-neutral, digital and globally interconnected industry. **A predictable, consistent and coordinated regulatory framework for the Single Market requires social, environmental and economic impact assessments and cumulative costs assessment of regulations** that are transparent, standardised, holistic and in continuous calibration with stakeholders. If necessary, only the most appropriate regulatory tools should be chosen to ensure a consistent and effective regulatory framework, with simple compliance tools that can be easily managed by both companies and enforcement authorities. Regulation should take into account the environmental impacts and benefits of products during their whole life-cycle and minimise the life-cycle impact of products. At the same time, progressive harmonisation of framework conditions such as in waste management, as well as effective and market surveillance coordinated at the European level is key in guaranteeing proper functioning of the internal market. Small businesses should also be encouraged to grow and expand across borders, but that requires fast and simple procedures across the Member States, e.g. for registration of new companies.

Mainstreaming climate considerations into financial markets is key to account for the impacts and effects of climate change. By internalizing climate change costs, and by aligning costs on carbon and natural resources to the recommendations by the IPCC, policy will be creating strong financial incentives to reduce emissions and unrecovered waste by our industry while promoting innovation. To avoid disadvantages in Europe, this has to be aligned with global action. A fair and predictable tax system throughout the EU is also a prerequisite if we want businesses to thrive sustainably. EU and foreign companies have to deal with not only different tax system in every Member State but also with regular changes in scope and rate of taxation in each market. This creates additional costs for companies and creates a disincentive to invest. Free flow of capital is also a cornerstone for innovation and industry. Easy cash-in and cash-out processes in all EU countries are fundamental to support industry looking for alternative financing sources. Foreign investments are sometimes necessary for companies, especially start-ups and growing companies, to reach a critical size or survive difficult times.

As 90% of global growth is expected to come from outside the EU[33], ensuring **free and fair trade** is also key for EU industry, which is increasingly operating in global value chains. **Reciprocity in trade relations and investment** is required to address increased global competition. This is best achieved through free trade & investment agreements, which on top of opening markets also contribute to raising global environmental and social standards.

Adequate EU state aid and competition policy are also essential for supporting the competitiveness of EU industry. EU competition rules should be regularly reviewed, taking account of technological disruption and other developments, e.g. such reviews may show that changes are required to ensure effective competition enforcement in the digital sector. The EU should continue to take all necessary measures to promote the creation of a global level playing field before international multilateral fora such as the World Trade Organisation (WTO), the Organisation for Economic Co-operation and Development (OECD) and the International Competition Network. In particular, the EU should advocate in favour of establishing transparent subsidy control systems in third countries. The EU

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[33] Trade for All. Towards a more responsible trade and investment policy. COM(2015) 497 final.

should also identify how to fill existing gaps in EU law to address the distortive effects of foreign state ownership and state financing by third countries.

The establishment of **infrastructure for businesses to fully embrace the next digital revolution** is also key. For EU businesses to embrace the revolutions to come, they will need proper access to digital physical infrastructures, e.g. very high capacity broadband networks, storage and computing infrastructure in Europe. Private investment in networks will necessarily focus on dense areas, leaving aside less populated and remote regions. Therefore, public investment in high capacity broadband networks, done **while respecting European health and safety standards**, is crucial if we want to make sure that the next digital revolution will be more inclusive than the previous ones. Similarly, inclusive access to infrastructure in energy, transport, as well as in services remains important.

3.5. Social fairness and wellbeing

The social situation in Europe has been improving in recent years – with economic recovery underway, we see improvements on labour markets and social progress. However, Europe is facing important societal challenges, inequalities among regions persist, demographic trends pose a challenge and mental health issues are on the rise.

At the same time, the European social model and our highly-skilled and committed workforce can create the right ambient framework for industry to thrive in. Improving the performance of labour market, e.g. by active labour market policies and effective social systems, is essential to preserving this model. While digitisation is changing the labour market, SMEs, together with start-ups, are expected to continue to provide most of the employment in Europe. More jobs and growth are not enough: Europe needs better jobs. Using the Social Scoreboard[34], which is part of the European Semester process, we also need **to continue and, where necessary, improve measuring social fairness and wellbeing** to enable and incentivise the EU Industry to better contribute to shared, sustainable prosperity.

Europe also needs more diffusion, acceptance and affordability of technologies. They will work best if anchored from the bottom up, by all stakeholders and citizens in Europe, starting from the stakeholder engagement into the identification of challenges for which there is a need for innovative solutions. **Technologies that distribute wealth and power by design[35],** rather than by default, should be further developed. And data should be used to deliver collective value rather than for profit or control. This way Europe has a chance to globally demonstrate alternative technological paths based on its values.

Digital technologies also enable **new work constellations.** The gig and the freelance economy demonstrate a purpose-driven generation that often seeks the 'right' problem to solve as opposed to the right organization to work for. Europe needs a model in which this type of current and future shifts are supported without the cost of increased precariousness.

In an ever faster changing economic and technological reality, social dialogue and social integration is key to co-define modern social security systems and well-functioning labour markets, for and with European citizens. Considering the speed with which technologies and new business models transform entire industries, planning structural disruption regularly and proactively is key. The establishment of a culture of **social dialogue at all levels** (company, sector, regional, national) becomes imperative to **ensure smooth and just workforce transitions**, to help re-train those whose jobs are at risk and to support the regeneration of adversely affected regions.

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[34] It monitors Member States' performance in relation to the European Pillar of Social Rights, which was signed as an inter-institutional Proclamation by the European Parliament, the Council and the Commission in 2017.
[35] E.g. Tech for Good initiatives, which use the power of technology to positively impact people, communities and the planet.

4. Delivery: what actions are needed to reach our vision 2030?

To implement the vision presented in the first part of this report we need the following strategic imperatives for EU's industrial policy:

- **Manage a fast and inclusive transformation**: design an appropriate ecosystem stimulating innovation and technology uptake; accelerate the transformation towards climate-neutral, circular and resource-efficient industry; ensure reliable access to sufficient and affordable low carbon energy and raw materials supply, while respecting planetary boundaries; boost the EU digital economy; finance the transition.

- **Champion global competitiveness**: ensure a greater role for the Single Market to benefit from a continent-wide market; strengthen strategic value chains; lead in an open, fair, multilateral trading system; take global action for EU industrial leadership.

- **Address social inclusiveness and values**: ensure social fairness of industrial transition; spread benefits of the transformation in European regions; build a learning society anticipating and developing skills; ensure co-ownership and inclusive governance for the transformation; build an enabling environment for more sustainable business activities.

4.1. Manage a fast and inclusive transformation

- Design an appropriate ecosystem stimulating innovation and technology uptake:

  - Encourage **cross-border collaborative approaches** along all steps in the innovation lifecycle and relevant value chains, involving policy makers, industry, trade unions, NGOs and academics to market entry and social acceptance of new products and services. Support the creation of synergistic industrial clusters and industrial symbiosis as an important tool for industrial transformation.

  - Avoid investment leakage and support competitive companies in key areas **to stay and expand** in their regional economy and industrial innovation ecosystems. Ensure that the first **industrial application of the results of European funded R&D** takes place in the EU and brings benefits to the EU's economy. Make the best use of new market access opportunities created by trade policy and join European forces to improve access to main markets.

  - **Establish modern strategic infrastructures.** On one hand, they include smart grids, demand response, energy storage and networks for hydrogen or synthetic methane, charging and refuelling infrastructures for transport (including EU-wide access to charging/refuelling service) and related well-connected rolling stock. On the other, they also include digital infrastructures, which give access to standardised data for re-use by service providers (e.g. regulatory or traffic data for transport), and ultra-high-speed broadband across the EU and high-performance 5G networks (that incorporate security by design and take into account EU standards). At the same time, we also need to ensure modernisation of existing basic infrastructure like energy grids.

  - Boost investment in testing and validation infrastructures to **help business cross 'the valley of death'.** Advanced manufacturing centres, pilot plants, digital innovation hubs and regulatory sandboxes are helping actors in the innovation system cross the valley of death and translating innovative technology into business, dealing not only with technology challenges, but also with business challenges. An investment boost and regulatory flexibility for construction, update and operation of the demonstrating and piloting facilities are required for deploying European lead-markets and fostering digital transformation, supported by instruments at all policy levels. Offering wide access to this infrastructure and share of resources (equipment, technological expertise, etc.) is also important.

o Facilitate the **allocation of** EU, regional and national **funds** to investment (CAPEX) and operation (OPEX)[36] of **testing and demonstration facilities** that support the scaling-up of new technological developments and ensure innovation-friendly state aid provisions for investments in their construction, upgrading and use.

o **Take the innovation principle to a new level** through specific measures for its application across all policies, together with the precautionary principle. Potential avenues include a Commission communication or guidance documents, which could also demonstrate how both principles could contribute to the achievement of the SDGs. Applying the innovation principle requires balanced regulatory systems for application of new technologies, relying on existing regulations when applicable and making revisions or developing new frameworks only when necessary – to allow Europe lead in economically and societally beneficial innovations.

