November 2020

Advanced Technologies for Industry – EU Report

Technological trends and policies

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Introduction

The objective of this EU report is to provide an overview about the performance of the EU27 in Advanced Technologies and to give a snapshot of the policy landscape supporting the production and uptake of Advanced Technologies at EU, national and regional levels. Country performance in Advanced Technologies is presented based on patent, trade and investment data.

The starting point of this analysis has been sixteen Advanced Technologies that are a priority for European industrial policy and that enable process, product and service innovation throughout the economy and hence foster industrial modernisation.

Advanced Technologies are defined as recent or future technologies that are expected to substantially alter the business and social environment and include *Advanced Materials, Advanced Manufacturing, Artificial Intelligence, Augmented and Virtual Reality, Big Data, Blockchain, Cloud Technologies, Connectivity, Industrial Biotechnology, the Internet of Things, Micro- and Nanoelectronics, Mobility, Nanotechnology, Photonics, Robotics, and Security*.

The full methodology behind the data calculations is available on the Advanced Technologies for Industry (ATI) website:

https://ati.ec.europa.eu/reports/eu-reports/advanced-technologies-industry-methodological-report.

The report complements the analysis provided in the ATI General Findings report that is available here: https://ati.ec.europa.eu/reports/eu-reports/report-technology-trends-technology-uptake-investment-and-skills-advanced

The report is structured as follows:

- The first section outlines the strengths and weaknesses of the EU27 in terms of technology generation and uptake across the sixteen Advanced Technologies.

- The other two sections summarise the latest policy priorities and main policy initiatives in the EU27 with examples from the national and regional level in support of Advanced Technologies.

Section 1

1. EU strengths and challenges in Advanced Technologies

1.1 Technological trends

In the quest for technology sovereignty, as highlighted in the European Commission's new industrial strategy[1] published in 2020, Europe needs to take more actions to defend its industrial competitiveness. Globally, all economies today are ruled by the extremely fast development of Advanced Technologies. European industry needs to bolster its strengths but also needs to gain leadership in digital domains where it is currently relatively weaker. Europe's industry has a global competitive advantage in high value-added products and services, and has strong innovation capacity and great potential to win the race for the benefit of our society.

The ATI project investigated how well the EU and its industries performed and the opportunities stemming from this in sixteen Advanced Technologies, as listed in the introduction, based on patent, firm-level data and novel data sources such as LinkedIn and Crunchbase-Dealroom[2].

Figure 1 provides a ranking of the advanced technologies in terms of their overall performance on technology generation, startup creation and skills in a global comparison with the US and China based on an assessment of the key indicators of the ATI[3].

It shows that the strengths of the EU27 lie especially in Advanced Manufacturing, but also in the Internet of Things and Advanced Materials. The EU27 is, however, lagging behind in the fields of AI and in particular in Big Data, Cybersecurity and Micro- and nanoelectronics. Technological capabilities are, however, much more nuanced when looking at the sub-areas and industrial applications of these technologies.

Figure 1: Overview of EU performance in Advanced Technologies

Source: Technopolis Group, 2020

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[1] European Commission (2020) A new industrial strategy for Europe, Brussels, 10.3.2020 COM(2020) 102 final
[2] Please see the detailed methodology at https://ati.ec.europa.eu/reports/eu-reports/advanced-technologies-industry-methodological-report

[3] The ATI indicators that allow for an international comparison include the share of global patent applications, share of startups in advanced technologies, weighted score of the number of professionals with advanced technological skills

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Advanced Manufacturing and Robotics

Advanced Manufacturing technologies are one of the technologies where the EU27 is particularly strong and has the highest share (30.5%) of world patent applications, the highest number of venture capital-backed firms and investment and supply of skills. It is also the EU27's remaining area of international advantage in terms of trade. In many ways, Advanced Manufacturing is the one area in which the EU currently maintains sound technological sovereignty based on diverse, high-level competences distributed across a substantial number of Member States.
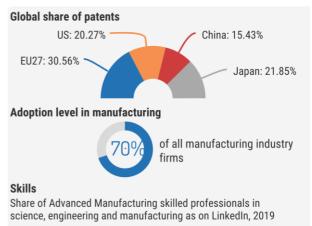
Besides **Germany**, Europe's prime producer of manufacturing technologies, relevant capacities can be found in **Austria, France, Italy, Spain and Sweden**, to name but the most prominent. Across many sectors, Europe's leading firms as well as a large number of smaller and mid-sized firms, offer a wide range of modern equipment which is sought after across the globe. From the US to China and Japan, European technologies continue to enable the world's production lines in manifold ways as – for the time being – many of them remain without substitute. Not least, countries like Austria, Germany, Italy and Spain feature a number of 'hidden champions' specialised in relevant, yet small markets for niche applications in specific sectors.
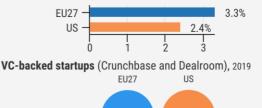
That said, the field of **Advanced Manufacturing has reached a certain degree of maturity so that both investment and technological capacity grow less dynamically** than in some other Advanced Technology areas. Despite Europe's remaining lead, various global competitors have come to master a broader array of technologies than they could before and continue to catch up with increasing momentum.
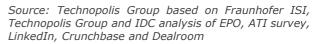
In particular, **Europe is at risk of losing substantial ground to China in the area of Robotics** where the EU27's share in global patent applications has significantly dropped in recent years. For the time being, this upfront impression conceals a continued dependence on core components, most of which still have to be imported from China to the EU27. Also, China's Robotics industry is in the course of seeing a downturn with subsidies lessening and the Covid-19 crisis beginning to take an additional toll[4]. In particular, China's capacities in Robotics remain several years behind that of its global competitors. In these areas, Europe's more relevant competitors are Taiwan, Japan and the United States. In general, these countries pose a substantial and increasing challenge to Europe in

various relevant areas of Robotics. While Europe continues to lead the US in terms of professionals with Advanced Manufacturing skills, it lags with respect to the share of professionals with Robotics skills in the manufacturing industries.

Figure 2: Advanced Manufacturing technologies

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

To a degree, this finding may be a reflection of the fact that the level of Advanced Manufacturing uptake is rather unevenly distributed across Europe. While some Member States (such as Poland and the Czech Republic) lag behind systematically, even industrially strong nations such as Germany, Sweden or Denmark see strong concentrations of Robotics installed in larger firms and selected sectors. On the upside, potential demand for Robotics and the safeguards connected with industrial installations will have substantial sales potential for years to come. This holds true both within Europe and beyond. While China has reached European standards with 140 robots per 10 000 workers even this leaves ample opportunity for additional investment, given that Germany has 338 and the US even less with 217 (2018)[5]. Overall, therefore, it appears likely that Europe is in a position to defend its status as a central Robotics exporter if adequate provisions are made.

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[4] www.therobotreport.com/chinese-robotics-market-look-ahead-2020/

[5] statista.de, original source International Federation of Robotics, 2020

Robots coupled with AI technology offer new potential to speed up and optimise manufacturing processes. An emerging challenge, however, is **whether Europe will be able to translate current strengths into related capacities in the area of Internet of Things**, as novel IoT-based components will ultimately supersede existing Advanced Manufacturing parts.

Internet of Things (IoT)

Europe is in an excellent position to become a global leader in IoT. Within the sixteen advanced technologies **the EU27 holds the second highest share of worldwide patent applications in the Internet of Things. In a global comparison it is world leader** and has a relative patent advantage. The number of venture capital-backed startups and scaleups also indicates that the EU27 has a relative advantage in this field compared to the US, but also in other international markets.

The Internet of Things represents the glue between the manufacturing and the the digital world. Well-targeted investment in IoT will be crucial not just to **revive the dynamics of Advanced Manufacturing, but also to fuel Artificial Intelligence** applications. A large part of the valuable data that drive AI can originate from IoT applications and devices. Good governance is needed to systematically capture, sort and store these data. In this respect, the advancement of IoT technologies is important not only in manufacturing as such but will have an impact on the broader economy.

Germany, the Netherlands, France and Finland had the highest share of global patent applications among the EU27 countries, while Spain, Italy and Belgium were the place for IoT-related entrepreneurial activity in 2019.
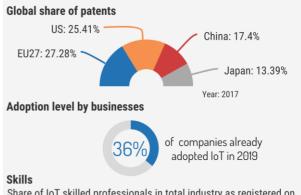
Analysis of LinkedIn data in 2019 suggests that the EU27 and US had a similar share of professionals with skills in IoT employed in industry, although the US showed a slight lead. While in the US 3.7% of employees have such skills, in the EU it is somewhat less at 3.1%. Yet the EU27 is performing better in the case of some specific sectors, such as automotive or chemicals where it is ahead of the US in supplying IoT professionals.

In 2019, 36% of companies were using the Internet of Things in the EU27, according to the results of the ATI Survey; alongside a growing uptake of technological solutions which has also accelerated other innovations. IoT is also one of the technologies (besides AI) where t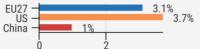he highest share of companies report strong willingness to invest in the next 12 months, suggesting that the diffusion of IoT is considerably fast.

Industrial IoT solutions in manufacturing operations, condition-based monitoring of connected equipment, freight monitoring, smart grid and telehealth monitoring are some of the key use cases where EU firms and startups have been active, as the analysis of Crunchbase and Dealroom data suggests. IoT will play a crucial role especially in smart grids, wearables, vehicles and medical devices. The main strengths of the EU lie in embedded systems and in complex system-level solutions.

Figure 3: Internet of Things

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

The potential of IoT is strongly connected to advancements in 5G rollout that will enable even greater data flows. Developments in the area of Cybersecurity technologies will be critical to increasing users' trust in IoT devices.

The future strengths of the EU in IoT will also depend on its **ability to secure international IoT standards that are driven by European industry** stakeholders[6].

The Chinese government has been actively driving the development of IoT. It has many IoT solutions based on Robotics due to its large manufacturing base, but as for cutting-edge and deep-tech IoT,

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[6] https://standards.ieee.org/initiatives/iot/stds.html

it is unclear if China will ever dominate[7]. The Chinese Ministry of Industry & Information Technology announced ambitious targets as well as guidance to promote IoT standards[8].

