

AI Watch

# National strategies on Artificial Intelligence

## A European perspective

2021 EDITION — a JRC-OECD report



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JRC122684

EUR 30745 EN

PDF

ISBN 978-92-76-39081-7

ISSN 1831-9424

doi:10.2760/069178

Luxembourg: Publications Office of the European Union, 2021

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How to cite this report: Van Roy, V., Rossetti, F., Perset, K., Galindo-Romero, L. (2021) *AI Watch - National strategies on Artificial Intelligence: A European perspective, 2021 edition*. EUR 30745 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-39081-7, doi:10.2760/069178, JRC122684.

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## Foreword


Artificial intelligence (AI) is likely to be the “general purpose technology” of our era and as such will have a tremendous impact on the way people live and work over the coming decades. While the technology attracts its share of hype, its significance is real and examples of beneficial applications of AI already abound. Yet AI’s full impact is still to come, as firms, governments and individuals take up and combine numerous AI applications in innovative ways.

That is why it is important to keep track of the progress of AI development and deployment. All EU Member States are developing and implementing policies and national strategies to seize the benefits of AI for the economy and society. Keeping a tab on how countries are supporting the development of AI and how successful different policies are is critical for public policy-makers. It enables countries to benchmark their progress and to learn from good practices implemented elsewhere.

To prepare this publication the EU and the OECD have joined forces, continuing our cooperation on AI policy. The [EC-OECD database](#) of national AI policies and strategies that we began to build in 2019 contains over 650 AI policies and strategies from over 60 countries, including all the EU Member States. It has now been expanded to include emerging trends in AI policy, such as AI regulatory initiatives.

Building on this database, the present joint report from the EC Joint Research Centre’s AI Watch and the OECD’s AI Policy Observatory team provides information on the latest policy developments and trends in AI policies for research and development, jobs and skills and much more.

We would like to take the opportunity to thank EU Member States, Norway and Switzerland for the substantial and detailed contributions that have made this report possible. We intend to continue our successful cooperation over the coming years to together help our members share and shape successful AI policies.



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## **Acknowledgements**

The authors are grateful for the feedback and amendments provided by representatives of EU Member States, Norway and Switzerland. This report benefitted significantly from their input and comments. In addition, this report has been enriched with policy initiatives of an interactive database of AI policies jointly launched by the OECD and the EC, and presented on the [OECD.AI Policy Observatory](#). In particular, the authors thank Francesca Sheeka (OECD) for her substantial contributions to the content of this report. The authors wish to thank also colleagues from the Directorate-General for Communications Networks, Content and Technology (DG CNECT), Irina Orssich, Maikki Sipinen, Eric Badiqué, Tatjana Evas and Filipe Jones Mourao, and finally colleagues from the Joint Research Centre (Digital Economy Unit), Paul Desruelle and Karen Fullerton, for their valuable comments.

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## Executive summary

Artificial intelligence (AI) is transforming the world in many aspects. It is essential for Europe to consider how to make the most of the opportunities from this transformation and to address its challenges. In 2018 the European Commission adopted the **Coordinated Plan on Artificial Intelligence**<sup>1</sup> that was developed together with the Member States to maximise the impact of investments at European Union (EU) and national levels, and to encourage synergies and cooperation across the EU. One of the key actions towards these aims was an encouragement for the Member States to develop their national AI strategies. The recently published **2021 review of the Coordinated Plan on Artificial Intelligence**<sup>2</sup> presents the actions taken by the European Commission and sets concrete proposals and recommendations for further joint actions between the EU and Member States in order to strengthen the EU's competitiveness in the global AI landscape.

The review of national strategies is one the tasks of AI Watch, which was launched by the European Commission to support the implementation of the Coordinated Plan on Artificial Intelligence.<sup>3</sup> The first review of national strategies was published in February 2020.<sup>4</sup> Building on the 2020 release, this report presents an updated **review of national AI strategies from the EU Member States, Norway and Switzerland**. By June 2021, **20 Member States and Norway had published national AI strategies**, while 7 Member States were in the final drafting phase. Since the 2020 release of the AI Watch report, additional Member States – i.e. Bulgaria, Hungary, Poland, Slovenia, and Spain – published their strategies, while Cyprus, Finland and Germany have revised their initial strategies.<sup>5</sup>

This report reviews the national AI strategies and provides an overview of national policy initiatives across the following policy areas:

- Human capital;
- From the lab to the market;
- Networking;
- Regulation;
- Infrastructure.

These policy areas are consistent with the actions proposed in the Coordinated Plan on Artificial Intelligence and with the policy recommendations to governments contained in the **OECD Recommendation on AI (hereafter “AI Principles”)**. Further to the above policy areas, the report includes a section on AI policies to address societal challenges.

National approaches on AI differ in strategic priorities, budget allocations, and timeframe of implementation, however **all EU Member States and Associated Countries have ambitious plans** to support the uptake and development of AI.

Specifically, on the objective to nurture human capital in AI, Member States set various actions. First, all governments are **supporting education reforms** to increase the offer of AI-related courses and study programmes at all education levels. These initiatives are complemented by **lifelong learning and upskilling opportunities** to provide advanced AI and digital skills to the workforce. Measures addressing broader labour market trends and challenges remain at a very early stage of development. Furthermore, governments are deploying **national competence centres in AI** to build a strong AI research capacity and are fostering academic partnerships between public and private AI research institutions.

Governments are also setting up **investment programmes for AI innovators**, to foster the deployment of innovative ideas into marketable products and services, with particular attention for AI start-ups and SMEs. Commonly reported priority sectors for the deployment of AI are manufacturing, agriculture, healthcare, transport and energy. The majority of the countries are also taking several actions to **stimulate the use of AI in public services**. Many national AI strategies include a requirement for experimental projects to learn by doing and sharing good practices. Some national strategies mention funding programmes to support AI projects in public administration.

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<sup>1</sup> European Commission, [Coordinated Plan on Artificial Intelligence](#) (COM(2018) 795 final)

<sup>2</sup> European Commission, [Coordinated Plan on Artificial intelligence 2021 Review](#), (COM(2021) 205 final)

<sup>3</sup> More information is available on the [AI Watch](#) portal.

<sup>4</sup> Van Roy, V. (2020). AI Watch - [National strategies on Artificial Intelligence: A European perspective in 2019](#), JRC Technical Report.

<sup>5</sup> See Table 2 for an overview of the status of national AI strategies in the EU Member States and Norway.

Governments are actively **supporting collaborative partnerships among relevant stakeholders**, across the public sector, private sector, and civil society. Such partnerships are typically built by setting up innovation communities, through setting up digital innovation hubs and organising public awareness programmes. Several Member States have also developed maps of AI players and applications to better monitor ongoing technological and scientific activities in AI and to facilitate national and international collaborations.

Many governments have established **AI ethics oversight bodies**, to ensure that the development of AI is grounded in European values and fundamental rights. These bodies aim to raise ethical awareness through the provision of good practices, training and ethical codes of conduct for researchers and practitioners. Several Member States are also deploying AI certificates to acknowledge that AI systems have been developed in an ethical, transparent and socially responsible manner. To further ensure trustworthy AI, most governments are adopting new **legislative frameworks for AI technologies**, which are often sector-specific and cover areas such as autonomous driving, healthcare and e-justice. Lastly, several governments are **setting up regulatory sandboxes**, offering controlled environments for AI experimentation and testing.

Data governance and cutting-edge ICT infrastructures are also key for the uptake of AI. In this respect, all national AI strategies mention having developed accessible repositories for public data. Governments are building on their open data policies to **promote data access and sharing for AI**. Governmental data chief officer functions have been created or are being considered in several countries to further support and encourage data use and exchange. These public bodies act as facilitators to coordinate and stimulate the management of national data assets by adopting open data governance. Open access to public sector data continues to be a priority as national data strategies increasingly focus on AI to foster a robust digital ecosystem for AI and to advance AI R&D. Policies to promote access to public data and initiatives that enable private sector data sharing include data trusts and data spaces. To foster the development of AI, all Member States and Associated countries support access to **secure data storage, high-performance computing, affordable high-speed broadband networks** and next-generation software for data analytics.

Lastly, the current edition of the report highlights and analyses national policy initiatives that support the **use of AI to tackle societal challenges**, notably the COVID-19 pandemic and climate change. Policy makers have set up ambitious AI R&D programmes, rolled out long-term investment funds, provided access to data and infrastructure, and supported national and international collaborations to accelerate the diagnosis, prevention and recovery of diseases during the COVID-19 pandemic and to find innovative solutions to mitigate climate change.

The collection of AI policies is conducted **jointly by the European Commission's Joint Research Centre (JRC) and the OECD's Science Technology and Innovation Directorate<sup>6</sup>**, while the analyses presented in this report are carried out by the JRC, with contributions from the OECD. Both institutions joined forces to ensure that the information supplied by [AI Watch](#) and the [OECD AI Policy Observatory](#) is harmonised, consistent and up to date. The [EC-OECD database of national AI policies](#) contains national AI strategies and AI-related policy initiatives from over 60 countries. This report is based on the EC-OECD database of national AI policies, validated by Member States' representatives.

To conclude, the current report serves as a starting point in identifying national AI policies and governance approaches in EU Member States and Associated Countries. Further 'deep dives' at country level into the content and implementation of AI policies are needed to acquire more in-depth policy intelligence about their economic and societal impact. In terms of policy implications, this report demonstrates the importance of working closely with relevant stakeholders to share lessons learned, good practices and challenges when shaping AI policies.

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<sup>6</sup> The European Commission and the OECD have been [collaborating](#) on global monitoring and analysis of Artificial Intelligence developments, notably through a joint database of national AI policies at OECD.AI launched in February 2020.

# 1 Introduction

## 1.1 Background

Continuously growing computing power, and increased availability of data, have led to an unprecedented upsurge of breakthroughs in artificial intelligence (AI)<sup>7</sup>, over the last few decades.<sup>8</sup> These advances and innovations in AI are significantly reshaping economies and societies across the world. They offer many opportunities for better living conditions, for example through enhanced efficiency of production systems, improved health care with better and more precise diagnosis and prevention of diseases and innovative solutions for climate change mitigation and adaptation.<sup>9</sup> While AI technologies open up many new opportunities for Europe, they also entail challenges.

The overall goal for the European Union (EU) is to make the EU a world-class hub for AI, while ensuring that AI is human-centric and trustworthy and grounded in European values and fundamental rights.<sup>10</sup> To this end, all EU Member States and Norway signed a **Declaration of cooperation on Artificial Intelligence**<sup>11</sup> in April 2018 to work together on the opportunities and challenges brought about by AI. The European Commission proposed a strategy on Artificial Intelligence for Europe, which was endorsed by the European Council in June 2018.<sup>12</sup>

To increase synergies between national and EU level actions, the European Commission (EC) adopted a **Coordinated Plan on Artificial Intelligence**<sup>13</sup> in December 2018 to maximise the impact of investments at EU and national levels, encourage synergies and cooperation across the EU, including on ethics and foster the exchange of good practices. The plan was developed together with the Member States and it proposes joint actions for closer and more efficient cooperation between Member States, Norway, Switzerland and the European Commission in key areas including increasing investment, making more data available, fostering talent and ensuring trust. One of the key actions in the Coordinated Plan was encouragement for all Member States to develop their national AI strategies.

A European approach to AI is further developed in the **White paper on Artificial Intelligence - A European approach to excellence and trust**<sup>14</sup>, released in February 2020. The White paper announced the update of the Coordinated Plan on Artificial Intelligence, and presented policy options for a future EU regulatory framework for AI. As a next step, the European Commission released the **2021 review of the Coordinated Plan on Artificial Intelligence**<sup>15</sup> in April 2021. It builds on the Coordinated Plan of 2018 and the White Paper on Artificial Intelligence and puts forward a concrete set of joint actions for the European Commission and Member States on strengthening Europe's leading position in the development of human-centric, sustainable, secure, inclusive and trustworthy AI. On the same day, the European Commission also released a **legal framework on AI**<sup>16</sup>, which addresses the risks of AI and proposes proportionate and flexible rules to address the specific risks posed by AI systems and set the highest standard worldwide.

In May 2019, the OECD Council adopted the Recommendation of the Council on Artificial Intelligence (**OECD AI Principles**)<sup>17</sup> to promote AI that is innovative and trustworthy and that respects human rights and democratic values. In June 2019, the G20 adopted human-centred AI Principles that draw from the OECD AI Principles. The OECD AI Principles identify five complementary values-based principles for the responsible stewardship of trustworthy AI systems: inclusive growth and well-being; human rights and fairness; transparency and explainability; safety, security and robustness; and accountability of AI actors for the functioning of AI systems in line with these principles. Consistent with these value-based principles, the OECD AI Principles also provide five priority recommendations to governments: promoting investment in AI R&D;

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<sup>7</sup> For a definition of AI, see the European Commission [Proposal for a Regulation laying down harmonised rules on artificial intelligence](#), (COM(2021) 206 final)

<sup>8</sup> See the JRC Report [AI Watch – TES analysis of AI Worldwide Ecosystem in 2009-2018](#) (Samoili et al., 2020).

<sup>9</sup> European Commission, [White Paper on Artificial Intelligence: a European approach to excellence and trust](#), COM(2020) 65 final

<sup>10</sup> European Commission, [Communication Fostering a European approach to Artificial Intelligence](#) COM(2021) 205 final

<sup>11</sup> European Commission, [Declaration of cooperation on Artificial Intelligence](#), 2018

<sup>12</sup> European Commission, [Communication on Artificial Intelligence for Europe](#), (COM(2018) 237 final)

<sup>13</sup> European Commission, [Coordinated Plan on Artificial Intelligence](#) (COM(2018) 795 final)

<sup>14</sup> European Commission, [White Paper on Artificial Intelligence: a European approach to excellence and trust](#), COM(2020) 65 final

<sup>15</sup> European Commission, [Coordinated Plan on Artificial intelligence 2021 Review](#), (COM(2021) 205 final)

<sup>16</sup> European Commission, [Proposal for a Regulation laying down harmonised rules on artificial intelligence](#), (COM(2021) 206 final)

<sup>17</sup> OECD, [Recommendation of the Council on Artificial Intelligence \[OECD/LEGAL/0449\]](#), (2019)



data, AI compute, software & knowledge; reviewing policy and regulatory frameworks and using testbeds; building skills and preparing labour markets; and co-operating internationally on AI.

As agreed through the 2018 Coordinated Plan, most Member States have been active in developing and adopting national AI strategies.<sup>18</sup> The Coordinated Plan on Artificial Intelligence 2021 review provided an overall view on the status of adoption of national strategies.<sup>19</sup> This report provides a more detailed and structured overview of actions and priorities of each country, as well as common directions and developments at European level. Careful monitoring and analysis of national AI strategies is important as is the foundation for identifying and building synergies, and learning from each other. EU's strength lies in the variety of national strategies combined with close cooperation to bring good practices to the European level.

## 1.2 Objectives of the report

In support of the Coordinated Plan on Artificial Intelligence, the European Commission has launched the **AI Watch**<sup>20</sup> initiative, the European Commission *knowledge service to monitor the development, uptake and impact of AI for Europe*, implemented by the Joint Research Centre of the European Commission in close coordination with DG CONNECT. Monitoring and analysing national AI strategies is in the core of AI Watch's mandate and goals.

This report gathers information on EU Member States' AI policies in unified form to:

- Provide a useful resource for Member States' policy makers to help them compare their strategy to those of other countries, and to identify areas for collaboration;
- Support, at the EU level, the monitoring of the implementation of the Coordinated Plan on Artificial Intelligence and provide input for its development.

The first AI Watch report on national AI strategies<sup>21</sup> presented the status of EU Member States' national AI strategies up to the date of its release in February 2020. The current report builds on the previous edition and presents an **updated review of Member States' national AI strategies** from March 2020 till June 2021. This report has been enriched with a more in-depth analysis on **national AI strategies in the EU**, highlighting similarities and differences in Member States' national policy approaches. This exercise allows identifying good practices and common strengths on which the EU can reinforce its position as a top AI player at global level. Second, this report is complemented with a dedicated section on **AI policies to tackle societal challenges** on sustainable climate and environment, and the COVID-19 pandemic. Lastly, the report now has a broader country coverage and also covers Associated Countries: Norway and Switzerland.

The collection of AI policies is conducted **jointly by the European Commission's Joint Research Centre (JRC) and the OECD Science Technology and Innovation Directorate**<sup>22</sup>, while the analyses presented in this report are carried out by the JRC, with contributions from the OECD. Both institutions joined forces to ensure that the information supplied by [AI Watch](#) and the [OECD AI Policy Observatory](#) is harmonised, consistent and up to date. The [EC-OECD database of national AI policies](#) contains national AI strategies and AI-related policy initiatives from over 60 countries. This report is based on the EC-OECD database of national AI policies, validated by Member States' representatives.

This report is structured as follows. The next section, Section 2, presents an overview of the current status of national AI strategies in the European Union, Norway and Switzerland. Section 3 discusses the methodological approach to gather and structure information on national AI policy initiatives. Section 4 offers insights from national AI strategies. Lastly, Section 5 outlines country reports for all Member States, Norway and Switzerland, summarising the AI policy measures at national level.<sup>23</sup>

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<sup>18</sup> See section 2 for an overview of the status of national AI strategies.

<sup>19</sup> The Coordinated Plan on AI 2021 review also includes an annex with short updates on the national strategies. This report gives a deeper and more structured overview to supplement the review.

<sup>20</sup> More information on the initiative is available on the [AI Watch](#) portal.

<sup>21</sup> Van Roy, V. (2020). AI Watch - [National strategies on Artificial Intelligence: A European perspective in 2019](#), JRC Technical Report.

<sup>22</sup> Since February 2020, the European Commission and OECD [collaborate](#) on global monitoring and analysis of Artificial Intelligence developments.

<sup>23</sup> This report provides information on the status of national AI strategies until the 1<sup>st</sup> of June 2021. The next release of this report will be published in 2022. For updated information on a regular basis, please refer to the country pages on the [AI Watch portal](#).

## 2 Overview of national AI strategies

By June 2021, **20 Member States and Norway had adopted national AI strategies**, while 7 Member States were in the final drafting phase and ready to publish their strategy in the coming months. Table 1 provides an overview of national AI strategies in the EU Member States and Norway.<sup>24</sup>

After the publication of the 2020 AI Watch report on national AI strategies (Van Roy, 2020) released in February 2020, Bulgaria, Hungary, Poland and Spain adopted their strategy in the third and fourth quarter of 2020, and Slovenia released its strategy in May 2021. Other Member States, such as Cyprus, Finland and Germany, have revised their initial strategies. Cyprus has launched a call for tender to develop an Action Plan to follow-up the progress and implementation of its national AI strategy. In November 2020, Finland launched the Artificial Intelligence 4.0 programme<sup>25</sup> to promote the development of AI in companies, with a special focus on SMEs. Lastly, since the release of its AI strategy, Germany revised it twice and committed in December 2020 to increase the initial public investment for AI from EUR 3 billion to EUR 5 billion.

Eight Member States (Austria, Belgium, Croatia, Greece, Ireland, Italy, and Romania) currently have final drafts of their strategies and intend to publish their strategy before the end of 2021.

**Table 1.** Overview of national AI strategies in the EU Member States and Norway

Country	Status	Date	Country	Status	Date
 Austria	In progress		 Italy	In progress	
 Belgium	In progress		 Latvia	Published	Feb. 2020
 <b>Bulgaria</b>	Published	Dec. 2020	 Lithuania	Published	Mar. 2019
 Croatia	In progress		 Luxembourg	Published	May 2019
 <b>Cyprus</b>	Published Last update	Jan. 2020 Jun. 2020	 Malta	Published	Oct. 2019
 Czech Republic	Published	May 2019	 Netherlands	Published	Oct. 2019
 Denmark	Published	Mar. 2019	 Norway <sup>AC</sup>	Published	Jan. 2020
 Estonia	Published	Jul. 2019	 <b>Poland</b>	Published	Dec. 2020
 <b>Finland</b>	Published Last update	Oct. 2017 Nov. 2020	 Portugal	Published	Jun. 2019
 France	Published	Mar. 2018	 Romania	In progress	
 <b>Germany</b>	Published Last update	Nov. 2018 Dec. 2020	 Slovakia	Published	Jul. 2019
 Greece	In progress		 <b>Slovenia</b>	Published	May 2021
 Hungary	Published	Sept. 2020	 <b>Spain</b>	Published	Dec. 2020
 Ireland	In progress		 Sweden	Published	May 2018

Source: JRC – European Commission

Note: Last update of the table on the 1<sup>st</sup> of June 2021. The information in the table is based on input from national contact points or public sources. It presents release dates of national AI strategies in their native language. Countries in bold have published or updated their national AI strategy since the release of the [previous AI Watch report](#) in February 2020. In addition to EU Member States, this table also includes Norway as Associated Country highlighted with the superscript <sup>AC</sup>. Switzerland does not intend to release a national AI strategy.

<sup>24</sup> Switzerland is not included in Table 2 as it does not intend to release a national AI strategy.

<sup>25</sup> The [AI 4.0 programme](#), Ministry of Economic Affairs and Employment of Finland (November 2020).

### 3 Methodology

This report is based on information on national policy initiatives collected by [AI Watch](#) and by the [OECD.AI Observatory](#) and information provided by Member States. The collection of information benefited from close collaboration between JRC, DG CONNECT and the OECD and regular consultations with Member States' representatives.<sup>26</sup> These exchanges were set up so that Member States' representatives could provide initial feedback and – after revision – a formal validation of the information presented in this report.

This report follows the same methodology as the 2020 AI Watch report on national AI strategies (Van Roy, 2020). It provides an overview of AI policies along the key policy areas outlined below and it highlights AI policies to tackle societal challenges related to the climate and environment, and to the COVID-19 pandemic.

#### AI policy areas

The national policy initiatives are presented in this report according to the following policy areas:

- **Human capital:** includes all policies to foster the educational development of people in using and developing AI solutions. It includes aspects of formal education and training (e.g. reforms of educational systems towards the inclusion of AI courses and programmes), vocational and continuing learning (e.g. AI training for the workforce), and labour market intelligence and needs (e.g. identifying forthcoming skill needs due to changes in technology developments);
- **From the lab to the market:** encompasses policy initiatives to encourage research and innovation in AI towards business growth in the private sector and increased efficiency of public services. This area also includes policy instruments to facilitate testing and experimenting with newly developed AI pilots and services;
- **Networking:** covers all policy initiatives related to AI collaborations across private and/or public sectors and directed to increasing the (inter)national attractiveness of the country (e.g. policies aiming at attracting foreign AI talented individuals and firms to the focal country). This area also includes policies related to the dissemination and uptake of AI such as promotional campaigns and mapping of AI players and applications;
- **Regulation:** covers policies for the development of ethical guidelines, legislative reforms and (international) standardisation;
- **Infrastructure:** covers initiatives to encourage data collection, use and sharing, and to foster the digital and telecommunication infrastructure.

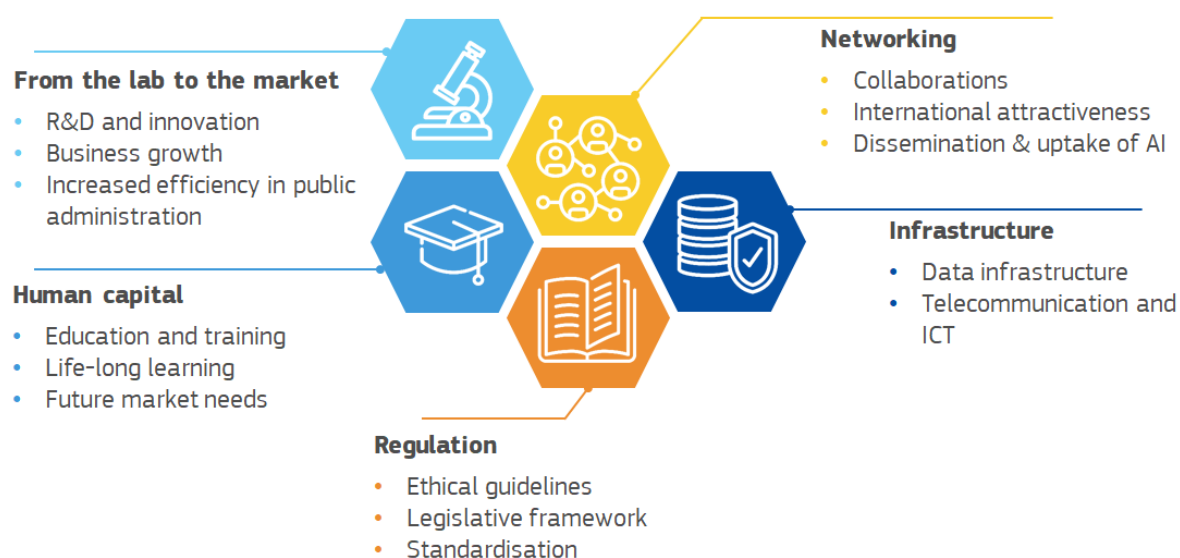
These policy areas are consistent with the actions proposed in the Coordinated Plan on Artificial Intelligence and the policy recommendations to governments contained in the OECD AI Principles.

Figure 1 provides an overview of these relevant policy areas for AI and the key objectives to unleash the full potential of AI in Europe.

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<sup>26</sup> The European Commission organises regular meetings with the [AI Watch Steering Group](#) composed of Member States and Associated Countries representatives. The Steering Group provides strategic guidance and monitors the implementation of AI Watch activities, including the current report.

**Figure 1.** Overview of relevant policy areas for AI



Source: JRC – European Commission

### AI to address societal challenges

In addition to the five abovementioned policy areas, this report includes a specific section on AI policies to address two societal challenges, climate change and the COVID-19 pandemic. The impacts of ongoing climate change and the COVID-19 pandemic are compelling and significantly impact human lives, the environment and economic development. With its recent proposals on the **European Green Deal**<sup>27</sup>, the EU is leading the way in tackling climate and environmental-related challenges. At the same time, the European Commission is working on all fronts to fight the spread of the coronavirus, to support national health systems and to counter the socio-economic impact of the pandemic.<sup>28</sup>

AI is perceived as a game changer in tackling these societal challenges. In this respect, the 2020 White Paper on Artificial Intelligence<sup>29</sup> highlights that (p 2.) “*digital technologies such as **AI are a critical enabler for attaining the goals of the Green Deal***”. The 2021 review of the Coordinated Plan on Artificial Intelligence proposes forthcoming policy actions to foster the role of AI in support of the European Green Deal and the recovery of the ongoing COVID-19 pandemic. In addition, AI has contributed to **countering the current COVID-19 pandemic**. The COVID-19 crisis has acted as a boost for AI adoption and data sharing, and created new opportunities for society and the economy.<sup>30</sup> At the European level, AI is also recognised as a key technology to respond to the socio-economic disruption caused by the COVID-19 pandemic. The Recovery and Resilience Facility (a temporary recovery instrument to raise funds to help repair the immediate economic and social damage and centrepiece to **Europe’s recovery plan NextGenerationEU**, in which 20% of the funding is earmarked for digital including AI) **highlights the importance of green and digital transitions for recovery**.<sup>31</sup>

<sup>27</sup> European Commission, [The European Green Deal](#), COM(2019) 640 final

<sup>28</sup> See the [timeline of EU action](#) for more information about the EU measures in response to the COVID-19 pandemic.

<sup>29</sup> European Commission, [White Paper on Artificial Intelligence: a European approach to excellence and trust](#), COM(2020) 65 final

<sup>30</sup> For the detailed analysis see, [AI Uptake in Health and Healthcare](#), JRC Technical Reports (De Nigris et al. 2020).

<sup>31</sup> See the [Recovery plan for Europe](#) webpage for more information about NextGenerationEU and the Recovery and Resilience Facility.

## 4 Insights from national AI strategies and policies in the EU

This section provides insights from national AI strategies across EU Member States, and Associated Countries (Norway and Switzerland). It highlights a range of policy approaches across diverse policy areas and provides examples of good policy practices. National strategies differ in both the scope and approaches to the regulation of AI, ranging from high-level strategies with different policy initiatives to concrete action plans with specific milestones and time frames (e.g. Bulgaria, Estonia and Hungary). AI policies can also be incorporated in a wider strategy of digital transformation, as for Slovakia. Recently published or updated strategies (e.g. Germany and Spain) include policy initiatives in response to the COVID-19 pandemic and sustainability issues, such as environmental and climate change.

More detailed information on AI policies for each specific country can be found in Section 5 of the report and is available on the [EC-OECD database of national AI policies](#), the [AI Watch Portal](#) and the [OECD AI Policy Observatory](#).