GAME-CHANGING ACTIONS

The Next Enlightenment for Technological Leadership: EU would place 2-3 moonshot technological bets in areas where Europe is already strong or would like to build a competitive advantage e.g. green automation, Quantum Computing, multi-scale robotics, GHG Production Technologies, Carbon Capturing and Utilization, advanced bio-materials. These technological moonshot bets would be chosen based on specific methodology, and for their spillover potential across multiple global value chains (which still requires further research) supporting climate-neutral economy. Additional selection criteria would be used to heighten their potential to create powerful and proud European stories. Their support would include providing financing and investments, skilled workforce and right framework conditions. Empathy and Experience Centres (both physical and virtual) would also be developed on a regional and local level to demonstrate the potential technological benefits for the society, economy and environment. This would help to further involve and engage citizens in the industrial transformation. Delivery role: EU, Member States, regions, local authorities.

Strategic Programme for Technological Infrastructures: A strategic programme supporting the networking of existing technology infrastructures to help Europe stay at the forefront of innovation capacity, by coordinating regional programmes and investments. It would be based on a bottom-up approach: smart specialisation strategies combined with opportunities to team up and complement the existing offer. It would provide technology access vouchers and define a European catalogue of infrastructures (in cooperation with Member States), prioritized according to their relevance for European technology sovereignty, smart specialization and EU policy priorities. This plan would be launched within the next EU multiannual financial framework (within Horizon Europe, in combination with other EU funds, e.g. the European Structural and Investment Funds, InvestEU). Delivery role: EU (overall coordination and excellence funding), Member States (support for strategic national interests), regions and local authorities (support for placed-based ecosystems for impact and smart specialisation).

- Accelerate the transformation towards climate-neutral, circular and resource-efficient industry:

o Strive to establish through market-based instruments **appropriate price signals** towards a climate-neutral economy by 2050, by introducing a coherent and homogenous carbon pricing in the EU for the activities outside the EU ETS, thereby providing a carbon price for the whole economy.

o **Setting the first meaningful steps in the decarbonisation of energy-intensive industries,** while keeping in mind the long-term targets of the Paris Agreement and the European strategic

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[36] It needs to be clarified that ERDF will not fund OPEX.

long-term vision. Decarbonising those industries is a huge technological, financial and political challenge and can be key in the decarbonisation of the whole of industry. It requires technologies and processes, adequate financing, new business models, solutions for the price difference between low-carbon products and traditional products, promotion of the uptake of low-carbon products, organising the circular economy around them. Moreover, aligning deep decarbonisation policies with energy policies is indispensable, as the transition will require a strong increase in the supply of (renewable) electricity. EIIs decarbonisation should be done while safeguarding international competitiveness to allow EU companies to become global leaders in clean technologies.

o The **cost of decarbonisation measures supporting the transformation should be fairly distributed** among all actors, avoiding that those measures result in growing inequality and have negative effects on income distribution. The work of the Strategic Forum for IPCEI and the High Level expert Group on Energy-Intensive Industries will contribute to this objective.

o Ensuring the competitiveness of other sectors of EU economy, including **industrial manufacturing sectors** (such as automobiles and industrial engineering and machinery), as well as **buildings, construction, transport and mobility** via the uptake of technologies.

o Developing a forward-looking and **integrated strategy to increase demand and deployment of technologies**, including through industrial pilot projects and interdisciplinary public-private-partnerships.

o Use appropriate **policies and incentives, as well as standards and certification to create markets for innovative technologies and solutions** (e.g. less dependent on fossil raw materials and contributing to less greenhouse gas emissions) **and new circular business models** (e.g. bio-feedstock, biodegradable plastics, new recycling technologies). The circular economy is more than closing the loop: elements such as renewable energy, resource savings during lifetime of products and virtual and shared economy strategies have to be realized to reach the overall aim of resource savings. Therefore, the EU should define and implement a consistent, robust and straightforward regulatory framework and incentives which ensure industry invests in new technologies in Europe and becomes an indispensable supplier of a low-carbon circular economy:

    ✓ Supportive measures to **promote (bio)mass balance approaches** to make new feedstocks available, to increase the share of **sustainably sourced bio-based sourced products.**

    ✓ Support and promote **life-cycle approaches** to assess products impact along the entire life-cycle (from product design to recycling) while ensuring that material solutions which perform well during their use phase and contribute to waste are not phased-out because recycling capacity is not yet available.

    ✓ **Invest in recycling infrastructure** and develop a market for secondary raw materials at industrial-level quality and costs and second markets for products.

    ✓ **Complement EU recycling targets** with **guidance stipulating the technology neutrality** of such targets.

    ✓ Establish EU-wide end-of-waste criteria[37] allowing a recycling operator to declare end-of-waste status for his products by issuing a statement of conformity. This mechanism could include processes similar to registration under REACH.

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[37] End-of-waste criteria specify when certain waste ceases to be waste and obtains the status of a product (or a secondary raw material).

- o Ensure bigger **consumers' uptake of circular products and services**, as well as **societal dialogue** on circular business models, responsible consumption choices, or impact of emission reduction on costs and behavioural changes for everyone.

- Ensure reliable access to sufficient and affordable low carbon energy and raw materials supply, while respecting planetary boundaries:

  - o Given the increased electrification of most industrial and private activities, electricity demand will massively increase, potentially even double or triple. Therefore, **any gaps in the EU electricity market design need to be identified** to ensure the secure and competitive supply of **affordable low-carbon electricity, at sufficient scale**, which is critical and requires adequate electricity production from clean and renewable sources, as well as developing storage technologies and infrastructures.

  - o **The infrastructure supporting the switching of industrial production from fossil fuels to low greenhouse gas electricity and feedstocks**, such as bio-based, hydrogen or ammonia, will need to be developed on time, as it is a prerequisite for this industrial transformation.

  - o **Efficiency in other sectors** will be important, e.g. improving the energy efficiency of houses at affordable costs, increasing the circularity of the built environment and improving industrial symbiosis.

  - o **Consider energy sources in line with circular economy principles** and respecting the waste hierarchy for possible conflicting objectives among policy options, i.e. waste products or energy investments.

  - o Take a proactive approach towards the expected **significant increase in demand for primary raw materials** and use various instruments, e.g. support for R&I for material substitution, recycling as strategic stocks, promotion of circular economy, or trade agreements to secure sustainable supplies.

  - o Consider the access of industry to affordable renewable electricity in the review of **the EU Guidelines on State aid for environmental protection and energy**.

GAME-CHANGING ACTIONS

Carbon-leakage 2.0 plan: A global stocktaking exercise of climate ambitions will take place in 2023 under the Paris Agreement. While calling major trading partners to commit to comparable ambitions as Europe, the EU should continue to monitor the effectiveness of carbon leakage measures. If it demonstrates that the current measures are insufficient, a "carbon-leakage 2.0" plan should be developed, including a toolbox of possible measures. Subject to a solid assessment of potential impacts and legal, practical and political feasibility, they could include better protection under the EU ETS, specific climate elements in free trade agreements, carbon border adjustments (while avoiding protectionist measures) or other new instruments. Delivery role: EU.

Green Deal with industry: An agreement between EU, Member States, regions and industry to share risks and benefits related to the sustainable transformation, including cash contributions similar to the "Entrepreneurial State"[38] concept. This should use the potential of the Modernisation Fund and Innovation Fund under the EU ETS. Moreover, the EU would create an Industrial Transformation Co-Fund for industrial experimentation at scale and breakthrough technologies would be developed (see: The Next Enlightenment for Technological Leadership action), in a co-ownership programme. This would allow Europe to go beyond the deployment of no-regret technologies (such as

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[38] Concept developed by prof. Mariana Mazzucato, which presents the public sector not only as focused on fixing market failures, but also actively shaping and creating markets.

renewables), which are not sufficient for a net-zero greenhouse gas emissions economy[39], towards a truly climate-neutral economy. <u>Delivery role: EU, Member States, regions and industry.</u>

Standardised carbon reporting: global standardised reporting of industry on greenhouse gas emissions, which would encourage industries to be on track and benchmark[40]. It could be done with the support of Corporate Reporting Lab for example, which would stimulate innovations in corporate reporting. It would also require the engagement of international fora. Institutional investors (e.g. pension funds) would be encouraged to divert from fossil fuels and mobilise investments that can bring significant improvements in emissions reductions. This would also influence energy companies to change climate targets[41]. <u>Delivery role: international organisations (e.g. OECD), EU, Member States, industry.</u>