Industrial Biotechnology

The EU27 holds a high share of patent applications in Industrial Biotechnology. However, it lags behind the US as well as Japan. Venture capital investment has also shown to be a bit weaker than in the US, but at the same time the EU can boast more startups in the field. The share of professionals with Industrial Biotechnology skills has also been higher within manufacturing industries in the EU than in the US (see Figure 4).
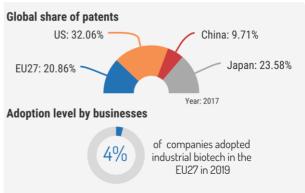
Over time, the EU27 has constantly invested in research, development and innovation activities and remained competitive with rather stable global shares in patent applications. In past years, European bioeconomy has been supported through various actions underpinned by a range of strategies and policies at EU and national levels. For instance, the EU27 issued the 'Updated Bioeconomy Strategy'[9] and Germany launched a 'National Bioeconomy Strategy'[10] in 2020. In the Bio-based Industry Joint Undertaking, €717 m was granted in the call for applications from 2014-2019.[11]

Until now, technological activities in the bioeconomy and in Industrial Biotechnology field, in particular, have been largely concentrated in Germany, France, the Netherlands, Denmark and Spain, while countries such as Bulgaria and Romania have been lagging behind, with some exceptions.

Specifically, the **EU27 has a strong technological base in environmental biotechnology as well as in the use of waste and by-products**. Moreover, there is increasing focus on updated strategies and research policy on sustainability and mission-oriented innovation in the EU27. This is emphasised and supported by the European Green Deal, which has given bio-based innovations a prominent role.
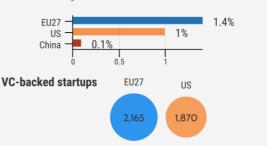
The US is leading in private investments and activities regarding synthetic biology and bioinformatics. It also provides public support for new commercial and large-scale biotech plants. China and other Asian countries are already well

established in Industrial Biotechnology, producing commodities such as amino acids, vitamins, etc. Moreover, there are clear signs that China is catching up not only in the number of patent applications, but also in creating connections between science and industrial application.

Figure 4: Industrial Biotechnology

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

The potential reasons for China's successful technology upgrading in Industrial Biotechnology include new technological opportunities in the field, non-path-dependency (e.g. not relying on long-term trial development), and the strong involvement of enterprises in scientific activities.[12]

As many innovations in Industrial Biotechnology are becoming more mature, the path to manufacturing and the market is a key step and challenge in the coming years. Manufacturing in the life sciences requires specific skills, laboratories and plants. Hence, the direct adoption of Industrial Biotechnology by business and the share of required skills are limited.

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[7] https://www.smart-industry.net/iot-made-in-china-the-race-is-on/

[8] http://www.chinabankingnews.com/

[9] https://biooekonomie.de/nationale-biooekonomiestrategie

[10] https://www.bmbf.de/de/nationale-biooekonomiestrategie-fuer-eine-nachhaltige-kreislauforientierte-und-starke-10654.html

[11] This is only a proxy for public IB investment in the EU, As IB is not all in bio-based projects used for conversion. But

on the other hand, the BBI JU investments do not cover some H2020 projects in the LEIT pillar or SME calls related to IB.

[12] Wang, L., Chen, F., & Knell, M. (2019). Patterns of technology upgrading–the case of biotechnology in China. Asian Journal of Technology Innovation, 27(2), 152-171.

For commercialisation of large-volume products, larger firms (e.g. in the chemical or plastic industries) are important players due to their investment capabilities, breadth of required competencies and market access. Here, the EU27 has a rather stable position in some segments, e.g. compared to electronics, which is relevant for many ICT technologies.

Looking at the current production sites, the EU27 possesses good capacity in the small-volume market, such as the production of enzymes or biopharmaceuticals, but has rather limited production capacities in large-volume products (e.g. lysine, bioplastics, biofuels). Here, a potential role for countries neighbouring key production sites would be to offer complementary biomass production, as nearby production sites would be necessary to limit transportation costs. Hence, the establishment of pan-European networks and value chains appears of high importance for the future role of the EU in mass segments.

Artificial Intelligence and Big Data

In the field of **Artificial Intelligence, despite the gap between the EU27 and the US as well as China, the EU is catching up fast.** The EU27 falls behind the US and China in world share of patents (EU 17.23% vs US 25.32% and China 25.55%), but AI is the most dynamically developing technology in terms of patent filing and startup activity in Europe (outpacing the US).

Furthermore, the availability of professionals with skills in AI is also growing very fast and it outpaced the US in the period 2018-2019, as the results of the analysis of LinkedIn data suggest. The EU market is expected to grow faster than the global market. IDC forecasts the total spending on AI to grow at a five-yearly Compound Annual Growth Rate (CAGR) of 26.5% for the period 2018-2023, up to €96 bn at the end of that period[13].
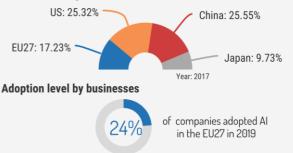
On the contrary, **Big Data is a European weakness compared to the US and China,** although it plays a crucial role in the future development of a digital-based economy and is highly relevant in enabling the deployment of Artificial Intelligence.

The share of global patent applications in Big Data is the smallest among all Advanced Technologies, and the EU27 is behind both the US and China. The EU27 is also performing worse than the US in terms of the share of professionals with Big Data skills in the economy and various industries, even though they are necessary to process and handle large datasets. In the coming years, the key to winning the AI battle will be access to trustworthy and large, high-quality datasets.

The key hotspots of AI technology within the EU27 are **Germany, France, the Netherlands and Sweden,** according to various metrics including patents, adoption and skilled professionals. Ireland stands out in terms of its startup ecosystem and Finland in terms of the supply of skilled professionals in AI relative to their size.

Figure 5: Artificial Intelligence

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

The adoption of AI is on the rise as firms continue to invest and harness new opportunities that machine learning or natural language processing are offering. According to the ATI Survey, 24% of European organisations are currently adopting AI and another 24% are planning or evaluating whether to adopt AI systems in the near term.

With regard to the number of currently employed AI professionals, the EU is lagging behind the US but is ahead of China (according to LinkedIn data analysis). The EU27 competes better when looking at the share of AI professionals employed in the manufacturing industry.

Indeed, the European Union will need to bolster its actions to attract and nurture AI talent that tends to move to places where it finds a stimulating and challenging ecosystem. In order to motivate AI

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[13] ATI (2020): https://ati.ec.europa.eu/reports/technology-watch/technology-focus-artificial-intelligence

talent, access to high-profile projects and interesting datasets should be ensured.

On a global scale, **EU strengths include the development of AI applications in manufacturing, in particular automotive, industrial electronics[14] and medical devices**. AI deployment through autonomous advanced Robotics is also a field where the EU has an advantage over China and the US, although its advantage is shrinking fast. The European AI startup ecosystem focuses on the development of a broad array of AI applications including business services and analytics, AI linked to IoT and sensors, electronics and healthcare.

Advanced Materials and Nanotechnology

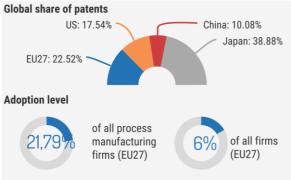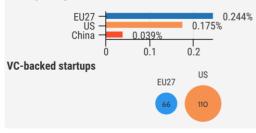The EU27 holds its third **highest share of global patent applications in Advanced Materials, but it lags behind Japan.** The EU27 shows strengths also in the area of Nanotechnology, but it lags behind the US. Advanced Materials is one of the areas where European firms witnessed relatively more venture capital investment than in the US, while in the area of Nanotechnology investments have been close to the US. **Germany, France, Italy, Belgium and the Netherlands** had the highest share of global patent applications among EU27 countries.

Figure 6: Advanced Materials

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

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[14] Only if taking into account the electronics industry producing industrial products and not consumer electronics where the US is ahead, according to the data analysis

Both Advanced Materials and Nanotechnology are essential for areas such as clean energy, batteries and healthcare, to name a few, and they also play an important role in national security. Understanding the nanometre-scale phenomena enables a lot of innovation and diverse applications, for instance in the area of high-accuracy sensors and detectors. Nanomaterials are also increasingly used in large-scale manufacturing processes for high-tech products. Advanced ICT and quantum materials form the backbone of microelectronics innovations. Biomaterials help the development of biodegradable products and better agricultural processes.

Nevertheless, in some cases having access to raw materials is a challenge especially due to restrictions posed by China, ongoing trade wars and the result of the Covid pandemic. The rethinking of supply chains and securing access to components necessary for advanced materials will continue to be a key challenge.

As measured by the ATI business survey in 2019, **21.79% of process manufacturing firms in the EU27 used Advanced Materials,** while 8.62% of firms in the sample adopted Nanotechnology.

In terms of the share of **professionals with skills in Advanced Materials employed in industry, the EU27 is ahead of the US** and also China (as the analysis of the registered users on LinkedIn suggests).

The **EU27 startup landscape has attracted more venture capital investment in the area of Advanced Materials than the US** in the last decade although it had a lower number of startups (as captured by the analysis of Crunchbase and Dealroom data platforms).

Cybersecurity

Being prepared for cyber threats has become even more important in a world that is increasingly digital, as more and more business is conducted online under Covid-19 conditions. The magnitude of cyber attacks can be devastating and cybersecurity resilience will be a key pillar of digitalisation both for industry and society.

The European Union has a **strong research base in Cybersecurity** both in terms of academic and industrial research, as well as product development-related activities. The EU is among the **world leaders in quantum technologies** and has unique expertise and a strong research community in post-quantum cryptography, leading in secure implementations of

cryptographic algorithms in both hardware and software[15].

Despite the research efforts, **Cybersecurity is a technology where the EU27 falls behind the US,** according to the results of several metrics including the share of global patent applications, creation of startups, investments, and the supply of professionals with cybersecurity skills.

The **US has relatively higher shares of Cybersecurity professionals than the EU27** in all industries investigated including ICT, finance, electronics, medical devices, automotive, and chemicals. The overall weighted score for cybersecurity professionals is also much higher in the US than the EU27. This finding points at weaknesses in terms of technology uptake compared to the US, despite indications in the ATI business survey that 62% of all firms in the sample have adopted cybersecurity technology.