### 4.1 Human capital

As part of the national AI strategies, governments are supporting human capacity building in AI and aim to prepare for the labour market transformations brought about by AI technologies. The objective is to provide current and future generations with the necessary skills and competencies in AI and to anticipate labour market trends. To this purpose, several EU Member States have developed **AI skills strategies** to address the challenges posed by the increasing digital transformation of the world of education and work. For example, as outlined in Malta's AI strategy, the Malta College of Arts, Science & Technology has released an [AI Strategy and Action Plan 2020-2025](#) in which it outlines policy actions towards the introduction of AI in higher education (see Section 5.19.1). Similarly, the Swiss Government published a strategy on [Artificial Intelligence in Education](#) highlighting the opportunities and challenges of AI for the education system (see Section 5.27.1).

Most countries commonly follow a similar policy approach to nurture AI talents. First, national strategies aim to strengthen the provision of AI competencies at all education levels with **supportive policies for education reforms**. Education reforms in the primary and secondary education systems typically include courses on ICT, digital literacy and AI, often complemented with courses on judgement and problem solving, creative and critical thinking, and interpersonal communication. AI competencies at tertiary education levels are fostered through increased support for science, technology, engineering, and mathematics (STEM) subjects, and the creation of Bachelors, Masters, PhD and postgraduate programmes in AI-related fields.<sup>32</sup> To guarantee high-quality levels of education in AI, most countries also develop policies to enhance teachers' competencies in teaching and working with digital and AI technologies.

Second, national strategies also propose actions to promote a culture of **lifelong learning and continuous up/reskilling** of citizens. This is typically done through massive open online courses (MOOCs) and on-the-job trainings in AI for employees in the public and private sector. An example is the Finnish MOOC [Elements of AI](#) (see Section 5.9.1)<sup>33</sup>, which aims to demystify AI with a basic and more advanced course on AI. While Finland initially aimed to train 1% of its population, the course attracted more than 100,000 participants, representing more than 2% of the population. To reach as many people as possible, the online course is being translated into [all languages](#) of the European Union.

Finally, governments are setting up policies to evaluate the **future needs of the labour market** in terms of digital and AI competences. The Czech Republic, for example, will monitor the labour market and anticipate future labour requirements to improve career guidance, worker mobility and reskilling opportunities (see Section 5.6.1). Similarly, Sweden developed a [pilot project](#) to identify the skills needed for better use of emerging technologies such as AI (see Section 5.28.1). Germany is monitoring the impact of AI on the labour market for policy intervention through the Observatory for Artificial Intelligence in Work and Society (or AI Observatory)<sup>34</sup>, and also supports the OECD Programme on AI in Work, Innovation, Productivity and Skills (AI-

<sup>32</sup> A recently published JRC report on [Academic Offer of Advanced Digital Skills in 2019-20. International Comparison](#) provides an overview of the education offer for advanced digital skills in fields such as artificial intelligence, high-performance computing, cybersecurity, and data science (Righi et al, 2020). It covers the EU Member States, Norway, Switzerland, United Kingdom, Canada and United States, and Australia.

<sup>33</sup> The University of Helsinki also released a MOOC on [Ethics of AI](#).

<sup>34</sup> For more information on human capacity building in AI in Germany, see [Germany's human-centred approach to AI](#) on the OECD AI Policy Observatory.



WIPS). AI-WIPS analyses the impact of AI on the labour market, skills and social policy while providing opportunities for international dialogue and policy assessments.<sup>35</sup>

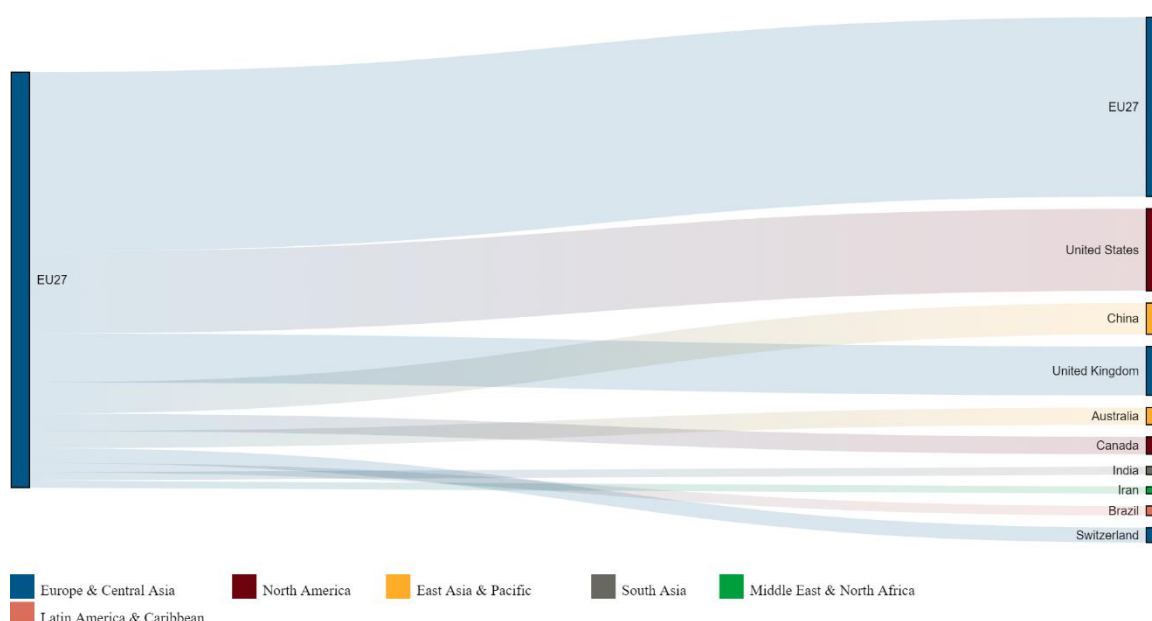
## 4.2 From the lab to the market

Bringing AI developments **from the lab to the market** can only be successful in a well-supported enterprise-driven ecosystem with sufficient scope and funding for AI research and innovation activities<sup>36</sup>, including incentives for experimentation. Funding and support programmes should target the development of initial ideas to pave the path towards promising emerging fields in AI. In addition, it is critical to support the transformation of AI concepts into successful products and services, with policy instruments all along the innovation process from the lab to the market.<sup>37</sup> It equally requires support mechanisms for the uptake and use of AI in public administration.

Against this background, countries have taken various measures to stimulate and support AI research. A large majority of the EU Member States, Norway and Switzerland have developed or are in the process of creating **national competence centres in AI research**. Examples of national competence centres include the Finnish Centre for Artificial Intelligence (FCAI), the French interdisciplinary institutes of Artificial Intelligence (3IA), the Danish National Centre for Research in Digital Technologies (DIREC), the six German Competence Centres for AI Research and the Hungarian Artificial Intelligence National Laboratory (MILAB). Some research centres have a more general approach and target many research fields in AI, others are more specific. The Hungarian National [Laboratory for Autonomous Systems](#) is for instance focused on autonomous systems, while the Polish Centre for CyberSecAI<sup>38</sup> and the forthcoming competence centre in Slovakia<sup>39</sup> are specialised in cyber security procedures for AI systems. Lastly, Estonia has a Competence Centre Specialised in Machine Learning and Data Science (STACC).

Cross-border co-operation in AI research is also a priority for EU countries. Figure 2 illustrates AI international research collaboration.

**Figure 2.** International collaboration on AI research



Source: OECD.AI (2021), visualisations powered by JSI using data from MAG, version of 15/03/2021, accessed on 17/5/2021, [www.oecd.ai](https://www.oecd.ai)

Note: the thickness of a connection represents the number of joint AI publications between two countries for the selected time period. Data downloads provide a snapshot in time. Caution is advised when comparing different versions of the data, as the AI-related concepts identified by the machine learning algorithm may evolve in time. Please see the [methodological note](#) for more information.

<sup>35</sup> For more information on AI-WIPS, see <https://www.oecd.ai/work-innovation-productivity-skills>.

<sup>36</sup> This section also includes co-funded initiatives by e.g. the EU and the OECD.

<sup>37</sup> European Commission, [Coordinated Plan on Artificial intelligence 2021 Review](#), (COM(2021) 205 final)

<sup>38</sup> Established at the [NASK Public Research Institute](#).

<sup>39</sup> As proposed in the [Action plan for the digital transformation of Slovakia for 2019–2022](#).

To increase **innovation in AI** and foster the creation and growth of AI businesses, many countries are complementing existing and general funding instruments for innovation with more AI-focused funding schemes and support programmes. Commonly reported funding instruments that have been in place for many years are innovation vouchers, seed capital, venture capital schemes (particularly targeting SMEs), and business growth programmes. Malta, for example, has reformed its Seed Investments Scheme with more favourable tax credit conditions for innovative AI firms.

Several countries have developed or are developing **AI readiness tools** to evaluate the digital and AI maturity of businesses and to identify government guidance and policy actions for innovation support. The Finnish [AI maturity tool](#) helps organisations to increase their business opportunities in identifying their most important areas for improvement in AI (see Section 5.9.2). Other policies such as the Danish [Sprint:Digital](#) offer support for the digital transformation of Danish SMEs and the development of new digital business models (see Section 5.7.2).

To **support AI start-ups** during their first business years, Belgium, Malta and Sweden have developed dedicated support programmes on AI for young companies. Through the Belgian [Start AI](#) programme and [Tremplin AI](#) programme (see Section 5.2.2), the Swedish [Startup AI activities](#) funding (see Section 5.28.2) and the Maltese [YouStartIT](#) accelerator (see Section 5.19.2), start-ups are supported in their discovery of AI at early stages of the innovation process (e.g. during the proof of concept (PoC) phase). In a similar vein, though not necessarily targeting only start-ups, Finland launched the [Artificial Intelligence Accelerator](#) to facilitate companies in bringing AI experiments into production (see Section 5.9.2). Cyprus and Hungary are planning to set up similar AI accelerator programmes/centres in the near future.

Most countries highlight various **priority sectors** in their national AI strategies with a high potential for AI applications. The most commonly reported sectors are manufacturing, agriculture, healthcare, transport and energy. In addition to these priority sectors, a number of countries prioritised language technologies in their AI strategies as key to enabling interactive dialogue systems and personal virtual assistants for personalised public services. For example, Denmark, Norway, Portugal, Slovakia, and Spain report supportive policies for natural language processing. Slovakia is developing a tool for natural language processing to accelerate the development of AI in the private sector and improve the quality of public services. Spain launched a project on the Spanish Language and AI ([LEIA](#)) to promote and enable the use of the Spanish language in the digital world. These policy efforts continue the action lines outlined in the [National Plan for Advancement in Natural Language Processing](#) (see Section 5.27.5). Denmark is focusing on language technologies to support ‘AI in Danish’ and in June 2020, launched a [platform](#) displaying metadata of existing linguistic resources to facilitate the development of language technologies in Danish (see Section 5.7.5).

Lastly, governments are also setting up policies to spur **AI innovation and use in public administration**.<sup>40</sup> Such policies include AI programmes for public services, e-governance strategies to improve the digitalisation process of public administration, support for innovative public procurement and sharing good practices. Initiatives such as [GovTech Polska](#) and [GovTech Lab Lithuania](#) are good examples of how to boost the innovation ecosystem in the public administration and AI.

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<sup>40</sup> For an Overview of the use and impact of AI in public services in the EU, see the JRC AI Watch report on [Artificial Intelligence in public services](#) (Misuraca, G. & van Noordt, 2020). This report will be updated in 2021.

### 4.3 Networking

Networks and collaborative platforms are important for a swift deployment of AI. Bringing the relevant community together and combining expertise and efforts from various sources can help to seize (the often ambitious) AI opportunities.<sup>41</sup>

Against this background, many governments have set up policies to build **innovation communities** by bringing together tech companies, research centres, innovation actors and citizens. Examples are the Belgian [Beacon](#) initiative, the Czech [Knowledge Transfer Partnerships](#) programme, the Finnish [AuroraAI](#) national programme, the German the [Plattform Lernende Systeme](#), the Norwegian [AI Research Consortium](#), the Polish [Virtual Research Institute](#), the Portuguese [collaborative laboratories](#), and the [SlovakAI](#) platform.

To further increase innovation community building, the governments of Belgium, the Czech Republic, Germany, Finland, Poland and Spain have developed **maps of AI actors and applications**. These maps provide an overview of academic institutions, research centres, public administrations and companies active in AI. They also monitor ongoing technological and scientific activities in AI and encourage networking opportunities.

In addition, EU Member States, Norway and Switzerland support the establishment and further expansion of **digital innovation hubs** (DIHs). DIHs are important channels for networking opportunities to foster the digital and AI transformations of industries. Well-established DIHs in AI-related fields are the [CYRIC Digital Innovation Hub](#) of Cyprus (expertise in IoT and robotics), the [Ventspils High Technology Park](#) of Latvia (expertise in robotics and automation), and the Luxembourg [Digital Innovation Hub](#) (expertise in AI and digital infrastructure, such as HPC and data centres).

Global and Pan-European networks are further developed through initiatives such as the **OECD.AI Network of Experts**. The [network](#) is a multi-stakeholder and multi-disciplinary group that provides AI-specific policy advice to the OECD and contributes to the **OECD.AI Policy Observatory**. It is composed of over 200 experts, including AI policy experts, technical experts and experts from social sciences and humanities. The network consists of a working group on classifying AI systems; a working group on implementation tools for trustworthy AI; **a working group on national AI policies** and a task force on AI compute.

The EC and some EU Member States also participate in the **Global Partnership on AI** ([GPAI](#)). The GPAI brings together experts from industry, civil society, governments and academia. It supports cutting-edge research and applied activities on AI-related priorities. In May 2021, the European Commission and the following EU Member States were involved in the Global Partnership in AI: France, Germany, Italy, the Netherlands, Poland, Slovenia, and Spain.

Many countries are also setting up policies to **attract AI talent and investments from abroad**. To this purpose, some countries have dedicated strategies, such as the researchers' mobility programme in Cyprus and the forthcoming Spanish Talent Hub programme. Other policies aim to improve working conditions for foreign talents by facilitating administrative procedures. This is achieved by simplifying and accelerating procedures to acquire a residence and a working permit for foreign researchers and their family members. The Czech Republic, Finland, Italy, Malta, Portugal and Spain are implementing this through start-up visas and fast-track services for valuable talents coming from abroad.

Lastly, the majority of countries is also **exploiting social media channels and organising public events** to raise awareness on AI and to increase networking opportunities. The Maltese strategy announces for instance a public investment of EUR 1 million per year for promotion campaigns and outreach activities. Slovenia plans to launch a communication platform for the collection and dissemination of good practices and case studies on the use and deployment of AI in society. Similarly, Hungary will organise an annual innovation award for AI application projects to make AI developments visible to the broader public.

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<sup>41</sup> European Commission, [Coordinated Plan on Artificial intelligence 2021 Review](#), (COM(2021) 205 final)

## 4.4 Regulation

The use of certain AI technologies raises ethical and legal issues, necessitating the development of a legal framework for human-centric and trustworthy AI.<sup>42</sup> These issues relate to human rights, privacy, fairness, algorithmic bias, transparency and explainability, safety and accountability, among others.

National actions to address ethical concerns differ across countries in terms of **strategic approach** and level of focus. Finland released the government report on [Ethical information policy in an age of artificial intelligence](#) outlining principles for fair data governance, including guidelines for the use of information and ethical values. Denmark proposes a specific focus on the responsible and sustainable use of data by the public and private sector. In December 2019, a [Data Ethics Toolbox](#) was launched to support companies to adopt and implement data ethics into their business models. In January 2021 a Danish law entered into force on data ethics compliance for Denmark's largest companies. It is accompanied by a [guide for business](#) on how to include data ethics in their annual reports. Sweden established an [AI sustainability centre](#), which acts as a hub co-founded by companies, universities and public authorities with a specific focus on the social and ethical aspects of AI.

To facilitate the development of ethical guidelines many governments have established **AI ethics committees** and councils. These bodies provide recommendations on ethical issues and continuously monitor the use and development of AI technologies. They also raise ethical awareness through the provision of good practices, training and ethical codes of conduct for researchers and practitioners in both the public and private sector.

Many governments also implement monitoring and reward systems for **compliance with principles for trustworthy AI**. Malta has developed an AI [certification](#) framework, issued by the Malta Digital Innovation Authority (MDIA). It serves as valuable recognition in the marketplace that the AI systems of successful applicants have been developed in an ethical, transparent and socially responsible manner (see Section 5.19.4). Similar quality seals or labels - acting as hallmarks for a responsible approach in AI - have been adopted in other countries such as Denmark and Germany. The Czech Republic, Italy, Lithuania, and Spain are considering developing them as well. Similarly, the [AI registers](#) set up by the cities of Amsterdam and Helsinki (see Section 5.9.4) aim to ensure a secure, responsible and transparent use of AI algorithms.

Various EU Member States are setting up **AI Observatories and knowledge centres** to support and enable socially responsible and ethically sound implementations of AI. An example of such an initiative is the planned Artificial Intelligence Regulation and Ethics Knowledge Centre of Hungary. This centre aims to create and coordinate an extensive pool of experts to advise on legal issues and ethics of AI.

In terms of legislation, many governments highlight the need to evaluate the current legal framework and to adopt new EU level legislation to guarantee a **binding regulatory framework** for the successful uptake and deployment of AI. Countries are starting to develop **sector-specific regulations** for well-defined fields of AI that are currently not or not sufficiently covered by existing EU legislation. A notable example in this respect is the regulation on automated driving. Many governments (e.g. Austria, Belgium, Czech Republic, Germany, Lithuania and Spain) have adopted regulations to allow for the testing of automated vehicles and associated technologies on public roads. Other regulatory fields that receive particular attention are (health care) data and automated decision making. Norway is for instance working on proposals for amending its [Health Register Act](#) to delineate the use of data for patient treatments and rules of consent from individuals (see Section 5.21.4). Slovakia is also preparing a new Act on Data to better define regulations on data protection, disclosure principles, data access and open data regulations. Regarding the latter field, the Dutch Government has implemented the Law Enforcement Directive in its national legislation, which contains provisions on automated decision making for law enforcement. Finland and Portugal are also developing national regulations for automated decision-making to determine liability issues among others.

Many governments are also considering the establishment of controlled environments for AI experimentation, for example by developing **regulatory sandboxes**.<sup>43</sup> The objective of the sandboxes is to facilitate experimentation in real-life conditions while temporarily reducing regulatory burdens to help testing

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<sup>42</sup> In April 2021 the European Commission proposed a legal framework for AI, see [Proposal for a Regulation laying down harmonised rules on artificial intelligence](#), (COM(2021) 206 final)

<sup>43</sup> Article 53 of the [Proposal for a Regulation laying down harmonised rules on artificial intelligence](#) (COM(2021) 206 final) includes a provision on AI regulatory sandboxes.

innovations.<sup>44</sup> Although announced in several national AI strategies of EU Member States, Norway and Switzerland, the development of regulatory sandboxes for AI is still at an embryonic stage in most countries. Germany's AI strategy plans the establishment of AI [regulatory sandboxes](#) and [testbeds](#), such as the "Digital Motorway testbed A9" (administrated by the Federal Ministry of Transport and Digital Infrastructure). These make it possible to test technologies in a real-life setting and to screen the regulatory environment and make adjustments (see Section 5.11.2). Similarly, The Italian Government put in place regulatory sandboxes through the [Sperimentazione Italia](#) initiative to facilitate controlled experiments with innovative products, including AI.

## 4.5 Infrastructure

As AI algorithms often involve large amounts of data, it is crucial to establish a solid data environment to collect, share and analyse big data.<sup>45</sup> To this purpose, governments are supporting the development of data infrastructures to ensure the provision of reliable and high-quality data that can be shared with a wide range of users in a robust and accessible way. Several EU Member States have developed specific **national data strategies** to set the foundations for trustworthy data use and exchanges. Commonly, these strategies outline policy actions for open data governance, the creation of data repositories and data management such as the improvement of data interoperability across databases and the protection of individual and collective rights. The [Data Strategy](#) of the German Federal Government for instance identifies four concrete fields of actions: the improvement of data provision and access, the promotion of responsible data use, the increase of data competencies in society and the development of a data culture for data sharing and use. Similarly, the Czech Republic launched a [National Strategy on Open Access to Research Information](#) for the years 2017-2020 to initiate a gradual process to open access to scientific information at the national level. Other countries, such as Spain, integrate their policies towards a data economy into the broader umbrella of the [Digital Agenda 2025](#) strategy.

To create an open data culture, countries are setting up **open data and open science policies**. In this respect, the Portuguese [Open Data Policy](#) and the Danish [Open Science Policy](#) are good examples of how to provide guidelines for managing and sharing data in the scientific community, while ensuring data integrity and open access.

Open **data platforms and portals** have been developed in all EU Member States, Norway and Switzerland. They commonly aim to provide free access to data of the public administration and to encourage its secondary use. In addition to non-commercial data, some governments are planning to support commercial data platforms. Hungary for instance foresees to support the creation of a data market place to encourage the transmission of non-personal data of high quality for commercial purposes.

Finally, several EU Member States and Norway have set up governance bodies and **data chief officers** to support and encourage data utilisation. These public bodies act as facilitators to coordinate and stimulate the management of national data assets and to foster open data governance.

A wide range of policies is also taken by governments to **foster the quality and capacity of the telecommunication and ICT infrastructure**, crucially needed to enhance data analytics resources for AI. All Member States and Associated countries mention supporting the access to secure data storage, high-performance computing, affordable high-speed broadband networks and next-generation software for data analytics. Participation in the **European High-Performance Computing Joint Undertaking** ([EuroHPC](#)) is often highlighted in national AI strategies. EuroHPC announced eight sites to host world-class supercomputers. They are located in Sofia (Bulgaria), Ostrava (Czech Republic), Kajaani (Finland), Bologna (Italy), Bissen (Luxembourg), Minho (Portugal), Maribor (Slovenia), and Barcelona (Spain). Some countries have also released dedicated strategies for the creation of high-performance computing. The [Advanced Computing Portugal 2030](#) strategy outlines action lines to transform Portugal into an advanced computing service economy by 2030 (see Section 5.23.5). In addition, governments are increasing computing capacities through investments in **cloud services and quantum computing**. In this respect, the [Malta Hybrid Cloud](#) initiative procured by MITA is an example of how to enable access to cloud platforms for the public and private sector

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<sup>44</sup> In addition to regulatory sandboxes, the [Coordinated Plan on Artificial intelligence 2021 Review](#) (COM(2021) 205 final) outlines forthcoming EU actions on Testing and Experimentation Facilities (TEFs) and European Digital Innovation Hubs (EDIHs) to support innovation and uptake of AI technologies.

<sup>45</sup> European Commission, [A European strategy for data](#), COM(2020) 66 final, 2020



(see Section 5.19.5). Finally, governments mention their support for high-quality connectivity and nationwide 5G deployment.

## 4.6 AI to address societal challenges

### Climate and environment

To tackle the ongoing climate change and environmental challenges, Member States and Associated Countries are embracing AI solutions and support the development of innovative ideas from the lab to the market. As highlighted in the Coordinated Plan on AI 2021 review<sup>46</sup>, AI technologies could primarily support the achievement of the Green Deal objectives through four main channels: 1) transition to a circular economy, 2) better setup, integration and management of the energy systems, 3) more efficient transport, and decarbonisation of buildings, agriculture and manufacturing, and 4) enabling new solutions that were not possible with other technologies.

Many governments are setting up **ambitious R&D programmes and calls for proposals** to support the development of AI solutions for the achievement of the Green Deal objectives. Prominent examples are the German [Lighthouses of AI for Environment, Climate, Nature and Resources](#) (see Section 5.11.6), the Lithuanian call for proposals on [Green industry innovation](#) (see Section 5.17.6) and the Swedish R&D call on [AI in the service of climate](#) (see Section 5.28.6). These programmes commonly target applied research projects, not only in the fields of energy efficiency and reduced greenhouse gas emissions but also e.g. for the protection of biodiversity, water management and sustainable consumption.

At the same time, the **education offer with a combined focus on AI and environmental issues** remains rather limited. Most Member States are expanding their education offer at all levels, including formal and informal education programmes for advanced digital skills in fields such as AI and high-performance computing. However, little attention seems to be given so far to the development of education programmes that teach how AI can be used to address critical and global environmental challenges.<sup>47</sup>

The creation of AI technologies for a greener and more sustainable economy and society is further supported through the **development of cutting-edge data ecosystems and high-end ICT infrastructure**. Countries, such as France and Switzerland, have for instance developed **strategies on energy and data**.<sup>48</sup> These strategies outline recommendations and policy actions to mitigate climate change and to support digital and AI-related innovations for energy efficiency based on improved data infrastructures. Other countries, such as the Netherlands and Latvia support the use of AI to **exploit the vast and often untapped environmental data sets** in their public administrations. To this purpose, the Royal Netherlands Meteorological Institute ([KNMI](#)) provides access to its databases and has created the [KNMI DataLab](#) to facilitate and coordinate innovations in the fields of climate change, weather forecasting and seismology (see Section 5.20.6). Similarly, Latvia provides access to the data repositories from the Latvian Environmental, Geological and Meteorological Centre ([VSIA](#)) containing meteorological radar images, measurements, and forecasting data. In addition, **high-performance computing centres** run the data-driven and computationally-intensive environmental models. Ireland has various projects at the Irish Centre for High-End Computing ([ICHEC](#)). First, in collaboration with other institutes, this centre has established various national platforms to ensure the provision of high-quality data (on satellite images and oceanographic data, among others) and to enhance possibilities for data exchange. Second, the complex compute solutions and infrastructures of the centre are used in many collaborative projects with public institutions both at the national and European level.<sup>49</sup> Moreover, other high-performance computing centres, such as the Vienna Scientific Cluster 4 ([VSC-4](#)) and the Bulgarian Strategic Centre for Artificial Intelligence ([SCIA](#)) leverage their facilities to forecast the impact of climate change using big data and machine learning techniques.

### COVID-19 pandemic

To quickly respond to the COVID-19 pandemic, governments actively support the development of AI-powered technologies with **targeted R&D programmes and investment funds**. Member States and Associated countries are supporting dedicated research projects within hospitals, research centres, and universities. For

<sup>46</sup> European Commission, [Coordinated Plan on Artificial intelligence 2021 Review](#), (COM(2021) 205 final)

<sup>47</sup> Out of 1032 education programmes identified in the field of AI in the JRC report '[Academic Offer of Advanced Digital Skills in 2019-20. International Comparison](#)', it identifies only one with a combined focus on AI and environmental issues.

<sup>48</sup> For more information about these policy reports, see Section 5.10 for France and Section 5.29 for Switzerland.

<sup>49</sup> See Section 5.14.1 for an extensive list of projects in which the Irish Centre for High-End Computing ([ICHEC](#)) participates.

example, the Danish Government has allocated a total of EUR 20 million for [research and development](#) to combat the pandemic and has launched various [signature projects](#) on AI and health.<sup>50</sup> Similarly, Ireland established the [Rapid Response Research and Innovation](#) programme in March 2020 to enable the research and innovation community to respond to the challenges raised by the pandemic. Other examples include the [R&D projects](#) at the Finnish Centre for Artificial Intelligence, the [AI-enabled methods](#) to model the COVID-19 replication process at the French HPI research laboratory, the innovative AI-powered tools to track and model the spread of the virus at the Dutch National Institute for Public Health and the Environment and the [COVID-19 Activities](#) at the Swiss Tropical and Public Health Institute.

To increase the speed of scientific breakthroughs for developing COVID-19 solutions, many governments are encouraging **national and international collaborations** among relevant stakeholders, including the public sector, private sector, and civil society. This is commonly done by fostering collaborative partnerships and organising hackathons, which help to collect innovative ideas about deployable AI and robotics solutions to face the ongoing COVID-19 crisis. Notable examples of initiatives supporting **collaborative partnerships** are the EU Framework programmes (e.g. Horizon2020) and the Global Partnership on AI (GPAI).

With respect to Horizon2020, in August 2020, the Commission announced to support 23 new collaborative research projects with EUR 128 million in response to the continuing coronavirus pandemic.<sup>51</sup> Also, the GPAI is supporting the responsible development and use of AI-enabled solutions to COVID-19 and other future pandemics. To this end, a working group on AI and pandemic response has been formed to promote cross-sectoral and cross-border collaboration in this area. Multiple **hackathon** events have been organised in Europe. Among them, the [#EuvsVirus](#) hackathon promoted cross-European partnerships to come up with innovative solutions to fight against the COVID-19 pandemic.<sup>52</sup> Many countries, such as the Czech Republic, Greece, Latvia and Lithuania have also organised hackathons at a national level.

The global challenges stemming from the COVID-19 pandemic have urged governments to **provide access and promote sharing of research data**. In April 2020, the European Commission and several stakeholders established a [COVID-19 data portal](#) to enable rapid and open sharing of research data. Similarly, the Swedish COVID-19 [Data Portal](#) provides information, guidelines, tools and services, to support researchers to use Swedish and European infrastructures for data sharing.