Circular Industrial Champion: Setting ambitious targets and a clear pathway for the EU to become a global Circular Industrial Champion by 2030. This would include phasing out the single use of raw materials (following the EU ban of single-use plastic) and incentivising the application of circular resources in industry where technically possible, economically feasible, and environmentally sustainable. It would also require large-scale demonstrators, EU harmonized end-of-waste regulation, advanced materials, incentivisation of new recycling technologies, i.e. mechanical, organic and chemical recycling, and Innovation Principle. Target examples could include: reusing critical raw materials: nearly 100% of the raw materials of the EV car batteries that are imported into EU will be reused for new batteries by 2025; converting waste back into feedstock in addition to established mechanical recycling will recycle up to 50 % of plastics waste.[42] <u>Delivery role: EU.</u>

- Boost the EU digital economy:
  - **Lead the technology revolution on the application of AI** (and its further advancement towards Deep Tech AI) **and digitization** to optimise energy and resource use and in areas where EU has a competitive advantage, such as highly educated population, mobility and transportation interoperable across borders, manufacturing industries and advanced machinery, healthcare and education systems.
  - **Create AI excellence centres across Europe** that would serve as world-leading research hubs, global talent attractors and local reference for the community and stakeholders. Machine learning, robotics and machine reasoning sought to be explored in the context of these domains. Building on those efforts, form Deep Tech AI superclusters[43] to scale up and better coordinate promising developments and accelerate innovation.
  - Create a **true internal market for cybersecurity** and build a **world-leading strategy**, including incentives and development of networked infrastructure (including testbeds and demonstration sites) for cybersecurity that capitalizes on the EU's strengths in data security

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[39] COM(2018) 773 final.
[40] Building on related actions proposed under the Sustainable Finance Action Plan, in particular the upcoming disclosure regulation.
[41] E.g. pension fund ABP forced Shell to link bonuses to concrete climate targets.
[42] "How plastics waste recycling could transform the chemical industry", by Thomas Hundertmark, Mirjam Mayer, Chris McNally, Theo Jan Simons, and Christof Witte, McKinsey 2018, https://www.mckinsey.com/industries/chemicals/our-insights/how-plastics-waste-recycling-could-transform-the-chemical-industry.
[43] Supercluster is based on a strong industrial cluster, or clusters, linked through their shared reliance on specialized inputs, including technologies, talent and infrastructure.

and protection and advances public trust in digital technologies. Foster cross-sectoral collaborations between business, security, and military experts to share best practices and develop new approaches.

- o **Human-centred integration of new technologies** (e.g. AI, biotechnology, automated transport) by ensuring that they are developed and implemented based on the value provided for the European citizens, e.g. wellbeing, positive impact on the achievement of SDGs, future of work, quality of working conditions, social cohesion, healthcare, mobility etc.

- o **Human-Cyber-Physical Interaction** leveraged for the benefit of Europeans. Integration of human senses with technology, enabled by affective computing, haptic and vocal emotions technologies and other digital technologies, while conscious decision related to their various aspect, e.g. face recognition technologies, the integrity of our voices our thoughts. Europe should become a thought-leader in developing frameworks for how technology should be allowed to be integrated with humans and for what purposes.

- o Create a **Sustainable Social Network Enabled by the Wisdom of the Crowd –** an online machine-learning network to combat fake news, disinformation campaigns, spread of extremism and to find genuine and fact-checked news and information. The effort to build and maintain this platform can be self-funded through long-term subscription fees, micro-payment based pay-per-view, to distribute funding as broadly as possible and thus to avoid conflicts of interest and sensationalism, and/or supported by private donations and public funds, with the initial support from the EU. The platform should also have a mechanism that equips users to recognize fake news and disinformation, encourages, incentivizes, and enables online fact-checking activities, thus contributing to positive democratic development.

GAME-CHANGING ACTIONS

City of the future: Plan and create a model city where completely new concepts for housing, mobility and logistics, energy, renewables and energy efficiency, water, education, recreation and healthcare facilities could be integrated using AI, robotics and other technologies. This could be implemented in two ways: as a virtual model city, and as a part of the "Clusters of change" action. It would provide a testbed for testing and exporting Europe's vision of an advanced democratic, inclusive, fair and prosperous society to the rest of the world. It would also help to transform urban degraded areas and fight social exclusion. Industry involvement (e.g. connected and automated vehicle manufacturers, robotic companies, telecom providers and technology industries) would be a key element of this initiative. Delivery role: local authorities and industry, with the EU support.

Open data for industry: Clear European guidelines and incentives for the promotion of open data as a valuable resource for all types of private companies. This could be realised by providing legal frameworks, guidance, incentives and support for B2B data sharing, including suggested guiding principles and business models, legal and practical considerations and technical means to facilitate easy, secure and fair sharing of industrial data in processes and operation. This would help to ensure that industrial data would be broadly available under FRAND (fair, reasonable and non-discriminatory) conditions. Delivery role: EU.

Digital online ID for Europeans: Establishing a unifying European digital online ID for each EU citizen. The ID could be used for verification concerning the job market, academia, health care and social services as well as in connection to financial transactions. This concept would be built on blockchain-based verification systems. Digital signatures and verification on a European level would significantly decrease transaction costs in most sectors and industries, enable true mobility of talent within the EU and save administrative time and transaction costs. For example, easy access to academic credentials (results, exams and degrees) would enable an individual with any official degree to easily

verify his or her credentials for any job or further academic position in any other EU country (currently, those are recorded locally or nationally). A similar approach would be used for health care records and others. <u>Delivery role: EU, Member States.</u>

- Finance the transition:

  o Strengthen the existing and develop **new adequate financial instruments** to support the transition to a climate-neutral industry.

  o Building on the Capital Markets Union, **strengthen capital markets** in case of market failures to support companies in key strategic areas in finding European capital (without the need to look abroad due to a lack of European capital), e.g. European Fund for Strategic Investments and InnovFin for venture capital.

  o Facilitate **access to both public and private financing** in the early stages, (when research results are being translated into potential technological products) and in the growth-stages (when products are being scaled globally). To achieve this, dedicated grant financing should be set aside to boost the earliest and riskiest stages of technology development. Europe needs to further grow its competitiveness in the venture capital landscape (e.g. through the European Fund of Funds) to retain innovative companies requiring financing. Moreover, Further, dedicated patient capital instruments for Deep Tech start-ups should be developed and take into account long development cycles of most disruptive technologies. That should be done in full respect of the EU's international obligations including in the context of the WTO. In parallel, active social dialogue on the achievements of these public initiatives should be fostered.

  o Provide an **ambitious level of EU funding** for research and demonstration (e.g. at least €120 billion for Horizon Europe) and deployment of innovative, technologies and business cases (e.g. through the Connecting Europe Facility and InvestEU) and a strong mandate for scientific excellence, interdisciplinary partnerships, and focused missions.

  o Develop an **appropriate taxonomy** for sustainable finance[44] as well as new forms of sustainable financing (e.g. green bonds) in a smart positive and science-based way, to promote long-term investment and to incentivise investments in sustainable business activities. This taxonomy should reflect the contribution of business activities in all industrial sectors (including sectors in transformation) to the sustainability of the whole industrial value chains, while avoiding penalising entire sectors. It should also reflect enhanced transparency and reporting about environmental, social and governance (ESG) factors in a balanced approach between flexibility and the standardisation of disclosure of information that enables sustainable investment decisions and attracts long-term venture capital.

4.2. Champion global competitiveness

- Ensure a greater role for the Single Market to benefit from a continent-wide market:

  o **Complete and fully enforce the Single Market for goods and services,** avoiding fragmentation due to technical barriers to trade, different transpositions of EU Directives or de-harmonised national legislation and regulation, ensure smooth functioning for cross border roll out of new technologies (constant future-proofing).

  o Complete the **Single Market in networks** (energy, transport, ICT) e.g. by fast-tracking the Europe-wide roll-out of fibre optics on a harmonized basis and secure widespread 5G

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[44] See final report of the High-Level Expert Group on Sustainable Finance.

coverage, cooperative intelligent transport systems and by shaping a future-proof EU Data Framework (regulatory aspects and data/digital infrastructures) that drives industry's transformation and supports innovative services as well as to boost the leadership of the EU in alternative fuels transport systems, and by realising interconnection between national transport networks and between transport modes as well as removing bottlenecks and bridging missing links.

o Create favourable **policies and business environment** within the Single Market **for rapid demand creation in digital business** by supporting cybersecurity market development, and fostering public trust through skills training and widespread connectivity. This should be combined with finding growth opportunities beyond the European markets by ensuring market access reciprocity at global level, and competing head-on with other global players in their markets.

o Avoid current and future legislative overlaps and regulatory instability **by considering and integrating both competitiveness and sustainability elements from the design phase of legislation**.

o **Ensure the rule of law**[45] and legal certainty within the regulatory framework to stimulate investments and innovation in Europe, clarify the distinction between mandatory legal requirements and voluntary standards as a compliance tool to meet these requirements, ensure the regulatory framework matches the specific needs of SMEs.

o Use adequate policies and incentives, including demand-side policy instruments[46], dedicated investment programmes or Intellectual Property Rights, to **create well-functioning markets** for innovative and sustainable products, services and new business models.

o Make the **best use of EU competition and state aid legislation,** and review as appropriate, to allow for a global level playing field and enable European technology leadership in line with international obligations, taking all European and global parameters into account. For example, examine whether changes to the EU's competition tools and processes may be required to deal with competition enforcement in the digital sector[47] which is undergoing rapid transformational change and global concentration trends.

o Strengthen **connectivity initiatives** with other parts of the world to create a wide variety of business opportunities for industry in enabling faster and more sustainable construction, greater energy efficiency, better infrastructure and better logistics solutions for better integration of production sites. Based on the achievements of the Single Market the EU can also offer regulatory experience, technical expertise and funding opportunities at the service of projects that help interoperability and convergence, promote fiscally and environmentally sound growth, and strengthen global connections.