The **investment gap in cybersecurity** between the EU27 and US is confirmed by the analysis of venture capital data based on Crunchbase and Dealroom. Both the total amount invested in Cybersecurity startups since 2010 and the number of firms were much lower in the EU27 than in the US, and also lag behind China.

European VC-backed firms have been active in the area of security and infrastructure solutions for cryptocurrencies and blockchain applications as well as leveraging secure hardware technology for industrial IoT applications. In the US, most private equity and VC investment went into ventures protecting data and securing online activities, but also using AI and machine learning to solve security problems.

Within the EU27, **France and Germany** are noteworthy contributors to EU strengths in cybersecurity patenting, followed by **Sweden, the Netherlands and Finland**. Facilities supporting the cybersecurity of high-performance computing or AI, especially in areas such as energy, space and defence, are only well established in specific EU countries that can afford such costly investment, or have strong industrial players around[16].

Critical IoT-based infrastructure, such as in health, energy and transportation, will need trustworthy digital applications and, hence, strong cybersecurity measures. Accompanying any IoT, AI or Big Data initiative with relevant cybersecurity measures will be a must to build safe environments where **investment in digital technologies and cybersecurity go hand in hand**.

Figure 7: Cybersecurity

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

Links to other technologies such as blockchain promise new avenues for cybersecurity applications. Blockchain technologies can enhance trust, integrity, data provenance, and functionality and enable the authenticity of data and processes. These interlinkages among technologies will need more attention in the future, both by public and private investments in technological development.

Blockchain

Blockchain is still a niche technology, but the EU27 shows some gains over competitors in terms of startup creation, VC investment and also in the supply of skilled professionals.

Blockchain exhibits a moderate adoption level (5% of all companies surveyed) and is relevant for a specific range of industries and sectors. Nevertheless, its uptake is increasing rapidly and expected to play an important role in industrial transformation.

Today, blockchain is mainly applied in the financial sector, but new application areas are emerging. In manufacturing, for instance, Blockchain is used to keep track of and certify product sources along the value chain[17]. Blockchain also has great potential in the art market where it can be used not only for issuing tokens to artworks sales, but also to verify

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[15] ENISA, 2018
[16] Nai Fovino I. et al (2020). Cybersecurity, our digital anchor, JRC121051

[17] ATI (2020): https://ati.ec.europa.eu/reports/technology-watch/technology-focus-artificial-intelligence

their provenance and authenticity, which is one of the biggest challenges in the sector.

Startups active in the area of Blockchain are located most often in **Germany, the Netherlands, France** and **Spain,** but **Estonia and Ireland** are also attracting a large share of the European Blockchain startups relative to their country size.

Half of the blockchain startups develop their applications for the **financial sector**, followed by **trading platforms and e-commerce**. Blockchain is also linked to agriculture and creative industry-related startups.

Figure 8: Blockchain

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

More professionals with skills in Blockchain technology have been employed by the relevant industrial sectors in Europe than in the US, as the analysis of the registered users on LinkedIn suggests.

Photonics

The EU27 holds a good share of global patent applications in Photonics but it lags behind Japan.

Photonics is rapidly gaining in uptake and is thus expected to play a prominent role in the industrial transformation process in Europe. According to the ATI Survey, 7% of European organisations adopted Photonics in 2019 and another 3% are planning or evaluating whether to adopt it in the near future. This share is higher within the discrete manufacturing industry, notable 16%.

The analysis shows that commercialising research efforts in Photonics is still difficult and applied in very specific sectors such as automotive, healthcare and electronics. Photonics has a long track record in applications for sensors. Photonics technologies are also used in smart farming in order to analyse soil and crop or to forecast harvest time[18].

The EU27 is a global technology leader in various areas of photonics such as microscopy, laser technology, sensors and analytics[19]. Photonics can be applied to optical devices and allow miniaturisation, parallel fabrication and efficient packaging of optics, as well as integration of optics and electronics[20].

In terms of the share of **professionals with skills in Photonics employed in industry,** the EU27 and the US show a similar performance (as the analysis of the registered users on LinkedIn suggests).

Figure 9: Photonics

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

The **EU27 startup landscape has attracted more venture capital investment in the area of Photonics than the US** in the last decade and had a higher number of startups (as captured by

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[18] ATI (2020). Product Watch: Photonics technology for high intensity farming available at: https://ati.ec.europa.eu/reports/product-watch/photonics-technology-high-intensity-farming

[19] https://ec.europa.eu/info/sites/info/files/research_and_innovation/funding/documents/ec_rtd_he-partnerships-for-photonics.pdf
[20] Solgaard (2009). Photonic Microsystems

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Micro- and nanoelectronics

In Micro- and nanoelectronics, the EU27 takes a smaller share of global patent applications than the US, China and Japan. The absolute number of patent applications has declined in the area of Micro- and Nanoelectronics in the EU27 since 2010.

According to the ATI Survey, 4% of European organisations and **32% of manufacturing firms** (in discrete manufacturing) adopted Micro- and nanoelectronics in 2019. Micro- and nanoelectronics show a high level of verticalisation. Europe is especially well positioned in electronics segments covering the automotive industry, industrial, aeronautics, defence, security and healthcare electronics, but weaker in the stand-alone and consumer electronics segments[21].

Figure 10: Micro- and nanoelectronics
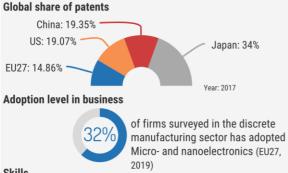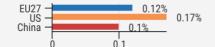

Source: Technopolis Group based on Fraunhofer ISI, Technopolis Group and IDC analysis of EPO, ATI survey, LinkedIn, Crunchbase and Dealroom

In terms of the share of **professionals with skills in Micro- and nanoelectronics employed in industry,** the EU27 and the US show a similar performance (as the analysis of the registered users on LinkedIn suggests).

The EU27 startup landscape has attracted less venture capital investment in this technology than the US in the last decade but had a similar number of startups (as captured by the analysis of Crunchbase and Dealroom data platforms).

Looking at the intersections of technologies and other capabilities

Nevertheless, beyond looking at individual technologies, it is important to connect the dots and see the bigger picture. For instance, advances in the Internet of Things will enable the generation of more data and, ultimately, improve performance in Artificial Intelligence-based applications. Digital transformation will be trusted only if cybersecurity solutions are in place and can effectively respond to all malware attacks. Connecting advances in life sciences and Artificial Intelligence will enable new medical breakthroughs.

Industrial value chains will be transformed by the interplay of Advanced Technologies, and future competitiveness will depend on the **ability to combine technological but also other types of organisational innovation capabilities in a strategic manner.** Technologies need to be translated into useful products and services that also respond to societal challenges. To this end, technology is not enough; industrial stakeholders will need to invest in new business models, new structures, creative skills and problem-solving.

1.2 Covid-19 impacts on European industry and Advanced Technology development

The Covid-19 pandemic and corresponding lockdown measures have disrupted European industry, damaged supply chains and profoundly changed consumer behaviour. The ongoing crisis made policymakers and industry realise how vulnerable their economic sectors are to shocks, and that other challenges are around the corner, such as climate change or other trade disruptions. The impact on developing and using advanced technologies has been manifold.

Rethinking supply chains and reshoring to Europe

Global supply chains of various industries are still in shock as they try to adjust to a new normal which affects access to raw materials, production processes and end-markets. It is still to be seen if companies will prioritise doing business with suppliers and customers that are located closer to them geographically, and thus become more spatially concentrated. Many experts believe international trade will look more inward in response to these forces, leading to more local

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[21] ATI (2020): https://ati.ec.europa.eu/reports/sectoral-watch/electronics-sectoral-watch

concentration[22], and it might create an opportunity for various industries to reshore activities to Europe. Supply chains will need to become more robust and reorganisations will be inevitable.

Widespread decreases in demand and customer confidence

While there have been peaks in additional demand for certain products, such as orders of computer equipment (as organisations have strengthened their remote-working capabilities), decreased consumer confidence and reduced disposable income have had a negative impact on demand around the world. As a result, the sales pipelines for firms in most countries are drying up as companies become more cautious about procuring new services, starting new projects or buying IoT hardware.

At the same time, software is proving to be a growth catalyst, as many businesses have had to upgrade their remote working capacities in a rush to remain operational. Providers of online collaboration tools, teleconferencing software, VPN services, security software, virtualisation interfaces, and cloud infrastructure have substantially benefited as a result. Furthermore, the need for faster access to data and automation will enhance the focus on network equipment and speed up 5G network deployments.

Disruption of business and technology development opportunities

Cancellations of events and ongoing business travel restrictions mean fewer client interactions and hence business development opportunities. While existing cooperations are being maintained remotely, new ones are difficult to forge and build[23]. Furthermore, technology standards are usually developed in lively exchanges among expert groups which are difficult to replace with remote interactions. As a result, decision-making and the release of new standards become delayed, e.g. Release 16 for 5G was delayed by three months due to Covid-19, and Release 17 is also delayed[24].

Disruption of recruiting

A slowdown and forced reorganisation of recruiting procedures has affected and delayed the hiring of skilled workers[25]. Furthermore, the current economic downturn has prompted many firms to put hiring on hold altogether, or at least hire

relevant talent more cautiously. The international mobility of talent has been also disrupted and causes an issue for access to employees with the necessary skills.

Decrease of tech budgets

Many companies are struggling financially, which is placing a strain on technology budgets as funds are redirected to other domains. Recent research by Enterprise Technology Research suggests that technology budgets may drop in the order of 5% compared to previous years[26].

Cyberthreats

Cybersecurity risks have risen sharply with more people working remotely, not uncommonly with little experience and improper training. As a result, cyberattacks have increased and hacker strategies proliferated[27]. Disinformation on digital platforms may pose further challenges to the smooth operation of businesses and detrimentally influence both customer confidence and the general market environment.