Various AI-enabled technologies such as **virtual assistants and chatbots** have been launched to help governments and healthcare organisations provide people with reliable information about COVID-19. Examples of these AI solutions include the Czech Republic's [chatbot](#), Estonia's chatbot [Suve](#), Lithuania's AI-powered virtual assistant [ViLTē](#) and France's virtual phone assistant [AlloCOVID](#). All these AI-powered solutions have the objective to provide accurate and trustworthy information about the emerging situation related to COVID-19.

Finally, countries offered their **support in the field of high-performance computing (HPC)** to help to find treatments for the novel coronavirus. In this respect, the EU-funded Exscalate4CoV ([E4C](#)) project is a good example of how European supercomputers can be used to find new therapies for COVID-19. This project consists of a coalition between public and private partners located across seven European countries (Belgium, Germany, Italy, Poland, Spain, Sweden and Switzerland). Participating pharmaceutical firms, research institutions, and biological laboratories exploit the computing power of three HPC centres in Bologna, Italy; Barcelona, Spain; and Jülich, Germany.

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<sup>50</sup> See Sections 5.7.2 and 5.7.6 for more information about these initiatives.

<sup>51</sup> See European Commission press release on [new research projects](#) to address the COVID-19 pandemic.

<sup>52</sup> Examples of winning projects proposing AI solutions and having their headquarter in EU Member States are the Italian [aiLearning](#) and [Jobiri](#) projects (see Section 5.15.6) the Lithuanian [Katana ML](#) project (see Section 5.17.6), the Luxembourg [COVID19 Smart Screening Tool](#) (see Section 5.18.6), the Spanish [PoCOVIDscreen](#) project (see Section 5.27.6), and the Greek [SERS4SARS](#) project (see Section 5.12.1). Many of these projects are conducted with the participation of other Member States.

## 5 Country reports

This section includes country reports for all EU Member States, Norway and Switzerland. The country reports provide an overview of the status and implementation of national AI strategies. It outlines ongoing and planned policy initiatives to foster AI deployment in the economy and society.

Policy initiatives are presented across various policy areas including human capital (i.e. educational development), from the lab to the market (i.e. R&D and innovation, business and public sector development), networking (i.e. collaboration and dissemination), regulation (i.e. ethical guidelines, legislation and standardisation) and infrastructure (i.e. data and telecommunication infrastructure). The policy overview is complemented with a dedicated section on AI policies related to the societal challenges concerning environment and COVID-19. This latter section presents national initiatives that support AI solutions to address environmental sustainability (in line with the European Green Deal) and to tackle the COVID-19 pandemic.

The last section of country reports relates to monitoring and future update as it highlights 1) the public body in charge of implementing and monitoring the AI strategy, 2) the time period covered by the strategy, and 3) when updates may be expected.



## 5.1 Austria

In August 2017, the Ministry for Transport, Innovation and Technology established a [Council on Robotics and Artificial Intelligence](#). It consists of experts on robotics and AI from research centres, academia and industry and it serves as an advisory board to provide recommendations about the current and future challenges and opportunities of AI. The council has been commissioned to help the Ministry to develop its national AI strategy.

The Austrian Government has been very active in shaping policy initiatives for the future of AI in Austria. In November 2018, the Council published the [white paper](#), entitled Shaping the future of Austria with robotics and artificial intelligence, with policy recommendations on robotics and AI, covering policy areas related to smart governance, smart innovation and smart regulations. The Federal Ministry also highlights the use of AI for evaluating judicial proceedings, as mentioned in its [National e-justice strategy](#). In June 2019, the Austrian Government issued the policy report [Artificial intelligence mission Austria 2030](#) (Austria, 2019) providing the first steps towards an official strategy for AI.

Under the direction of the Federal Ministry for Climate Action and Federal Ministry for Digitalisation the Austrian AI strategy has been finalised and is currently under political consultation. It defines the framework conditions for a prosperous, responsible and safe use of AI in all areas of life in accordance with European requirements for trustworthy AI. The objectives of the Austrian strategy are formulated in close coordination and comprehensive agreement with the AI foundations, objectives and joint action of the European Union. Key focus areas will include regulatory framework (ethics, legal), safety and security of AI, defining standards, AI infrastructure, data use and sharing, conditions for R&D&I, transfer and uptake of AI, cooperation between education, research and business societal dialogue and creating awareness, and AI in the public sector.

The AI strategy is expected to be released by the end of Q2 2021.

### 5.1.1 AI to address societal challenges

#### Climate and environment

Several initiatives are currently ongoing in Austria to support the use of AI in reaching the ambitious climate and energy targets:

- Contributing to the Mission Innovation ([MI](#)) initiative, which regroups 20 countries and the European Commission. This initiative supports the development of clean energy technologies and identifies the innovation needs, challenges and opportunities of clean energy in addressing the climate change. In this endeavour, AI plays an important role as highlighted in the summary report of the Mission Innovation Austria Week Pre-Event on [Artificial intelligence and 5G technologies in future integrated energy systems](#). Mission Innovation Austria is supported by the Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology;
- Strengthening the Vienna Scientific Cluster 4 ([VSC-4](#)), which is the most powerful supercomputer in Austria. This high-performance computing facility is established and managed by a network of several Austrian universities and it enjoys considerable financial support from the Austrian Federal Ministry of Education, Science and Research ([BMBWF](#)). Among others, this supercomputer supports research projects that forecast the impact of climate change using big data and machine learning techniques.
- The Austrian Federal Ministry for Climate Policy, Environment, Energy, Mobility, Innovation and Technology ([BMK](#)) is launching a call for proposals for AI in June 2021. The "AI for Green" programme promotes research-intensive technologies in the field of AI. The fields of application include both climate protection (mitigation) and adaptation to the consequences of climate change.

#### COVID-19 pandemic

To ensure favourable conditions for the development of AI-enabled technologies that counter the COVID-19 pandemic, the Austrian Government strengthens **support initiatives towards promising start-ups**. These support initiatives could significantly increase the proliferation of successful use-cases in which AI acts as a key enabler to fight the COVID-19 outbreak, such as:

- The Viennese start-up [Prewave](#), a spin-off from the Vienna University of Technology, has created a [Coronavirus disruption map](#) to monitor and prevent disruption of the supply chain caused by COVID-19. This map uses AI to analyse vast amounts of data from news channels, social media and industrial partners in more than 50 languages to provide a visual representation of interrupted supply chains for coronavirus hotspot areas. Specifically, this map depicts the effects of the coronavirus pandemic on industrial supply chains, focussing on the hotspots that are important for industrial manufacturing, including China, the USA, India and European countries such as Austria, Germany, Italy, Spain, France and the UK;
- The Graz-based company [KML Vision](#) launched a new and free image analysis application capable of detecting COVID-19 cases from chest X-rays on their [online platform IKOSA](#). The underlying AI model is based on an algorithm published by a Canadian research group from the University of Waterloo and DarwinAI.





## 5.2 Belgium

The Belgian Government plans to release its national AI strategy in the first quarter of 2021. The objective of the national AI strategy is to provide a strategic and operational action plan for the development of AI in Belgium. It takes stock of the policy report of the [AI4BELGIUM](#) coalition and presents ongoing actions and plans for the future along three strategic pillars and thematic priorities:

- Creating a technological impact by supporting high-quality expertise in AI and outlining a responsible data strategy for AI;
- Ensuring social and economic benefits by encouraging continuous skills development in AI, building a robust and prosperous AI economy and optimising public services through AI;
- Building appropriate conditions for the development of an ethical, resilient and secure society through AI.

The transversal nature of AI and its pervasive impact on the Belgian economy and society at large, calls for a multi-level governance approach given the division of competencies in a federal state such as Belgium. To take this into account, the Belgian AI strategy presents policy actions at federal and regional level, distinguishing between measures for the Federal State, Flanders, the Walloon region, Brussels Capital and those of the Wallonia-Brussels Federation.

In March 2019, the Flemish Government launched the [Flemish action plan](#) to foster AI in Flanders. The Flemish AI action plan foresees an annual budget of EUR 32 million for its implementation, broken down as follows: EUR 15 million dedicated to the implementation of AI within companies, EUR 12 million allocated to basic research, and EUR 5 million to supporting measures (training, ethical and legal aspects related to AI-adoption, and outreach activities). This funding is complemented with other policy instruments of both FWO (funding for HEIs) and VLAIO (funding for enterprises). In 2020 FWO invested about EUR 15 million and VLAIO some EUR 45 million in AI related projects. The same amounts are expected for the following years.

In the Walloon region the [DigitalWallonia4.ai](#) programme has the objective of accelerating the adoption of AI in the region. This programme is supported by the Digital Agency, Agoria, the ICT Cluster Infopole and the AI Network. Its official launch was celebrated on November 27, 2019 but the effective start took place on July 1, 2019. The overall budget, which also includes industry 4.0 and the regional digital strategy "Digital Wallonia", is EUR 18 million per year. Since December 2020, the regional AI programme includes a research project called "[ARIAC by DigitalWallonia4.ai](#)" launched in the framework of the TRAIL consortium, which brings together universities and research centres in the Wallonia-Brussels Federation. The EUR 32 million project is funded by the Walloon Region and runs from 2021 to 2026.

Although the Brussels region does not have a dedicated action plan for AI, it launched a wide range of initiatives in order to boost AI-related activities in Brussels. All these initiatives have been recently listed on a new [website](#), in order to clarify the regional support offer for AI. This website includes information over all the public and semi-public programmes, and more specifically everything related to funding, training, accelerations programmes, support services, the AI ecosystem and available data.

Besides, in the last two years, the regional innovation funding body [Innoviris](#) has been playing a major role in the support of AI-related research and innovation effort, through a strong development of its support programmes with a dedicated budget of EUR 22 million. Overall, the region has already invested around EUR 44 million in AI since 2017.

The Belgian AI strategy draws up a comprehensive overview of AI actions and support programmes at federal level and in the various regional ecosystems. A summary of the national and regional AI policy initiatives is presented below across the main policy areas related to human capital, R&D and innovation, networking, regulation and infrastructure.

### 5.2.1 Human capital

One of the key cornerstones for a successful deployment of an AI ecosystem is the access to human capital in AI. Against this background, the Belgian strategy highlights the need to encourage continuous development and maintenance of AI knowledge. The Belgian AI strategy aims to tackle this challenge at various fronts.

First, it foresees the **reinforcement of human skills in AI at all education levels**. This includes reforms at primary, secondary and tertiary education levels to integrate AI-related courses and programmes in the

school curricula. It equally requires training and upskilling opportunities for teachers to teach AI-related courses. Second, various policies provide tailored incentives for **lifelong learning and reskilling** at large scale through massive open online course (MOOCs) and reskilling programmes to acquire the necessary digital skills.

#### *Flanders*

In order to foster the development of AI knowledge and skills in Flanders, the Flemish Government supports various policies to increase STEM and digital skills (including AI-related subjects) at all education levels:

- Stimulating AI in primary and secondary education through the [Smart Education @ Schools](#) programme, and tools such as the [EDUbox on AI](#), the [STEM academy](#) (with an overview of all STEM-related activities outside school hours for students between 5 and 18 years), and [STEM partnerships](#);
- The Flemish Agency for Innovation and Entrepreneurship ([VLAIO](#)), in collaboration with the Flemish Ministry of Education, aims to foster personalised learning methods in digital skills in primary and secondary education through projects as “School of the Future” and [i-learn](#);
- Supporting the reform of Bachelors and Masters Programmes to include AI-related courses (a list of academic offers in Flemish universities is available in the national AI strategy);
- The Flemish Government has approved its “Action plan DigiJump”, which is an ICT plan to support schools in delivering qualitative digital education with attention for data literacy, data usage and AI.

In addition to education reforms, the Flemish Government also supports practical courses in STEM and AI-related subjects in the context of lifelong learning, targeting the workforce and citizens in general:

- The higher levels of secondary schools can call upon [DataBuzz](#) and the [VUB AI Experience centre](#) for educational support on AI and robotics applications and demonstrations. The two expertise centres on Data and Society and Media Literacy cooperated in creating [open teaching modules on AI](#) that are distributed via the educational portal [Klascement](#) (targeting schools);
- Massive online courses: Already two [online courses](#) on AI organised by Agoria and a [MOOC](#) from the Flemish Employment and Vocational Training Service (VDAB) to understand the basics of AI, to learn about the business drivers for AI and to receive practical guidance on how to get started with AI business opportunities;
- The master course on [Data Innovation beyond the Hype](#) led by the Sirris Data and AI Competence Lab ([EluciDATA Lab](#)), provides pragmatic and industry-oriented sessions and webinars on data-driven innovation;
- The [AI Academy](#), an initiative set up by the Howest University of Applied Sciences ([Howest](#)) and the Flemish employer’s organisation ([Voka](#)), offering a series of seminars for entrepreneurs interested in AI applications.

Overall, the [Flemish action plan](#) for AI foresees the following investments to enhance continuous skills developments in AI:

- Fostering and developing strong digital skills for students, doctoral candidates and high profile professionals via the [Flemish AI Academy](#)<sup>53</sup> that collects, creates and distributes courses and trainings on AI (EUR 1 000 000 per year);
- Accelerating the cross-cutting implementation of digitalisation through targeted initiatives for the coaching and guidance of schools and teachers (EUR 1 000 000 per year);
- Improving AI/digital skills competence building in the job/on the floor (EUR 1 000 000 per year).

#### *The Wallonia-Brussels Federation*

The growing importance of AI in society is reflected by its increased presence in education. More AI training in primary, secondary and tertiary education systems is fostered through the following actions in the Wallonia-Brussels Federation:

- Provision of state-of-the-art technology equipment to the primary and secondary schools of the Wallonia-Brussels Federation through the [Digital School](#) project;

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<sup>53</sup> Not to be confused with the AI Academy mentioned earlier.

- Projects to raise pupils' awareness of new technologies on a pedagogical platform ([E-class](#)), to motivate pupils to acquire ICT skills ([ICT passport](#)), to organise conferences for school leaders and teachers on emerging trends and changes in education ([#edTechforum](#)) and to provide initiation courses on coding for pupils and computer science courses for teachers ([Wallcode](#));
- The [Wallonia Wonder Women](#) campaign fosters the participation of girls in science and technology fields;
- University Masters and Bachelors tracks containing AI-related courses (a list of academic offers in Walloon and Brussels' universities is available in the national AI strategy).

#### *The Brussels-Capital Region*

The Brussels-Capital Region is committed to raising awareness among students and promoting the choice to engage in a STEM discipline, through various initiatives:

- [STEM Projects](#), a programme granting subsidies to entities (companies, non-profit organisations, research centres) promoting STEM. 80 to 90 projects are thus taken up annually, receiving a subsidy ranging from 5,000 to 10,000 euros;
- [Brussels Science Promotion Network](#), a networking programme for actors active in the field of science promotion;
- [STEM Project Call](#), a funding programme for STEM micro-projects. In 2021, the theme of the project call is "Science for Climate";
- The yearly election of a [Science Ambassador](#) to promote science and technology to women;
- The yearly edition of the [I Love Science Festival](#), which consists of three days of experiments, labs, activities, conferences, workshops and exhibitions.<sup>54</sup>

Following policy actions are ongoing to equip the current and future workforce with digital and AI-related skills in the Brussels-Capital Region:

- IT training and awareness raising by [mapping](#) the various ICT courses available mainly for jobseekers and students in the Brussels Region;
- The establishment of [Digitalcity.brussels](#), as part of Brussels [Next Tech plan](#), to improve the quality and availability of ICT training in Brussels region, among others;
- Supporting initiatives that provide digital and AI-related courses and training for the workforce and job seekers, such as the technology hub [MolenGeek](#), the [BeCode](#) training programme in AI, and [Numeria](#) providing a complete training programme for business, project or developer profiles with 4 skill levels.

The Wallonia-Brussels Federation (WBF), Walloon region and Brussels-Capital region aim to further strengthen collaborations in education in the future as stated in WBF's [Declaration of community policy 2019-2024](#) and the [General policy statement 2019-2024](#) of the Walloon Government.

### **5.2.2 From the lab to the market**

The Belgian AI strategy contains a myriad of policy initiatives to **spur research and innovations in AI**. The objective is to support businesses in their innovative process in bringing AI applications to the market and to create a competitive enterprise-driven AI ecosystem. At the federal level, research and innovation are stimulated through a series of tax incentives. This is achieved through favourable tax measures of R&D staff, deduction of notional interests for companies, and tax credits among others. In addition, the public service responsible for programming science policy ([Belspo](#)) is funding a wide range of AI-related research projects.

Furthermore, the Belgian AI strategy calls for initiatives to **stimulate the uptake of AI applications in the public administration**. Several federal public services (FPS) have introduced AI methodologies to increase the efficiency and quality of their services. [FPS BOSA](#) has also a number of ongoing initiatives concerning the development of AI applications (e.g. the use of AI for a chatbot pilot and for the audit of the accessibility of websites).

These federal measures are complemented with ongoing and planned policy actions at regional level.

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<sup>54</sup> The 2020 edition could not take place due to the sanitary restrictions caused by the COVID-19 pandemic.

## Flanders

To strengthen cutting-edge strategic research on AI in Flanders, the Flemish Government approved the implementation of the [AI research programme](#) in June 2019. This programme is the first pillar of the [Flemish action plan](#) to foster AI in Flanders. With an annual budget of EUR 12 million, the **AI Research Programme** supports demand-driven applied research in Flanders in the field of AI and addresses four strategic challenges:

- Help to make complex decisions through data science: hybrid, automated, trusted, and actionable;
- Deliver AI to the edge: real-time & power efficient AI;
- Interact autonomously with other decision-making entities: multi-agent collaborative AI;
- Communicate and collaborate seamlessly with humans: human like AI.

Roadmaps have been developed for each challenge, including feasibility milestones. The research programme is adapted each year to meet future research needs.

The research agenda for AI in Flanders is supported by a wide range of academic institutions, research laboratories, associations and governmental institutions such as the federal employer's organisation ([Agoria](#)), the Flemish Department of Economy, Science and Innovation ([Ewi](#)), the Flemish research foundation ([FWO](#)), the Interuniversity Microelectronics Centre ([Imec](#)), the collaborative research centre for Belgian technology industry ([Sirris](#)), the Flemish Agency for Innovation and Entrepreneurship ([VLAIO](#)), and the Flemish employer's organisation ([Voka](#)).

Financial support of the Flemish AI research programme is complemented with funding available through the regular, bottom-up instruments of both FWO (funding for HEIs) and VLAIO (funding for enterprises). Thanks to these regular instruments, in 2020 FWO invested about EUR 15 million and VLAIO some EUR 45 million in AI related projects.

Lastly, cutting-edge research in AI is further supported through the establishment of the VUB [AI experience centre](#) and initiatives for public-private partnerships between research, industry and public authorities such as the [City of Things](#) project on smart cities in Antwerp.

A second part of the [Flemish AI policy plan](#) focuses on the implementation of AI in the Flemish business community and **support for AI innovations**. Under this implementation component, VLAIO is designated as a driving force. With an annual budget of EUR 15 million, different types of actions with the following objectives are put forward:

- To raise awareness, to inform and to advise companies about the possibilities of AI;
- To guide and support companies in their AI applications;
- To support companies developing AI technology.

The Flemish AI policy plan also draw particular attention on the development of **AI for the healthcare sector**. In line with the Flemish policy plan for 2019-2024 and the framework of [Flanders Care](#), a specific focus is given to support new cooperation models between the public health care sector and the industry. Agoria has recently launched an [AI-MOOC for the health sector](#).

Finally, to further promote AI innovations, Flanders supports the development of test environments. To this purpose, the [Sandbox Vlaanderen](#) initiative has been launched to provide companies a safe environment to **test and validate new products and technologies**. Although this initiative is not specifically targeting AI, it is beneficial to AI start-ups and SMEs that search for testing, piloting and experimentation infrastructure.

With respect to the **uptake and stimulation of AI in public administration**, the Flemish region foresees the following initiatives:

- The courses and training offerings of the FAIA (see elsewhere) can also be attended by civil servants;
- Innovative Public Procurement programme: this [programme](#) is an initiative of the Flemish Government and is managed by the Flemish Department of Economy, Science and Innovation ([Ewi](#)). It enables different public services to launch innovative AI projects, among others. The public services which form part of this programme are entitled to fifty percent co-financing for the implementation of their projects.

The national AI strategy document also provides a comprehensive overview of existing and planned AI applications in public services.

### *The Walloon Region*

As part of the [DigitalWallonia4.ai](#) programme to accelerate the adoption of AI in Wallonia, two action plans have been launched to **foster the development of AI innovations** in Walloon businesses:

- [Start AI](#) programme: the objective is to support companies in their discovery of AI, through a 3-day coaching by one of the members of the AI expert pool of Digital Wallonia. The AI expert helps businesses to identify opportunities through AI, measure their return on investment and define an action plan for the implementation of AI. 4 calls for "Start AI" projects have been launched since the launch of the programme. More than 60 companies have been supported by the Experts of the DigitalWallonia4.ai AI Expert Pool;
- [Tremplin AI](#) programme: this initiative intends to support promising proof of concepts (PoCs) on AI in the Walloon Region. Currently, the programme supports 19 PoCs submitted by individual firms and 8 PoCs involving a collaborative consortium of firms. More PoCs may be supported in the future, potentially within sectoral themes;
- [Cap AI](#) programme: launched in April 2021, this programme aims to support companies in bringing their AI solution to market with the help of a strategic expert.

In order to further support Walloon digital start-ups, the Digital Wallonia programme established the Wallonia Innovation and Growth ([W.I.N.G](#)) fund. Launched in 2016, more than 60 start-ups were already eligible for funding totalling around EUR 7 million of financial support.

Several subsidies, and financial grants to companies have been simplified and brought together in the form of a [business voucher](#). Launched in 2017, this business support system helps to speed up, and simplify the access to financial support. In total, over EUR 2 million of funding has already been allocated in the form of vouchers for almost 400 companies.

With respect to the **uptake and stimulation of AI in public administration**, the Walloon region foresees the following initiatives:

- Establishment of a Chief Information Officer ([CIO](#)): A CIO team was established in 2019 for a three year period to develop an integrated digital strategy for the Walloon Public Services, focusing on building innovative and inclusive digital governance;
- As part of the Digital Wallonia strategy, the [Smart Region](#) project aims to propose a new model of governance for Walloon cities in order to transform them into Smart Cities. The idea is therefore to rethink the experience of public administration offered to citizens. A budget of EUR 4 million was allocated to the Smart Region project in 2019;
- As part of the DigitalWallonia4.ai programme, a study on the impact of AI in the public sector has been funded. In addition, a Start AI programme dedicated solely to public organisations was developed.

Lastly, Wallonia is making its mark with an ambitious research initiative called Trusted AI Labs ([TRAIL](#)) launched with the help of Digital Wallonia, among others. TRAIL is a consortium bringing together the universities and research centres of the Wallonia-Brussels Federation. TRAIL is partly materialised through the TRAIL Factory marketplace, which represents a platform for hosting technological bricks developed by research in Wallonia for the Walloon and international ecosystem. The platform is currently under development.

Within the framework of TRAIL, a first research project was formalised in December 2020. This project is called "[ARIAC by DigitalWallonia4.ai](#)" and is based on an agreement between the Walloon Region - including a major involvement of the Public Service of Wallonia on Economy, Employment and Research ([SPW-EER](#)) - and the actors of the TRAIL consortium. This research project has a budget of EUR 32 million spread between 2021 and 2026. In particular, it aims to finance 50 PhDs in 4 technological orientations seen as strategic for the Region: Human and AI, Trusted AI, AI-models hybridisation and Embedded AI.

### *The Brussels-Capital Region*

In the last two years, the regional innovation funding body [Innoviris](#) has been playing a major role in the support of AI-related research and innovation efforts in Brussels. Back in 2018, Innoviris launched for instance the Anticipate programme to support projects implemented by academic researchers who have a forward-looking vision in the field of AI. Financial and operational support for **applied research in AI** is achieved through a strong development of policy programmes of Innoviris, such as:



- The [R&D Project](#): a financial support instrument made available by Innoviris to companies wishing to implement an innovative R&D project;
- The [Joint R&D Project](#): a funding programme to foster collaboration between academia and the industry. In 2020, the theme of the programme was ‘The Industry of Tomorrow: Green, Human & Smart’, referring in particular to AI;
- [International projects set-up](#): a funding programme to help companies in preparing submissions for European R&D programmes (e.g. Horizon 2020, Horizon Europe);
- [Eureka clusters](#): Innoviris offers support to companies interested in joining the European network Eureka Clusters, which brings together a multitude of companies with a common objective: to invest together in the development of new technologies in sectors that are strategic for European competitiveness, such as AI.

From an industrially focused approach, Innoviris has a wide range of initiatives to **foster innovation in AI**, such as:

- [Innovation vouchers](#): a maximum of EUR 10,000 in financial aid offered by Innoviris for limited technical support in a research centre. This initiative mainly targets start-ups and SMEs and echoes the [Start AI](#) programme of Digital Wallonia;
- In addition to the various R&D programmes mentioned above, Innoviris funds AI and data related projects for more than EUR 6 million subsidy per year (equivalent to a quarter of its budget dedicated to industrial support) through its open calls dedicated to companies;
- Financial support for start-ups (not specifically targeting AI) through initiatives on seed capital funding ([Bruseed](#)), business concepts ([proof of business](#)), and incubation and coaching services ([ICAB](#));
- As part of Brussels [Next Tech plan](#) for the period 2017-2020, the Brussels Capital region has supported various AI-related projects involving companies, research centres and academic institutions.

While the approach so far was meant to be cross-sectorial, Innoviris is now engaged in a more specialised track with for example an ongoing call dedicated to predictive medicine and an upcoming call dedicated to Industry 4.0.

The SPW-EER also offers funding programmes dedicated to research. Numerous actions are [regularly published](#) and address a wide range of research fields, including digital and AI:

- [Win2Wal](#): support research projects with a high potential of valorisation in themes linked to identified strategic industrial needs;
- [BelCOO](#): Innovate in collaboration with companies in Flanders, Wallonia and/or Brussels and work on a transregional research or development project.

Finally, with a view to achieving greater gender equality, the Brussels Capital Government intends to promote women’s entrepreneurship in digital and technology oriented fields. Initiatives such as [Women in Tech](#) aim to empower women in the entrepreneurial ecosystem.

### 5.2.3 Networking

A wide range of policy initiatives have been deployed at national and regional level to encourage networking, raise the international attractiveness and increase awareness on AI.

National and regional governments have appointed National Contact Points ([NCPs](#)) to provide advice and coaching to the business community, which can enhance collaborative efforts and awareness on AI. NCPs are helped by a large network of experts in various domains. Among others, NCPs disseminate information to potential candidates about European research programmes and share good practices with business actors.

Also the [DigiCoach](#) initiative reinforces this awareness thanks to inter alia events, media, articles and personalised recommendations to companies.

#### *Flanders*

To increase cooperation among businesses, public administrations and citizens, the Flemish Government has set up the following initiatives:

- The [Beacon](#) initiative: an innovation community, bringing together tech companies, research, skills, innovation actors and citizens to collaborate on smart solutions for keeping the world liveable and sustainable. It focuses on the key AI & IoT innovation domains of smart city, mobility, logistics and industry;
- [ICON](#) projects: funding for interdisciplinary research projects involving the cooperation of one or more research organisations and at least three industrial partners from Flanders. This funding initiative is not specifically targeting AI-related projects, but has a broader perspective;
- Projects for Collective Research & Development and Collective Knowledge Dissemination ([COOCK](#) and [TETRA](#)): funding for research organisations focusing on AI-challenges that apply to a large group of companies, with the aim of accelerating the introduction of AI;
- The [Imec.start](#) programme: an initiative that supports start-ups to develop their business idea. Start-ups participating in this initiative receive financial support and are entitled to support. In addition, the Imec facilities are also available to start-ups, which can make intensive use of the network of partners and investors;
- VLAIO stimulates networking and thematic events about AI through a network of structural partners;
- A citizen science programme (called [AMAI](#)) has been set up. A dissemination campaign to stimulate citizens send in challenges (in the domains of mobility, climate, work and/or health) on what they see as important societal challenges in their life where AI could help. The intention is that these challenges will lead to the selection of 4 projects to be implemented in 2022 by consortia of research groups, SMEs and citizens. The total programme has a total cost of EUR 1 million spanning over 2 years of which the 4 projects take up EUR 300,000 (i.e. EUR 75,000 per project). The selected projects will start at beginning of 2022.
- The [Digihubs](#): initiatives to coach and advise SMEs within their transition towards data-driven organisations and the introduction of new digital technologies (including AI);

#### *The Walloon Region*

Within the framework of Digital Wallonia, the Walloon Government has launched various policies to increase networking among public and private actors:

- [Industry of the future](#) programme: this initiative organised in a consortium promotes and supports manufacturing companies in their digital transformation towards Industry 4.0. The consortium brings together Walloon poles of excellence, sectoral federations, and research centres;
- The [Digital Wallonia International](#) project, which aims to increase the visibility and presence of the Walloon digital sector at international level. In collaboration with Wallonia Export-Investment Agency ([AWEX](#)), [Digital Wallonia](#) offers a programme of international missions and sets up a network of international hubs to support Walloon companies in their international development;
- [Digital Wallonia Champions](#) are ambassadors of the Digital Wallonia strategy. Their mission is to promote the digital transformation in Wallonia, and to disseminate the actions of Digital Wallonia. Launched in 2017, the programme has more than 200 champions at present.