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[45] The rule of law is enshrined in Article 2 of the Treaty on European Union as one of the founding values of the Union. Under the rule of law, all public powers always act within the constraints set out by law, in accordance with the values of democracy and fundamental rights, and under the control of independent and impartial courts. The rule of law includes, among others, principles such as legality, implying a transparent, accountable, democratic and pluralistic process for enacting laws; legal certainty; prohibiting the arbitrary exercise of executive power; effective judicial protection by independent and impartial courts, effective judicial review including respect for fundamental rights; separation of powers; and equality before the law.

[46] Demand-side policies and instruments support and increase the uptake of new products and services in society. They can involve, e.g. legislation, safety regulations, standards, or public procurement. These demand-side tools complement supply-side policy tools such as public funding schemes.

[47] In line with the recommendations of the Report of the Special Advisers on "Competition Policy for the Digital Era".

- Strengthen strategic value chains:

  o Strengthen **strategic value chains** that are key to EU industrial competitiveness and strategic autonomy. Monitor their competitiveness and make sure they have access and resources to grow to a global scale. The first IPCEI on microelectronics, approved by the Commission in 2018, sets an example on how to build other strong European value chains. The work of the Strategic Forum on IPCEIs, based on a specific methodology, will further help facilitate industrial collaboration and strategic alliances, as a way to support companies to move to the value chains of the future.

  o Further **develop IPCEIs and their spillover effects** as well as EU platforms to facilitate cooperation along the value chain, like the Battery Alliance or the Plastics Alliance.

  o Building on the current Strategic Forum on IPCEI, **create a new EU governance for strategic value chains**. A high-level and permanent governance should be established at EU level to monitor strategic technological areas and create the conditions for key value chains to be established in Europe. As the window of opportunity for the successful deployment of technologies is typically at the interface between applied research and commercialization, this new governance process should be extremely vigilant in monitoring developments.

  o Support and provide **advisory mechanisms for SMEs** to enable them to redefine their value chain positioning, absorb advanced technologies and master innovation management.

  o Put innovation at the heart of the EU by **fully leveraging the powerful innovation networks** of large companies, SMEs and start-ups together with research institutes and universities, regions and cities. By building on Europe's recognized industrial strengths in managing complex cross-domain, cross-disciplinary projects, as well as Europe's tradition of excellence in scientific research, EU industry can strengthen its position at the cutting edge of new technologies (for instance in developing trustworthy Artificial Intelligence, automated mobility and logistics, advanced materials, biotechnology and 3D printing).

GAME-CHANGING ACTIONS

Clusters of change: Boost clusters[48] of change, a new generation of value creation networks that are open, multi-collaborative, entrepreneurship-driven, cross-sectorial, SDGs focused and inter-connected across Europe. By 2030, clusters of change will develop a unique pan-European scaling-up mechanism, will Europeanise and globalise our regional industrial innovation ecosystems, and will multiply the impact of the regional smart specialisation strategies exponentially. They will also (co-)host regional SDG-driven centres of excellence for upskilling and reskilling introducing SDG growth as a new industrial indicator. This action should be linked with newly created AI excellence centres across Europe that serve as world-leading research hubs, global talent attractors and local reference for the community and stakeholders (clusters of change could be also an integral part of the City of the future action). Delivery role: EU, Member States, regions, cities to implement locally, clusters and industry.

Constellations of standardisation: Support the creation of groups of innovative industries around industrial smart themes for fast creation of technical specifications, which might be transformed into standards, in a creative process, while taking into account increasingly rapidly changing environment, outside the formal processes[49] and including a global approach. Adopt a European industry standards reference architecture as a navigator for cooperation areas in the fields of

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[48] There are currently 2500 industrial clusters in Europe. Some of them have already become the place and space for experimentation and systemic growth, orchestrating industrial innovation ecosystems regionally and connecting these Europe-wide, growing start-ups into scale-ups and leading the change in key sectors.

[49] Industry can develop standards also outside the system of Harmonized European Standards.

machine2machine learning, industrial artificial intelligence, optimizing automation, networked robots, industrial cybersecurity. Balance the industrial global standards with the European regulatory framework to enhance innovation and the free circulation of goods worldwide, with European industry being the driving force for industrial globalization. <u>Delivery role: industry, EU.</u>

Minimum Viable Regulation: Facilitate Regulatory Sandboxes[50] outside of existing regulatory frameworks, where new technologies or new business models can be experimented with in collaboration between incumbents, challengers, regulatory bodies and stakeholders across civil society. This would potentially result in the full-fledged or bespoke authorization of innovation, changes in regulation, or a cease-and-desist order. This should also simplify and provide regular updates to regulation to avoid overregulation, reduce the cost of innovation, foster competitiveness and enable Europe to develop new global champions. Full consequences would be drawn in case of failure of the experiment (full reversion to normal regulation, no compensation to investors for financial losses, full compensation to employees for job losses, at the expenses of the employer). <u>Delivery role: EU, Member States, regions and local authorities.</u>

Acceleration centres: Develop a comprehensive plan to stimulate across Europe creation of centres key for industrial transformation by synergistic bundling in one geographic location of various institutions. These would include experimentation centres with the newest technologies (such as the Dutch Fieldlabs), showrooms of local industries[51], universities and vocational schools, training centres, financing institutions and export promotion specialists etc. This will create synergies, by working more closely together. These centres would be linked together across Europe (similar as planned for the Digital Innovation Hubs). <u>Delivery role: EU, Member States, regions, industry.</u>

- Lead in an open, fair, multilateral trading system:
  - Ensure that the EU is at the forefront of an international trading system built on **openness, multilateralism and clear rules with a reformed WTO at its core**. The EU should remain strongly engaged in the WTO modernization process to increase its efficiency, transparency and legitimacy and ensure the organisation remains also in the future the key rule-making body for global trade addressing the 21st century challenges of a globally connected economy (e.g. IP protection, subsidies, sustainable development, regulatory cooperation, digital economy). WTO should also be enabled to further assume its other key functions of dispute settlement and trade liberalisation.
  - Pursue the most **ambitious agenda of balanced and progressive trade agreements in the world** with the EU's main trading partners, allowing for first-mover advantages, while ensuring their effective implementation and enforcement. Trade and investment agreements shall remain the preferred way to achieve more reciprocity for European investors in third countries. The EU should also strengthen its market access strategy and diplomacy to eliminate non-tariff barriers and investment hurdles in third countries.
  - Promote the **development of common, global rules on export credits**[52]. Continue to take all necessary measures to promote the creation of a global level playing field via multilateral fora such as the WTO, OECD and the International Competition Network, in view to increase the

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[50] See the 2017 UNSGSA "Briefing on Regulatory Sandboxes",
https://www.unsgsa.org/files/1915/3141/8033/Sandbox.pdf
[51] See the Erasmus+ Call for Sector Skills Alliances 2019 Lot 1 "Platforms of Centres for Vocational Excellence" https://ec.europa.eu/programmes/erasmus-plus/resources/programme-guide_en
[52] Currently, this is dealt with by the OECD sector understandings, which cover only the industrialised nations.