Artificial Intelligence

Demand for Artificial Intelligence-based solutions has experienced a surge as a result of the Covid pandemic. Hospitals in Belgium, Estonia, France, Italy, Portugal, Romania, Spain, Sweden and in the Netherlands have been installing AI-based tools in order to support medical diagnosis and analyse images of pulmonary infections. In China, AI vendors have introduced more advanced AI-powered temperature screening systems in various places including subway and railway stations. Using this tool, they can screen people from a distance and within minutes test hundreds of individuals for fever. AI-based software has also been put in place to accelerate medical research on drugs and treatments. These examples show that AI technologies have been playing a key role in the Covid response and their uptake will be expected to accelerate.

3D printing

3D printing has offered a solution for companies that have been left without suppliers to turn to for innovations in this area. For instance, 3D printing has been used to create medical equipment. Covid has given the technology an opportunity to prove its viability as it offers printing components on the spot at very short notice[28].

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[22] See for instance Pisch (2020). Just-in-time supply chains after the Covid-19 crisis, Bonadio et al (2020). The role of global supply chains in the Covid-19 pandemic and beyond
[23] https://www2.deloitte.com/global/en/pages/about-deloitte/articles/covid-19/understanding-covid-19-s-impact-on-the-technology-sector-.html
[24] https://iot-analytics.com/the-impact-of-covid-19-on-the-internet-of-things-part-2/

[25] https://www2.deloitte.com/global/en/pages/about-deloitte/articles/covid-19/understanding-covid-19-s-impact-on-the-technology-sector-.html
[26] https://etr.plus/articles/covid-19-impact-march-2020
[27] Nai Fovino I. (2020). Cybersecurity, our digital anchor, EUR 30276 EN, JRC
[28] https://www.sirris.be/industry-40-times-covid-19-and-then-what

Robotics

Following a slowdown in global demand for industrial robots, major industrial vendors have been struggling in the first half of 2020[29]. However, there is increased interest in robots, drones, but also in related Artificial Intelligence. These technologies can help deal with massive staffing shortages in healthcare, manufacturing, and supply chains, and can solve issues emerging as a result of social distancing, while also accelerating diagnosis and treatment.

Risks of widening digital disparities

Covid-19 is expected to further widen the digital divide between those who abandon digital transformation and those that prioritise it[30]. Those that have still not taken digital initiatives seriously and reduced their technology investments will fall further behind, while others may find new digital business models that put them in a leading position in their industries for years to come.

The real danger in this for Europe is that companies in EU Member States most affected by the crisis will have less funds available to support these investments than those in others that were less hit by the crisis in the first place, or that find themselves financially better positioned to contain it.

[29]https://www.businesswire.com/news/home/20200429005604/en/Global-Industrial-Robotics-Market-Analysis-2009-2020-2020-2025

[30] https://iot-analytics.com/the-impact-of-covid-19-on-the-internet-of-things-part-2

Section 2

2.   EU policy framework

2.1   Building 'open strategic autonomy'

Building resilient industrial ecosystems and ensuring technological sovereignty will be the key leitmotifs across Europe in the months and years to come. The EU will need to increase its "*investments in the resilience of its economic and social systems so that these can recover rapidly from shocks and disruptions, and adapt quickly to changing contexts*"[31].

Well before the Covid crisis, the European Commission had already drawn the attention of EU Member States to the need to protect key technological and industrial facilities against hostile foreign investments. This is underlined in the debate on the deployment of 5G technology in Europe and the positions taken by the American administration on Chinese suppliers contributed to this awareness[32].

Nonetheless, the crisis has also alluded to technological interdependencies across countries, where political decisions need to maintain a careful balancing act. Technology sovereignty but also openness to global collaboration must go hand in hand, and what the EU should aim at is essentially '**open strategic autonomy'**[33], as recently expressed by Commissioner Margrethe Vestager.

In these circumstances, the two recent priorities of the European Commission have become more important than ever. The Von der Leyen Commission has included among its six headline priorities **"a Europe fit for the digital age – empowering people with a new generation of technologies"**[34].

It has stressed that Europe must strengthen its digital sovereignty and set standards with a clear focus on data, technology and infrastructure. Another key initiative, the **European Green Deal**, has also been launched. It is concerted strategy for a climate-neutral, resource-efficient and competitive economy.

2.2   Recent EU policy strategies and communications relevant for Advanced Technologies

The **new European Industrial Strategy**[35] was presented in March 2020. Its objective is to transform European industry and make it greener, more circular and more digital, while remaining competitive on the global stage. The strategy also identifies a series of factors to support industrial transformation:

- To make the single market deeper and digital
- To uphold a global level playing field
- To help industries achieve climate neutrality
- To build a more circular economy
- To embed a spirit of industrial innovation
- To skill and reskill workers
- To invest and finance the transition

At about the same time, the Commission also presented its Communication **'Shaping Europe's digital future'**[36], which outlines the European digital strategy. The objective is to ensure that Europe seizes the opportunity and gives its citizens, businesses and governments control over digital how the transformation takes place. It is also relevant to positioning Europe as a global player. As part of the strategy, the EU aims to become a global role model for the digital economy, support developing economies in their digital transition, and develop digital standards internationally.

The **European Data Strategy**'s[37] objective is to make the European Union a leader in a data-driven society. The creation of a data single market will facilitate the free flow of data within Europe and across all sectors. This will benefit companies, researchers and public administrations. By making non-personal data available, people, businesses and organisations are empowered to make better decisions. Additionally, the **European Data Spaces**[38] will provide European businesses with the possibility to build on the single market. Common EU rules

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[31] Fraunhofer ISI (2020). Technology sovereignty From demand to concept
[32] https://www.frstrategie.org/en/publications/notes/european-technological-sovereignty-response-covid-19-crisis-2020
[33] https://carnegieendowment.org/2020/04/30/covid-19-eu-and-u.s.-responses-event-7320
[34] European Commission's priorities 2019 -2014, https://ec.europa.eu/info/strategy/priorities-2019-2024_en
[35] A new industrial strategy for Europe, COM (2020) 102 Final, https://eur-lex.europa.eu/legal-

content/EN/TXT/?qid=1593086905382&uri=CELEX:52020DC0102
[36] Shaping Europe's digital future, https://ec.europa.eu/info/sites/info/files/communication-shaping-europes-digital-future-feb2020_en_4.pdf
[37] European Strategy for data, COM (2020) 66 final, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0066&from=EN
[38] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy

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and enforcement mechanisms will ensure that European rules and values, in particular data protection, consumer protection legislation and competition law, are respected.

The **White Paper on Artificial Intelligence[39]** has also been published that presents the European approach to foster excellence and trust in AI. The White Paper suggests measures that will streamline research, foster collaboration between Member States and increase investment in AI development and deployment. Policy options have also been put forward for a future EU regulatory framework that would determine the types of legal requirements applying to relevant actors, with a particular focus on high-risk applications.

With regard to skills that can underpin talent supply and enable the development of Advanced Technologies, the **new European Skills Agenda[40]** sets an EU-wide framework. In its strategy published in July 2020, the European Commission has reaffirmed its ambition to invest in skills as a core industrial policy element in order to foster upskilling and reskilling within the next five years. The European Pact for Skills brings together all stakeholders and benefits from an increased budget. The EU wants to ensure the right to training and lifelong learning, provide the skills required to master the digital and green transitions, and to invest in a sustainable recovery after the coronavirus pandemic.

The agenda promotes education for young people, and especially women, in the field of science, technology, engineering and maths, or STEM. It also encourages the acquisition of transversal skills, such as cooperation and critical thinking, which underpin the development of Advanced Technologies.

2.3 Policy programmes supporting Advanced Technologies

Funding programmes

Strengthening European capabilities in Advanced Technologies is a key component of all key European programmes that target various aspects of technological transformation, such as from the perspective of research, business or skills development.

The European Commission's proposal for the **Multiannual Financial Framework 2021-2027** (MFF 2021-2027) has been adopted in July 2020, taking into account the latest Covid-19 developments and consequences. The budget has three main investment areas, such as supporting EU Member States to recover, kick-starting the economy, and helping private investment. Investing in a green, digital and resilient Europe is a key objective where advanced and digital technologies will play a crucial role in the recovery.

To repair the European economy from the recent pandemic, the European Commission has announced the **NextGenerationEU[41]**, composed of grants, including provisioning for guarantees, and loans. In September 2020, the European Commission set out strategic guidance for the implementation of the **Recovery and Resilience Facility** with €672.5 bn of loans and grants in frontloaded financial support for the crucial first years of the recovery[42]. **Digital and clean technologies form the backbone of the announced flagship projects**. They focus on green technologies to accelerate smart transport and energy efficient buildings, but also target Connectivity, 5G networks and Cloud capacities.

After the success of **InvestEU** between 2014 and 2020, the programme will continue, and is expected to mobilise at least €650 bn in additional investment. The programme will focus on five main areas[43]:

- Sustainable infrastructure: €20 bn
- Research, innovation and digitisation: €10 bn
- SME: €10 bn
- Social investment and skills: €3.6 bn
- Strategic European investment: €31 bn

A part of the MFF 2021-2027, the **Digital Europe Programme[44]** is expected to invest €9.2 bn in the ever-increasing digital challenges. The programme aims to boost investment in the areas of supercomputing, Artificial Intelligence, Cybersecurity, advanced digital skills, and to ensure the use of digital technologies in all sectors of the economy and society, including through Digital Innovation Hubs.

In Table 1 below we present an overview of these key EU initiatives.