#### *The Brussels-Capital Region*

Various policies have also been deployed in the Brussels Capital region to improve knowledge transfers and fully benefit from a network of relevant stakeholders in the field of AI:

- [Hub.Brussels](#) initiative: Hub.Brussels is the competent body in the Brussels Region for the provision of intelligence and business support, where [Finance&Invest.brussels](#) and [Innoviris](#) are responsible for financing innovative projects (including AI). The objective of this initiative is to put their network of experts at disposal of businesses to advice and support them in their start-up and development phase, including internationalisation. The AI companies supported so far were active in the healthcare and software sector;
- [Icity.brussels](#) initiative: funded by the European Regional Development Fund ([ERDF](#)) and Innoviris and as a joint initiative of ULB, VUB and Sirris. It is devoted to strengthening Research and Innovation in Information and Communication Technologies (ICT) in Brussels. It has already launched R&D ICT projects in several key domains like education, e-Health, mobility, Internet of Things and 5G.

Finally, the [Joint R&D project](#) aims to foster collaboration between academia and industry. This programme is a reflection of the Brussels region approach to AI development, which puts a great emphasis on collaborative research and open innovation.

### 5.2.4 Regulation

The Belgian AI strategy emphasises the need to ensure a reliable, safe and trustworthy AI development by establishing a **legal and regulatory framework** that encourages innovation while respecting the fundamental rights and freedoms of citizens.

With respect to regulation, the Belgian Government adopted a [Royal decree on tests with automated vehicles](#) in March 2018. It paves the way for the development of fully autonomous vehicles, as it allows the use of automated vehicles on the road for testing purposes and under restricted conditions.

#### *Flanders*

The third pillar of the [Flemish action plan](#), with a dedicated budget of EUR 5 million, is targeting support activities on awareness, training and ethics. This pillar includes among others the launch of the [Knowledge Centre Data & Society](#), which focuses on the interplay between data, AI and society. The Centre enables socially responsible, ethical and legal implementations of AI in Flanders. It is funded by the [Flemish Department on Economy, Science and Innovation](#) and is managed by a consortium of three organisations: [imec-SMIT \(Vrije Universiteit Brussel\)](#), [imec-MICT \(Ghent University\)](#), the [Centre for IT & IP Law \(KU Leuven\)](#) and the Flemish Government.

#### *The Walloon and Brussels-Capital Region*

Policy makers of the Walloon and Brussels-Capital Region recognise the importance to develop AI applications in line with appropriate ethical and legal frameworks, and compliant with national and international laws. Policy efforts to create a regulatory ecosystem for AI are ongoing.

### 5.2.5 Infrastructure

Data is an essential prerequisite for the use of AI. Hence, the Belgian AI strategy recognises the importance of **facilitating access to data** and making it available for citizens, businesses, public authorities and researchers.

At Federal level, following policies have been deployed to facilitate free access to data and to support data sharing and processing:

- The open data portal [Data.gov.be](#) provides access to 15,000 datasets across various categories such as education, energy, environment, health, transport and public sector. The portal also provides an overview of the tools available to support the processing and sharing of data;
- [Statbel](#), the statistical institute of Belgium, provides free access to a hundred datasets, which can be used for commercial and non-commercial purposes.

#### *Flanders*

To facilitate the access to high-quality data, the Flemish Government has set up the following initiatives:

- The [Kruispuntbank.Vlaanderen](#) programme to promote the Flemish Government data ecosystem. The objective of this programme is to make data accessible through APIs, to ensure high-quality standards, and data integrity;
- The [Semantics@YourFingertips](#) project, launched under the Innovative Public Procurement Programme (IPO), has the objective to effectively re-use the information contained in the decisions of the local authorities through linked data. The re-use of structured data for administrative and political purposes will be greatly simplified and will improve efficiency of operations;
- The [LBL0D](#) initiative aims at linking and making available local data and information (such as policy for parking lots in a city, opening hours of a public swimming pool etc.). The linked data complies with the OSLO standard (open standard for linking organisations - [data.vlaanderen.be](#)).

In addition, the steering group for Information and ICT policy approved in February 2020 the Flemish action plan [Open data 2020-2024](#) to increase the availability and use of Flemish open data. The Flemish Government has also expressed its intention to create a *Flemish data utility company* that should act as a third trusted party and can create vertical data sharing within industry sectors as well empower citizens with more ownership over their personal data.

### *The Walloon Region*

In order to stimulate open data, the Walloon Government and the Wallonia-Brussels Federation (WBF) have launched the platform [opendata.digitalwallonia.be](https://opendata.digitalwallonia.be). The ambition of this portal is to promote the access to data from public services at regional, provincial and municipal level in order to be re-used by other administrations, businesses and citizens.

### *The Brussels-Capital Region*

The Brussels Government has launched several open data portals to promote data sharing and data analysis:

- The [datastore.brussels](https://datastore.brussels) platform, undertaken by the Brussels Regional Informatics Centre ([BRIC](https://bric.brussels)), is the regional platform for opening up and sharing data and services in the Brussels-Capital Region;
- The [opendata.brussels](https://opendata.brussels) portal is the open data initiative of the City of Brussels;
- To improve the quality of health care, the [Brusafe+](https://brusafe.brussels) initiative allows sharing of patient data among health professionals while ensuring data protection of citizens;
- The platform [analytics.brussels](https://analytics.brussels) has been created to collect business-related data and to analyse the business ecosystem development in Brussels.

## **5.2.6 AI to address societal challenges**

### **Climate and environment**

The Belgian Ministers of Digital Agenda highlight in the [AI4 Belgium](https://ai4belgium.be) policy report that AI is an important driver to support solutions for the climate change. AI should be considered as an ally against climate change. In this respect, AI needs to be developed and deployed so it can meet society's needs and protect the environment by saving more energy than it expends. Several initiatives are ongoing or have been recently conducted in Belgium to take advantage of the untapped potential of AI in order to reach the ambitious climate targets. At the time being most of these initiatives are concentrated at local and regional level. To increase their impact, such initiatives could be scaled up at national level:

- The [Smart Education @ Schools](https://smarteducation.be) programme from the Flemish Government, coordinated by Imec and KU Leuven and promoting the use of smart educational technologies. One of the supported projects in this programme is the "Artificial intelligence, climate change, stomata project" ([KIKS project](https://kiks.be)). This project encompasses online courses directed to the secondary education in Flemish schools in which the benefits of AI techniques are explained to fight the current climate change;
- The [Joint R&D Project](https://joint-rd.be): a funding programme launched by Innoviris which aims to foster collaboration between academia and the industry. In 2020, the theme of the programme is "The Industry of Tomorrow: Green, Human & Smart". The programme contributes to enrich the Brussels Region-based industries with new modes of production: smarter (including AI) and more efficient, but also more respectful of the environment and its workers;
- At the end of 2020, the Flemish Government launched the Circular Manufacturing Initiative. Using a quadruple helix concept, an agenda will be developed to support the circularity of manufacturing. Digitisation and the use of data and AI will be a crucial lever for a greener production;
- "[Energy-efficient AI systems](https://energy-efficient-ai.be)" is one of the four main research themes in the [Flanders AI Research Programme](https://flanders-ai.be). Also Imec works on an [integrated approach](https://integrated-approach.be) that combines innovations in data usage, hardware and software. Lastly, two use cases in the Flanders AI Research Programme for the energy sector focus on: (i) improving the prognostic health management and production of energy in wind turbine parks (ii) decision support for smart energy distribution in low voltage grids;
- The [Brussels Smart City](https://brussels-smart-city.be) initiative highlights the environmental transition for a green and sustainable city among its main axes and identifies an important role for AI in this respect. This will be achieved by developing a solid data infrastructure and a smart grid network that could be exploited with AI tools, guaranteeing a smooth transition towards green IT;
- In March 2021, two universities located in Brussels (ULB and VUB) launched the [FARI Institute](https://fari-institute.be) - AI for Common Good. FARI is a unique structure that aims to bring together more than 300 researchers in AI and related disciplines, around projects that can benefit society. The institute will promote research on reliable and transparent AI. It will also aim to help the Brussels-Capital Region to tackle social and environmental challenges. FARI researchers will contribute to projects on transport, sustainable development, health services, citizen consultations on AI and algorithms. The projects will actively engage citizens and boost awareness about AI and its impacts in the region;

- The [DigitalWallonia4.ai](#) programmes stimulate and strengthen initiatives of Walloon companies in the field of the climate change, the circular economy, and the European Green Deal. In the future, the Start AI and Springboards programmes could be developed for specific sectoral themes to encourage companies to take steps in these areas. A good example includes for instance the selected proof of concepts of the [Tremplin AI](#) programme, in which the IA4GIS project proposes the use of AI technologies for satellite and aerial image analyses. Machine learning and deep learning tools are used to automatically detect changes and abnormalities in treated images, which can be helpful to observe environmental changes due to the climate change.

### COVID-19 pandemic

Several successful Belgian use-cases provide insightful examples on how **AI-enhance robots and digital tools** are used to combat COVID-19 outbreak. Only a selection is included below:

- [Belgian hospitals and shops](#) are employing robots that speak more than 53 languages, which are used to detect if people are having fever and to control whether they are wearing their face masks properly. These robots can for instance steer individuals with signs of fever to a separate area. This way, they have an important role in pre-screening the many visitors of hospitals during the pandemic;
- Belgian hospitals are participating in a collaborative project on [Imaging COVID-19 AI](#). The objective of this project is to enhance computed tomography (CT) in the diagnosis of COVID-19 by using AI. The project team creates a deep learning model for automated detection and classification of COVID-19 on CT scans, and for assessing disease severity in patients by quantification of lung involvement;
- The Flemish foreign trade agency [Flanders Invest & Trade](#) mentions the use of AI by a Flemish company [Robovision](#) to analyse CT scans automatically in order to guide radiologists towards a faster diagnosis;
- [IcoMetrix](#) has developed IcoLung, with support of the Flemish AI Plan and European Funding (from the H2020 project [icovid](#)). This application is currently used by more than 800 hospitals in Europe on a daily basis to process CT images and to decrease the workload in clinical practice. It provides a fully automated assessment of the total and lobular disease burden by offering fast and objective quantification of lung pathology on chest CT scans in admitted COVID-19 patients;
- Single-cell transcriptomics data for COVID-19 patients was generated: a pipeline for scalable preprocessing of single-cell transcriptomics was implemented, and run on the Flemish Supercomputer infrastructure. This data is made [publicly available](#) within the framework of a CZI COVID-19 Atlas project;
- [CrowdScan](#) provides a wireless crowd density system that predicts size and density of large crowds to monitor the capacity in terms of humans per m<sup>2</sup>;
- A [Global Data Sharing Initiative](#) was built together with several researchers from the Flemish AI Research Programme to host the health data of Multiple Sclerosis (MS) patients from more than 80 countries. These data were collected and analysed to adjust the COVID-19 advice for people with MS based on data-driven insights. This medical advice is now available in 14 different languages across the globe.

### 5.2.7 Monitoring and future update

The Federal Government and competent entities at regional level will evaluate the national AI strategy on a regular basis and update it where needed.



### 5.3 Bulgaria

The Bulgarian Government published its [National AI strategy](#) (Bulgaria, 2020) in December 2020. The strategy has been based on a [framework](#) established by scientists of the Bulgarian Academy of Sciences ([BAS](#)) and finalised by experts of the Ministry of Transport, Information Technology and Communications (MTITC) after a public consultation with the state institutions and interested stakeholders. A version in English has been released on the portal of the Council of Ministers with the title **Concept for the development of artificial intelligence in Bulgaria until 2030**.

The Bulgarian AI strategy presents policy initiatives for the development of AI in Bulgaria for the period 2020-2030. It offers a comprehensive policy vision for the development and use of AI in Bulgaria and identifies main areas of impact such as infrastructure and data availability, research and innovation capacity, knowledge and skills, and building trust in society. The objectives are:

- Nurturing a solid knowledge and skills base in AI;
- Developing a strong research capacity for scientific excellence;
- Supporting innovations to foster the implementation of AI in practice;
- Building a reliable infrastructure for AI development;
- Ensuring sustainable conditions for financing AI developments;
- Raising awareness and building trust in society;
- Creating a regulatory framework for the development and use of reliable AI in accordance with international regulatory and ethical standards.

It takes stock of and further complements on prior national strategy reports on the [Digital transformation of Bulgaria 2020-2030](#) and the [National programme digital Bulgaria 2025 and roadmap](#).

#### 5.3.1 Human capital

As stated in Bulgaria's national AI strategy, education reforms are needed across all education levels, as well as placing greater emphasis on vocational training and lifelong learning, to enable people to acquire and improve their digital and AI-related skills.

The following initiatives are undertaken by the Ministry of Education and Science ([MON](#)) to actively increase the **knowledge and skills in AI**:

- Applying AI tools in education to increase the quality, attractiveness and efficiency of the learning process;
- Improving students' competencies in ethical issues related to the use of information technologies;
- Planning measures to increase students' participation in STEM subjects;
- Expanding bachelor and masters programmes with AI-related courses, not only restricted to computer science but targeting multidisciplinary fields. This may also include courses with a specific focus on the legal, ethical and social aspects of AI;
- Creating adequate conditions for a sharp increase in the number of PhD students in AI fields;
- Enhancing teachers' competencies in teaching and working with digital and AI technologies.

Policies related to vocational training, retraining and lifelong learning include among others:

- Offering short-term trainings and traineeships aimed at acquiring and upgrading digital skills in programming and data analytics;
- Designing and implementing life-long learning programmes to expand the stock of IT professionals with AI-related skills;
- Setting up specialised (re-)qualification schemes for professional profiles at risk of unemployment due to automation, in cooperation between business, trade unions, higher education institutions and public authorities;
- Creating more opportunities for the validation of non-formal learning to ensure more flexible labour mobility;
- Building an Education and AI platform with online AI courses, educational policies, and good practices for AI in education.



### 5.3.2 From the lab to the market

Policy initiatives to spur research excellence are presented in the recently updated [National research strategy 2017-2030](#), the [National roadmap for scientific infrastructure](#) and the funding schemes of the [National scientific programmes](#).

In addition, Bulgaria's national AI strategy highlights the following activities to foster **research capacities in the field of AI**:

- Creating a Bulgarian AI Research Centre of Excellence to bring together scientific organisations and higher education institutions with proven excellence in AI research. Research will focus on the fields of neural networks, machine learning, natural language processing, semantic technologies, robotics;
- Stimulating research in priority areas and providing growing opportunities to experienced AI scientists;
- Expanding and enriching the activities of the Bulgarian Association of Artificial Intelligence ([BAIA](#)).

To foster innovation, the Ministry of Economy ([MoE](#)) recently launched [Bulgaria's strategy for the fourth industrial revolution](#). It aims to support the integration of intelligent production systems and processes in the economy. This includes AI-based products and services that are enabled through a cutting-edge communication and data infrastructure.

Additional policies to develop **innovation and testing capacity in AI** in Bulgaria encompass:

- Establishing at least one Digital Innovation Hub specialised in AI;
- Creating Living Labs and virtual information centres for companies, in particular SMEs, to learn about success stories of AI products and services;
- Expanding financial mechanisms to support the deployment of AI solutions in industry and services, in particular for SMEs;
- Financing innovation laboratories at company level to test new AI technologies and business models in practice;
- Stimulating innovation capacity in public research organisations and higher education institutions.

Bulgaria's national AI strategy presents several **priority sectors**. The choice of these sectors for the next 3 to 5 years was based on their readiness to use and develop AI. Among the thematic areas, it highlights smart agriculture, health care and the public administration.

#### *Smart agriculture*

In May 2019, the Ministry of Agriculture, Food and Forestry ([MZH](#)) released its [Strategy for the digitisation of agriculture and rural areas](#), which includes measures related to AI and blockchain for the agriculture sector. The strategy supports the introduction of computer technologies in the production of agricultural products, including the use of AI to carry out controls on production, to protect plants against harmful organisms and to reduce administrative burdens for farmers. To further strengthen smart agriculture in Bulgaria, following initiatives are foreseen:

- Setting up an intelligent AI-related system for information management to support more efficient, environmentally-friendly and ecological farming;
- Establishing a monitoring system based on AI technologies and satellite imagery to improve forecasting, extraction and production of agricultural resources.

#### *Health care*

The e-health and in general, the transformation of the digital health sector are among the main priorities of the National Digital Transformation Strategy for 2020-2030. It aims at ensuring the digital transformation in the health sector based on three technology pillars: cloud solutions, wireless networks (4G/5G) and enhanced deployment of high-speed fiber optics networks. The national AI strategy mentions the plan to set up a National Health Information System, including a national system for citizens' electronic health records, and electronic referrals. The aim is to improve the interoperability of health systems and to facilitate the exchange of health data at national and international level. In this regard, towards the end of 2020, electronic health records and electronic prescriptions have been successfully launched in Bulgaria.

### Public sector

An [updated strategy](#) on the development of e-government in the Republic of Bulgaria 2019-2023 has been adopted in 2019, together with an updated roadmap of measures for its implementation. The update ensures the implementation of the European e-governance principles put in place at national level. Among others, it includes the development of information technology to improve the interaction between public administrations. The [Bulgarian open data portal](#) further improves efficiency by enabling data sharing and re-use in the public sector.

### 5.3.3 Networking

The national AI strategy of Bulgaria emphasises the need to strengthen research and innovation capacities and the uptake of AI technologies by means of **active collaborations** between research institutions and industry at national and international level. This is achieved through:

- Promoting cooperation spaces between researchers and AI professionals and encouraging the creation of collaborative networks in AI between universities, vocational schools and companies;
- Supporting the participation in European AI and digitalisation networks, such as [CLAIRE](#) and [CLARIN & DARIAH](#) initiatives;
- Participating in European testing and experimentation centres related to health, robotics and agriculture.

In addition, the Bulgarian AI strategy foresees policies to raise both citizens' awareness on the benefits and risks of AI (e.g. the malicious use of AI for mass impact, manipulation and disinformation). Following policies are planned to **improve the public dialogue and to build trust** in AI:

- Ensuring visibility of the AI applications developed in AI Research Centre of Excellence and presenting the expected benefits for society;
- Exploiting social media channels and events to raise awareness on AI and to share successful examples of AI applications and companies;
- Organising AI competitions and hackathons for students to raise their knowledge and experience in working with AI systems.

### 5.3.4 Regulation

The Bulgarian Government commits to establish a regulatory basis for the development and use of trustworthy AI in line with international regulatory and ethical standards. The principles of respect for fundamental rights, non-discrimination and the protection of personal data should be seen as an integral part of the regulatory framework that ensure the safety of AI technologies. To this purpose, the following policies are proposed:

- Establishing a national framework to assess the impact and risks associated with the development of AI technologies. The aim of the framework is to enable a comprehensive overview of the legal and ethical aspects of AI technologies;
- Creating a toolkit to stimulate the adoption of safety and legal responsibility principles among actors involved in the development, deployment and use of AI technologies. The toolbox will include a combination of procedures and flexible approaches that promote informed judgement in decision-making processes.

### 5.3.5 Infrastructure

Bulgaria's national AI strategy highlights the need to invest in infrastructure for delivering high performance computing, secure data collection, storage and processing, 5G connectivity and next-generation software to support the development and deployment of AI. This requires investment in the construction and maintenance of computing infrastructure, communications and service software, as well as the accumulation of big data. Bulgaria is already setting up a modern ICT computing infrastructure and is planning both the further development of the 5G network and the provision of data under the Digital Europe Programme 2021-2027. In particular, following policy initiatives are foreseen:

- Establishing platforms to ensure access to and sharing of company data, enabling real-time data transmission in priority sectors such as smart agriculture and e-health;

- Integrating scalable high performance computing infrastructure in the national AI Research Centre of Excellence;
- Setting up clusters of experts in priority areas (such as health and agriculture) to set up standardisation approaches and to ensure interoperability and compliance to FAIR principles. These measures should be integrated in the national [Open data portal](#);
- Establishing guidelines for anonymisation and pseudonymisation of personal data for the purpose of sharing health data, with clear rules on transparency, governance and privacy protection.

The need to improve existing infrastructure by ensuring wide deployment and use of high capacity networks is also presented in the policy report on [Digital transformation of Bulgaria for the period 2020-2030](#), adopted in July 2020. The strategy report states that improving connectivity will enable the development of innovative business models in many sectors such as research, industry, digital and remote health, security, logistics, autonomous and connected vehicles, digital governance and digital education, as well as the development of smart cities.

Finally, to achieve a safe and secure cyberspace for the development of society and industry, the Bulgarian Government released the [Cyber security strategy](#). It provides a framework for the development of a national cyber security plan to tackle potential threats and attacks to autonomous and intelligent systems.

### 5.3.6 AI to address societal challenges

#### Climate and environment

In January 2020, the Bulgarian Government released its [Vision, objectives and priorities for the national development programme: Bulgaria 2030](#). The policy report sets out strategic objectives to accelerate economic development and reducing inequalities. One of the development axes to achieve these strategic objectives relates to a green and sustainable Bulgaria. Along the priority of ensuring a more sustainable environment, digital connectivity is mentioned as a core component to support developments in this field.

In addition, the Bulgarian Strategic Centre for Artificial Intelligence ([SCIA](#)) aims to support and develop projects that use AI to tackle the most difficult societal and business problems. According to its mission statements, its objective is to solve humanity's biggest problems from terminal diseases to climate change, by using big data, machine learning, and robotics. The centre has the following partners and stakeholders: Partnership for Advanced Computing in Europe ([PRACE](#)), [SophiaLab](#), and the National Centre for Supercomputing Applications ([NCSA](#)).

#### COVID-19 pandemic

Since the COVID-19 outbreak, the use of AI has tremendously increased as an essential and effective tool to observe and predict the evolution of the pandemic. At the same time, it also helps in the recovery phase.

Against this background, [Sofia Investment Agency](#), and [Innovative Sofia](#), have recently met with a number of industry associations in participation with the Sofia Deputy Mayor for digitalisation, Mr. Vladimir Danailov. The objective of the online meeting was to discuss potential actions on how to rebuild the business ecosystem after the COVID-19 crisis. The proposed measures are outlined on the [European Cluster Collaboration](#) platform. Among others, Sofia-based companies dealing with big data, business intelligence, AI, telemedicine, cybersecurity, automation and robotics of business processes, clinical trials and more, should be engaged in a working group to develop a three- or five-year plan to implement working digital models for the healthcare sector.

### 5.3.7 Monitoring and future update

AI policy making is spread across various governmental institutions. Given the horizontal nature of the activities, responsibilities are shared between the Ministry of Transport, Information Technology and Communications (MTITC) and other administrations, including the Ministry of Education and Science, the Ministry of Economy, the Ministry of Labour and Social Policy, the Ministry of Agriculture, Food and Forestry, the Ministry of Health, and the State Agency for e-Government, among others.

The coordination of Bulgaria's national AI strategy implementation is under consideration. To effectively and continuously monitor the implementation of the AI strategy, an interdepartmental working group will set up a roadmap outlining the policy measures, responsible institutions, expected results and monitoring indicators.



## 5.4 Croatia

The Croatian Government is currently working on its national AI strategy. A working group consisting of experts from academia, business, civil society and the public sector has been appointed to develop the AI strategy. The working group has finalised a first draft of the **National plan for the development of artificial intelligence**, including policy measures and actions for the period 2021 to 2025. A final version of the strategy will be completed in 2021.

### 5.4.1 AI to address societal challenges

#### Climate and environment

During the Croatian Presidency of the Council of the European Union, the Faculty of Electrical Engineering and Computer Science, University of Zagreb hosted a workshop on [ESA - Croatia "Space technologies for the green plan and digital economy"](#). The workshop, organised by the European Space Agency (ESA) in collaboration with the Faculty of Electrical Engineering and Computing, University of Zagreb and the Ministry of Science and Education was meant to discuss the contribution of the space industry and technology to all key goals of the EU Council Presidency. On this occasion, the **private and public sector experts from Croatia** learnt more from leading European experts on how opportunities under ESA since Earth Observation, have become key to measuring progress towards goals for sustainable development and the Green Plan as one of the central goals of the President of the European Commission. **Europe's leadership in Earth Observation produces an incredible wealth of data available for environmental monitoring and security in Europe**. New opportunities related to information technology, big data, AI and miniature satellites are available to the benefit of environment.

On the 15th February 2020, a new Installation Research Project entitled "[Software sensor augmentation at environmental data analysis laboratory](#)" funded by the Croatian Science Foundation started. This initiative encompasses the following partners: the University of Split; the Faculty of Science of the University of Zagreb; the Faculty of Transport and Traffic Sciences of the St. Kliment Ohridski University; the Faculty of Technical Sciences of Ericsson Nikola Tesla; and the R&D Institute of Oceanography and Fisheries. The scientific goal of the project is to employ machine learning models to ultimately reach a more efficient resource utilisation with positive effects on industry and environment.

#### COVID-19 pandemic

Croatia deployed a digital assistant called [Andrija](#) that can be activated on WhatsApp and that guides people towards diagnosing and managing suspected COVID-19 infections. This "virtual doctor" powered by AI was developed by Croatian IT companies in cooperation with epidemiologists.



## 5.5 Cyprus

In January 2020, the Council of Ministers has approved the [National AI strategy](#) of Cyprus (Cyprus, 2019a). It focus on the following priority areas:

- Cultivating talent, skills and lifelong learning;
- Increasing the competitiveness of businesses through support initiatives towards research and innovation and maximising opportunities for networking and partnerships;
- Improving the quality of public services through the use of digital and AI-related applications;
- Creating national data areas;
- Developing ethical and reliable AI.

### 5.5.1 Human capital

Concerning improvements to the **education in AI**, the policy report mentions among others the creation and upgrade of higher education programmes in AI, the development of reskilling and upskilling opportunities for the labour force and an overall extension of societal knowledge in the use and application of AI technologies.

**Education reforms** will aim to support new technological skills, particularly in STEM subjects and will provide support to teachers to improve their education methods. Besides improving technological skills, the Cypriot Government emphasises the importance of integrating soft skills in students' curricula, such as interpersonal communication and problem solving skills. At higher education levels, Bachelors and Master programmes will be created in the field of AI in collaboration with the [Higher Education Quality Assurance and Accreditation Agency](#) of Cyprus.

To ensure that education programmes are **adapted to the rapidly changing needs of the labour market**, the Cypriot strategy recommends the creation of tailor-made programmes for further training and lifelong learning for the workforce. The introduction of Massive Open Online courses (MOOCs) in AI will be considered as an effective tool to educate citizens in general. More flexible and personalised trainings could target the working population and respond to the new labour market challenges. In this perspective the Cyprus Human Resource Authority ([AnAD](#)) can provide information and incentives to employers for upgrading the workforce skills and competencies in digital and AI-related fields.

### 5.5.2 From the lab to the market

The Cypriot Government devotes particular attention to policy actions fostering research and innovation, including the creation of a **Centre of Excellence for applied research in AI**, and the formation of new financial support and funding schemes. The establishment of a special Task Force for Researchers is also considered to help the AI Expert Group in developing AI policies.

A vibrant start-up ecosystem in AI will be fostered through the development of an **AI accelerator programme**, to support the start-up and growth of AI business ventures. This programme will provide expertise in developing AI solutions, and will help firms accessing expert communities. Besides creating opportunities to team up with other firms and research institutions, and facilitating the access to **flexible and effective financial funding**, this programme will also provide dedicated support to testing and open data environments (including regulatory sandboxes). The growth of the AI start-up ecosystem will be encouraged through national funding programmes and state incentives, which will be complemented with European funding programmes (e.g. Horizon2020).

The Cypriot Government also commits to encourage the use of AI in the public administration by means of automatic decision chains to accelerate administrative processes. Introducing more AI-related applications in the public sector will increase transparency and foster citizens' trust in the state and institutions.

### 5.5.3 Networking

Regarding networking, the Cypriot strategy highlights the need to encourage partnerships with leading international organisations to increase the level of research and innovation in AI. This will be achieved by setting up new collaboration models. Among others, **Digital Innovation Hubs (DIH)** will be expanded and meetings will be organised with foreign countries to obtain guidance and good practices about successful AI applications. These collaborative meetings will also aim to assess how public-private partnerships can be improved in the future.