EU competitiveness. In particular, the EU should advocate in favour of establishing transparent subsidy control systems in third countries and take steps necessary to subject the most harmful types of subsidies to a stricter treatment. The EU should also proceed to fill existing gaps in EU law to address the distortive effects of foreign state ownership and state financing by third countries.

o **Strengthen European economic diplomacy** through a comprehensive and EU-supported approach in key focus areas. That includes continued support for export promotion, by better coordination between the Commission and Member States' Trade Promotion Organizations (without duplicating existing structures), and further support for the activities of ETPOA (European Trade Promotion Organizations Association). Moreover, the EU should continue its strong support to European businesses in third countries and include EU business and industry in various missions to third countries in a more systematic way. Continued good cooperation between the Commission and Member States' trade promotion organizations (facilitate witnessing of Memorandum of Understanding and deal signings; allow for targeted business promotion on a case-by-case basis; arrange a single contact point in the Commission or Member States) would also be important.

o Effectively implement the recently modernised **trade defence instruments** to address unfair competition and address **trade-distortive subsidies by third countries**, e.g. through the approval of the International Procurement Instrument and by strengthening existing instruments at the WTO level (such as the Subsidies and Countervailing Measures Agreement).

o Make sure that European markets remain open to **foreign direct investment,** which complies with common market rules and existing legislation. Address unfair competition practices (from state-sponsored non-EU investors, which is forbidden in the EU). The implementation of an effective FDI screening mechanism should ensure that the EU remains open to foreign investment while taking into account threats to security and public order concerning critical infrastructures, critical technologies, or the security of supply.

o **Strengthen internationalisation support for SMEs and hidden champions[53]**, which provide significant know-how and technological knowledge to export goods and services, e.g. via economic diplomacy.

o Promote trade in environmental goods (currently the Environmental Goods Agreement is faltering in the WTO) and services while ensuring a non-discriminatory definition of environmental goods which is not limited to end-products but reflects the functioning of industrial value chains. **Strengthen EU's competitive advantages in innovative and sustainable products and services** by proactively using United Nations as platform to **seek growth opportunities in developing countries as they are going through their industrialization process,** and continued inclusion of specific provisions in the sustainable development chapter of the EU's free trade agreements[54]. Provide support in particular for SMEs in their internationalization efforts (access to market, the roll-out of their products) through international cluster cooperation and EU Green Tech Hubs in Third Countries.

o **Strengthen global social rights**, by continuing to engage with partners around the world to promote the implementation of the International Labour Organisation's core labour standards on a national level, e.g. via the trade and sustainable development chapters of the EU's trade agreements. This approach is important to achieve a level playing field for EU companies, increase public support for trade policy and improve the living conditions of millions of workers

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[53] Little known mid-sized companies, which are world market leaders in specialised or niche products.
[54] Those chapters contain commitments to respect multilateral labour and environmental agreements and to ensure that labour and environment standards are not lowered in order to attract trade.

in third countries. Positive incentives and cooperation are favoured over sanctions-based approaches.

- o Promote good governance on a global scale by **tackling corruption, illicit trade, social dumping, human trafficking and counterfeiting**. This should not only apply to public authorities but also multinational companies by developing voluntary frameworks for corporate accountability throughout the value chain based on due diligence as required by the UN Guiding Principles on Business and Human Rights. Organise due diligence in international supply chains.

- o Make sure that the EU as well as its trading partners **respect international obligations** including with regard to subsidies under the WTO and make sure that EU measures do not undermine EU efforts to push back on distortive state interventions by third countries.

- Take global action for EU industrial leadership:

  - o **Lead the implementation of the Paris Agreement globally and at home**, by leading by example in clean innovative technologies and decarbonisation policies. To address the risk of carbon and investment leakage, that should be accompanied by addressing competitiveness concerns of European industries, notably EEI (as long as the climate policies of other major economies do not match the European efforts).

  - o Ensure that policies in support of the transition to a low-carbon economy address the **whole value chains rather than individual sectors**.

  - o **Strive to establish appropriate price signals through market-based instruments, including carbon pricing and taxes on a global level**. Coherency of carbon prices needs to address both direct and indirect carbon leakage risk of some sectors. This should be seen in combination with the development of a "Carbon Leakage Plan".

  - o Secure sufficient **access to alternative energy sources and raw materials** at competitive prices, e.g. large quantities of power and fuels from renewable sources.

  - o **Promote global technical harmonisation** (e.g. UN framework), which is a key factor in strengthening the competitiveness of traditionally highly export-intensive sectors. Mutual recognition of standards and regulatory cooperation can reduce development costs and avoid duplication of administrative procedures.

4.3. Address social inclusiveness and values

- Ensure social fairness of industrial transition:

  - o Foster a culture of **constructive and effective social dialogue** at all levels of the economy (company, sector, country), according to national industrial relations systems and timely information and consultation processes as key elements for anticipating and managing change, i.e. skills.

  - o **Implement the European Pillar of Social Rights**. Its 20 principles and rights are essential for fair and well-functioning labour markets and welfare systems in 21st century Europe. It focusses on equal opportunities and access to the labour market, fair working conditions and social protection and inclusion. The Pillar is about delivering new and more effective rights for citizens, encouraging reforms through the European Semester process, to help encourage a race to the top, benefiting all citizens across the EU.

  - o Put in place a **European Well-being Index**, as part of exploring different approaches to measuring happiness, which would take into account economic as well as social and health-related factors.

- Spread benefits of the transformation in European regions:
  - o Ensure that the benefits of globalization are more equally spread among EU's regions and society in line with EU's principles of solidarity and sustainability, e.g. through fiscal, labour, educational, social policies. Develop adequate measures in support of those that risk being at the losing side of globalisation. Support the **regional dimension** of industrial policy: smart specialisation strategies, strategic interregional investment projects, re-development plans for vulnerable regions and industrial transition. Europeanise and globalise regional ecosystems, creating a pan-European scale-up mechanism.
  - o Identify vulnerable regions and support regional re-development plans by further developing the **toolbox for anticipating and managing** climate-neutral and circular economy **transition** in a socially responsible and inclusive way, and **targeting EU funds** (e.g. cohesion policy) into key priorities.
- Build a learning society anticipating and developing skills:
  - o **Link education and training policy more strategically to the industrial policy** for instance by reinforcing cooperation between companies (especially SMEs), social partners & industry and education and training providers.
  - o Enhance **industry's active role in upskilling and skills development**. EU citizens of all ages need to be sensitized to engage in lifelong learning. At the same time, private sector, in collaboration with EU, national and European social partners, should be encouraged to provide training and life-long learning opportunities for all workers. This could be done by establishing new and innovative educational programmes and solutions to complement the role of academia and scaling-up successful existing initiatives, e.g. work-based learning[55] and dual systems[56], modularized learning offer, e-learning; promotion of quality and effective apprenticeships; promotion of sector-specific training initiatives; providing adult learning opportunities to prevent skills obsolesce and support employability; installing a culture of lifelong learning, including through the promotion of the internal mobility of workers inside the company.
  - o Help Member States' and industry's **educational and training systems adapt to the requirements of the digital, climate-neutral and resource-efficient economies** and ensure access to skilled staff.
  - o Maintain or increase the employability of the workforce, especially in sectors in transition, by **up- and reskilling of the workforce** to the jobs of the future, and supporting a smooth transition from one job to another (group outplacement, employment cells, tailor-made training programmes, job search assistance). This should be a shared responsibility between industry and the public sector.
  - o **Strengthen the provision of key competences** as foundations for lifelong adaptability, employability and career transitions by balancing the focus on job-specific skills with a broader set of competences. This should help to prepare society for the challenges of the future.
  - o **Building skills intelligence** on emerging and disappearing occupation and on future skill needs, establish feed-back structures from skills research to education and training systems so that timely action can be taken to avoid future skills mismatches, e.g. by implementing the Blueprint for Sectoral Cooperation on Skills. Build STEM careers as role models for the coming generations. Support micro and SMEs to identify their skills needs and to develop appropriate training schemes.

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[55] E.g. through the European Alliance for Apprenticeships https://ec.europa.eu/social/main.jsp?catId=1147
[56] E.g. in Austria, Denmark or Germany.

o Introducing a **European AI and new technologies course** available free of charge to every European citizen. Understanding AI is or will become an important skill for many jobs in industry and educating Europeans will improve their skills, support innovation on the work floor and spread the European way of human-centred AI.

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GAME-CHANGING ACTIONS

A European coalition for 21ˢᵗ-century skills: Build a pan-European coalition[57] involving the EU, Member States, regions, industry, education and training systems and trade unions to take a systemic approach to skills. This would lead to the change in the skills paradigm and transform Europe into a centre of excellence for reskilling and upskilling. Under the coalition, the EU will build on existing instruments to further[58] facilitate flexibility and fast response mechanisms to react to changing labour market needs through procedures for the certification and compatibility of skills and qualifications across borders and industrial sectors, e.g. using skills badges[59], which shall recognize informal learning, e.g. by working in a company. To calibrate the system to the needs of the economy, the Commission will also develop further the EURopean Employment Services (EURES), and especially its European job mobility portal[60], for seamless job and skills matching across the EU. The relaunched Europass Online Platform will help citizens understand their own skills profile and skills gap, to pursue targeted further training or move to a higher value-added job across Europe. Skills intelligence from EURES, Europass and other sources will serve as a feedback loop to the Coalition, which would monitor both the number and the quality of jobs created[61] (e.g. amount of new skills upgraded, amount of new jobs matched, level of work engagement or well-being). This action should help to achieve reduced skills mismatches, higher levels of skills and qualifications for people of working-age, and the uptake of various tools supporting citizens to better acquire and document skills. This action could benefit from a framework for the financing of an individual learning account for every working age adult to accumulate training entitlements (e.g. hours or money) to support their professional transitions. To be successful, this individual right needs actions to foster reskilling and upskilling and it should be supported by appropriate investment on a cost-sharing basis among the actors concerned. It also needs to be accompanied by quality career guidance, and mechanisms to value and make visible the skills acquired. This approach should also encompass jobs' and skills' effect on the SDGs. <u>Delivery role: EU, Member States, regions, industry, education and training providers, employees.</u>

Improving basic skills of all Europeans: Building on already existing developments[62], including the European Pillar of Social Rights[63], Member States should monitor and regularly assess the achievement of educational objectives for basic skills (literacy, numeracy, digital) at secondary level 1[64] and improve provision for adult learning. This would not only provide for quality assurance and

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[57] It would build on the experience of already existing initiatives, e.g. The Digital Skills and Jobs Coalition, or High-Level Expert Group on the Impact of the Digital Transformation on EU Labour Markets.