[39] https://ec.europa.eu/digital-single-market/en/news/white-paper-artificial-intelligence-european-approach-excellence-and-trust
[40] https://ec.europa.eu/social/main.jsp?catId=1223&langId=en
[41] https://ec.europa.eu/info/live-work-travel-eu/health/coronavirus-response/recovery-plan-europe/pillars-next-generation-eu_en

[42]https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1658
[43] https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_947
[44] Digital Europe Programme, https://ec.europa.eu/digital-single-market/en/europe-investing-digital-digital-europe-programme

Table 1: Overview of key EU initiatives targeting Advanced Technologies

Advanced Materials

Research in Materials, Horizon Europe

European Union Observatory
for Nanomaterials

European Network for Pilot
Production Facilities and
Innovation Hubs

Advanced Manufacturing

Advanced manufacturing funding
through Horizon Europe

Innovation support: EIT Manufacturing

European Advanced
Manufacturing Support Centre

'Factories of the Future' €1.15 bn
EU public-private partnership

Artificial Intelligence

Horizon Europe, AI4EU

Artificial Intelligence Watch

European AI Alliance

Digital Europe Programme
dedicated to AI, €7 bn

Covid: AI-Robotics vs Covid-19

European Partnership on
AI, Data and Robotics

Augmented/ Virtual reality

as part of the Next Generation
Internet initiative

Big Data

High Impact Project on European data
spaces and federated cloud €4-6 bn

European Data Initiative
Collaborative Data Infrastructure

European Data Science Academy

European Partnership on AI, Data and Robotics

Blockchain

EU Blockchain Observatory and
Forum

Horizon Prize on Blockchains
for Social Good

Cloud

High Impact Project on European
data spaces and federated cloud
€4-6 bn in 2021 - 2027

European Open Science Cloud -
EOSC
€45.000 per funded initiative

Connectivity

5G for Europe: an Action plan

European 5G Observatory

5G Public Private Partnership

Connecting Europe Facility Digital
programme for 5G deployment

European Partnership for Smart
Networks and Services

Cybersecurity

European Cybersecurity Industrial,
Technology and Research
Competence Centre €9.2 bn in 2021-
2027

European Cybersecurity
Certification Group

Internet of Things

Alliance for Internet of Things
Innovation

IoT European Platform Initiative

Industrial Biotechnology

Bioeconomy Observatory

Biotech Research under Horizon
Europe

Robotics

SPARC, public private
partnership on robotics

AI-Robotics vs Covid-19

European Partnership on
AI, Data and Robotics

Nanotechnology

European Union Observatory for
Nanomaterials

European Network for Pilot Production
Facilities and Innovation Hubs

Safety assessment of nanomaterials

Micro- and nanoelectronics

ECSEL

IPCEI in Microelectronics €1.75 bn
public plus €6 bn private funding

European Partnership for Key Digital
Technologies

Photonics

Horizon Europe Photonics

European Partnership on
Photonics21

Source: Technopolis Group

Note: ECSEL refers to the Electronic Components and Systems for European Leadership; IPCEI refers to Important Projects of Common European Interes

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Horizon Europe, the research and innovation programme successor of Horizon 2020, has a proposed budget of €100 bn for the 2021-2027 period. Horizon Europe is expected to dedicate around €15 bn to projects and initiatives in Advanced Technologies. The link between the key

societal challenges and the European economy (growth and jobs) will be ensured. Horizon Europe will also support the so-called 'Institutionalised Partnerships'[45], where the EU participates in research and innovation funding programmes that are undertaken by EU countries. Proposals focus on key digital technologies, smart networks and services, circular economy and innovative health.

The **Connecting Europe Facility (CEF2) Digital programme** will support and catalyse investments in digital Connectivity infrastructures of common interest during the period 2021-2027. The deployment of and access to very high-capacity networks, including 5G systems is among the priorities.

As part of the funding programmes presented above, several initiatives target the development of Advanced Technologies and aim at providing the right framework conditions and a conducive regulatory environment.

Covid-related responses and Advanced Technologies

Most importantly, the EU's research and innovation programme **Horizon 2020** has been quickly mobilised to target the most urgent questions raised by the pandemic. Existing projects have been refocused in order to bring together the best of European researchers, pharmaceutical companies, technologies and research infrastructures to fight the virus.

Horizon 2020 Advanced Technology projects against Covid – example of AMable

AMable is a European project supported by Horizon 2020 that aims to create a new eco-system for the uptake of additive manufacturing. The prime target group is small and medium-sized companies. AMable helps to empower people by enhancing their skills in response to Covid-19, and has been supporting SMEs in developing functional products that address specific challenges in their area of business or expertise.

Source: https://www.amable.eu/covid-19

A new call for proposals has also been launched to work on Advanced Technology-based solutions for our society and economy. A **European Research Area Corona Platform[46]** has been launched that is a one-stop shop providing comprehensive information about funding opportunities in relation to Covid at European Union and national levels.

The European Commission has launched an initiative to collect ideas about deployable **Artificial Intelligence (AI) and Robotics** solutions as well as information on other initiatives that could help tackle the ongoing Covid-19 crisis. The initiative aims to create a unique repository that is easily accessible to all citizens, stakeholders and policymakers and forms part of the common European response to the outbreak of Covid-19.

Digital Innovation Hubs

The Digital Innovation Hubs (DIHs) help European companies improve their processes, services and products through the use of digital technologies[47]. The DIHs support companies providing technical expertise and experimentation opportunities, allowing them to test the technologies before making an investment. They also provide other services relevant for the digital transformation of companies, such as financing advice, training and skills development.

At the moment, there are 339 fully operational DIHs covering all levels of technological readiness, and technical competences in fields such as organic and large-area electronics (OLAE), Micro- and Nanoelectronics, Robotics and autonomous systems. There are also another 217 facilities in preparation, and 74 facilities from Horizon 2020 have potential to become DIHs[48].

Important Projects of Common European Interest

In its Communication published in 2014[49], the European Commission presented the criteria under which state aid is compatible with the internal market rules, as so-called Important Projects of Common European Interest (IPCEI),

IPCEIs have the following characteristics: they contribute to the objectives of the EU and have an impact on competitiveness, sustainability, or value creation across the EU. The projects involve more than one EU Member States, have positive spillover effects on the internal market and society, and benefit more than the MS and companies involved. The projects are co-financed

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[45] https://ec.europa.eu/info/horizon-europe/european-partnerships-horizon-europe_en
[46] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/covid-19
[47] Digital Innovation Hubs in Europe, https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs

[48] Catalogue of Digital Innovation Hubs, https://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool
[49] Criteria for the analysis of the compatibility with the internal market of the state aid to promote the execution of important projects of common European interest, COM 2014/C 188/02, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0620(01)&from=EN

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by the beneficiary and must be of an innovative nature or of important added value.

Through the **IPCEI framework, support of** €1.75 bn is provided for **Microelectronics** by France, Germany, Italy and the UK, aiming to mobilise an additional €6 bn of private investments to enable research and develop innovative technologies and components in Microelectronics.

In 2019, the European Commission approved an IPCEI introduced jointly by Belgium, Finland, France, Germany, Italy, Poland and Sweden whose objective was to support research and innovation in the priority area of **batteries**. The seven Member States involved will provide in the coming years up to approximately €3.2 bn in funding for this project, which is expected to unlock an additional €5 bn in private investments. The completion of the overall project is planned for 2031 (with differing timelines for each sub-project)[50].

The IPCEI on batteries focuses on downstream applications which are complementary to upstream research and innovation activities, and is anticipated to have an impact on consumer devices (e.g. home appliances and connected cars) as well as commercial and industrial devices (management systems for batteries used for electric mobility and energy storage). In terms of impact, the IPCEI on Microelectronics is expected to promote the delivery of energy-efficient chips, power semiconductors, smart sensors, advanced optical equipment and compound materials.

EIT Digital and EIT Manufacturing

The European Institute of Innovation and Technology (EIT) plays an instrumental role in creating the right entrepreneurial framework conditions for Advanced Technologies.

EIT Digital[51] is one of the Institute's communities whose objective is to have a global impact through European innovation fuelled by entrepreneurial talent and digital technology. It is strengtherning Europe's position in the digital world thanks to the delivey of breakthrough innovations to the market and by fostering entrepreneurial talent for economic growth and better quality of life.

EIT Digital is an ecosystem made up of more than 200 top European corporations, SMEs, startups, universities and research institutes spread out across several locations on the continent.

EIT Digital invests in strategic areas to accelerate the market uptake and scaling of research-based digital technologies focusing on some of Europe's strategic, societal challenges such as digital technology, digital cities, digital industry, digital wellbeing, and digital finance.

EIT Manufacturing[52] is another community under the European Institute of Innovation and Technology umbrella. Its objective is to build a network of ecosystems where people can acquire skills and find opportunities, and where innovators are able to attract investors and venture capital.

EIT Manufacturing has established four flagships as a demonstration of its ability to solve complex challenges, while delivering a powerful societal and industrial impact. These flagships include the following:

- People and robots in sustainable work
- Additive manufacturing for full flexibility
- Waste-free manufacturing for a circular economy
- Platforms for digitalised value networks

EIT Manufacturing brings together 50 leading European partners from business, education and research spanning 17 countries.

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[50]https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6705

[51] EIT Digital, https://www.eitdigital.eu
[52] EIT Manufacturing, https://eitmanufacturing.eu

3. National and regional policies in support of Advanced Technologies and industrial transformation

3.1 National technology and industrial policies in times of Covid

Despite Covid-19, the long-term vision of 'Industry 4.0' and technology strategies has remained unchanged across European countries. Even so, policy attention has been drawn to the importance of digital transformation and certain technology- related policy initiatives have been elevated. Recently, governments in France, Germany, Italy, and Spain have all bolstered their actions in supporting technology development and the digitalisation process in companies. The most important policy priority is to relaunch the economy, but strenghtening technological (and in particular digital) capabilities is seen as a key part of the solution. A review of national policies related to advanced technologies is included in Table 2 at the end of this chapter.

Supply chains and relocalisation

In a quest to create more robust supply chains and to ensure more autonomy in industrial production, many countries have put the question about relocalisation from Asia to Europe back to the policy agenda. Policy initiatives have appeared that aspire to bring manufacturing jobs back home by rebuilding local production chains.

This is particularly the case for certain strategic industrial sectors such as pharmaceuticals and medical devices where, for instance, Germany recently called for financial incentives to bring pharmaceutical production back to Europe[53].

'Made in Italy', 'Made in France', 'Made in Germany' debates are proliferating and witnessing renewed impetus. Among the new policy plans in Italy is now to **launch a tax incentive on labour costs linked to the reshoring of business activities to Italy, and to introduce a hyper-depreciation scheme on company assets that bring production back home**[54].

In France, among the main sectors where relocalisation is sought after are health (drugs, equipment), energy, textiles and agriculture/food[55].

In countries such as Poland and Hungary recent policy discussions are centred around the strategy to foster key EU manufacturers, bringing their suppliers from East Asia closer and investing more in these countries. On the other hand, relocalisation efforts from Asia to Europe might be more complex than it seems. A recent report by Bruegel[56] provides a detailed economic analysis and finds that EU15 imports from Central Eastern and Southern Europe decreased in recent years, while imports from China had reverted back to their 2019 level by April 2020. This points to the fact that changing the sourcing strategies of global manufacturers might not happen so easily.