At national level, Cyprus has already established several DIHs such as the [CYRIC Digital Innovation Hub](#), the [KIOS Innovation Hub](#), the Robotics Control and Decision Systems (RCDS) Lab at the University of Technology, and the [Entrepreneurship Centre](#) at the Cyprus University. These DIHs are active in various market segments (e.g. agriculture, health, construction, transport, manufacturing and energy) and in a wide range of technological areas, including AI, big data, cloud computing and cybersecurity. The AI Expert Group considers the creation of a (virtual) AI DIH with dedicated AI research programmes that could serve as a platform where the scientific and business community could access and share knowledge.

To determine in which domains collaborations are most favourable, the AI Expert Group can make use of the recently published [Competitiveness report](#) of the Council of Economy and Competitiveness (Cyprus, 2019b). This report provides a general overview of the structure and performance of the Cypriot economy, highlighting the comparative advantages, weaknesses and risks to the economy, including recommendations on how to address them.

The Cypriot Government will increase the **international visibility of the country** to attract AI experts from abroad. To do so, the Cypriot Government considers setting up mobility programmes for experts between research centres in Cyprus and abroad. In addition, the AI Expert Group recommends to create an inventory of researchers and experts in the field of AI in order to assess the country's needs and areas in which to attract foreign talents.

#### 5.5.4 Regulation

The Cypriot Government will develop a **legislative framework** to ensure the availability of data with transparent regulations, in particular on data protection. This legislative framework will take into account EU directives on the [free flow of data](#) and [general data protection](#) and will facilitate the interoperability of data. To this purpose, it is important that the new legislative framework enables digital services to use up-to-date and high-quality information, while taking into account the protection of personal data.

With respect to ethics, the Government of Cyprus is currently developing guidelines to ensure **ethically sound and reliable developments in AI**, i.e. by defining measures of transparency, responsibility, privacy, equality, diversity and safety among others. The developed guidelines should preserve human rights and social values. To coordinate the development of ethical guidelines, the Cypriot strategy advocates the creation of a **National Committee on Ethical and Reliable AI**. This Committee will continuously and systematically monitor and analyse issues related to the use and development of AI technologies and will provide recommendations for legal and ethical reforms. To successfully conduct this exercise, the Committee will take into account the [Ethics guidelines for trustworthy artificial intelligence](#) as prepared by the High-Level Expert Group on AI.

Cyprus is also active in developing **international standards for AI** to foster and facilitate industrial and economic developments in this field. The Cyprus Organisation for Standardisation (CYS), will establish a National Commission constituting of technical experts from the public and private sectors to monitor and evaluate the work of International and European Committees on AI. It will also be responsible to apply and introduce AI standards in all sectors of the Cypriot economy.

#### 5.5.5 Infrastructure

The Cypriot Government commits to create a **data ecosystem** with guidelines and regulations about data interoperability and data exchange agreements. Respecting the anonymisation process during data collection is of particular importance in data exchange agreements, as to prevent the leakage of personal data contents. Overall, the national data environment will be reinforced through the further development of the [National open data portal](#), and the creation of a National Research Data Portal. The National Open Data Portal is an API interface that provides access to a large data repository of the public administration. In the same vein, the National Research Data Portal will provide access to data produced by research institutions. In general, both initiatives aim at fostering the availability of open, high-quality and trustworthy data to leverage the benefits of research and development in the field of AI.

In terms of **digital and telecommunication infrastructure**, the Cypriot strategy recommends to improve access to analytical systems such as Platform-as-a-Service (PaaS) and Machine Learning as-a-Service (MLaaS). Investing in High Performance Computing infrastructures such as to those offered by the Computation-based Science and Technology Research Centre (CaSToRC) is also considered. In this respect, Cyprus is participating in the joint pan-European undertaking for developing supercomputers ([EuroHPC](#)).



## 5.5.6 AI to address societal challenges

### Climate and environment

The [Cypriot national AI strategy](#) mentions that AI can enhance the reduction of energy consumption through the optimal use of natural resources, reduce the need for pesticides by contributing to a cleaner environment, improve weather forecasting and lead to disaster prevention. In general AI aims to improve the living conditions of the modern human being in a circular and sustainable development environment. A series of initiatives are currently ongoing in Cyprus to address the climate change and create more sustainable living conditions. The Government is actively involved in the implementation of projects, co-funded by the European Commission, relating to the smart cities and smart environments sectors with dedicated projects to fight the climate change:

- The [KOIOS Centre of Excellence](#) is a pioneer in the field of supervision, control and security of critical infrastructures, which are inextricably linked to smart environments. The multidisciplinary research conducted in this centre touches upon climate change issues. The [SOLAR-ERA.NET](#) project develops an ICT platform for improving the operation, maintenance and diagnosis of solar photovoltaic systems;
- The [MaRITeC-X](#) project proposes the creation of innovative solutions in the maritime sector, based on the use of smart meters and infrastructure. The objective of the project is to develop a scientific and business centre of excellence in marine and maritime activities which will focus among others on the climate and the environment. The use of AI will be a key tool in the research projects funded by this centre.

### COVID-19 pandemic

In order to track contagions at a first stage of COVID-19 pandemic, Cyprus developed [CovTracer](#), a pilot mobile app to targets the movements of individuals who were keeping on working under the lockdown (e.g., doctors, nurses, police officers, fire fighters, security forces).

## 5.5.7 Monitoring and future update

The national AI strategy of Cyprus will be reviewed on a regular basis to assess the policy progress and to foster the development and use of AI. To this end, in June 2020, the Deputy Ministry of Research, Innovation, and Digital Policy has launched a procurement for tender to develop an Action Plan that will detail the progress and implementation of the national AI strategy, which has been very recently concluded. The overall objective of the action plan is the preparation of an implementation plan of the national strategy for AI, based on the mandate for utilisation and adoption of innovative technologies, a broader strategy not only just from a purely technological perspective, but primarily in relation to the digital transformation action plan, so that both can constructively, maximise the perceived benefit for society and Cypriot citizens.



## 5.6 Czech Republic

In May 2019, the Czech Republic released its [National AI strategy](#) (Czech Republic, 2019) that builds on both the [Innovation strategy 2019–2030](#) and the [Digital Czech Republic](#) strategy. The aim of this AI strategy is to improve the national economic growth and competitiveness in AI by means of:

- A responsible and trusted AI ecosystem;
- The digitalisation of enterprises, in particular SMEs;
- Equitable opportunities and benefits in AI to boost the economic development of society.

To achieve these objectives, the Czech Government envisages policy actions across key areas like education, R&D support, financing, industry, social impacts, regulation and international cooperation. The Ministry of Industry and Trade will coordinate the overall AI strategy, while the Ministry of competence will coordinate each specific key area.

The strategy follows this structure: for each key area, it highlights the responsible Ministry, the policy initiatives to develop, the cooperating entities, and the key objectives until 2021, 2027 and 2035 respectively.

The strategy provides annexes of facts and figures on employment and on AI applications in public and private institutions. It also includes funding estimations for public research teams in AI, but lacks budget allocations for the implementation of the national AI strategy. However, since the launch of the strategy, the Technology Agency of the Czech Republic supported various AI projects for a total of EUR 120 million.

### 5.6.1 Human capital

The Czech Republic envisages actions to **reform the primary, secondary and higher education** towards AI learning. Primary and secondary education systems will teach courses on IT, digital literacy, AI, and on soft skills (i.e. creative thinking) for AI. Higher education will provide Master and Doctoral Programmes in AI. Finally, the Czech Industrial Strategy foresees a governmental programme to support innovative academic programmes entirely on AI.

The [Strategy for the education policy of the Czech Republic up to 2030+](#) also aims to support educators in upgrading their teaching curricula with digital technologies. In 2021 new curricula for elementary education was approved, doubling the number of computer science classes and introducing new digital key competences.

The Czech strategy emphasises the importance of **lifelong learning, vocational training and reskilling opportunities**. Since educational reforms should track the labour market dynamics, the Czech Government will closely monitor the labour market by commissioning analyses to predict the jobs' creation and loss due to AI. The predictions on **future labour requirements** will enter into the National Register of Professions and the Central Competence Database for a systematic promotion of updated jobs by means of career guidance, worker mobility and reskilling opportunities.

### 5.6.2 From the lab to the market

An adequate **support to basic and applied research in the field of AI** is key to deploy AI successfully. To this purpose, the Czech Government will cooperate to establish a Centre of Excellence in AI Research, Digital Innovation Hubs (DIHs) and a Centre for Humanities and Social Science to analyse the impact of AI on the economy. In April 2021, the Czech Republic counted 8 DIHs that are fully operational and 4 in preparation stage performing in 8 regions.

**Stimulating breakthrough innovations in AI** through an efficient AI entrepreneurial ecosystem is key for the Czech Government. The Innovation Hub in AI (IHAI), co-funded by [CzechInvest](#), and the start-up support programmes and accelerator instruments, among others, will prompt AI economic activities and innovations.

The Czech Government introduced the [2019-2030 Innovation strategy](#) with a roadmap to improve the innovation system as for the strategic management (e.g., education and research), and trends of digital technologies and skills. “**The Country for the Future**” (CFF) programme by the Ministry of Industry and Trade is the implementation tool for the Innovation Strategy as it allocates a budget of CZK 6.1 billion (approx. EUR 232.6 million) to support innovative companies, digital services and R&D-based innovations.

The Czech strategy envisages **financial instruments to support AI in the private and public sector**. The [Digital Czech Republic Programme](#) will fund the Centre of Excellence in AI research with resources from the City of Prague and private partners. In the long-term, the Czech Republic plans to set up grant programmes for AI with funds from the [Grant Agency of the Czech Republic](#) (GA CR) and the [Technology Agency of the Czech Republic](#) (TA CR). In addition, the access to finance for AI businesses will expand to market-based financial instruments of the [Czech-Moravian Guarantee and Development Bank](#). On top, European initiatives like Digital Europe, Horizon Europe, and Connecting Europe Facility will support additional AI developments. The Czech Government will also develop specific grants and investment programmes for SMEs, start-ups and spinoffs with highly innovative services and business models. Although many financing tools address the private sector, the Czech Ministries envisage programmes to support AI start-ups and applications in the public sector too.

Finally, the effectiveness of all support programmes will be regularly evaluated and integrated with alternative forms of financing.

### 5.6.3 Networking

The Czech strategy foresees policy recommendations to foster both **national and international partnerships**. The Czech Government suggests to include AI into the V4 priorities in order to increase collaboration in this field across Poland, Czech Republic, Slovakia, and Hungary. Bilateral collaborations are very important too, like 1) the Czech-German strategic dialogue on research, development and innovation, 2) the Czech-French Strategic partnership on digitisation and 3) the Czech-Slovak partnership on education and industry 4.0. Finally, the Czech Government will increase networking opportunities by participating to working groups of international organisations (EC, OECD, UN), by creating the European Centre of Excellence in AI Research and by establishing Digital Innovation Hubs.

**Collaborations between SMEs, start-ups and scientific research centres** will receive support from specific programmes like the [Knowledge Transfer Partnerships](#) for the development of a mutually beneficial partnerships between the business community and research organisations. The Czech Republic will also launch calls for tenders to foster the development of AI innovations in multidisciplinary teams. In addition, an expert group made of representatives from academia, research centres and the private sector will support collaborative investment programmes in AI.

The Czech Government foresees policy actions to **increase the international attractiveness** of the country, and to attract and retain foreign talent in AI. For example, the Czech strategy aims to revise the Act on the Residence of Foreigners and long-term residence permits for scientific researchers. The upcoming governmental programme will introduce simplified procedures that will help researchers and their families to acquire the residence and working permits faster. Scientific researchers will be able to remain in the Czech Republic for nine more months after the end of their work contract to search for another job in the country.

The Czech Republic recommends the promotion of the Czech AI ecosystem, inside the country and abroad, to enhance the **dissemination and uptake of AI** in the economy. In collaboration with CzechInvest, the Confederation of Industry and AICZECHIA, the Ministry of Industry and Trade has prepared an [interactive web mapping](#) of actors from the private sector, academia and other AI institutions in the Czech Republic. Forthcoming in-depth analyses will study the socio-economic impact of AI.

### 5.6.4 Regulation

A human-centric AI requires an effective regulation to protect human rights, and to clarify responsibilities, intellectual property rights and liabilities. The Czech strategy dedicates a section to legal and social aspects of AI with reference to ethics, consumer protection and security issues.

The objective is to define an **ethical and legal regulation** that also releases the development of AI technologies from needless regulatory constraints. First, the Czech Republic plans to identify the sectors whose research and development efforts in AI are mostly refrained by inappropriate legislations. All issues of data access, data ownership and (personal) data protection will receive strong consideration within a sector-specific approach to the heterogeneous legislations of different sectors. For instance, an AI Committee will analyse the current Czech legislative framework for autonomous cars. Other examples relate to certificates and standards for cybersecurity, and specific data regulations for the healthcare sector. Regulatory sandboxes will also contribute optimal conditions for testing AI concepts.

Lastly, the Czech Republic launched the [AI Observatory and Forum](#) (AIO&F), an expert platform on legal aspects of AI to create a favourable social and legal environment for research, development and use of responsible AI. Audits in the public and private sector will also detect the existence of legal barriers.

### 5.6.5 Infrastructure

A **well-functioning data infrastructure** is a key prerequisite of AI developments. Therefore, the Czech Republic has set up a [National strategy on open access to research information](#) for the period 2017-2020 to start opening the access to scientific information at national level.

The modernisation of the **digital and telecommunication infrastructure** will foster the provision of high-quality data. Within the context of the EuroHPC JU initiative, the Czech Government plans to expand the [IT4Innovations](#) national supercomputing centre with the petascale HPC system [Karolina](#), participates in the [LUMI](#) consortium aiming to build pre-exascale HPC systems and supports the [EuroHPC](#) research and innovation call.

The [Digital Czech Republic](#) strategy highlights that the Government will prioritise connectivity improvements on the internet infrastructure to deploy the 5G networks in the country during the coming years. To this purpose, the Ministry of Industry and Trade of the Czech Republic and the Bavarian State Chancellery aim to create a common 5G-corridor between Munich and Prague, which should also become part of the programme "[Connecting Europe Facility](#)" of the European Commission.

### 5.6.6 AI to address societal challenges

#### Climate and environment

The upsurge of global temperatures caused by increasing carbon emissions calls for new tools to help to better manage the impacts of climate change and to protect the planet. According to a [recent analysis of PwC consultancy](#), technologies with potential for addressing climate change are: advanced materials, cloud technology including big data, autonomous vehicles, including drones, synthetic biology, virtual and augmented reality, AI, robots; blockchain, 3D printing and the Internet of things (IoT).

Furthermore, the [Digital Czech Republic](#) strategy highlights the importance of a public and political debate to find new and innovative ways of adapting to the emerging climate change through digital and AI-enhanced technologies and tools.

#### COVID-19 pandemic

During the outbreak of the COVID-19 pandemic, several initiatives and projects using AI have been developed. The Czech Republic has released a tracing system of [Smart Quarantine](#) based on AI principles and also developed an AI-enabled [chatbot](#) for answering COVID-19 related questions. As an interesting use case, the mapping application [Mapy.cz](#) uses location sharing in relation to COVID-19 to alert citizens of potential risky encounters. Developers are further attempting to obtain anonymous data about people who tested positive and compare it with the location of users by means of advanced algorithms. This would help identifying cases of probable contacts with a person who has been confirmed positive for COVID-19.

The [Hack the Crisis](#) hackathon has also contributed to the development of AI based applications (e.g. mapping of people density in public spaces, strengthening cybersecurity of the hospitals against cyberattacks using AI during the pandemic, evaluation of personal protective equipment and determining its FFP standard).

The Czech Government also intends to focus on Digital Innovation Hubs and Testing and Experimentation Facilities (TEFs) for different applications of AI in the health sector. For the TEFs, a concept for the cooperation of hospitals with technical capacities is in consideration. Moreover, the [TREND Programme](#) from the Technology Agency of the Czech Republic subsidises, among others, projects aiming to counteract the COVID-19 pandemic and using 5G technology.

### 5.6.7 Monitoring and future update

While the Ministry of Industry and Trade will coordinate the national AI strategy of the Czech Republic, an AI committee will supervise its implementation. The AI committee is a subcommittee of the Steering Committee of the [Digital Czech Republic](#) strategy. This strategy consists of seven chapters with dedicated working groups on education, R&D support, financing, industry, social impacts, regulation and international cooperation. Each working group is responsible to monitor the fulfilment of the strategic objectives. Once a year, the Steering

Committee and the Czech Government will receive a progress report on the strategy implementation. The national AI strategy will be updated along the goals of the 2021 review of the Coordinate Plan on AI.

The Ministry of Industry and Trade is preparing a call to co-finance Digital Innovation Hubs in the upcoming Digital Europe Programme with the aim to create an interconnected and sustainable EDIH ecosystem in the Czech Republic. With other sources as ESIF, the Czech Republic plans to boost also a network of national DIH to address the local needs of companies.



## 5.7 Denmark

In March 2019, the Danish Government published its [National AI strategy](#) (Denmark, 2019). The Danish strategy sets out the goals and visions for AI development in Denmark, it presents the challenges to be addressed and it identifies specific policy initiatives and priority areas.

It aims at putting Denmark at the forefront of responsible development of AI and sets out four objective to achieve this goal:

- Develop a common ethical and human-centred basis for AI;
- Prioritise and support research in AI;
- Encourage the growth of Danish businesses by developing and using AI;
- Ensure that the public sector uses AI to offer world-class services for the benefit of citizens and society.

The strategy originally contained 24 initiatives for which EUR 9.2 million has been reserved by the Danish Government for the period 2019–2027. The budget has since been reprioritised and lowered to EUR 5 million. The government plans to evaluate the strategy in order to determine future actions regarding AI.

In addition, the 2019 national budget earmarked EUR 39.5 million for research in new digital technologies. An additional EUR 26.8 million has been earmarked for an Investment Fund (2019–2022) to help municipal and regional government authorities develop and adopt digital welfare solutions and new technologies. Technological possibilities, such as AI, also play a role in the research funding established via the 2020 budget.

The outlined policy initiatives below also include those presented in the [Strategy for Denmark's digital growth](#) (Denmark, 2018), a policy report setting the direction for how Denmark can seize the opportunities of the digital transformation. The report contains 38 initiatives, some of which relate directly to AI or provide initial policy steps that will push the development of AI technologies.

### 5.7.1 Human capital

In terms of **formal education and training**, the Danish Government has launched these programmes:

- Technology Pact: the [pact](#) signed by 80 participating institutions aims to attract 250 participating members and to increase the number of students choosing STEM subjects ((science, technology, engineering and mathematics) by 20%, or 10,000 students by 2028;
- A four-year test programme has been launched (2019–2021) to strengthen technology understanding in primary and lower secondary education. Various teaching models will be evaluated and efforts will be devoted to developing the skills of teachers.

Furthermore, a national action plan to strengthen digital competencies and digital learning on higher education institutions was launched in April 2019, including funding to support continuous upskilling courses for teachers (EUR 6 million in 2019).

The Danish Government is not only targeting an increased uptake of education in digital and AI-related skills, but is also promoting a **culture of lifelong learning and continuous up/reskilling of the existing workforce**. The government thus has set up a vocational adult education and training working group to advise new forms of vocational education programmes to target the upcoming needs of the labour market. The Government will set up a centre for the application of IT in vocational education teaching, and will support vocational courses, among others in AI.

As a consequence of COVID-19, the Danish Government has allocated EUR 16.1 million in order to create more study places in which a significant portion will be allocated to STEM- programs including IT programs. This comes on top of the [extra EUR 13.7 million allocated to more study places in STEM](#) in December 2019. As a result, the intake in [STEM education programmes increased by 9%](#) (1,380 study places) at the 2020 summer intake.

### 5.7.2 From the lab to the market

As mentioned above regarding the national budgets for 2019 and 2020, Denmark is investing in a range of programmes to **boost research and development** in digital and AI research and pilot projects. Policy initiatives include:



- The creation of the Digital Research Centre Denmark (DIREC): the aim of the [centre](#) is to develop and support the digital field through research in AI, big data, Internet-of-Things (IoT) and IT Security. The centre was established in 2020 and the Innovation Fund Denmark has supported DIREC with DKK 100 million (approx. EUR 13.4 million);
- AI research funds: The [Innovation Fund Denmark](#) and the [Independent Research Fund Denmark](#) financially support research into new technological possibilities such as AI.

To increase **innovation in AI** and foster the creation and growth of AI businesses, the Danish Strategies highlight the following policy initiatives and investment instruments:

- Investment for AI businesses: The Danish Growth Fund will launch a pilot project in the form of an investment pool of EUR 3.1 million over four years targeting companies with a business model based on AI. It will take the form of co-investments with private investors;
- [Sprint:Digital](#) – a coordinated scheme to support the digital transformation of Danish SMEs, which can benefit their ability to innovate in AI. The aim of this policy is to promote the digital transformation of SMEs by using agile design sprints to develop and test new digital solutions and business models.

The Danish AI strategy foresees the following **four priority areas**:

- Healthcare;
- Energy and utilities;
- Agriculture;
- Transport.

Besides policies directed to the private sector, the Danish Government aims to also support more effective deployment and use of new technologies, including **AI, across the public sector**:

- National Centre for Public Sector Innovation (COI): this [centre](#) supports more effective deployment and use of new technologies, such as AI, in the public sector;
- The [Digital strategy 2016-2020](#) set the course for Danish public sector digitisation efforts and their interaction with businesses and industry. It played a significant role in preparing the public sector to upcoming technological challenges and opportunities of AI and big data (Denmark, 2016). A new national digital strategy is currently expected in late 2021;
- Investment fund to boost the adoption of AI by municipal and regional government authorities: In 2019, 2020, and 2021, the Government, municipalities and regions agreed to launch 28 signature projects financed by the fund. The projects focus on healthcare, social affairs, employment, administration, and climate mitigation and adaptation.

To develop AI tools into effective and efficient products and services, both public and private sector players should have the **possibility of testing AI solutions**. For this purpose, the Danish Government has initiated several policy initiatives:

- [Performance contracts](#) with seven Danish [GTS](#) institutes: the government is setting up performance contracts with seven GTS institutes allowing them to test new technologies, including for instance AI;
- The Danish Government has allocated approximately EUR 27 million to an investment fund for testing, scaling, and encouraging the uptake of AI in the public sector, with a particular focus on healthcare, public administration, and the green transition.

### 5.7.3 Networking

A major challenge for the Danish Government is to create a collaborative environment for the development of digital technologies. In this respect, the Danish AI strategy pays particular attention to **improve opportunities for partnerships between public and private sectors**, in particular for new technologies such as the Internet of Things, AI and data analysis:

- National Centre for Public Sector Innovation: one of the objectives of this [centre](#) is to help strengthen public-private collaboration, so that the public sector incorporates private sector competencies, resources and experience.

## 5.7.4 Regulation

The Danish strategy led to the development of an ethical framework for AI based on six principles in order to improve the level of trust and confidence in AI. The six principles for AI relate to self-determination (i.e. ensuring that citizens can make informed and independent decisions) and to human dignity, equality and justice (i.e. ensuring that there is no infringement of human rights and maintaining respect for diversity). It also covers aspects of responsibility and explainability (i.e. openness and transparency). The sixth principle stipulates that AI development should be ethically responsible. To ensure that **ethical issues** are addressed, the Danish Government set up the following initiatives:

- In May 2019 an independent [Data Ethics Council](#) was established. The Council makes recommendations on ethical issues relating to data and new technologies, in particular on responsible and sustainable use of data by the public and private sectors;
- In December 2019 a [Data Ethics Toolbox](#) was launched to support companies to adopt and implement data ethics into their business models;
- A [joint cybersecurity and data ethics seal](#) (a labelling scheme) will be launched in 2021. It is founded by an independent multi-stakeholder consortium involving the national industry organisations and the Danish Consumer Council.

In terms of **legislation**, the Danish strategy highlights the need to evaluate the current legal framework and to adopt new legislation to guarantee the responsible development of AI applications. The new legislation relates among others to data ethics and security regulations and include initiatives as:

- Law on disclosure of Data Ethics Policy: A [legislative amendment](#) to the Danish Financial Statements Act affects Denmark's largest companies and how they conduct their annual reporting. The law requires companies with a data ethics policy to provide information on compliance, while companies without a data ethics policy must explain why they do not have a policy – much like they do today on corporate social responsibilities (CSR). The law entered into force on 1 January 2021 and a [guide for businesses](#) on how to include data ethics in their annual reports has been developed;
- Cyber security directive: This directive, properly known as the Directive on security of network and information systems (NIS), requires Member States to adopt a national cyber-security strategy. Denmark's current [national cyber-security strategy](#) was published in May 2018, and a revision is expected in 2021;
- On 30 May 2017, the Danish parliament adopted an amendment of the Danish Road Traffic Act allowing the testing of self-driving cars. According to the amended Act, any company that wishes to carry out testing of self-driving cars must apply to the Ministry of Transportation for a permit.

The Danish strategy recognises the importance of **international standards** in AI. In this regard, the Danish Government will initiate work to develop national technical specifications based on the specific needs of Danish businesses. In particular, the [Strategy for Denmark's digital growth](#) foresees to:

- Support the development of international standards for small and collaborative robots (cobots).

## 5.7.5 Infrastructure

Data is an essential prerequisite for the use of AI. Hence, the Danish Government recognises the importance of facilitating access to data and making it available for citizens, businesses, public authorities and researchers. Concretely, the Danish Government is developing the following **policy initiatives related to data infrastructure**:

- Common Danish language resource: The aim is to foster language technology solutions by providing access to a high-quality shared language resource. In June 2020, the Danish Government, in collaboration with municipalities and regions, launched the website [sprogteknologi.dk](#) where metadata about existing language resources are gathered and displayed. Future actions include the development of further Danish language resources, e.g. a central word register and the development of a time-coded and transcribed speech corpus in Danish;
- Access to public sector data: the need to prepare a strategy for data in the public sector which will encourage the use and dissemination of public-sector data. A concrete example:
- Access to Danish health data:

- The Danish health data is internationally unique because many health registers and databases cover the entire population over many years. It is possible to combine various sources of health data (e.g. national health registries, clinical quality databases, biobank samples and health record data) and other data (e.g. socioeconomic data) by using the unique personal identification number. This provides good opportunities for valuable research, quality development and the development of new innovative solutions to the benefit of patients;
- To support researchers in accessing health data the Danish Government and Danish Regions have launched a common entry for health data. The entry will consist of an overview of available health data and a digital entry for guidance and application for access to health data for research.
- The Danish Life Science Strategy from April 2021 includes an initiative to explore potentials for establishing a secure national analysis platform for secondary use of health data. The aim is to support data users in accessing health data and other data from various data sources and performing advanced data analysis (e.g. machine learning and algorithm training) with the use of comprehensive data types (e.g. genome data and imaging data) in a secure way;
- Development of digital export certificates: the government supports the development of digital certificates for exported goods (in particular in the food sector) aiming at improving traceability and transparency of the export process. The use of big data from the system will be used for smarter and more focused guidance for exporters;
- Fostering the [Open Science Policy](#): the Danish Government's policy of Open Science is focused on three important elements, including open access to scientific publications, research integrity and open research data.

In addition, the policy framework for AI is further strengthened with initiatives for a good **digital and telecom infrastructure**, including a modernised telecommunications agreement and a 5G action plan:

- Cloud technologies: the need to establish a strategy for fostering data storage in the cloud to allow cheap access to massive computational power and storage capacity;
- A new national strategy for digital research infrastructure was launched in 2019 comprising recommendations for a strengthened national cooperation with respect to digital research infrastructure.

## 5.7.6 AI to address societal challenges

### Climate and environment

The Danish Government believes that it is increasingly important at national and local level to use data and digital technology in developing climate neutral and circular solutions.

In order to meet the Danish ambitious target of cutting carbon emissions by 70 % by 2030, [13 climate partnerships between the government and 13 industrial sectors](#) have been set up. In March 2020 they published their first set of recommendations including many recommendations for the use of AI and data, especially on setting up data-sharing.

The Danish Government continually works on securing a responsible digital economy where trustworthy, ethical and secure use of data and AI goes hand in hand with the ability to provide innovative solutions. Thus, partnerships on the responsible use of energy and resource data, and data for smart city solutions for making data available for data driven solutions that can lower energy and resource consumption are under investigation.

In addition, an ongoing project within the framework of the Danish strategy for AI is investigating the use of public datasets for AI, which has the potential to strengthen the green transition in Denmark. Several of the upcoming high-value datasets mandated by the Open Data Directive – including environment and climate data, or location data in the transport area – can contribute to the development of AI technologies.

As part of the Danish national AI strategy, the Danish Government and the Danish municipalities and regions have established an investment fund to boost the use of AI by municipal and regional government authorities. In total, the fund will allocate approximately EUR 27 million in 2019-2022 for testing, scaling and encouraging the uptake of AI in the public sector, with a particular focus on healthcare, public administration and the green transition.