[58] Member States are already committed to putting in place mechanisms that validate skills acquired in a non-formal (courses) or informal (at work) environment: Council Recommendation of 20 December 2012 on the validation of non-formal and informal learning (2012/C 398/01).

[59] E.g. Digital Skills Badge, Trustworthy AI Badge, Robonatives Badge, the Digitally-Signed Qualifications (to be piloted as part of the Commission's Digital Education Action Plan), and other badges that will be in demand between now and 2030.

[60] https://ec.europa.eu/eures/public/opportunities

[61] E.g. according to the Gallop [MOU1] 2012, 63% of the global workforce are not engaged at work, 24% are actively disengaged.

[62] The Council Recommendation of 22 May 2018 on key competences for lifelong learning (2018/C 189/01); Open method of cooperation; European Quality Assurance Framework for VET https://www.eqavet.eu/.

[63] Chapter 1: Equal opportunities and access to the labour market.

[64] In line with OECD PISA.

comparability of the results of school education but also constitute a solid skills level of young people to pursue a Vocation Education and Training pathway in an efficient and targeted way. This is urgently needed to secure the supply for skilled workforce in the industry. Delivery role: Member States.

Reforming Europe's education and training institutions: A fundamental reform in education and training across Europe to systematically embed innovation and entrepreneurship, starting from early school curricula. This will help to stimulate entrepreneurship and tear down disciplinary borders, make education and training more challenge-driven, and integrate in work-based learning situations the students may face later on in their working life. Strong disciplinary collaborations between education and training institutions and industry should be build based on this actions. Delivery role: Member States, education and training providers, EU.

- Build co-ownership and inclusive governance for the transformation:
  - Assume **thought and value leadership in global standard setting**, especially in new areas linked to transformation, e.g. ethics in human-centric and trustworthy AI, an open standard for the industrial Internet of Things, human-centred technology.

  - Introduce appropriate measures so that the **benefits of technologies and business activities are spread fairly as value to all citizens,** e.g. FRAND conditions to access digital services, software, platforms and data; integrated management accounting, helping companies to steer business activities taking into account economic, environmental, and social capital.

  - Become the leading region in **gender equality and diversity**, which is also related to workforce mobility in the Single Market and attractiveness of Europe as a place to work. Avoid polarisation on labour markets.

  - Promote **industry as the provider of sustainable and inclusive solutions** for the many societal challenges and increase its attractiveness to young employees.

  - **Adapt governance structures** in the Commission, the Council and in Member States to ensure **strong political leadership and integrated approach to industrial competitiveness** across various policies, including environmental and climate policies. This is necessary to achieve the vision presented in this report. It should also take into account the new governance for value chains proposed above.

  - The integrated approach to industrial competitiveness should rely on the **timely and trustworthy capacity to monitor and analyse** the economics of innovation, technology development, competitiveness and societal effects of the complex and rapid evolution of the European industry and of its competitors (at macro- and micro- levels).

- Build an enabling environment for more sustainable business activities:

  - **Support the development of industrial traceability along the value chain**: Support voluntary actions to convey information along the value chain (from the mine/field to the final professional/consumer good) and along the product lifecycle (from the drawing board of the engineering department to production, purchase, delivery, maintenance, repair, re-manufacture, re-use and recycling). This should help to support end-to-end long-term interoperability and to build the foundations of an industrialised circular economy.

  - Support and **promote voluntary initiatives & platforms** that address sustainability and sustainable supply chains e.g. "European Business Alliances on CSR".

- Encourage **traditional enterprises to work more with social enterprises**, for example in the context of public procurement or within business support organisations, to foster mutual learning and capacity building.

- Bolster the **development of social economy, social innovation** and other types of businesses which use their business models to achieve a positive social impact, thanks to a powerful commitment of management and the staff and supported by a specific governance and operating model. Reduce their barriers to growth and increase public authorities' support toward them.

- Promote the development of **workplace innovation and other modern practices,** which influence both wellbeing and economic performance of companies.

GAME-CHANGING ACTION

Value to society balancing initiative: Support and promote (at EU and international level) innovation in the field of corporate reporting in Europe by identifying and sharing good practices to enable smart integration of impact measurement and valuation as a concept for company performance measurement (e.g. value-to-society approaches). This action will enable companies to measure and value their overall impacts and dependencies on society and nature along value chains and their effect on business value. For example, by developing the language and methods on how to assess the value of a company in economic, ecologic and social terms (tangible and intangible) and its financial and pre-financial value contribution to society (costs and benefits, impacts and dependencies); or by understanding the interdependencies of financial and pre-financial value contribution to society and its relation to enterprise value. It should not create an additional burden, in particular for SMEs, but rather help to assess natural, social and human capital to compare the total value (contribution) of a company. The results of those initiatives should be publicly available. This would strengthen long-termism and multi-capital thinking and optimize the business contribution to the SDGs, as well as upskilling and improving the well-being of the workforce. Delivery role: international organisations (e.g. OECD), industry, supported by EU.

Annex: Key figures on EU industry and trends towards 2030

I.   EU industry at a glance

Added value to the economy

Industry represented almost 20% of the total value added in Europe in 2018, with Manufacturing representing over 16%, and Manufacturing and Industry value added are increasing in absolute terms. In this context, it is important to keep in mind that the trend of servitisation, through which manufacturing firms have increased their competitiveness, is not visible in the data due to statistical limitations.
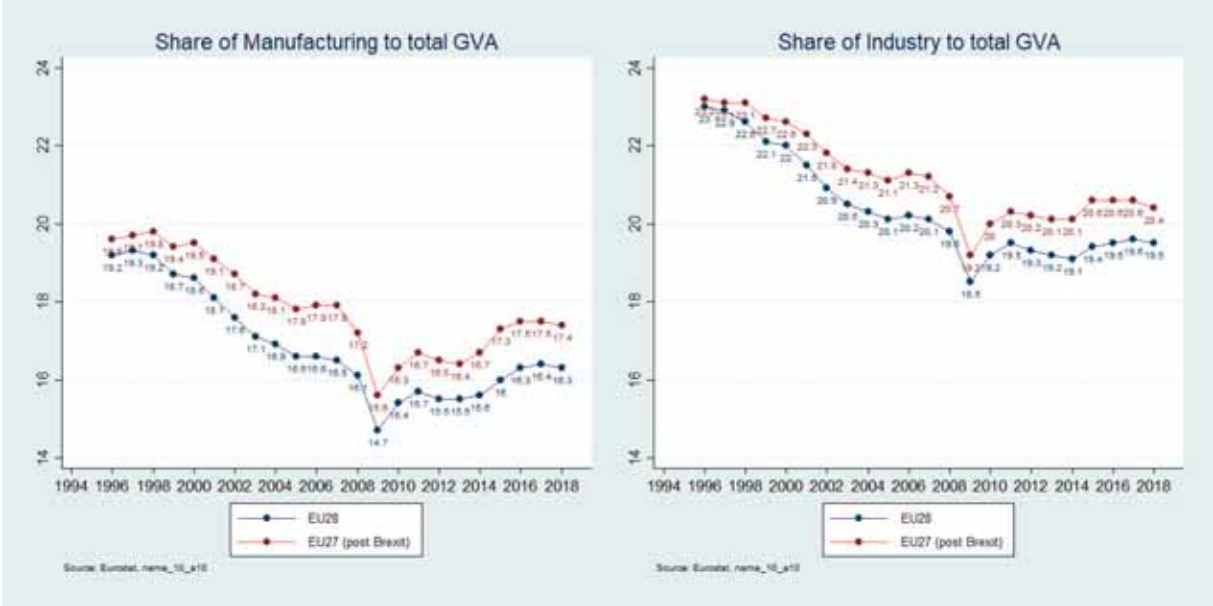
Employment

When considering Industry as a whole[65], EU28 employment stands at almost 24%. International comparisons show a general decline of employment in Industry, with the EU positioning above both the USA and the OECD average.