Technological sovereignty

The agenda of technological sovereignty on various national policy debates has moved forward in terms of priority and gained momentum in the Covid era. Both in Germany and France, the

> **Technology sovereignty on the German industrial strategy agenda**
>
> The German Ministry for Economic Affairs and Energy, which also covers industry associations and clusters, has put technology sovereignty (back) on the agenda of the future Germany industrial strategy. The most intensive discussions about sovereignty concern questions around vaccine development, 5G technology infrastructure and Artificial Intelligence.

governments aim to boost localised production and technological development.

In France, especially since the 2018 Villani Report on Artificial Intelligence[57], a series of government initiatives are aimed at speeding up policies in this area. Technology sovereignty is at the core of recently launched policy measures.

As part of the French 'Investing in the Future Programme' new calls are dedicated to companies

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[53] https://www.pharmazeutische-zeitung.de/produktion-zurueck-nach-europa-holen/
[54] www.pmi.it
[55] https://www.lesechos.fr/politique-societe

[56] https://www.bruegel.org/2020/08/relocating-production-from-china-to-central-europe-not-so-fast/
[57] Lexcellent C. (2019) The Villani Artificial Intelligence Report, January 2018

developing 'sovereign future technologies'. The so-called **'French Tech Sovereignty Fund' launched in June 2020 will help French companies developing technologies of a sovereign nature** that could potentially fall prey to large foreign players or be overtaken by competitors. The Fund has an initial funding of €150 m. The programme is managed by Bpifrance[58] and targeted at:

- Startups that develop, on French territory, sovereign technologies of the future whose investment risk is high, in particular technologies related to Artificial Intelligence, quantum computing, health and even Cybersecurity

- Startups at any stage of their development[59]

Similarly, Germany is boosting its actions supporting technological measures. In June 2020, the German Ministry of Education and Research (BMBF) launched a flagship initiative called '**Trustworthy Electronics**'[60] for the development of electronic products of local origin. Such electronic components are vital for healthcare, smart factories and self-driving cars; all key strategic sectors of the economy. Ensuring technological autonomy will also be vital to source the necessary network equipment for 5G and 6G mobile communication locally. Meanwhile, the Germany '**Technology You Can Trust**' initiative will support projects working on processors for edge computing and on Artificial Intelligence to the tune of €25 m.

In Italy, the government presented its new **'Business Plan 4.0 Plus'** in September 2020, which is dedicated to frontier technologies. Besides the support given to traditional innovators, special **tax breaks and other financial incentives will be provided for firms that, on the one hand, develop frontier technologies such as Artificial Intelligence, quantum computing and Blockchain,** and on the other hand, to those that intend to use these digital technologies to solve a societal challenge, such as workplace safety (addressing the issue of social distancing in production lines) and green transition[61].

Elsewhere in Italy, priority areas have been defined in its 'Made in Italy' Relaunch Plan focused on food and beverage, fashion, furniture, aerospace, life sciences and automation and Robotics.

The Irish government also presented a new budget in October 2020[62] with the addition of a new interdepartmental group formed to develop proposals on how to establish an Equity Fund to invest in domestic high-innovation enterprises. The aim is to attract more private investment toward early stage, indigenous tech startups and build a pipeline of scaling companies that will reduce economic dependency on foreign direct investment.

Technology policy as part of economic recovery programmes

Besides Western Europe, other countries and regions are also active in putting technology development higher on the agenda as part of the recently launched recovery packages. In September 2020, the Polish government announced a new strategy called '**Poland: the economic centre of Europe**' that includes a range of tax and regulatory simplifications to help attract investments to Poland and to support domestic business. One key pillar of the strategy involves tax exemptions for companies reinvesting their profits and tax incentives for businesses **investing in automation and robots** (tightly linked to industrial modernisation efforts). Investments in Big Data and Cloud will also be pursued in a public-private partnership. In 2020, Microsoft announced a billion-dollar digital transformation plan in Poland and plans to build a data centre in order to provide Cloud services to businesses and government institutions[63]. The cooperation agreement has been signed between

Digital investments as key part of the 'French Relaunch'

Digital acceleration measures are a key priority of the recently launched 'France Relance' strategy. The French 'Future Industry Alliance' has promoted widely that "investing massively in digital technology is the only way to move the country up a gear". As part of the recovery plan, the government is mobilising €40 m in 2020 and 140 m in 2021 to support investment dynamics. Subsidies will be provided for SMEs but also to mid-sized companies. The French Fab loans will provide 45 million euro to promote industrial investment.

Source:http://www.industrie-dufutur.org/actualite/plan-france-relance

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[58] https://www.entreprises.gouv.fr/fr/actualites/plan-de-soutien-pour-entreprises-technologiques
[59] https://www.grantthornton.fr/fr/insights/articles-et-publications/2020/covid-19-new-12bn-aid-package-to-support-french-tech/
[60] https://www.bmbf.de/de/elektroniksysteme-made-in-germany-850.html

[61] https://www.innovationpost.it/2020/07/01/il-mise-al-lavoro-sul-futuro-degli-incentivi-ecco-come-sara-impresa-4-0-plus/
[62] https://www.gov.ie/en/press-release/3464b-budget-2021-preparing-businesses-and-protecting-jobs/
[63] https://www.premier.gov.pl/en/news/news/microsoft-to-invest-1-billion-in-digital-transformation-in-poland.html

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Microsoft and the Polish National Cloud and the Polish Development Fund.

Estonia – highly advanced in digital technologies – has turned its previous steps taken to digitalise the country into success factors to combat the coronavirus crisis. Many of the public services including education continued as before, because they were already online (e.g. digital teaching material was already in place) or quickly adapted to the new situation[64]. Estonia also continued to strengthen its efforts in Artificial Intellgience as part of the national AI strategy launched in 2019. The Estonian government has taken a leading role in accelerating and supporting the use of AI-based applications in the public and private sectors, and is investing €10 m over the course of 2019-2021 to implement the strategy. **In 2020, Estonia launched the KrattAI[65] vision** and policy initiative for public services. KrattAI will let people in Estonia use public information services by voice-based interaction with AI-based virtual assistants. The concept of KrattAI would allow people to get things done such as ordering a new passport from any device, and in the future, also from popularly used virtual assistants.

In **Sweden, the government has strengthened the investment capacities of Almi Invest** to help small innovative businesses deal with the crisis. Additional funding of €38 m supports innovative startups and scaleups to

minimise the loss of structural capital and intangible assets in the **life science sector** but also other technological areas. Small firms often operate in international markets and act as important subcontractors and innovation partners in global value chains, and the Covid disruptions are causing serious problems. The funds will also allow companies to pursue new investments, which are important as there is a risk that there may be fewer private equity capital alternatives in the future[66].

In Ireland, support was announced under the Digital Trading Online Voucher in 2020 for small independent retailers to help them get online and develop their capabilities. This support aims to address the challenges of many independent shops that are struggling due to a lack of footfall brought about by the pandemic.

Pursuing efforts toward mission-driven innovation

Nordic countries and also the Netherlands have continued to pursue their strategy of focusing innovation policy on societal challenges. Missions offer an opportunity both for European policymakers and industrial leaders to upscale their innovation efforts. In the Netherlands, policy attention has been shifted towards four main societal challenges, which were selected as priorities in 2020, notably energy transition and

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Business Finland – mission-oriented innovation, the Nokia Veturi Programme

Source: Business Finland, September 2020, presentation of Jarkko Pellikka

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[64] https://www.weforum.org/agenda/2020/07/estonia-advanced-digital-society-here-s-how-that-helped-it-during-covid-19/
[65] https://www.kratid.ee/burokratt

[66] https://www.government.se/press-releases/2020/05/government-boosts-almi-invests-investment-power-to-bridge-crisis-in-small-innovative-businesses/

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sustainability, agriculture, water and food, health and care, and security.

Mission-oriented innovation has been important in Finland as well. Over the summer of 2020 **Business Finland organised a competition where it challenged leading multinational companies to resolve significant future challenges** and increase their research, development and innovation (RDI) investments in Finland. Three projects by four leading companies, notably Neste, Nokia, Metsä Group and Fortum, were selected as the winners. Business Finland provides funding for RDI related to these leading companies' ecosystems. The funding is intended for joint projects between companies and between companies and research organisations[67]. The selected 'ecosystem roadmaps' include challenges such as tackling the climate crisis, novel sustainable solutions for transportation and chemicals, unlocking industrial 5G beyond connectivity, and accelerating the development of sustainable bioproducts.

Pan-European initiatives

Pan-European initiatives that tackle strategic technological challenges have been reinforced in 2020.

Ministers from France and Germany launched Gaia-X[68], a pan-European Cloud initiative that aims to establish a unified ecosystem of Cloud and data services, and an interoperable data exchange through which businesses can share data under the protection of European laws. The system would see various suppliers of Cloud services linked up via an interoperable data exchange acting as a vessel across industries. It will also act as a repository that businesses can search when looking for specific data services – such as Artificial Intelligence, IoT, analytics and Big Data.

3.2 Examples of national policy initiatives

Germany: Platform Industry 4.0 and Lead Markets for the Future

In the context of its economic and industrial strategy the German federal government considers production technology and Industry 4.0 as one of five central lead markets, besides health, Mobility, climate/resources-energy/environment and Advanced Materials[69].

The federal Ministries of the Economy (BMWi) as well as Research and Education (BMBF) have jointly maintained the platform Industry 4.0 since 2015[70]. This platform promotes the development of Industry 4.0 in Germany by: developing concepts for solutions and putting them into practice, supporting companies with recommendations for action, information and use cases for practical application (e.g. through a map with more than 350 use cases and an SME Transfer Network), and by organising a concerted feed-in of ideas into the international discourse and standardisation processes.

The platform brings together more than 6 000 member companies under the umbrella of the participating associations BITKOM (telecommunication and IT), VDMA (machine building) and ZVEI (electronics industry). The platform has defined autonomy, interoperability and sustainability as its main strategic fields of action.