Selected signature projects focus on the use of AI to tackle climate change:

- Forecast tools for planning, mapping and warnings for flood prevention and management in rural and urban areas;
- Energy management and optimization of existing building stock;
- Intelligent fleet management and smart traffic patterns.

### **COVID-19 pandemic**

The Danish Government has allocated a total of DKK 150 million (approx. EUR 20.1 million) for [research and development in the fight against coronavirus](#). Part of this budget will go to 10 new research projects conducted in Danish universities and hospitals. The research projects will receive funding between DKK 750,000 (approx. EUR 100,000) and DKK 7.4 million (approx. EUR 1 million). The funding programme also supports small and medium-sized companies with innovation and development projects that can help the society during the corona crisis.

In addition to the governmental funding, The [Novo Nordisk Foundation](#), an international foundation focusing on medical treatment and research and primary owner of Novo Nordisk, has awarded a total of DKK 82.5 million (approx. EUR 11 million) for 45 projects that aim to mitigate the short-term health-related effects of the COVID-19 epidemic.

As AI is a cornerstone in the fight against the coronavirus, part of these budgets also support the exploit of AI within the COVID-19 medical context. By means of examples, several funded projects using AI as a key technology against COVID-19 are presented below:

- Project on machine learning models based on Danish registry data: the objective of this project is to identify – based on machine learning algorithms – cancer patients who are at high risk of having a surgically complicated course of treatment. During the corona pandemic, these identified patients could be prepared for surgery via optimisation outside the hospital;
- Project using AI to predict the course of the disease for COVID-19 patients: based on medical records, gene analyses (genome sequencing) as well as detailed studies of the immune system, the project will develop a model that can predict which patients will need intensive and respiratory care;
- Project on real-time risk assessment of patients with COVID-19: AI is used to analyse patients' data in order to develop new, data-driven decision support models to the advantage of future patients. Specifically, by employing the analyses about patient records and treatments, the project aims to model the risk of intensive care and ventilator breathing support of newly diagnosed COVID-19 patients;
- Project on Corona Application Tool for Collaborating Hospitals ([CATCH](#)): AI employs patients' data to identify the key factors contributing to severe illness, and this will generate updated risk assessments for the patients from their admission and onwards;
- Project on imaging analysis for COVID-19 diagnosis: This project employs AI to characterize the type of infection that is shown on x-ray images of lungs in order to detect the degree of infection and the similarity with COVID-19 infection.

### **5.7.7 Monitoring and future update**

The outlined strategy constitutes a first step towards the development of AI in Denmark. As new challenges will arise in the future, it will be necessary to adjust existing initiatives and to define new policy actions. To this purpose, Denmark is currently considering the most effective way to address and, if needed, revise the existing national AI strategy from 2019.



## 5.8 Estonia

In July 2019, an expert group led by Ministry of Economic Affairs and Communications and the Government Office presented a [policy report](#) together with proposals to advance the up-take of AI in Estonia (Estonia, 2019a). Based on the proposals, the Ministry of Economic Affairs and Communications presented [Estonia's national AI strategy](#) (Estonia, 2019b). Estonia's strategy provides a comprehensive overview of both existing and proposed policy measures, along with their objectives, deadlines and budget estimations. The objective of the strategy is to fully harness the potential of AI by developing and implementing policy measures in the following areas:

Encouraging the use and development of AI applications in both the public and private sector;

- Providing direct support to research in AI and increasing the relevant skills and competencies to do so;
- Developing a legal environment to facilitate the uptake of AI.

With regards to funding, the Estonian Government estimates an investment of at least EUR 10 million in 2019-2021 for the implementation of its AI strategy.

### 5.8.1 Human capital

Estonia's strategy foresees several **reforms to the formal education and training** systems in order to increase skills and competencies in AI. Reforms at the level of preschool, primary and secondary education will be primarily covered through an upgrade of the [ProgeTiger Programme](#), which offers technology curriculums to schools. Awareness rising about the possibilities of AI is also supported through the [technology compass](#) offered by the Estonian Education and Youth Board. Reforms to the higher education include the Master's programme in the field of data science and AI (in autumn 2020 the first students were admitted to the [course](#) at the University of Tartu), the promotion of elective courses on AI in postgraduate disciplines (including also non-ICT disciplines), and the increase of [PhD scholarships](#) in AI-related fields.

Additional further education trainings are in preparation and include among others online courses for citizens to raise the public awareness of AI and a training programme targeting employees of companies developing AI solutions. The Ministry of Economic Affairs and Communications has developed training courses and instructional materials in AI for managers and developers in the public sector, courses to raise awareness of AI in the public sector and data governance training courses aimed at data stewards and upper management to support the development of AI. In this respect, the University of Tartu is also providing a [MOOC](#) on AI. In addition, an Estonian language version of [Elements of AI](#) has been launched by TalTech in November 2019. The importance of providing a digital focus on lifelong learning was already anticipated in the [Estonian lifelong learning strategy 2020](#) published in 2014.

### 5.8.2 From the lab to the market

To foster AI developments, Estonia foresees to **increase the capacity of AI research**. This is achieved by developing [AI-related research](#) support measures and by increasing the capacity and awareness of funding opportunities. The uptake and development of AI in the private sector will be supported through existing funding measures such as [innovation vouchers](#), [development vouchers](#) and [product development grants](#). Other existing policies, such as the Technology Competence Centre ([TCC](#)) and in particular the Competence Centre Specialised in Machine Learning and Data Science ([STACC](#)) are providing support measures for companies to develop innovative AI products and services.

In addition, the Estonian Government is preparing an innovation competition to promote AI developments based on governmental datasets. Another funding scheme provides financial support to pilot projects at various levels of their technology readiness. These instruments will be complemented with **new funding measures** to foster the [digital transformation of companies](#) (including AI and robotics) across all sectors. Flexible and sufficient funding opportunities for the AI uptake in the public sector has been earmarked through structural funds, joint procurements and new upcoming funding measures. Lastly, sandboxes are currently developed to foster testing and developing AI applications in the public sector.

### 5.8.3 Networking

To **improve networking and collaboration** opportunities, the Estonian Government is developing a policy tool to monitor available technology developments on the market and to liaise companies with R&D institutions. As a part of the European Digital Innovation Hubs (EDIH) network, AI & Robotics Estonia is established. The centre will be operational in June 2021 and it will allow SMEs from all sectors to obtain free services to develop knowledge-intensive solutions in the field of AI and robotics. Dissemination and uptake of AI is also targeted in the public sector among others the identification of use-cases, the organisation of meetings, conferences and a website to share experiences and good practices.

One of the actions of the AI strategy to foster public and private sector cooperation is ordering and making available AI core components, which can then be further trained by the subsequent institutions on the basis of their data and needs. The first such core component was made available through a public sector code repository in autumn 2019. A company called Texta concluded a memorandum of understanding with the Ministry of Economic Affairs and Communications to offer a [free open-source text and data analysis software](#) to all state authorities. As of 2021, there are five different [core components](#) made available to the public, including machine translation, speech synthesis, speech recognition and topic tagger. Another AI core component includes the development of an open-source chatbot established in cooperation with public bodies, spell corrector, process analyser, customer contact classifier, abstract generator, and anonymization toolkit. There are various networking events taking place to increase awareness of AI solutions, among others aimed at presenting the results of AI projects.

### 5.8.4 Regulation

With respect to **regulation**, the Estonian strategy foresees amendments to the legislation to facilitate the development and uptake of AI. Introducing a new AI specific regulation is not planned at the moment, instead, modifications to the existing legal framework (Administrative Procedure Act) are envisaged. In addition, the Estonian Government released voluntary [procurement guidelines](#) that aim to give an overview of the most common issues as well as possible solutions that could be considered in a data science project. Finally, the Estonian Government is currently working on a self-assessment questionnaire for developers of AI that is based on the Assessment List accompanying the [Ethics guidelines for trustworthy AI](#).

The Estonian Government is also working on national metadata standard and data quality framework, which will be implemented in a combination of guidelines and mandatory binding legislation.

### 5.8.5 Infrastructure

The Estonian strategy devotes salient attention to **data infrastructure policies**. It includes data governance tools, instruments to increase the availability and responsible use of data, the creation of a Chief Data Officer in various – and potentially all – ministries, the compilation of data catalogues/sharing platforms, and the provision of funding for data audits. The [project](#) on the compilation of data catalogues has been successfully finalised and will be further developed. The data catalogue will contain all data from the public registries and will include metadata providing more information about the type of data and its availability. The [open data](#) portal will give access to all public data without restrictions. There is currently a project underway to develop a data management tool, which will initially focus on metadata management. Finally, the recommendations of the [Open science in Estonia](#) report will be further developed into cost-effective solutions for implementing open science principles at the national level.

To foster the **telecommunication infrastructure**, the Estonian Government continues the completion of an ultra-fast broadband fibre optic cable network and foresees activities to support the rollout of 5G network as highlighted in the [Digital agenda 2020 for Estonia](#), released in 2018 and in the upcoming Digital Agenda 2030 (expect to be approved by the parliament in autumn 2021). In addition, Estonia joined the [EuroHPC](#) project to enjoy the benefits of supercomputing.

### 5.8.6 AI to address societal challenges

#### Climate and environment

In January 2020 the Estonian Prime Minister, presenting the on plans e-health, e-state and energy revolution at the World Economic Forum, mentioned the fight against climate change and the development of AI as [priority pillars](#) of the future. Following the need of finding [innovative solutions](#) to respond to global challenges



such as combating climate change, the Estonian Prime Minister encouraged entrepreneurs from Estonia and the Kansai region to establish business contacts during a business seminar in Kyoto in February 2020.

Currently Estonia has several ongoing research projects that combine AI-related techniques to create a more sustainable environment:

- **Ice map based on satellite data:** The purpose of the ice [map solution](#) is to compile raster maps and satellite images for monitoring the snow and ice cover of Estonian coastal waters and large lakes (Lake Peipus). The maps and images are based on the European Space Agency's as well as EUMETCast satellite data, which is made available via national satellite data centre ESTHub, in addition to *in situ* measurements of ice. The technology of raster maps and satellite images is based on the **supervised machine learning** approach, as much as possible. Ships, icebreakers, Police and Border Guard Board, Rescue Board will use ice maps in order to give warnings about ice conditions and to rescue people who have drifted with ice. Using such, already existing satellite data, reduces the need for *in situ* monitoring and increases the accuracy of data-based decisions. Ice map project will be finalised by the end of 2021;
- **Remote monitoring of forest resources:** The purpose of the project is to create an information technology solution that enables the compilation of raster maps of Estonian woody vegetation (tree species, height, forest reserves and site clearance). The maps will be constructed using multispectral satellite data, aircraft scanning data (LIDAR) and **machine learning methods**. The data processing should be as automated as possible and with minimal manual work by the user. The main input data for the processing are Sentinel-2 MSI multispectral satellite images obtained from the national satellite data centre ESTHub. The output of the project are four different maps: map of forest clear-cuts, map of tree species composition prediction, map of forest height prediction, map of forest stem volume prediction. With the help of such maps, it is possible to assess the forest resources and plan economic decisions on this basis. The project was finalised in July 2020;
- **Monitoring and species identification using images and AI:** The purpose of the project is to create a prototype based on **AI (machine learning)** platform for identifying animals and birds using image data (photos and videos from trail cameras). Prototype will contain **machine learning** models for identifying wild animals and birds in Estonia by Estonian Environment Agency. Instead of manually viewing wildlife image data (46 000 photos manually analysed in 33 hours), the AI will analyse these images in 1-2 hours. The project will begin in few months and will be finalised in 2021.

### COVID-19 pandemic

As for the COVID-19 emergency, during the first phase of the crisis, the chatbot [Suve](#) helped Estonians and foreign residents of the country in finding official information about the coronavirus situation. Since then, the Estonian Government has undergone several projects and are currently developing an open-source AI-based chatbot solution. Various governmental agencies are using transcription and analysis in customer communication to understand the root causes of customer inquiries and thereby reduce the number of calls and improve satisfaction with public services.

### 5.8.7 Monitoring and future update

A working group will be set up to monitor the implementation of this action plan, to initiate additional policy initiatives if necessary and to start the preparation of Estonia's long-term AI strategy for 2022.



## 5.9 Finland

In October 2017, the Finnish Ministry of Economic Affairs and Employment published its national AI strategy entitled [Finland's age of artificial intelligence](#) (Finland, 2017). This report fits under the umbrella of a broader [Artificial Intelligence Programme](#) in Finland (also labelled as AI Finland) with a view to establishing AI and robotics as the cornerstones of success for Finnish companies.

The strategy highlights Finland's possibilities in the global market along with its strengths and weaknesses in AI. It describes how AI will transform society and provides a range of policy actions and recommendations for Finland to thrive in the age of AI.

The goal was to position Finland as a leading country in AI. Finland has thereafter adopted an open data policy and aimed to create adequate conditions for a prosperous development of AI. Overall, the strategy strived to:

- Increase the competitiveness of business and industry;
- Provide high-quality public services and improve the efficiency of the public sector;
- Ensure a well-functioning society and wellbeing for its citizens.

In 2018 the national AI strategy was complemented with a policy report on [Work in the age of artificial intelligence](#) (Finland, 2018). It is a thematic report that reflects on the impact of AI on labour market dynamics and skills requirements. In 2019 the Finnish Ministry of Economic Affairs released the final report of Finland's Artificial Intelligence Programme, entitled [Leading the way into the age of artificial intelligence](#) (Finland, 2019). On pages 80-82 of this report, the Finnish Government provides investment figures for several flagship policies. For instance, the AI Business Programme has been allocated EUR 100 million over a four-year period. The Finnish Centre for Artificial Intelligence (FCAI) was granted EUR 8.3 million in flagship funding for 2019–2022.

In November 2020, Finland has launched an updated AI strategy: the [Artificial Intelligence 4.0 Programme](#) promotes the development and introduction of AI and other digital technologies in companies, with a special focus on SMEs from several industrial and service sectors.

### 5.9.1 Human capital

The presence of a well-established, harmonised and effective education system is one of Finland's main strengths. As a result, Finland has a highly educated and tech-friendly population. However, current available skills directed to the utilisation and development of AI and robotics are mainly present in technological and mathematical fields, which are often too broadly defined to support society in these times of change. Hence, the Finnish Ministry of Economic Affairs and Employment proposes an active reform of education systems towards the provision of high-quality courses in AI. The reform should not only include AI-oriented courses but should also incorporate communication and social skills, problem solving and creativity.

A Competence and Innovations Committee has been established under the Artificial Intelligence Programme to support education reforms. In particular, the Finnish strategy provides the following policy recommendations towards **education and training in AI**:

- Guaranteeing AI literacy across the Finnish population (including elderly) to ensure that all citizens have a basic understanding of AI applications. This can be achieved through MOOCs to ensure elementary knowledge on AI:
  - [Elements of AI](#) course: the Elements of AI is a series of free online courses created by Reaktor and the University of Helsinki. The course series aims to demystify AI by offering a basic ([Introduction to AI](#)) and more advanced ([Building AI](#)) course on AI methods. With the objective to reach as many people as possible, the basic course is being translated in [all languages](#) of the European Union;
  - Online introduction course to [Python](#);
- Introducing Masters and Bachelors programmes at university providing courses in AI. Examples:
  - Master's programme on [machine learning, data science and AI](#) at Aalto university;
  - Master's programmes on [data science or digital humanities](#) at University of Helsinki.
- Incentives and training mechanisms for teachers to use AI in their courses and teaching methods.

Particular attention is devoted to the working-age population with policy recommendations targeting **vocational training and lifelong learning opportunities**:

- MOOCs in AI and programming as a possible tool for further education of people in the labour market;
- Lifelong learning opportunities to train working-age population with the provision of personalised and motivating learning methods;
- To promote lifelong learning, a skills account or voucher will be created for all working-age people, which they can use to update their skills and purchase the training they need.

As mentioned in the second AI report, about one million Finns are estimated to need reskilling/upskilling training to adapt to changes in occupational structures. In order to **close the gap of available skills and the needs of the labour market**, the Finnish strategy advocates modular education programmes to address incompatibilities between current skills and new skills requirements:

- Opportunities for expanding qualification contents will be integrated in education programmes to facilitate adaptations to workforce's skills needs.

### 5.9.2 From the lab to the market

To support AI developments from the lab to the market, [Business Finland](#), Finland's main funding agency for innovation, plays an important role in providing finance and support to AI companies. Initiatives from this agency are complemented with technical support on research and innovation from [VTI](#), the Technical Research Centre of Finland.

In particular, the Finnish Government is implementing the following policy initiatives to **encourage research and innovation in AI**:

- The creation of an [AI maturity tool](#), which has been in use since 2019 to help organisations increase their business opportunities by identifying their most important areas for improvement in AI;
- The formation of a Finnish Centre for Artificial Intelligence ([FCAI](#)) to promote both AI research, and the use and application of AI in companies and elsewhere in society. In September 2020, FCAI was selected as the host of The European Laboratory for Learning and Intelligent Systems ([ELLIS](#)) unit in [Helsinki](#);
- The launch of an Artificial Intelligence Accelerator ([FAIA](#)) to facilitate companies in bringing AI experiments into production. The accelerator is initiated as a joint venture by the Ministry of Economic Affairs, Technology Industries of Finland and Silo.AI. [The state of AI in Finland](#) report was published in two separate sets in September and November 2020;
- The use of innovation vouchers to support companies to innovate and grow;
- The launch of the [AI Business Programme](#) that offers innovation funding, networking and internationalization services for R&D, among others;
- The [Hyteairo](#) Programme (Well-being and Health Sector's Artificial Intelligence and Robotics Programme) to support utilisation of AI and robotics in the well-being sector;
- Support to the development of significant test environments and testbeds.

### 5.9.3 Networking

Fully exploiting the potential of AI requires seamless collaborations and networking between various players. Finnish businesses have traditionally low thresholds in engaging in collaborations. In this respect, the AI Business Programme supports 15 enterprise-driven ecosystems<sup>55</sup> organised in platforms to encourage the share of competencies at different levels (e.g. innovative solutions, data, but also legislation, ethical guidelines or standards).

Besides this initiative, the Finnish Government highlights various support instruments and reforms to **foster collaborations in AI**:

<sup>55</sup> Open customer-centred ecosystem, CleverHealth Network, Communication network operations, Connected Intelligence, Corridor as a service, Digital design and manufacturing excellence, Digital Fiber, Intelligent Industry Ecosystem, Intelligent Packaging, OneSea - Autonomous Maritime Ecosystem, OuluHealth ecosystem, Research alliance for Autonomous systems, Smart building ecosystem, Smart Otaniemi, Reboot IoT Factory.

- [Business Finland – Growth Engines](#): creating new AI business opportunities and growth areas in Finland through an enterprise-driven partnership model of companies, research organisations and public actors;
- [Business Finland – Connected Intelligent Industries](#) supporting AI and digital collaboration and joint-efforts of SMEs, large companies, R&D institutions and research organisations at every stage of innovation;
- [Business Finland – AI Business Programme](#): accelerating the global growth of the Finnish digital service business;
- [Business Finland – Sustainable Manufacturing Finland Programme](#) focuses on renewing business models and increasing productivity in manufacturing ecosystems, with emphasis is placed on machine tool systems, (opto)electronics and photonics;
- Support for the creation of Digital Innovation Hubs in Finland to foster the digital and AI transformation of industries, particularly SMEs based on multi-actor networks and ecosystems;
- AIPSE programme: a [programme](#) to promote novel applications of AI in physical sciences and engineering research with special focus on international collaborations;
- [DIMECC](#): a co-creation network to encourage breakthrough innovations and collaborations with companies, universities and research institutions. It is a large network of R&D&I professionals from a wide range of organisations providing support to speed up innovations and to supply courses in machine learning for industrial employees);
- [AuroraAI](#): a national AI programme to prepare Finland for a human-centric and ethical society in the age of AI. It provides a decentralised open network and data-based model for smart services and applications. AuroraAI is speeding up the establishment of an ecosystem serving the needs of citizens, public administration and industry.

To **improve the international attractiveness of Finland** for foreign AI talents and start-ups, the Finnish Government launched the following initiative:

- [Talent Boost](#) – International talents boosting growth action plan: a sectoral programme to make Finland more attractive to international talents. To attract start-ups from outside the EU in particular, this programme includes a [Finnish Startup Permit](#).

In terms of **monitoring and dissemination of the use and understanding of** AI to a larger population, the Finnish Government provides following initiatives:

- The development of a [Finnish AI landscape](#) presenting a regularly updated list of top AI companies in Finland. The landscape is an initiative of Finland's Artificial Intelligence Accelerator;
- The Business Finland's AI Business programme promoted the establishment of local AI Hubs in Tampere and Turku and disseminated AI and platform economy knowledge in smaller localities;
- A blog and forum on the [Artificial Intelligence Programme](#) website of Finland used to share understanding and information about the business impacts of the application of AI with concrete examples.

## 5.9.4 Regulation

In December 2018 the Finnish Government has proposed a new information policy to promote the good management and the effective utilisation of information. The government's report on [Ethical information policy in an age of artificial intelligence](#) outlines principles for fair data governance, including guidelines for the use of information and ethical values.

Information policies discussed in the report relate to data access rights, data ownership, copyrights, security and personal data protection. It constitutes the knowledge basis and a policy, upon which a roadmap with prioritised actions can be built in the future. The development and deployment of AI raises uncertainty about the application of the current legislation on these issues and increases the need for a reform of the legislative and regulatory framework.

Policy recommendations or initiatives towards a **reform of the legislative or regulatory framework** in Finland include among others:

- Reform of the [National cybersecurity strategy](#) by the Finnish Security Committee in view of developing comprehensive state security and expanding towards the fields of AI and digitalisation;

- [Act on Public Administration Information Management](#): defined the entire lifecycle of information in public administration. This reform intends to ensure consistent management of the authorities' data sets and secure data processing. It took effect on 1 January 2020;
- A review of the [Public Procurement Act](#) is needed in such a manner that it would enable effective public-private co-development. In addition, public sector operators should be secured sufficient resources and incentives to engage in such development, paying particular attention to sort out the rights of the outcomes of co-development;
- The Ministry of Justice and the Ministry of Finance are currently examining national regulation of automated decision-making. The impact assessment of algorithmic decision making is presented in a [policy report](#) released in 2019 and commissioned by the Finnish Government. The report is entitled "Algorithm as a decision maker?: Opportunities and challenges for the use of artificial intelligence in the national regulatory environment";
- The establishment of the [Road Traffic Act](#): the purpose of the new act, entering into force in June 2020, is to improve the smooth running and safety of transport and create preconditions for the digitalisation and safe automation of traffic;
- A new national intellectual property (IP) strategy is currently in preparation to improve the present IP situation in Finland.

In terms of ethics and values, the Finnish Government advocates the development of ethical foundations ensuring a sustainable use of AI that rests on fundamental and human rights. The creation of ethical principles are a first step towards a trust-based use of AI. It should be based among others on principles of transparency, reliability, and accountability, in which ownership and responsibilities are clearly defined. In February 2019, the Prime Minister's Office published a policy report commissioned by the Finnish Government on [Artificial intelligence in authority use - ethical and societal acceptance issues](#). It studies the concepts of ethics and acceptability in the context of technology development and application.

The Finnish Government has established an AI ethics committee to gain understanding on ethical principles and to ensure that Finland's AI development is human-oriented and based on trust. Policies directed to the development of **ethical guidelines** include:

- Setting up an AI ethics challenge on the [Artificial Intelligence Programme](#) website to incentivise companies to contribute to the creation of ethical principles for AI;
- Preparing the foundations for ethical guidelines in the public administration's ecosystem-based AuroraAI programme;
- Continuing the research project on Ethical AI for the Governance of the Society ([ETAIROS](#)). This project is funded by the Academy of Finland and has several Finnish universities as collaborators. The objective is to study and co-create governance frameworks and tools, which respond to the challenge of socially sustainable use of AI;
- Helsinki's AI register (in partnership with the city of Amsterdam): Helsinki and Amsterdam have launched open [AI registers](#) that track how algorithms are being used in the municipalities. A [White paper](#) on the AI register was published on September 2020 to inspire other governments/organisations wanting to be transparent about their use of algorithms and AI;
- Online course on [Ethics of AI](#): this course helps public administration, businesses and the general public understand what the ethical use of AI means and what it requires from both society and individuals. The course offered by the University of Helsinki has been designed in a partnership between the Cities of Helsinki, Amsterdam and London as well as Finland's Ministry of Finance.

## 5.9.5 Infrastructure

While several data infrastructure initiatives are deployed at large scale, others are proposed in a restricted environment and serve as regulatory sandboxes. In the public sector, regulatory sandboxes can for instance serve to 1) pilot opportunities for second use of personal data by the public sector with consent of citizens, 2) evaluate the usefulness for citizens and 3) prepare an appropriate legislative framework for successful deployment.

In terms of **data infrastructure with a regulatory sandbox philosophy**, the Finnish Government proposes the following policy initiative among others:

- Providing support to the [MyData](#) service<sup>56</sup>: a human-centred, open and compatible data management approach fostering data interoperability, sharing and protection of individual's rights on personal data.

A committee on Data and platform economy has been established to propose policy to facilitate the construction and use of data resources in all sectors. These initiatives are complemented and in line with an [Open Science Policy](#) to coordinate and foster a research community in which open science aims can be reached and monitored.

To foster the **digital infrastructure** for research purposes, the Ministry of Education and Culture has developed a research infrastructure [development programme for data management and computing](#) with research and innovation actors in 2017–2021. The development programme foresaw an investment of EUR 37 million in data management and computing infrastructures and related services. Finland is also participating in the [EuroHPC](#) initiative on the development of high-performance computing. The procurement contract of [LUMI](#), a new EuroHPC precursor to exascale supercomputers, has been signed by the European High Performance Computing Joint Undertaking and the company Hewlett Packard Enterprise, the selected vendor.

## 5.9.6 AI to address societal challenges

### Climate and environment

The initiative of [Business Finland – Growth Engines](#) aims at creating new AI business opportunities and growth areas in Finland through cooperation networks between companies, research organisations and public actors. Among others, the initiative foresees support through capital funding with an earmarked budget of EUR 30 million in 2019. A competitive bidding is organised to select the promising ideas and to promote ecosystem operators that generate at least EUR 1 billion of revenues.

In 2019 Business Finland selected [4 winning projects](#) on the competitive bidding on Growth Engines. These projects are estimated to generate nearly EUR 6 billion of new revenue in Finland, over EUR 9 billion in new exports and as many as 100,000 new jobs over the next decade. The technology areas of the winning projects are closely related to the **use of AI and curbing the climate change**: atmospheric carbon sequestration markets, smart ports, a marketplace for AI and new solutions for renewable energy production. The winning projects are:

- Compensate project – Growth boost for the market for carbon sequestration: Compensate is a non-profit foundation that brings together people and companies to stop climate change;
- Awake.AI project – Smart ports and shipping: The goal of Awake is to be the world's most trusted smart ports and autonomous shipping platform and a global ecosystem orchestrator by 2025;
- Silo.AI project – Marketplace for AI: The main goal of the Silo.AI ecosystem is to generate new business by the operators through AI-driven solutions and processes and commercialize Finnish top expertise;
- Flexens project – From a trial on the societal scale on renewable energy production to a global provider of comprehensive solutions: Flexens is a platform that offers combined solutions for the cost-effective integration of renewable energy production.

In addition, the Finnish Environment Institute ([SYKE](#)) – a research institute and government agency under the Ministry of the Environment – supports [environmental policies](#) by collecting environmental information suitable to decision-making. To this purpose, they are developing new environmental information methods that use deep learning, complex optimisation and AI to enable the faster utilisation of information in addition to welcome information produced by citizens.

In 2020, the Finnish Ministry of Economic Affairs and Employment published [a report analysis](#) focusing on industrial platforms and data-enabled value creation linked to industrial ecosystems.

### COVID-19 pandemic

The Finnish Centre for Artificial Intelligence ([FCAI](#)) is developing several [projects](#) to manage the COVID-19 crisis by means of AI recognising that “AI and machine learning methods can help in, for instance, outbreak

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<sup>56</sup> The following white paper published by the Finnish Ministry of Transport and Communications provides more details about the aim and working of the MyData service: <https://mydatafi.wordpress.com/portfolio/publications/>.



prediction, tracking and epidemiological modelling, drug development, and healthcare management". The FCAI together with the Helsinki Centre for Data Science ([HiDATA](#)) also published a series of [webinars](#) to shed light on how AI-based systems and data science could be of help while fighting against COVID-19.