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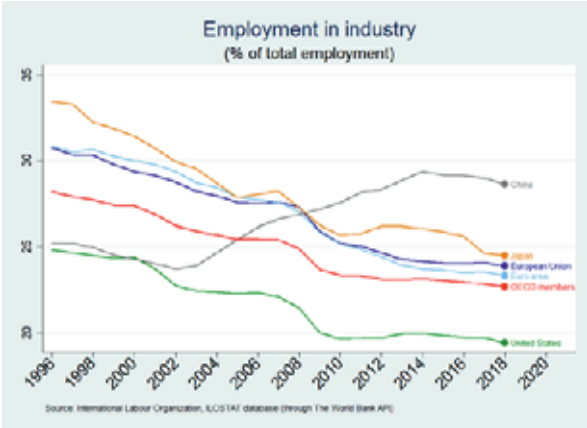
[65] By industry we mean here the aggregate of the NACE sectors B to E, hence including Mining and Quarrying (B), Manufacturing (C), Electricity gas, steam and air conditioning supply (D), Water supply; sewerage, waste management and remediation activities (E).

Productivity

Industry is the most productive part of the European economy. Moreover, productivity is steadily increasing. The USA still outperform the EU28, but it is interesting to notice that in the last 10 years, the EU has had a slightly faster productivity growth than the USA.
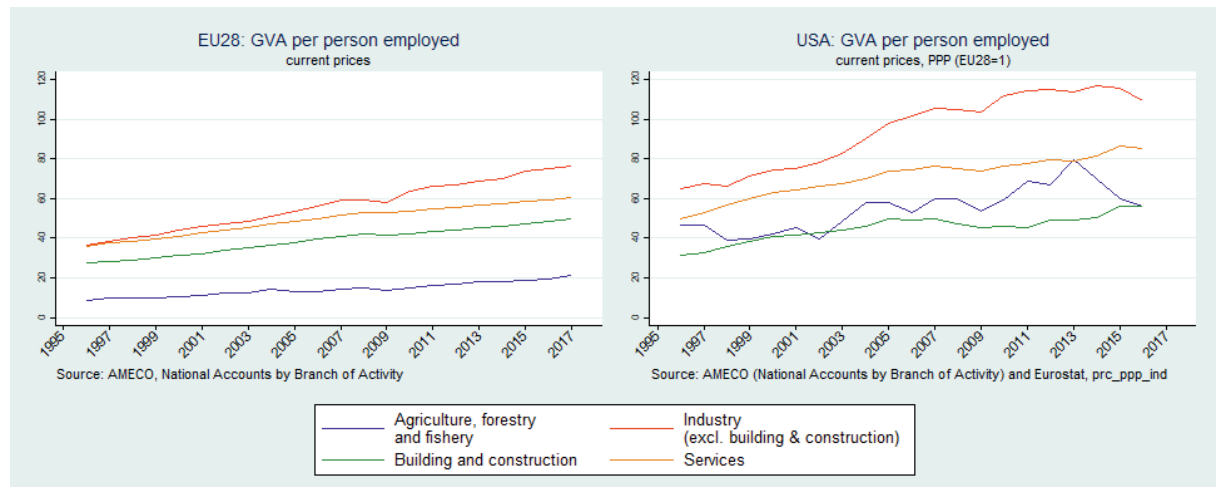
II.   Global geo-political and economic developments

By 2030, no country will be a hegemonic power[66]—nor the USA, China, nor any other large country. Enabled by communications technologies, power almost certainly will shift more toward multifaceted and amorphous networks composed of state and non-state actors that will form to influence global policies on various issues.

Asia might surpassed North America and Europe combined in terms of global power,[67] given its higher rate of economic growth, larger population, increasing military spending, and growing technological investment. China alone will probably have the largest economy, surpassing that of the United States a few years before 2030.[68] Meanwhile, the economies of Europe, Japan, and Russia are likely to continue their slow relative declines.

By the same year, the middle class is expected to grow by 150% (to 2 billion people) in the BRIC countries and by 116% (to 730 million people) in the N-11 countries.[69]

By 2040, the economic power of E7[70] (China, India, Indonesia, Brazil, Russia, Mexico and Turkey) could be double the size of that of G7 (USA, UK, France, Germany, Japan, Canada, and Italy), from being the same size in 2015 and half the size in 1995.

China is increasing presence in global value chains and is expected to become the largest economy in the world by 2050, followed by the US and India[71]. By 2050, EU's share of global GDP might decrease to 9%[72] (from 16% in 2018)[73].

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[66] National Intelligence Council, Global Trends 2030: Alternative Worlds, 2012.
[67] Atlantic Council, Global Power 2030, 2012.
[68] National Intelligence Council, Global Trends 2030: Alternative Worlds, 2012.
[69] Next 11 (N-11) are: Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, The Philippines, South Korea, Turkey and Vietnam. Dragon Star Plus, 2030 Megatrends, Disruptive Business Models & China, 2016.
[70] PwC, The long view: how will the global economic order change by 2050?, 2017.
[71] PwC, The long view: how will the global economic order change by 2050?, 2017.
[72] PwC, The long view: how will the global economic order change by 2050?, 2017.
[73] International Monetary Fund, GDP based on PPP, share of world, 2019.

III. Scientific and technological developments

As confirmed by the European Innovation Scoreboard 2019,[74] at the global level, the EU has surpassed the United States in innovation performance for the first time. The EU's performance lead over Brazil, India, Russia, and South Africa remains considerable, but China is catching up at three times the EU's innovation performance growth rate. Canada, Australia, Japan, maintain a performance lead over the EU. However, relative to Japan and South Korea, the EU has been falling behind, and the performance gap is expected to further increase in the coming years. South Korea is the most innovative country, performing almost 37% above the performance score of the EU.

In comparison to estimates, the EU was quicker to catch up –and now surpass- the United States than initially expected. The EU is also narrowing its gap with Canada, but China is catching up very quickly. As global competition intensifies, Europe needs to reinforce its efforts to innovate and move towards cleaner and smarter industry to boost its competitiveness and ensure the well-being of its citizens.

Technologies and the ecosystem that underpins their diffusion are developing fast. Hyperconnectivity is expanding fast[75]: more than 4 billion people around the world are using the internet; over 5 billion inhabitants now have a mobile phone (68% penetration); there are 3.2 billion active social media users worldwide—growing at an average of 11 new users per second in 2017.

The **level of digitisation among EU Member States** still varies considerably.[76]

Digital Economy and Society Index (DESI) 2019 ranking
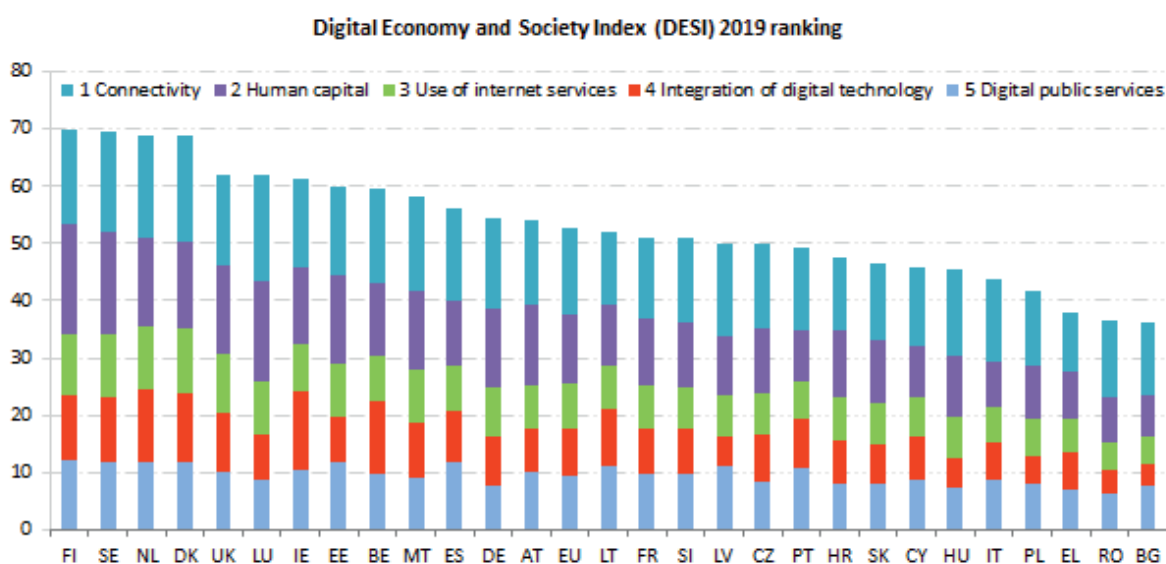
Physical-digital integrations, IoT and smart home tech, big data, Augmented Reality (AR) and Virtual Reality (VR), machine learning becoming a component of every form of technology are increasing the ability[77] of everything being improved even faster.

In the 2030s, humans might become hybrids with augmented intelligence[78], with the brains connected directly to the cloud via nanobots made from DNA strands. In the 2040s, thinking might be predominantly non-biological. Machines could be "alive"[79] and have full consciousness sooner than expected.