Overall, Advanced Manufacturing technologies investment in industry is supported through various initiatives, including the BMWi programmes 'autonomics for industry' and 'smart service world' with more than €100 m, as well as about €470 m in the context of the BMBF's Industry 4.0 'project of the future' that was established in 2011. Additionally, BMWi funds the setting up of 'SME Competence Centres for Industry 4.0' across the country and the BMBF supports the set up of 'Industry 4.0 Test-Environments in SME' (I4KMU). Taking into account further thematic as well as thematically open funding schemes relevant to the development and diffusion of Advanced Manufacturing technologies, more than €1 bn of public funding has thus been invested in the five years since the 'Industry 4.0' strategy was first launched in Germany.

Digital Hub Initiative (Germany)

With de:hub, the Digital Hub Initiative' (www.de-hub.de), the Federal Ministry for Economic Affairs and Energy has supported 12 centres of excellence across Germany since 2017. A Digital Hub connects medium-sized businesses and larger corporations with new innovation partners from the scientific and startup communities, and is a location where different players with an interest in digital and technological themes gather to exchange experiences and/or work on joint projects. Digital Hubs are run by independent operators that are their own legal entities. Some are set up by individuals, others are backed by research institutions and municipal authorities. The hubs have been established across the country in the areas of IoT and fintech (Berlin), smart systems and infrastructure (Dresden/Leipzig), fintech and Cybersecurity

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[67] https://www.businessfinland.fi/en/whats-new/calls/2020/partnership-funding-for-companies-and-research-organizations/
[68] https://www.data-infrastructure.eu/GAIAX/Navigation/EN/Home/home.html

[69]https://www.bmwi.de/Redaktion/DE/Textsammlungen/Industrie/leitmaerkte-mit-zukunftspotential.html
[70] https://www.plattform-i40.de/PI40/Navigation/EN/Home/home.html

(Frankfurt/Darmstadt), digital health (Nuremberg/Erlangen), future industries/AMT (Stuttgart), Mobility and insurance technology (Munich), AI (Karlsruhe), digital chemistry and health (Mannheim/Ludwigshafen), logistics (Hamburg and Dortmund), mediatech (Potsdam), and insurtech (Cologne).

While the Ministry provides the 'RCKT' Hub Agency about €2 m per year, the hubs themselves are financed by private supporters and partners, and/or through own innovation programmes. So far, related startups have secured up to a billion euro in investment.

Netherlands: key enabling technology policy and top sectors

The Dutch government prioritised selected key enabling technologies (KETs), in which the Netherlands excels scientifically and in which economic growth is expected in the coming years. Technological development is supported by specific funding instruments. In 2020-2021, key enabling technologies from the following eight categories are addressed:

- Photonics and light technologies
- Nanotechnologies
- Quantum technologies
- Digital technologies
- Advanced Materials
- Chemical technologies
- Life sciences technologies
- Engineering and fabrication

Besides KETs, the core of enterprise policy is a tailored approach focused on nine top sectors. Government support aims at strengthening the international position of the following sectors:

- Horticulture
- Agri-food
- Water
- Life sciences and health
- Chemicals
- High tech
- Energy
- Logistics
- Creative industries

Dutch Key Technology Policy – overview of programmes

National Portfolio of KET programmes				
Fenotype genotype prototype	Building Blocks of Life -	Plant breeding 2.0	High tech to feed the world	Direct conversion of solar energy
Improved photosynthesis	National Agenda Quantum Technology	Nano contamination control	Nano4society	Smart personalized food & medicine
Safe by design	Medtech	Biomedical engineering for health	Flexible electronics	Beyond5G
Photonics for Society	Integrated photonics	Light & Intelligent Lighting	Chip integration Technology Centre	Semicon Manufacturing equipment
Systemarchitecture & System-integration	CompositesNL	Industry 4.0 for built environment	Materials Innovations	Circular plastics
Smart Industry	Batteries of the Future	Hybrid electric aircraft	Maritime Key Technologies	National AI Research Centre
Smart AI Chains	AI Enabled Electronic components	Aerospace	Blockchain	Cybersecurity
Electrochemical Conversion	Biorizon	Climate Proof Chemistry	Catalysis & Procestechnology	Measuring & Detection technology
Evidence Based Sensing	Soft Advanced Materials	Materials Made in Holland	Big Science Facilities	Bridge – Life Science Technologies
Vitality Lifestyle & Ageing	Advanced Radar Technology	Smart safe and green mobility	Medical Isotopes	Photovoltaic Technology

Source: Presentation of the Ministry of Economic Affairs and Climate Policy, September 2020

The government, private sector, universities and research centres are working together in so-called Top Sector Alliances for Knowledge and Innovation to make the top sectors even stronger.

With the renewal of the national innovation policy in 2019, the Dutch government has taken an important step toward making more use of innovation policy for societal transitions. As pointed out above, **policy attention has shifted towards four main societal challenges,** notably energy transition and sustainability, agriculture, water and food, health and care, and Security. Consequently, both the top sectors and key enabling technologies have become primarily mission-driven.

As a result of the recent changes, the current key technology policy follows two tracks: on the one hand, it provides knowledge that can be applied to implement specific missions within the four societal challenges; and on the other hand, new knowledge is developed for which there are no direct applications, but which strengthens the Dutch knowledge base for future solutions.The new approach includes 25 missions that have been defined by the cabinet and resulted in knowledge and innovation agendas and public-private partnerships. Further programmes with broad

support include the National Agenda Quantum Technology, AI National Coalition and PhotonDelta. Moreover, additional programmes are expected in the area of med-tech and high-tech manufacturing equipment.

Spain: Connected Industry 4.0 strategy

The Spanish Ministry of Industry launched the **'Industria Conectada 4.0' strategy**[71] in 2015. Its objective is to:

- Increase industrial value added and qualified employment in the industrial sector
- Strengthen the industrial sectors of the future and develop the local supply of digital solutions
- Develop differential competitive levers to favour Spanish industry and boost its exports

In order to fulfil the above objectives the strategy has put in place several support programmes. Under 'Support for the Connected Industry 4.0 initiative'[72], funding is provided to bolster the incorporation of knowledge, technology and innovation aimed at the digitisation of processes and the creation of technologically advanced products and services with greater added value in industrial companies. Support is given to industrial research projects, experimental development projects, as well as organisational and process innovation projects. The financial assistance takes the form of repayable loans based on several conditions. The loan maximum is set at 80% of the bankable and must be repaid within ten years, including a three-year grace period. At minimum budget for the actions is set at €100 000. Another example is the Advanced Digital Self-Diagnostic Tool (HADA), an online application that allows companies to assess their digital maturity state.

In 2019, the Spanish government also published its **'National Strategy for Artificial Intelligence'**[73]. The strategy's objective is to foster the development and use of AI in Spain, to increase investment reinforcing excellence in AI technologies and applications, and to strengthen collaboration between public and private sectors, so as to produce a significant impact on Spanish society and the economy. In January 2020, the government also created two secretaries of state: one for Digitisation and Artificial Intelligence, and antoher Telecommunications and Digital Infrastructure[74]. The secretaries are in charge of

the framing and implementation of the government's policy for digital transformation and the development and promotion of Artificial Intelligence.

3.3 Regional policy examples

Innovation-led growth remains at the core of regional economic policies. The EU's cohesion policy framework aims at addressing the growing regional differences in economic development, where upgrading regional economies through new technologies, including digital technology, plays an important role.

Regional smart specialisation strategies (3S) have embraced technological development forcefully in the period 2014-2020. The smart specialisation concept aims at concentrating knowledge resources and linking them to a limited number of priority economic activities so that countries and regions can become, and remain, competitive in the global economy. Smart specialisation is also considered an important instrument for ensuring synergies between Horizon 2020 and the ESIF[75].

Several regions have prioritised technology development especially related to Advanced Manufacturing, Nanotechnology, Advanced Materials but also digital technologies. Digitalisation will be a major enabler for inclusive growth during the 2021-2027 programming period of cohesion policy and the next generation of 3S. One of the major goals of the revised regulations for the EU's cohesion policy after 2020 is to simplify the procedures and increase the effectiveness of EU investments. One of the five policy objectives includes 'A smarter Europe – innovative and smart economic transformation'[76]. This policy objective will allow regions to invest in innovation, digitalisation, SMEs, entrepreneurship and S3-relevant skills around prioritised Advanced Technologies.

Both at regional and national level, clusters play a crucial role in enabling SMEs to innovate and adopt advanced tecnologies. As underlined under the '2030 Vision for EU Industry'[77], industrial innovation ecosystems shall be developed around new type of smart clusters, which actively support the transformation of industry and act as an agent of change.

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[71] Estrategia industria Conectada 4.0:
https://www.industriaconectada40.gob.es/Paginas/index.aspx
[72] Ayudas a la iniciativa Industria Conextada 4.0:
http://www.ipyme.org/es-ES/Financiacion/IndustriaConectada/Paginas/IndustriaConectada.aspx
[73] Estrategia Nacional de Inteligencia Artificial:
https://www.ciencia.gob.es/portal/site/MICINN/menuitem.26172fcf4eb029fa6ec7da6901432ea0/?vgnextoid=70fcdb77ec929610VgnVCM1000001d04140aRCRD

[74] Secretarias de Estado: https://avancedigital.gob.es/es-es/SecretariaDeEstado/Paginas/secretaria_estado.aspx
[75]http://ec.europa.eu/research/industrial_technologies/pdf/analysis_of_RIS3_in_NMP.pdf
[76]https://www.europarl.europa.eu/factsheets/en/sheet/93/economic-social-and-territorial-cohesion
[77] https://ec.europa.eu/growth/industry/policy/industry-2030_en

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Currently there are 2 500 industrial clusters in Europe. The frontrunners amongst European clusters have transformed into spaces for experimentation and systemic growth, orchestrating industrial innovation ecosystems regionally. The **European Cluster Cooperation Platform[78]** is a key European initiative to support cluster development across Europe and help cluster organisations to set new ambitions.