Furthermore, an instant COVID-19 breathalyzer has been developed as part of a Co-created and Wellbeing project funded by Finland's Helsinki-Uusimaa [Regional Council](#), a joint regional authority for the region. The developed technology uses AI to identify the novel coronavirus in air exhaled by patients

Furthermore, the Finnish Government has set up a [website](#) to look for information on the coronavirus by telephone and chat and has the intention to introduce an [application](#) to trace chains of virus transmission which will be likely ready by August. The application – called Ketju – was funded by the Finnish innovation fund [Sitra](#) and was piloted at Vaasa Central Hospital. Based on Bluetooth technology, it is meant to provide confidential reporting of any encounters between users to trace COVID-19 contagions. Furthermore, the Finnish Institute for Health and Welfare ([THL](#)), in cooperation with Esri Finland Oy, produced an [open map application](#) displaying the data from the National Infectious Diseases Register about the confirmed cases in Finland.

### **5.9.7 Monitoring and future update**

In 2017, the Finnish Government has launched the [Artificial Intelligence Programme](#) to draw up an AI strategy for Finland. The programme has been finalised in spring 2019 and delivered among others three policy reports with concrete policy actions as outlined above. In the final report, the steering group of the Artificial Intelligence Programme has produced an implementation plan for the coming years and presents a vision for Finland in the age of AI till 2025. In November 2020, Finland has launched an updated national AI strategy. The [Artificial Intelligence 4.0 Programme](#) promotes the development and introduction of AI (AI) and other digital technologies in companies, with a special focus on SMEs. In the first [interim report](#), published in April 2021, the programme presented a vision for the future of the Finnish manufacturing industry, stating that in 2030 the Finnish manufacturing industry will be clean, efficient and digital. As stated in the report, seamless collaboration between high-speed telecommunications networks, cloud computing and AI are central to digital transformation.



## 5.10 France

In March 2018, Emmanuel Macron, the President of the French Republic presented his vision and a 5-year national AI strategy. The French AI strategy is entitled [AI for humanity](#) (France, 2018a) and has been developed on the basis of the [AI policy report](#) (France, 2018b) prepared by French Member of Parliament (MP) and renowned mathematician Cédric Villani.

The main objectives of the French AI strategy as highlighted by the French President are to:

- Improve the AI education and training ecosystem to develop, retain and attract world-class AI talent;
- Establish an open data policy for the implementation of AI applications and pooling assets together;
- Develop an ethical framework for a transparent and fair use of AI applications.

To this purpose, the French Government will dedicate EUR 1.5 billion to the development of AI by the end of 2022, including EUR 700 million for research.

In 2021, the Prime Minister Jean Castex announced a renewed open and shared data strategy following a 2020 Report by MP Eric Bothorel which includes data and datasets for AI.

Also, the 4<sup>th</sup> generation of the multi-year National Investment for the Future Programme is being framed in 2022. One sub-programme will be dedicated to AI and several other sub-programmes will include actions related to the National AI Strategy. This will allow updating the National AI Strategy funding and secure budget slots corresponding to the EU renewed Coordinated Plan.

### 5.10.1 Human capital

In order to reduce the AI, data science and robotics skills gap on the labour market, the AI strategy will continue to provide financial incentives to higher education and research institutions to increase the provision of initial training at all levels, intermediate and expert, dual programmes and the retraining or upgrading of talent. Initiatives to increase diversity in computer science and AI are being deployed.

- The number of graduates at Masters' level has doubled since 2016 and a new doubling target has been set;
- The range of training courses, in initial and part-time continuing education, summer or winter schools and executive programmes altogether has increased rapidly in 2019-2021, especially in the 4 [Interdisciplinary Institutes of Artificial Intelligence \(3IA\)](#) created in 2019: [Toulouse-ANITI](#), [Nice-Côte d'Azur 3IA](#), [Grenoble-MIAI](#) and [Paris-PRIAIRIE](#), but also in 3 other major education and research centres specialized on data science, AI and Robotics: [Paris-Saclay-Institut data-IA](#), [Institut Polytechnique de Paris-Hi!](#) and [Paris-Sorbonne-SCAI](#);
- Foster education of all players involved in the "algorithmic chain" (designers, professionals, citizens), including intermediate capacities for the working force and enable each citizen to improve its digital literacy to better understand the inner working of machines and the benefits of AI.

In terms of **vocational training and lifelong learning** initiatives, the French Government highlights:

- The formation of the Grande Ecole du Numérique ([GEN](#)): created to support training that helps to integrate people at risk of unemployment to the job market by developing their digital skills;
- The move towards quality labelling, certification and integration into rich professional training paths, including re-skilling and up-skilling, such as the efforts by the [OPIIEC digital occupations observatory](#).

The deployment of AI technologies will have a major impact on the job market. According to France's Employment Orientation Council roughly half of the occupations could be automated in the medium to long term. To tackle this issue, the French AI strategy devotes particular attention to a **better understanding of future labour demand and skill needs** to prepare successfully for professional transitions. The following policy recommendation is targeting increased labour market intelligence and forward-looking skills predictions:

- The creation of a public laboratory on the transformation of work to encourage reflection on the ways in which automation is changing occupations and to provide support for professional transitions.

### 5.10.2 From the lab to the market

The goals set by the National AI strategy extensively rely on applied research and innovation. The responsibility for coordinating the research side of the AI national strategy has been given to the French national research institute for the digital sciences ([Inria](#)), with a clear objective: to strengthen the entire French AI sector, accelerate technology spinoffs or transfers, and develop cooperation programmes with the industry. Among others, the research institute will coordinate the strategy's implementation, provide scientific and technological expertise and develop bilateral cooperation initiatives, in particular with Germany.

The network of interdisciplinary AI research institutes within universities relies on some form of specialisation, directly linked to the regional academic and economic ecosystem. Incitation schemes have been developed, implying that 1 euro of private partners' investment in collaborative R&D&I programmes results in 1 additional euro of state funding.

So far, the National AI strategy has helped to create 180 additional academic chairs and 300 additional PhDs in AI disciplines. Many other non-profit institutions help creating an innovation-friendly ecosystem and translating the strategy into reality:

- Several of the 16 Technology Research Institutes (IRT) or Energy Transition Institutes (ITE) help leading partnering projects in AI, among which [IRT-System X on Trustworthy AI](#), [IRT Saint-Exupéry](#) on Complex Systems embedding AI, [IRT nanoelec](#) on hardware components, [ITE Efficacity](#) in the Smart City domain, ITE Vedecom in the automotive industry. The association of IRT and ITE has developed a cross-institutes AI Programme, called [EngageAI](#);
- Several of the 53 French sectoral poles de compétitivité (Innovation Clusters) also develop active AI ecosystem animation, with a view to disseminate AI in industry, such as [Aix Safe Cluster](#) (Safe city and security), [Systematic-Paris-Region](#) (Deep Tech), [Paris-Cap-Digital](#), [Medicen Paris Region](#) (Health), [Rouen Mov'eo](#) (Mobility), and the [Toulouse Aerospace Valley](#);
- The [Teralab Institute](#) provides technological resources and a whole ecosystem of experts companies, to remove scientific and technological obstacles faced by organisations wishing to exploit their data and accelerate experimentation and technology transfer.

The AI for Humanity strategy prioritises policy support for research and innovation to **specific sectors** that show sufficient maturity to embrace major AI transformations: **health, transport, the environment, defence and security**. Hence, this will require sector-specific policy, including sector-specific data platforms for data compilation and exchange, large-scale computing infrastructures and testing facilities. While many of these aspects touch upon infrastructure (cf. below), the French Government advocates **creating test areas to facilitate the design and deployment of AI technologies**:

- Implement test areas and innovation sandboxes to facilitate experimentation in real-life conditions while temporarily reducing the regulatory burdens to help testing innovations;
- The economic national operator [bpifrance](#) (public investment bank France) also operates yearly generic funding, prizes and labels schemes that target the digital transition at large but whose share of AI projects has been steadily increasing. It proves essential to consider AI innovation as an applied and integrative endeavour.

### 5.10.3 Networking

Following initiatives are envisaged to foster networks and collaborations in AI:

- [Inria](#) will coordinate the network of French AI expertise by means of the development of the 3IA Institutes and other research-oriented collaborative support mechanisms;
- Trilateral French-Japanese-German research projects on AI: The French National Research Agency ([ANR](#)) together with the German Research Foundation ([DFG](#)), and the Japan Science and Technology Agency ([JST](#)) is announcing the first trilateral call for research proposals on AI. This [call](#) is intended to support collaborative projects of trilateral research teams over 3 years, bringing together research partners from France, Germany, and Japan;
- Fostering of public-private laboratories, so called LabComs to encourage collaborative AI research and innovations;
- Inria and the DFKI, signed a memorandum of understanding aimed at building a strategic partnership between France and Germany on AI. The goal is to pool strengths in order to overcome obstacles in

the fields of health, cybersecurity, robotics and industry. More information about this collaboration is presented on page 11 of the [2020 activity report](#) of Inria;

- Participating to the Global Partnership on AI ([GPAI](#)): a declaration has been signed between France and Canada to start a project on the creation of an international initiative to spur a responsible development and use of AI in full respect of human rights, inclusion, diversity, innovation and economic growth. The GPAI collaborates with international partners and organisations to bring together experts from industry, civil society, governments and the academic world. This initiative is stirred by a secretariat, hosted by the OECD in Paris, and it accounts for two Centres of Expertise in Montreal and in Paris.

To **foster the international attractiveness of AI** in France, the French strategy expresses the need for policies to boost France's appeal to expatriates and foreign talent by improving working conditions and salaries of researchers.

#### 5.10.4 Regulation

Ethical matters to ensure a fair and transparent use of AI technologies and algorithms are central to the French AI strategy. In this regard, Cédric Villani's recommendation in the [AI policy report](#) to create a "digital technology and AI ethics committee in charge of leading public discussion in a transparent way, and organised and governed by law" has effectively led to the creation early 2020 of a Pilot National Digital Ethics Committee (CNPEN). In the pilot phase, it has been tasked about 3 areas of AI ethics but will extend progressively its outreach.

#### 5.10.5 Infrastructure

The French strategy highlights the following **data policy** initiatives:

- [The AI-specialized high-performance computer infrastructure Jean ZAY](#), inaugurated in early 2020 and currently running at 28 petaflops capacity (X2 since inauguration);
- [The CASD secure Data Hub](#), a public interest group bringing together the State represented by the French National Institute of Statistics ([INSEE](#)), Groupe des Écoles Nationales d'Économie et Statistique ([GENES](#)), the French National Centre for Scientific Research ([CNRS](#)), École Polytechnique and HEC Paris to help exchange securely sensitive in protected data for R&D projects;
- Data sharing in private sector: the French Government has funded many AI Challenges (3<sup>rd</sup> season 2020) to help sponsors tackle data valorisation and problem resolution through AI in cooperation with start-ups and other innovators, and also funded several data hub projects to foster the setting up and development of sectoral data spaces (namely in agriculture, alimentation, logistics, health, sport), to be fully integrated in European data spaces;
- Encourage the creation of data commons fit for the AI age, including the provision of open data sets, and more real-time open data. This perspective is reflected in the [National plan for open science](#);
- Increased data portability: the right to data portability should be supported, allowing migration of data from one service ecosystem to another without losing data history.

In terms of **digital and telecom infrastructure** to encourage the development of machine learning and AI algorithms, the French strategy strongly supports and participates in the following policy initiative:

- The [GAIA-X project](#), initiated by Germany and France, is to create a secure, federated data system that meets the highest standards of digital sovereignty while promoting innovation.

#### 5.10.6 AI to address societal challenges

##### Climate and environment

The AI policy report, prepared by French MP Cédric Villani, includes a chapter entitled [Using artificial intelligence to help create a more ecological economy](#) with recommendations to:

- **Fostering greener AI:** within this area, public authorities are called to support a greener value chain and the ecological transition of the European cloud industry;
- **Promoting the dissemination of ecological data:** open ecological data (i.e. data on weather, agriculture, transport, energy, biodiversity, climate, waste, land registry and energy performance

assessments) are the key point around which green AI technologies can develop and promote ecological transition.

Another [AI policy report](#), published in 2019, on the prospective of AI in France commissioned by the Ministry of the Territorial Cohesion and the Ministry of Economy and Finance, presents a similar signal. It highlights the need to strengthen the national ambition for the **use of AI to the benefit of the energy sector and the environment**. Among others, it calls for the development of intelligent energy networks through the use of Smart grids (based on smart meters and appliances), and new generations of supervisory control and data acquisition (SCADA) with high levels of digitalisation and remote control interventions. A cutting-edge infrastructure can enhance the deployment of AI applications for the optimisation of energy consumption, a higher quality service on the network, and better energy storage capacities.

With respect to the environment, the use of AI could be beneficial in the following areas:

- Reduction of the use of natural resources;
- Anticipating environmental risks;
- Increasing the efficiency and integration of renewable energy sources.

Lastly, researchers in optimisation and AI at Inria Lille - North Europe have successfully completed [Perf-AI](#), a research project executed in the framework of the European H2020 programme. Carried out in collaboration with a start-up from the aeronautics sector, and based on the analysis of flight data, the project led to the development of digital aircraft models enabling the optimisation of flight plans. Perf-AI thus offers a solution to reduce the energy consumption of commercial airlines.

### COVID-19 pandemic

In terms of AI-related policies to response specifically to the COVID-19 pandemic, following collaborative initiatives are ongoing or in preparation:

- Within the framework of the [GPAI](#) a working group on AI and pandemic response ([AIPR](#)) has been formed to promote cross-sectoral and cross-border collaboration in this area. In November 2020, the working group released a [report](#) outlining its mandate and providing recommendations to foster and support the responsible development and use of AI-enabled solutions to address COVID-19 and future pandemics;
- The French Ministries of Social Affairs and Health Education and of Research and Innovation are supporting 20 [research projects](#) to fight against the COVID-19 of which [one](#) employs AI to reconstitute the COVID-19 replication process, to model it, and to finally test suitable inhibitors.

Furthermore, in the fight of the COVID-19 pandemic, the French National Institute of Health and Medical Research ([INSERM](#)) and researchers at the University of Paris created a national phone line operated by intelligent digital assistants. The name of this service is [AlloCOVID](#) and it operates with AI-based virtual phone assistants that can respond to more than a thousand people at the same time (24/7). In addition, French authorities have integrated new AI tools in the security cameras of the Paris metro system, which could be expanded to other public transport means. The software was developed by French start-up [DatakaLab](#) to create anonymous data that will help authorities anticipate future outbreaks of COVID-19.

### 5.10.7 Monitoring and future update

Inria, the French national research institute for the digital sciences, has committed to play a prominent role as coordinator of the national AI strategy. It is responsible for its implementation, in particular on its research and innovation side.

Launched in 2018 the first phase of the French national strategy in AI, with a budget of EUR 800 million for 3 years, put a strong emphasis (1/3 of spending) on boosting research, with the creation of interdisciplinary institutes 3IA, the extra financing of 180 PhDs and the opening of a petascale supercomputing facility.

The second phase of this strategy (2021-2022) sets main priorities on the upscaling of education and training, development of embedded AI and trustworthy AI in critical systems in order to strengthen the national industrial base while accelerating the digital and ecological transition of companies thanks to AI.



## 5.11 Germany

In November 2018, the German Federal Government launched its [National AI strategy](#) jointly developed by the Federal Ministry of Education and Research, the Federal Ministry for Economic Affairs and Energy, and the Federal Ministry of Labour and Social Affairs (Germany, 2018).

The strategy presents the progress made in terms of AI in Germany, the goals to achieve in the future and a concrete plan of policy actions to realise them. The range of policy initiatives outlined in the strategy aim to achieve the following goals:

- Increasing and consolidating Germany's future competitiveness by making Germany and Europe a leading centre in AI;
- Guaranteeing a responsible development and deployment of AI which serves the good of society;
- Integrating AI in society in ethical, legal, cultural and institutional terms in the context of a broad societal dialogue and active political measures.

The German Federal Government published an [interim report](#) presenting the main measures that have been implemented of the German AI Strategy after one year in November 2019. It provides facts and figures on the implementation of the strategy, fields of actions and perspectives for the coming years.

In October 2019, the Federal Governments Data Ethics Commission presented its ethical guidelines and specific [recommendations](#) on AI, algorithm-based decision making and the use of data.

In October 2020, the Study Commission on Artificial Intelligence – Social Responsibility and Economic, Social and Ecological Potential of the 19th German Bundestag presented its final report with [specific recommendations for action](#), on which the German Bundestag concluded its deliberations on 5 November.

In December 2020, the German Federal Government has adopted an [Updated AI strategy](#) (Germany, 2020). The review draws up an interim balance, shows relevant developments at national, European and international level, and sets out concrete measures to be implemented by 2022. The update report focuses on the following fields of action: research, knowledge and expertise, transfer and application, regulatory framework and society. In addition, new initiatives will inter alia focus on sustainability, environment/climate protection, pandemic control and international/European cooperation.

With the [Economic stimulus and future package](#), the German Federal Government committed to increase the planned expenditure of EUR 3 billion for the promotion of AI by an additional EUR 2 billion, resulting in a total of EUR 5 billion by 2025.

The summary below aims to provide the most recent and updated picture of ongoing AI policies in Germany.<sup>57</sup>

### 5.11.1 Human capital

The German strategy proposes several **policy reforms and initiatives for formal training and education**, with special focus to the formation of educators, trainers and the general public in order to guarantee a high-quality level of education in AI:

- Expanding learning platforms such as the [AI Campus](#) to develop a solid skill base in AI through courses, videos, podcasts and knowledge exchange;
- Creation of at least 100 additional professorships in the field of AI to ensure that AI has a strong foothold within the higher education system. AI professorships are for instance planned at the centres of excellence for AI and in the scope of the Tenure Track Programme and the Excellence Strategy;
- Getting students more involved in STEM subjects as outlined in the STEM Action Plan.

On top of formal education and training reforms, the German Federal Government proposes a broad-based set of instruments to **expand and upgrade AI-related skills of the workforce**. As the required skills of individuals will change significantly with the upcoming AI technologies, the German Federal Government launches some large-scale qualifications initiatives with attention for lifelong learning and for reskilling and upskilling employees across their entire careers:

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<sup>57</sup> A comprehensive overview of national strategies, national expert platforms, and national programmes and initiatives on digital technologies (including AI) is also presented on the [German Digital Technologies](#) portal.



- The creation of the [National skills strategy](#) to promote advanced vocational training in digital and AI-related aspects among others. The [Mittelstand 4.0 centres of excellence](#) for SMEs has successfully deployed and expanded [AI trainer programmes](#) to support skills development for businesses<sup>58</sup>;
- The launch of INVITE (Digital Platform for Continuing Vocational Training) innovation competition projects for the design of an innovative, user-oriented and coherent digital continuing education and training area;
- The formation of regional Centres of Excellence for Labour Research studying and organising labour in an AI working environment and imparting the necessary skills to management and the workforce;
- The expansion of AI education programmes such as the online course on [Elements of AI](#) (with a governmental patronage).

Other policy instruments aim to identify upcoming skills demand and to **respond in a flexible way to the digital and demographic changes of labour demand** on the job market. Hence, these initiatives aim at satisfying and bridging the needs of both the workforce and companies:

- The creation of a [Skilled labour strategy](#): a skills monitoring system to identify which skills are needed in the future;
- The formation of regional Hubs of tomorrow to address companies and employees with tailored information and innovative learning approaches in order to shape change.

The German Federal Government also pays attention to the possibilities and impact of AI in the **cultural and media sector**. These include the funding and expanding of AI projects for the preservation, development, accessibility, networking and communication of cultural programmes as well as the development of AI skills in categorising and verifying media content to ensure diversity of opinion.

### 5.11.2 From the lab to the market

Funding schemes and support initiatives to **foster research in the field of AI** comprise among others:

- Creation of **Competence Centres for AI Research**: The German Federal Government has established multiple national competence centres for AI research to strengthen excellence and competitiveness and to become a leading centre for AI research. To support their expansion and their development into a national research network on AI the ministry has doubled the funding of the competence centres until 2022. As mentioned in the [Updated AI strategy](#) (p. 12), “*the plan is to dovetail the existing centres at the universities in Berlin, Dresden/Leipzig, Dortmund/St. Augustin, Munich and Tübingen and the German Research Centre for Artificial Intelligence with other application hubs to be established to form a network of at least twelve centres and hubs*”;
- The launch of a **Reality Lab for Artificial Intelligence** in Civil Protection: operated by the German Federal Agency for Technical Relief ([THW](#)). This living lab it is meant to offer an interface between the Security Research Community, AI researchers and industry. It will also link AI research and developments with practitioner needs. The lab aims at testing and developing solutions that make AI based technologies accessible and useable for practitioners. Another core task is the development of data collection concepts, for which specific tools and equipment will be created to enable future AI applications. The THW living lab is funded through special funding of the German Federal Government from 2019 to 2022;
- [Gruender platform](#): online platform to support start-ups – including AI ones – from initial research to concrete AI applications;
- [Industrial Collective Research](#) programme fostering joint business and science research on collective AI projects in order to close the gap between basic research and industrial applications;
- Advisory and funding services to **foster the growth of AI start-ups** (e.g. [EXIST](#) programme focusing on university spinoffs) through for instance venture debt (e.g. Tech Growth Fund). This can also include policies to promote [company formations](#) in the field of top-rate research in human-machine interaction.

Support initiatives towards **innovation and testing** include:

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<sup>58</sup> For more information on human capacity building in AI in Germany, see [Germany's human-centred approach to AI](#) on the OECD AI Policy Observatory.

- Founding an Agency for Breakthrough Innovations with AI as a focus;
- Developing in-company [innovation spaces](#) to promote innovative solutions for digitalisation;
- Strengthening the Central Innovation Programme for SMEs ([ZIM](#)): funding programme for SMEs targeting individual and collective R&D projects;
- Speeding up the process of AI innovations by launching so-called transfer initiatives, [digital test beds](#) and [regulatory sandboxes](#), and promoting pilot and flagship AI projects, for example those that benefit the environment and the climate.

The German Federal Government also has research and innovation support programmes in targeted areas with dedicated AI policies in **specific sectors and geographical areas**. The updated AI strategy in 2020 highlights following priority areas: **healthcare, environment and climate, aerospace, and mobility**. Examples of policy initiatives are mentioned below and in Section 5.11.6:

- Digital innovations for the improvement of patient-centred care in the **health care system**: Within the [funding programme](#) "Digital innovations for the improvement of patient-centred care in the health care system", the German Federal Government has so far funded 22 projects for up to 36 months over the period 2020-2023 with a total funding amount of approximately EUR 50 million. The projects will investigate the benefits of smart sensors, smart data use, smart decision support systems and smart communication in clinically relevant application scenarios. The projects should contribute to demonstrating the potential benefits of AI methods in combination with the use and evaluation of large amounts of data for patient care;
- Research on AI technologies in **agriculture, health nutrition, food chain and rural areas**: The German Federal Government initiated a government funding of AI technologies in agriculture, health nutrition, food chain and rural areas with a public announcement in February 2020. A total of 82 plans were submitted with overall 305 subprojects and a total funding about EUR 92 million;
- Real-World Test Field for **Digital Mobility**: The German Federal Government is funding this large-scale [research project](#) that combines elements of classical traffic planning with mobility and innovation management, also using AI. A total of 10 sub-projects on digital mobility are being implemented in parallel and scientifically monitored in order to deduce how digitalisation can effectively contribute to achieving the climate goals in the mobility sector;
- **Data Space Mobility Germany**: under the direction of the German Academy of Science and Engineering ([acatech](#)), a stakeholder dialogue is currently taking place to jointly create a comprehensive Data Space Mobility Germany by the end of 2021. Among other things, the aim is to make available mobility data (real and synthetic training and test data) that can be used across competitors for the research, development, validation and certification of reliable AI algorithms in order to promote the development of **autonomous driving** in Germany.

### 5.11.3 Networking

The German strategy highlights a wide range of policy initiatives to **foster networks and collaborations** across the business community, academia and public research centres. The aim of networking is to encourage the development of multidisciplinary cutting-edge research and innovation projects and to fully exploit synergies and diversities across institutional players by promoting knowledge dissemination and transfers.

Support initiatives of the German Federal Government to encourage collaborations include:

- The formation of a **Franco-German R&D network** ("virtual centre"): bilateral funding and training programme with bilateral AI clusters in specific industries (e.g. healthcare, environment, robotics, mobility);
- Expanding the [Plattform Lernende Systeme](#) into an **AI platform** to host dialogue and networking between science, business community, civil society and the government. To foster networking and increase the international visibility of German's AI research, the German Federal Government launched the [map on AI](#). This map allows to discover innovative applications and projects on AI and to identify and learn more about all research institutions active in AI (including the AI competence centres and Digital Innovation Hubs);
- **Platform Industrie4.0**: a [platform](#) with a holistic approach to the shaping of digital ecosystems. It aims at supporting and promoting innovations and collaborations in a digital economy, with recently a more targeted focus on AI technologies;

- The development of [Next Generation Clusters](#): The aim of the initiative is to transfer fundamental, developable results from cutting-edge research into products and services, with a strong emphasis on collaborative partnerships;
- Further development of the [Digital Hub initiative](#) and the [Hubs for Tomorrow](#) initiative in Germany, in particular those related to AI, cybersecurity and other AI-related fields;
- Establishment of the “Civic Coding - Innovation Network AI for the Common Good”: The German Federal Government is developing an innovation ecosystem that aims at fostering “**AI for the greater good**”. It aims at providing know-how, financial assistance to AI projects, a matching platform that brings together start-ups, NGOs, scientists and governmental agencies, as well as a collaborative data exchange infrastructure for non-profits and civil society actors. The German Federal Government will combine different specific expertise, synchronize funding strategies and provide support with a targeted infrastructure. It will establish **Civic Tech Labs for Green**, which will focus on developing sustainable and broadly accessible IT infrastructure and tools. Moreover the German Federal Government will facilitate data exchange among civil society actors by means of a newly established **Civic Data Lab**. A **Civic Innovation Platform**, which serves to provide a marketplace for ideas on the use of AI-technology for the common good and facilitates access to funding opportunities. The joint project is currently underway with a variety of pilot projects and the establishment of project infrastructure. The innovation network was officially launched in May 2021 and start operations at the end of 2021.

Another field of action is international cooperation on AI:

- The German Federal Government is working to ensure that the further development and use of AI is aligned with the **Sustainable Development Goals** (SDGs). **International networking and collaboration** with developing and emerging countries plays an important role to enable everyone to participate in the use of AI technologies and to develop AI applications for sustainable economic, ecological and social development. The German Federal Government is strengthening AI capacity building and better access to open AI training data in the Global South to support inclusive and fair AI innovation. In addition to this, its initiative [FAIR Forward](#) is supporting the development of suitable political and regulatory frameworks for AI, such as the framework by the governmental alliance “Smart Africa”, which is developing regulatory recommendations on AI for 30 African member countries;
- The German Federal Government supports the establishment of international and multilateral structures for networking and cooperation in the area of AI: Germany is one of the founding members of the **Global Partnership on AI (GPAI)**, an international initiative to spur a responsible development and use of AI in full respect of human rights, inclusion, diversity, innovation and economic growth. The GPAI brings together experts from industry, civil society, governments and the academic world. This initiative is stirred by a secretariat, hosted by the OECD in Paris, and it accounts for two Centres of Expertise in Montreal and in Paris;
- Germany also contributes to the ongoing [work of the OECD on AI](#). AI is a priority area of the OECD’s work in the field of the digital transformation. In May 2019 the OECD adopted its Principles on AI, the first international standards on AI agreed by governments. The OECD.AI Policy Observatory, launched in February 2020, aims to help policymakers implement the AI Principles and is supported by a Network of Experts on AI (ONE AI). The German Federal Government supports the OECD programme Artificial Intelligence in Work, Innovation, Productivity and Skills (AI-WIPS), whose results and findings will make a major contribution to shaping the global AI debate.

Concerning efforts to foster the **international attractiveness** of the country, the German Federal Government aims to improve working conditions and remuneration to draw in and retain and attract the brightest minds. Along this side, the German strategy also proposes reforms of legislation to facilitate immigration procedures for skilled workers. Notable policy initiatives to attract AI experts and researchers, include:

- Alexander von Humboldt Professorship: With a value of EUR 5 million, the [Alexander von Humboldt Professorship](#) is the most highly-endowed research award in Germany and draws top international researchers to German universities. From 2020 to 2024, additional Humboldt Professorships can be awarded in the field of AI;

- Support to young female AI researchers: In order to increase the participation of women in German research on AI, women will be promoted in leading interdisciplinary research groups, with a particular focus on reconciling work and family life. The selection process will be competitive.

Other initiatives aim to monitor current **progress and uptake of AI** and to disseminate nation-wide information about digitalisation and AI:

- Strengthening the [Observatory for Artificial Intelligence in Work and Society \(AI Observatory\)](#) to monitor the uptake and impact of AI in society and the future of work. The Observatory was launched on 3 March 2020. Among others, the Observatory conducts impact analyses, scenario development and trend monitoring of the use of AI and provides guidelines and recommendations for enhancing skills, the development of AI and use of it on the shop floor, and social dialogue in the field of AI;
- Monitoring the AI landscape by compiling indicators on the [use of AI in the economy](#) and in [higher education and teaching](#) and in [work and society](#);
- Establishing a Digital Work and Society Future Fund to set up an information and policy campaign in the field of digital technologies such as AI and to promote multidisciplinary social technology design.