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[74] European Commission, European Innovation Scoreboard 2019, 2019.
[75] We are social, Digital in 2018: world's internet users pass the 4 billion mark, 2018.
[76] European Commission, The Digital Economy and Society Index, 2019.
[77] Forbes, 7 Technology Trends That Will Dominate 2017, 2016.
[78] CNN Business, Ray Kurzweil: Humans will be hybrids by 2030, 2015.
[79] The Economic Times, "Robots will have full consciousness in five years", says Sophia creator, 2018.

Data flows grew 45 times between 2007 and 2014, while global flows of goods and services remained substantially unchanged.[80] There is potential for systematic collection, analysis, and use of data. Taking away obstacles to data mobility is expected to generate an additional growth of up to 4% GDP by 2020. In this constellation, Open Data plays a significant part with a total market value estimated at 325 billion EUR by 2020, with 30.000 new jobs created for the Open Data sector and a cost saving estimation of 1.705 million EUR that national governments of the EU28+ can reach in 2020. [81]

International competitors are investing 3 to 7 times more than Europe in AI. In 2016: North America: $15-$23billion, Asia: $8-$12 billion, Europe: $3-$4 billion (see below)[82].
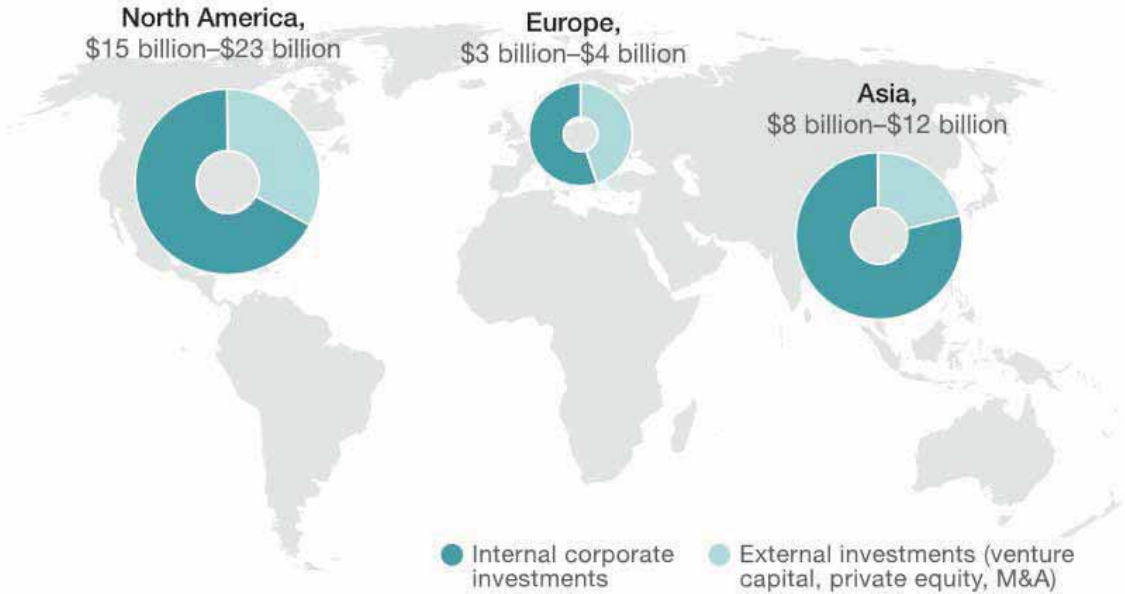

Figure 1: McKinsey Global Institute, 10 imperatives for Europe in the age of AI and automation, 2017.

The large potential contribution of AI to global economy is being captured by other big international players: AI could contribute up to EUR 13.33 trillion to the global economy in 2030, more than the current output of China and India combined. Of this, EUR 5.6 trillion is likely to come from increased productivity and EUR 7.73 trillion from consumption-side effects. Without change, 70% of the global economic impact of AI will be concentrated in North America and China. [83]

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[80] McKinsey, Digital globalization: the new era of global flows, 2016.
[81] Capgemini, Open Data Maturity in Europe, 2017.
[82] McKinsey Global Institute, 10 imperatives for Europe in the age of AI and automation, 2017.
[83] PwC, Sizing the prize What's the real value of AI for your business and how can you capitalise?, 2017.

Figure 2: "USA-China-EU plans for AI: where do we stand?", source: European Commission, Digital Transformation Monitor 2018.

IV. Social and societal developments

The world population is aging and in 2030 Europe will be the oldest region in the world[84].

The high share of young people "neither in employment nor in education" (NEETs) in the EU [85] constitutes a loss of talent and potential for the overall economy and society. At the same time, a high share of teenagers and adults have insufficient levels of basic skills[86]. Almost half of the population of the EU have low or no digital skills[87].

The demand for 21st century skills will rise by 2030. They cover STEM (science, technology, engineering and mathematics) subjects, basic skills (literacy, numeracy or digital), data literacy, as well a mix of cognitive and socio-emotional skills (problem solving, creativity, communication, collaboration, active learning and learning strategies). Digital competence developments are observed since very young age across Europe,[88] mainly in family context and in an uneven and patchy way, depending mostly on the digital landscape available and on the digital knowledge in family.

40 % of companies trying to recruit ICT specialists reported difficulties in filling vacancies: therefore, an upskilling plan for the workforce in the EU computational thinking will be necessary to fill the skills gap.[89] This includes technical skills but also entrepreneurial skills (such as critical thinking, interpersonal skills, leadership, etc.), necessary to thrive in a fast changing environment.

About one in five Europeans considers it very likely that several of their skills will become outdated in the next five years. In many industries and countries, the most in-demand occupations or specialties did not exist ten or event five years ago, and the pace of change is set to accelerate. 65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist'.[90]

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[84] ESPAS, Global Trends to 2030: Can the EU meet the challenges ahead?, 2015.
[85] Eurostat, Statistics on young people neither in employment nor in education or training, 2019.
[86] European Commission, Education and Training Monitor 2016, 2016.
[87] European Commission, The Digital Skills Gap in Europe, 2017.
[88] European Commission (JRC), Young Children (0-8) and Digital Technology, 2018.
[89] Eurostat, ICT specialists - statistics on hard-to-fill vacancies in enterprises, 2018.
[90] World Economic Forum, The Future of Jobs Reports 2018, 2018.

V.   Climate change and other environmental developments

The 2018 United Nations Intergovernmental Panel on Climate Change (IPCC) report[91] shows the urgency to limit global warming to 1.5°C, by stressing that we have only 11 years left until 2030 to limit the consequences of climate change. The IPCC report confirms that approximately 4% of the global land area is projected to undergo a transformation of ecosystems from one type to another at 1ºC of global warming, increasing to 13% at 2°C temperature change. For example, 99% of coral reefs are projected to disappear globally at a temperature increase of 2ºC.

Weather-related disasters caused a record EUR 283 billion in economic damages last year and could affect about two-thirds of the European population by 2100, compared with 5% today.

Investment of the US in renewable energies reached the European level. China has a leading role in new investments in clean energy: out of USD 333.5 billion of global clean energy investment in 2017, China's share was 40%.[92]

By 2030, the demand for food, water and energy is expected to increase by 35%, 40%, and 50% respectively, compared to 2012.[93] Food production should increase by 50% by 2050 compared to 2012.[94] Global water demand might increase 55% by 2050, compared to 2015.[95] Meanwhile, by 2025, 50% of the world's population might be living in water-stressed areas, while by 2030, there might be a 40% shortfall of water needs.[96]

Since 1970, the world is in ecological deficit.[97] At present, 1.7 Earth planets are needed to support humanity's annual demand on the ecosystem. In 2019, EU's Overshoot Day was on 10 May, meaning that if all humanity lived like EU residents, nature's annual budget would have been exhausted by that day and we would need 2.8 planets Earth to sustain our living style.[98]

The EU has limited domestic raw materials whereas the global consumption of material is expected to rise from 85 billion tonnes per year today to 186 by 2050.[99] A series of raw materials have been identified as being exposed to supply risk.[100]

[91] IPCC, Global Warming of 1.5°C, 2018.
[92] Bloomberg, Clean Energy Investment Trends 2018, 2018.
[93] National Intelligence Council, Global Trends 2030: Alternative Worlds, 2012.
[94] FAO, The future of food and agriculture - Trends and challenges, 2017.
[95] United Nations, The World Water Development Report 2015, Water for a Sustainable World, 2015.
[96] World Health Organization, Progress on drinking water, sanitation and hygiene, 2017.
[97] Global Footprint Network , Earth Overshoot Day 2018 is August 1, the earliest date since ecological overshoot started in the early 1970s, 2018.
[98] Global Footprint Network, EU Overshoot Day living beyond Nature's limits, 2019.
[99] International Resource Panel, Resource Efficiency for Sustainable Development, 2018.
[100] European Commission, Lists of Critical Raw Materials, since 2011.