Below are some examples of regional strategies related to Advanced Technologies:

Digitalisation Strategies in Baden-Württemberg digital@bw/KI@bw

In 2017, Baden-Württemberg launched a multi-disciplinary digitalisation strategy (digital@bw) followed by a strategy for Artificial Intelligence (KI@bw) in 2019. In a comprehensive approach, both strategies seek to address current digitalisation challenges in the federal states, both established and nascent areas of strength. By 2021, around €1 bn of broadband infrastructure investment is expected to have been delivered under this umbrella. On top of this, about €650 m of federal funds will be invested in a regional 'digital update' of primary and secondary education infrastructure. Regions and municipal governments will complement this with an aditional €150 m. Additionally, about 80 individual projects have been initiated in the context of the two strategies since 2017 and supported to the tune of more than €320 m. Examples include €35 m for 19 regional AI-labs, €20 m for the development of digital health applications, €19 m for the establishment of a new quantum computing research centre, €7.6 m for new digitalisation concepts at community level, and €2.5 m for nine cooperative AI research projects which will soon be complemented by a larger, second batch of projects with an envisaged volume of up to €10 m in total. Additionally, some regional initiatives are being awarded 'AI Champion' status in a competitive procedure with the aim of seeing them comprehensively promoted by the regional government. Finally, €500 000 has been invested in an ongoing feasibility study for a 'AI Innovation Park' following Asian examples. Alongside these major projects the regional government offers a number of low-threshold support measures to enable broad-based digitalisation including innovation vouchers and training support scheme.

Catalonia – digital strategy

The Strategy for the Smart Specialisation of Catalonia (RIS3CAT) provides a framework for the Catalan government in the area of research and innovation actions for the 2014-2020 period and supports the promotion of innovative projects[79].

Its key objectives are to:

- Increase the competitiveness of the business ecosystem by reorienting its production fabric, enhancing the efficiency of production processes, internationalisation, and the reorientation of consolidated sectors towards activities with greater added value
- Foster new emerging economic activities through research, creativity and innovation to create and develop new market niches
- Consolidate Catalonia as an international reference in technology and digital transformation, consolidate it as a European knowledge hub, and connect technological and creative capacities to existing and emerging sectors in the territory
- Improve the Catalan innovation system, increasing the competitiveness of companies and focusing public policies toward the promotion of joint actions for innovation, internationalisation and entrepreneurship

In terms of sectoral focus, the RIS3 in Catalonia highlights seven leading sectors for economic growth: agri-food industries, energy and natural resources, industrial systems, design-based industries, sustainable mobility, health industries and experience-based industries.

From the perspective of transversal technologies that transform the Catalan ecosystem, the focus is on **ICT, Nanotechnology, Photonics, Advanced Materials, Biotechnology and Advanced Manufacturing Technologies**. Other policy areas with specific focus include the digital agenda, entrepreneurship, eco-innovation, non-technological innovation, and training and talent.

As a response to the Covid crisis, the most recent priority of the **Catalonian Startup Ecosystem is to accelerate technological transformation and support deep tech startups** through seed funding. More specifically, the following three focus areas have been selected:[80]

- Strengthening the ecosystem by launching data hubs such as the directory http://startupshub.catalonia.com/ and online sectoral webinars (Barcelona Tech City, Mobile World Congress, Barcelona Activa, Fira Barcelona)
- Strengthening the competitiveness of startups by launching dedicated support schemes that

[78] https://www.clustercollaboration.eu/
[79] European Entrepreneurial Regions, EER report on Catalonia, 2020

[80] Presentation of Montse Riquer from ACCIO Barcelona, September 2020

can accelerate technological seed startups (Deep Tech Startups), and by putting in place the Startup Capital programme (€75 000 for pre-seed tech companies).

- International connections remain high on the agenda (such as continuing with International Pitch Events, International mentoring,

Corporate and Startup programme, Online Softlanding)

- Strengthening talent and skills, including the attraction of international talent – via the Barcelona Digital Talent programme. Policy highlights in support of advanced technologies across the EU27 in 2020.

Table 2: Policy highlights in support of advanced technologies across the EU27 countries in 2020

Country	Digital and technology policy latest highlights	Covid measures and technology
Austria	**Digital Action Plan Austria,** published in June 2020. Flagship project to PhysICAL (Physical Internet through Cooperative Austrian Logistics).	**Covid-19 investment bonus:** companies receive a 7-14% premium for their investment related to digitalisation, eco-innovation, health and life sciences in order to prevent firms postponing their investments as a result of the coronavirus crisis.
	5G pilot rollout, plan to target the countryside.	**Digital Team Austria**: With this measure small and medium-sized enterprises can obtain digital services free of charge for at least three months.
Bulgaria	**Strategy for Digital Transformation 2020-2030,** adopted in July 2020 (Ministry of Transport, Information Technology and Communications). 17 priority areas include: digital infrastructure; Cybersecurity; research and innovation; education and training; adaptation of the labor market (education), training and social protection; digital economy; agriculture; transport; environment and climate; healthcare; finance; culture; misinformation and media literacy; territorial development; digital control; security and citizen participation in the democratic process.	
Belgium	**Digital Wallonia**, a digital strategy, platform and brand, sets the framework for all of the Walloon government's actions in terms of digital transformation. Over €500 m have been harnessed over four years for its implementation.	
Croatia	**Croatia 2030 Strategy,** encompassing digital goals as part of the national programme published in 2020.	
Czech Republic	**Innovation Strategy 2019-2030**, described itself as the "country for technology, the country for digitalisation".	

Country	Digital and technology policy latest highlights	Covid measures and technology
Denmark	- 29	-
Estonia	**KrattAI** vision and policy initiative for public services.	
Finland	**Business Finland** launched a policy including a competition to challenge multinational companies to solve significant future challenges.	
France	**French Tech Sovereignty Fund,** launched in June 2020 to help French companies developing technologies of a sovereign nature.	Digital acceleration measures are a key priority of the recently-launched **France Relaunch** (*France Relancer)* strategy.
Germany	**AI-Investigation** or *AI-Enquete*, presented its results. Artificial Intelligence, Social Responsibility and Economic Potential Committee. **Trustworthy Electronics,** policy measure. Updated Bioeconomy Strategy	Increase in public investment for green and digital projects promoted with tax incentives, university research facilities and project-based research grants Measures towards 'biologisation of technology' and future technology of the bioeconomy.
Greece	**Digital Transformation of the Public Administration,** a new law published in September 2020. 5G call is planned for six licences. Microsoft have announced a major investment for Cloud services in the country.	A set of measures to support companies facing Covid-19 problems such as subsidies to employment, rents etc., though not addressing digital transformation directly.
Hungary	**Artificial Intelligence Strategy,** published in 2020.	Focus on strengthening local supply chains.

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Country	Digital and technology policy latest highlights	Covid measures and technology
Ireland	'**Budget 2021**', new package announced in October 2020[81]: - Reliance on new sectors to deliver growth as demonstrated by the support for the **digital gaming sector** - Creation of a €30 m **state-backed equity fund to invest in domestic, high-innovation enterprises** - increased funding allocated to the Data Protection Commission - Knowledge development box that supports R&D has been extended by two years to 31 December 2022 AI Strategy expected to be published in 2020.	Digital Trading Online Voucher in 2020 helping small independent retailers to go online and mitigate Covid impacts
Italy	'**Business Plan 4.0 Plus**' policy measure published in September 2020, dedicated to frontier technologies. **Bioeconomy** Strategy Action plan.	
Latvia	National 5G roadmap approved in February 2020	**Mitigate the impact of Covid-19** The aim of the programme is to develop scientific forecasts for future action scenarios in Latvia in autumn 2020, 2021 and 2022, including for overcoming new outbreaks by implementing research in three thematic areas: 1) health and public health; 2) engineering solutions, including for enhancing human safety, rapid detection of communicable diseases, development, testing and certification of personal protective equipment, provision of remote services in sectors and use of ICT in education; 3) the economy and societal well-being, including the resilience of the economy to epidemics and pandemics and post-crisis development opportunities.
Lithuania	-	-
Luxembourg	-	-
Malta	-	-

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[81] https://www.gov.ie/en/press-release/748e9-budget-2021

Country	Digital and technology policy latest highlights	Covid measures and technology
Netherlands	**Mission-oriented technology policy**, focused on four main societal challenges: energy transition and sustainability, agriculture, water and food, health and care and Security.	
Poland	Tax exemptions for companies reinvesting their profits and tax incentives for businesses investing in **Automation and Robotics.** Microsoft announced a plan to build a data centre in order to provide Cloud services to businesses and government institutions.	
Portugal	**Action Plan for the Digital Transition**, published in March 2020 Considered as catalysers of the digital transformation, special focus is also given to disruptive technologies such as Artificial Intelligence systems, 5G technology, Cloud and proximity computing, and the Internet of Things.	
Romania	**Artificial Intelligence: A strategy for the development and adoption of AI technology at a country level**, under preparation.	
Slovakia	-	-
Slovenia	-	-
Spain	**Digital Spain** *(Espana Digital)* **2025,** published in July 2020. The Spanish government created two secretaries of state for **Digitisation and Artificial Intelligence**, and for **Telecommunications and Digital Infrastructure** in January 2020.	
Sweden		**Strengthening investment capacities** to help innovative startups and scaleups continue investing in technologies during Covid.

Source: Technopolis Group review of national digital and technology strategies, government websites

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About the 'Advanced Technologies for Industry' project

The EU's industrial policy strategy promotes the creation of a competitive European industry. In order to properly support the implementation of policies and initiatives, a systematic monitoring of technological trends and reliable, up-to-date data on advanced technologies is needed. To this end, the *Advanced Technologies for Industry* (ATI) project has been set up. It provides policymakers, industry representatives and academia with:

- Statistical data on the production and use of advanced technologies including enabling conditions such as skills, investment or entrepreneurship;
- Analytical reports such as on technological trends, sectoral insights and products;
- Analyses of policy measures and policy tools related to the uptake of advanced technologies;
- Analysis of technological trends in competing economies such as in the US, China or Japan;
- Access to technology centres and innovation hubs across EU countries.

You may find more information about the 16 technologies here: https://ati.ec.europa.eu.

The project is undertaken on behalf of the European Commission, Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the Executive Agency for Small and Medium-sized Enterprises (EASME) by IDC, Technopolis Group, Capgemini, Fraunhofer, IDEA Consult and NESTA.

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