#### 5.11.4 Regulation

As a body established by lawmakers, the Study Commission on Artificial Intelligence repeatedly examined regulatory issues relating to AI. In its [final report](#), the Study Commission provides recommendations for actions. Among others, the Study Commission calls for sector-specific regulatory regimes for AI, while ensuring principles of proportionality and liability.

In line with these recommendations, the German Federal Government launched initiatives to tackle among others issues related to information management, data ownership, free flow of data, and standardisation. Reforms of the legislation target many domains, including codifying the rights of the labour force, consolidating competitiveness of the industry and developing rules with respect to data use and protection.

Following initiatives provide initial steps towards a **legislative framework for AI**:

- The launch of a Commission on Competition Law 4.0 serving as a political platform for a debate on how to further develop competition and copyright law. In 2019 the Commission presented its report on “[A new competition framework for the digital economy](#)”. The [Competition and Digitalisation Act](#) adopted by the Cabinet on 9 September 2020 addresses several of the Commission’s recommendations and implements them where this is essential to ensure functioning competition, for instance when it comes to improving access to data;
- The Federal Data Protection Act codifies data protection regulation and privacy (i.e. safeguard the control on personal data), compliant with EU law;
- Review and if necessary adaption of the legislation concerning the use of non-personal data as well as copyright; inter alia: the German Federal Government’s [Data strategy](#) and [Open data strategy](#);
- Implementation of the cyber security directive: this directive properly known as the Directive on security of network and information systems (NIS) requires Member States to adopt a national cyber-security strategy. In Germany it has been implemented by the NIS Implementation Act in June 2017.

The German Federal Government advocates using an “ethics by design” approach throughout all the development stages and use of AI-based applications. It recommends engaging in dialogue with other leading regions to reach an agreement on joint guidelines and ethical standards on AI. Hence, the strategy foresees to work on a **legal and ethical framework** aligned with European guidelines and where appropriate taking into account recommendations of the national Data Ethics Commission. Several initiatives tried to define ethical guidelines for AI in Germany:

- Guidelines for developing and using AI systems: The Data Ethics Commission ([DEC](#)) presented their [recommendations](#) in October 2019 containing general principles to ensure the ethical design and use of data and algorithmic systems;
- Ethical requirements to ensure transparency, verifiability and predictability of AI systems (e.g. [ethical guidelines](#) for self-driving cars).

Besides ethical guidelines and legislative reforms, standards form an essential aspect of an adequate and effective regulatory framework. Standards ensure high quality products and services. They reinforce security and open up possibilities towards collaboration due to higher degrees of comparability and interoperability.

Overall, standards for AI increase the public trust in the use and deployment of AI applications. With respect to **standardisation**, the German Federal Government proposes the following support initiatives:

- The [German standardisation roadmap on AI](#) describes the environment in which AI standardisation operates, identifies existing standards and specifications relevant to the field of AI, and outlines further standardisation needs. Even though it is a national publication, it focuses primarily on European and international standardisation efforts. In addition, it formulates concrete recommendations for action which are aimed primarily at industry, but also at stakeholders in quality infrastructure, research and policy. The Roadmap was developed by the national standards organisations DIN and DKE in cooperation with the German Federal Government as part of the German AI Strategy, along with more than 300 experts from industry, science, the public sector and civil society;
- Funding for the development of data standards and formats to encourage EU-wide collaborations;
- Funding for experts, particularly from SMEs and start-ups in order to support their participation in international standardisation processes.

### 5.11.5 Infrastructure

Regarding infrastructure the German Federal Government foresees to expand the current data infrastructure in order to create optimal conditions for the development of cutting-edge AI applications. The objective of data infrastructure investments is to obtain a trustworthy data and analysis environment to strengthen research in AI and to favour exchanges due to a more flexible data interoperability. In addition, the German AI strategy aims to develop the current telecommunication and digital infrastructure to ensure a better connectivity of the network and to improve cyber security. Lastly, the German Federal Government is setting up funding to foster learning capabilities and experimentation in AI by improving the digital infrastructure in the education system.

In particular, the German strategy foresees the following initiatives for the **improvement of the infrastructure in AI**:

- Improving data sharing facilities by providing open access to governmental data and improving the infrastructure for access to the Earth observation data;
- Building a trustworthy data and analysis infrastructure based on cloud platforms and upgraded storage and computing capacity;
- Setting up a National Research Data infrastructure ([NFDI](#)) to provide science-driven data services to research communities;
- Improving security and performance of information and communication systems with particular focus on resilience of AI-systems in case of attacks;
- Providing funding from the Digital Pact for Schools programme to improve digital infrastructure in schools;
- Expanding the Learning Factories 4.0 initiative, which sets up professionally equipped laboratories and puts them at disposal of students for learning purposes in AI;
- Introducing PLAIN – Platform Analysis and Information System by the German Federal Government as a blue print for government big data and AI applications.

Cornerstone initiatives in German's preparation for the **next-generation data infrastructure** are the **GAIA-X** project and the **Federal Government Data Strategy**. The objective of the [GAIA-X project](#), initiated by Germany and France, is to create a secure, federated data system that meets the highest standards of digital sovereignty while promoting innovation. The Federal Government [Data strategy](#) identifies four concrete fields of actions: the improvement of data provision and access, the promotion of responsible data use, the increase of data competencies in society and the development of a data culture for data sharing and use.

Notable examples of support programmes of the German Federal Government to create data infrastructures to boost the development of AI applications, include:

- [mCloud](#): an open data platform that provides free access to data from the mobility, spacial and weather forecasting sectors. The database is constantly updated by the German Federal Government with raw data and takes into account data from private providers from the mobility sector as well. It is primarily aimed at users from administration, research and the business sector;



- Mobility Data Marketplace ([MDM](#)): it offers suppliers and users of mobility data a neutral B2B platform to share, search and subscribe to traffic-relevant online data. The platform forwards the data supplied by the data suppliers unchanged to the data clients. With its defined standards for data exchange, MDM is nation's biggest volume of information on traffic flows, traffic jams, road works, mobility options, parking facilities and more;
- Smart Data Innovation Lab ([SDIL](#)): it offers researchers unique access to a large variety of [big data and in-memory technologies](#). Industry and science collaborate closely to find value in big data and generate smart data from it. Projects focus on the strategic research areas of Industry 4.0, energy, smart cities and personalised medicine;
- Research Data Centre (FDZ) at the Federal Institute for Drugs and Medical Devices: it offers researchers and health policy makers access to claims data of all statutory insured people in Germany. This representative and up-to-date database allows research on public health as well as health services research with AI applications.

In terms of **ICT infrastructure and high-performance computing**, the German Federal Government will work with the different Länder to accelerate the expansion of the Gauss Centre for Supercomputing ([GCS](#)) to Exascale capability in addition to developing the National Supercomputing Centre (NHR), especially taking into account future peak demand for AI applications and for analysing large data volumes. Particular attention will be paid to energy and resource efficiency as well as possibilities for industrial use. A connection to GAIA-X and the mobility data marketplace is planned here to create a new and trustworthy bridge to use by business

### 5.11.6 AI to address societal challenges

#### Climate and environment

The German Federal Government's [National AI strategy](#) explicitly mean to bring benefits for people and the environment, and to fund AI applications to benefit the environment and the climate. To this end, the German Federal Government has developed various support programmes and action plans to foster the role of AI in tackling the climate change:

- **Lighthouses of AI for Environment, Climate, Nature and Resources:** to boost the high potential of AI to environmental sustainability, the German Federal Government published a [funding programme](#) (EUR 40 million) in August 2019. The programme funds solutions that use AI to help solve environmental challenges and promote opportunities to use AI strategically for Environmental and climate protection. It targets application-oriented research projects active in the following digital ecological areas, e.g. in the fields of energy efficiency, resource efficiency, protection of biodiversity, nature conservation, species protection, water management, sustainable consumption or eco-friendly mobility. The projects can be funded for a period of three years with a maximum funding amount of EUR 3 million;
- **Remote sensing:** the national AI strategy highlighted the need to provide high-performance infrastructure to improve the accessibility of earth observation data (p. 34). To respond to this need, the German Federal Government is funding the analysis and evaluation of remote sensing data with AI-powered methods. Remote sensing enables monitoring activities at distance in existing infrastructure, buildings, vegetation and crowds of people, including in areas that are difficult to access;
- **Action plan for Digitalisation and AI in Mobility:** To implement the national AI strategy, the German Federal Government has drawn up the action plan "[Digitalisation and AI in mobility](#)". It aims to make "Mobility 4.0" effective and sustainable by exploiting the great efficiency potential of digital innovations and AI in mobility for all modes of transport and for the entire mobility system with regards to the climate targets and the European Green Deal. In this context, the German Federal Government promotes, among others, AI innovations for new forms of mobility, for automated and connected driving as well as through the data-based funding programme [mFUND](#). In order to actively support the development of AI-driven mobility, the German Federal Government also plans to establish AI centres for mobility in Germany, which will provide optimal networking for all participants, inspire and facilitate the application of AI in the mobility sector and the rapid transfer from research to practice, and thus strengthening competitiveness in this field.



## COVID-19 pandemic

The German Federal Government is currently funding a wide range of initiatives to foster the role of AI in countering the COVID-19 pandemic and in creating a healthy environment for society:

- **The HiGHmed Use Case Infection Control:** The infection control use case of the HiGHmed consortium develops a software system to analyse various data sources from hospitals, with the aim to detect potentially dangerous germs as early as possible. This automated early warning system helps to protect patients from new infections, but also to understand their causes and how infectious diseases spread. The software system is adapted to detect the pandemic SARS-COV-2 virus. The German Federal Government is funding the HiGHmed consortium as part of the [Medical Informatics Initiative](#) with around EUR 41 million in the current development and networking phase 2018-2022;
- **Chatbot/Voicebot at the German customs administration:** The German customs administration is planning to deploy an AI module in the field of information provision, which is intended to answer questions from companies and private individuals in different ways. It is planned to use a chatbot on the internet presence of the customs administration as well as the implementation of a voicebot to automatically answer calls received by the hotline of the central information office. The primary goal is to answer those questions without the use of human assistance, which are recurring, clear and homogeneous in content. With the help of the implemented knowledge database, the AI module should be able to cover the entire spectrum of responsibilities of the German customs administration. If automated processing is not possible, the chatbot forwards the query in writing to an officer or the voicebot connects the questioner with a hotline employee. The project is an important contribution to the improvement of the digital infrastructure of German customs in general and can help to avoid unnecessary personal contacts at the customs offices, which can help to maintain the necessary social distance in the event of a continuing pandemic. The project was initiated in June 2020, the technical conception completed in December 2020 and the final system introduction is foreseen for June 2021. Afterwards a permanent use of the AI module is planned;
- **Participating in the Global Partnership on Artificial Intelligence (GPAI):** Within the framework of the GPAI a working group on AI and pandemic response ([AIPR](#)) has been formed to promote cross-sectoral and cross-border collaboration in this area. In November 2020, the working group released a [report](#) outlining its mandate and providing recommendations to foster and support the responsible development and use of AI-enabled solutions to address COVID-19 and future pandemics;
- **Collaborative project on Imaging using AI:** German hospitals are also participating in a collaborative project on [Imaging COVID-19 AI](#). The objective of this project is to enhance computed tomography (CT) in the diagnosis of COVID-19 by using AI. The project group will create a deep learning model for automated detection and classification of COVID-19 on CT scans, and for assessing disease severity in patients by quantification of lung involvement;
- **Participation in EU-funded projects including AI and health:** Finally, Germany takes part in the EU-funded project [EXSCALATE4COV](#) that exploits the most powerful computing resources currently based in Europe to foster smart in-silico drug design while increasing the accuracy and predictability of Computer-Aided Drug Design. Specifically, the project involves three among the most powerful supercomputing centres in the EU: [CINECA](#) in Italy, the Barcelona Supercomputing Centre ([BSC](#)) in Spain and the Jülich Supercomputing Centre ([JSC](#)) in Germany. The collaboration also includes pharmaceutical companies and major institutes of biology and bio-molecular dynamics from across Europe.

### 5.11.7 Monitoring and future update

The German Federal Government is publishing regular updates of its national AI strategy that includes a stocktaking of the current policy actions and concrete steps for its implementation in the coming years.



## 5.12 Greece

Greece is currently developing its national AI strategy. The Hellenic Ministry of Digital Governance (MDG) is coordinating the development of the national AI strategy, involving major stakeholders in Greece, as well as experts from within the country and the EU.

AI is recognised as one of the main strategic axes of the **Digital Transformation Bible** (DTB), the flagship policy report that drives the digital transformation in Greece. In one of its chapters, this flagship report highlights the scope and objective areas of the national AI strategy in Greece:

- Determining the conditions for the development of AI, including the skills and trust framework, the data policy as well as the ethical principles for its safe development and use;
- Describing national priorities and areas for maximizing the benefits of AI to meet societal challenges and economic growth;
- Analysing the necessary actions related to the above priorities and proposing horizontal interventions as well as at least one pilot application per policy area.

The development of the national AI strategy is in its final stage. A Working Group comprised of members of major stakeholders in the AI ecosystem has been formed in order to provide feedback on current and planned initiatives in the AI national ecosystems as well as recommendations on the structure and content of the national AI strategy.

Finally, the Hellenic Government is expecting to publicly release its national AI strategy in 2021.

### 5.12.1 AI to address societal challenges

#### Climate and environment

By June 2021, date of publication of this report, Greece lacks policy initiatives for this section.<sup>59</sup>

#### COVID-19 pandemic

Greece has set up various initiatives with the aim to employ AI and machine learning to research tackling the COVID-19 outbreak:

- The Meteo Operational Unit of the Institute for Environmental Research and Sustainable Development ([IERSD](#)) employed machine learning to investigate possible relationships between COVID-19 epidemiological variables (number of confirmed cases and deaths) and meteorological parameters (temperature, humidity, sunshine duration), and the interaction of these variables with social distancing measures. This study would unveil the relative impact of each meteorological variables on the spread of the COVID-19 disease, therefore the possible influence of weather conditions on the spread of SARS-CoV-2;
- The General Secretariat for Research and Technology ([GSRT](#)) has launched the [Flagship Research Action](#) "Epidemiological study of SARS-CoV-2 in Greece through extensive testing for virus and antibody detection, viral genome sequencing and genetic analysis of patients, in response to the SARS-CoV-2 crisis". This study aims to produce relevant databases for innovative computational studies using AI and it is funded by the Ministry of Development and Investments under the Public Investments Programme (PIP);
- The Institute Nanoscience Nanotechnologies Demokritos ([NCSR](#)) coordinates the [BioASQ](#) project that organises challenges on biomedical semantic indexing by means of machine learning and AI. Specifically to the COVID-19, the NCSR launched a challenge to employ AI software tools of the BioASQ project to answer scientific questions on the coronavirus in order to expand the understanding of this virus and to find new solutions.

The Greek Prime Minister recently agreed to collaborate with the American tech giant Microsoft within the global programme [AI for Good](#). Among the points of the collaboration both climate challenges and the business impact of coronavirus belong to the points of this partnership.

In addition, Greece organised or participated in a series of hackathons to foster the role of AI in countering the COVID-19 pandemic:

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<sup>59</sup> The [AI Watch](#) portal will be updated to include AI policies for this section as they come available.

- [#HackCoronaGreece](#): In April 2020, a competition was organised with the support of the Ministry of Digital Governance to collect and accelerate the implementation of new proposals to tackle the pandemic COVID-19 in areas such as health, public administration, data analysis. The competition was designed and implemented by the companies Dataconomy and Data Natives, with the support of [eHealthForum](#) and EELLAK;
- [#COVIDhackGR](#): An initiative of the Ministry of Digital Governance organised as a competition to promote innovative digital solutions to tackle the COVID-19 virus;
- [Antivirus Crowd](#) hackathon: the first innovation marathon for digital applications and methodologies that face the consequences of the epidemic supported by the Attica Region;
- [#EUvsVirus](#) hackathon: Greece participated in the [COVID-19 Smart Screening Tool](#) presented during this hackathon. This project is jointly developed by Luxembourg and Greece with the objective to roll-out a generalised, scalable, yet resource-optimized strategy for de-confinement with a combination of COVID-19 testing and surveying based on machine learning, blockchain, and AI. Another winning project that was headquartered in Greece is the [SERS4SARS](#) project which proposes to develop reliable, cheap and quick solutions for detecting the virus based on AI.



## 5.13 Hungary

In September 2020, the Hungarian Government published its [National AI strategy](#), outlining the strategic vision and actions for the development of AI in the period 2020–2030 (Hungary, 2020). The strategy has been released by the Ministry of Innovation and Technology and developed by the Artificial Intelligence Coalition. In October 2018, the [AI Coalition](#) has been formed upon the initiative of the Ministry as a partnership between governmental institutions, prominent academics and practitioners from leading IT businesses. Made up of more than 320 members<sup>60</sup>, the AI Coalition released an AI Action Plan in October 2019, and in 2020 it drew up Hungary's AI Strategy for the Hungarian Government.

Hungary's AI strategy aims to support and boost all relevant sections of the AI value chain from data generation and management, through basic and applied research, to utilisation of the technology and raising awareness of the possibilities inherent in practical AI applications. Through a multi-layered set of goals the strategy aims to:

- Strengthen the **foundation pillars** of the Hungarian AI ecosystem: data economy, research development and innovation (R&D&I), AI uptake, education and competence development, infrastructure deployment, and regulatory and ethical framework;
- **Focus on specific sectors** and technology fields with the highest acceleration potential for Hungary: manufacturing, healthcare, agriculture, public administration, transportation, logistics and energy;
- Initiate **transformative programmes** with long term ambitious goals that offer direct benefits to citizens: autonomous systems and self-driving vehicles, health-consciousness in a digital world, climate-driven agriculture, data-wallet and personalised services, AI-supported development of personal competencies, automated administration procedures in Hungarian, and energy networks focused on renewable sources of energy.

### 5.13.1 Human capital

With respect to **education in AI**, Hungary's national AI strategy has the objective to raise citizen's awareness on AI and to leverage human competencies in using and developing AI technologies. One the key performance indicators is to reach up to 300 people with a PhD degree involved in an AI research topic and 8,000 citizens receiving adult education. To this purpose, the strategy foresees a wide range of policy initiatives to reform both the education system and competence building tools for the workforce.

Transformations of the educational system to prepare for the digital world take stock and build further on the policy recommendations outlined in the [Digital education strategy](#) that was released in October 2016. More closely related to the field of AI, **reforms to the education systems** highlighted in the AI strategy include policies targeting all education levels and reaching out to both students and teachers:

- Introducing games for improving high-level mathematical and logical skills from an early age and identifying talented children and teenagers;
- Developing AI-related general knowledge, skills and competencies in higher education among the students by offering and promoting AI-specific programmes;
- Establishing PhD programmes in the field of AI and broadening the available collection of AI-related doctoral courses;
- Offering teacher training to prepare teachers in public education with the necessary skills to support students in using and experimenting with AI.

Hungary's AI strategy equally emphasises the need to **raise the awareness and understanding of AI** of the population as a whole. To do so, it foresees to raise citizen's digital and AI-related experiences through:

- The establishment of the [AI Challenge](#): training 100,000 people in the basics of AI using domestically developed online course material. It will also aim to raise the awareness of 1 million people via interactive exhibitions, a website and online professional contents.

Besides, the national AI strategy presents several policies to support **lifelong learning and reskilling of the workforce**. Among others, the following AI policies are foreseen:

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<sup>60</sup> As of May 2021.

- Expanding the circle of managers who are aware of AI technologies and training them to support the implementation of AI innovations;
- Training experts in priority sectors and the public administration;
- Enhancing high-level mathematical and IT researchers' competencies for basic and applied research;
- Increasing the capacity development of data engineer competencies.

Finally, it is important to understand which skills will become increasingly important in the future. Hence, to prepare for the **future labour market needs** and to allow citizens to update their skills and competence portfolio, the Hungarian Government calls for the establishment of:

- **Personalised learning methods:** Personalised learning support and talent coaching for groups at risk of falling behind in the labour market (see also Section 5.13.2).

### 5.13.2 From the lab to the market

To foster **scientific research in the field of AI**, the Hungarian strategy highlights the following policies:

- Establishing a **National Laboratory for Autonomous Vehicles:** the [National Laboratory for Autonomous Systems](#) is a consortium led by the Institute for Computer Science and Control ([SZTAKI](#)) with the participation of the Budapest University of Technology and Economics and Széchenyi University of Győr. The Laboratory aims to provide efficient and innovative autonomous solutions for road vehicles, aircraft and mobile robots by relying on a wide group of Hungarian experts. Activities focus on research, development, and demonstration of the components and functional design of experimental vehicles, cyber-physical manufacturing and logistics systems. The Laboratory will operate an autonomous vehicle laboratory and collaborate with the ZalaZone autonomous vehicle test track;
- Creating an **AI Accelerator Centre:** the objective of the centre is to support AI businesses in their start-up and growth stage. The publication of funds for the selected tenders is expected by mid-2021.

While basic and applied research in AI is important, it is equally crucial to provide opportunities to develop high-potential ideas into successful products and services. In terms of policies **increasing the innovation potential** in AI, Hungary's strategy foresees the following:

- Establishing an **Innovation Centre for Artificial Intelligence:** the objective of this centre is to build technology training research and infrastructure marketplaces for the promotion of AI in SMEs. It is also used to disseminate and inform about events and social dialogues and to investigate about training needs on the labour market;
- Developing **corporate advisory services** based on AI (chatbots): within the framework of the EDIOP 3.2.1-15 Modern Businesses Programme (MBP), led by the Chamber of Commerce and Industry (MKIK), the development of such advisory services supports businesses in their digital development. The development of the chatbot can be integrated in the planned voice-based AI platform of the government.

To further support innovative efforts in Hungary, the national strategy presents several **transformative programmes with long term ambitious goals** in the fields of autonomous systems and self-driving vehicles, health-consciousness in a digital world, climate-driven agriculture, data-wallet and personalised services, AI-supported development of personal competencies, automated administration procedures in Hungarian, and energy networks focused on renewable sources of energy.

#### *Self-driving vehicles – autonomous systems*

The Ministry for Innovation and Technology and the Ministry of Interior foresee to build the necessary infrastructure and regulatory framework for the operation of autonomous transportation systems. This will be done by equipping single-digit road networks with **self-driving infrastructure** by 2025 and by harmonising domestic and EU legislative environments and traffic policy regulations.

#### *Health consciousness in a digital world*

Various policy actions are foreseen to support the data-based economy in the health care sector. An ongoing policy is focusing on the assessment of activities of businesses engaging in illegal data management, and on deploying enforcement measures to ensure data protection and integrity. In the first half of 2021, Hungarian

ministries will launch a campaign to **promote the use of healthcare data**. This will be complemented with the **mapping of digital healthcare applications** and the development of rating systems for healthcare data analytics applications. Finally, it is foreseen to adopt a legal framework with regard to the options of secondary use of own or self-collected healthcare data.

#### *Climate-driven agriculture*

Project proposals are in the making, under the lead of the Ministry of Agriculture, to **prepare for the impacts of the climate change**. In particular, they focus on 1) the development and application of AI-based, optimisation solutions in terms of plant production and stock farming and 2) the implementation of predictive, AI-based analytics methods to improve water, soil and air quality to enhance the efficiency of management.

#### *Data wallet and personalised services*

To facilitate the development of a **data wallet technology model**, the Ministry of Innovation and Technology through the Digital Success Programme is supporting the creation of a software solution to facilitate citizens controlling the use, sale or disclosure of their data by third parties in a one-stop-shop system. In parallel, Hungarian ministries are working on ensuring compliance with ongoing legislation on data protection such as GDPR and on regulating the disclosure of data collected by service providers.

#### *AI-supported development of personal competencies*

The aim of this transformative programme is to develop personalised, data-driven, and digitally-assisted ways of learning to fully **support individual learning paths**. It includes the establishment of an AI-supported career advisory system. To this end, the Ministry of Technology and Innovation supports the creation of a **personalised training recommendation service** that is tailored to individual life objectives and based on public education, vocational training, tertiary vocational training and adult education offers. For a smooth functioning of the system, ministries will aim to ensure interoperability of file systems. Customised learning paths with dedicated training courses will be set up. This will be facilitated by the establishment of a personal learning assistant that will primarily support citizens at risk of losing employment due to automation.

#### *Automated administrative procedures in Hungarian*

The objective of this transformative programme is to support the automation of administrative procedures using AI-based services. This is done through the creation of **language processing technologies for the Hungarian language**. To this purpose, the Ministry of Innovation and Technology and the Ministry of Interior are collecting both oral and written training data sets. The National Infocommunications Services Ltd., as part of the Ministry of Interior, is developing a telephone-based customer service for the public administration using AI solutions.

#### *Energy networks focused on renewable sources of energy*

The aim of the transformative programme is to enable, with the help of AI, a shift to a future- and climate-proof form of energy use. To support an efficient system integration of the production of renewable energy, the Ministry of Innovation and Technology is planning to upgrade the energy network infrastructure. This includes the development of smart meters, and the **implementation of smart-grid technologies**. The use of AI is foreseen in the introduction of forecasting/projection procedures and distribution mechanisms.

The above transformative programmes are complemented with sector-specific development goals to increase Hungary's competitive position in the global value chain. To this purpose, the Hungarian strategy also presents a wide range of policy actions that aim to start in 2021 in the following **sector-specific focus areas**: manufacturing, healthcare, agriculture and public administration.

Finally, innovation efforts are further encouraged by strengthening the organisational culture of experimentation. Purposeful and tailor-made **experimentation in AI** could be fostered through:

- The creation of a **corporate AI experimental and support fund**: a fund to support companies in reducing the costs of experimentation and undertaken risks until the "proof of concept" development phase. The fund is expected to be established by end of June 2021.



### 5.13.3 Networking

The Hungarian strategy emphasises the importance of establishing a broad-based and dynamic research ecosystem driven by **collaborative efforts** between national and international AI developers and researchers. The objective is to create and support at least 15 instances of cooperation in international research projects in technological fields, from which two in defence technologies and five in international AI patents. Among the key technological fields, the strategy identifies image processing, language technology, data anonymisation, and machine-learning that could be applied in priority sectors such as healthcare, manufacturing, agriculture, and public administration. Following initiatives are foreseen to expand domestic and international collaboration opportunities in research and development:

- Establishing a **National Artificial Intelligence Laboratory (MILAB)**: MILAB, coordinated by the Institute for Computer Science and Control ([SZTAKI](#)), aims to promote and finance publications, patents, technology transfer and industrial relations on key topics related to AI. Another important goal is to connect the industry, universities and research institutes operating in the field, and to jointly represent them in market and international projects. The main research areas of MILAB are: the mathematical foundations of AI, deep learning, natural language processing, medical and biological applications; biometric applications, data processing technologies for the protection of personal data, agri-food industry, transport, manufacturing, defence and telecommunication;
- Encouraging **industry-led networking in AI research**: collaborations between AI researchers and users (e.g., industry, public administration, healthcare) will be fostered through the implementation of collaborative projects, jointly financed research and the creation of an academic AI competence map;
- Launching a central Hungarian [AI portal](#) by the AI Coalition in which AI developers can present local case-studies to foster collaboration and awareness.

In order to **increase the international attractiveness** of the country, the Hungarian Government is preparing a policy to attract major AI players from abroad:

- Attracting **international AI research centres** to Hungary: the objective of this initiative, mandated by the Ministry of Foreign Affairs and Trade and the Ministry for Innovation and Technology, is to incentivise International research centres and companies to relocate their AI development centres to Hungary.

Finally, the **dissemination and uptake of AI** is fostered through:

- Establishing an **Innovation Award for AI Applications**: an event is planned annually to award AI applications per category (across firm size and industry).

### 5.13.4 Regulation

Hungary's national AI strategy aims to ensure a responsible, reliable and human-centred utilisation of AI technologies by means of the following policies:

- Creating an **ethical framework**: developing an AI code of conduct by the first half of 2021 in collaboration between the Ministry of Justice, the Ministry for Innovation and Technology, AI Innovation Hub and the Central Statistical Office;
- Setting up an **Artificial Intelligence Regulation and Ethics Knowledge Centre**: the aim is to create and coordinate an extensive pool of experts to help resolve legal issues and matters of ethics relating to the regulation of AI and the implementation of the strategy;
- Establishing a **regulatory framework** for AI: the objective is to amend the current regulatory system to suit AI and to align it to EU regulations;
- Building **data management regulation**: the objective is to set up regulations for the use and exchange of public and private data and to define rules regarding data monetisation.

As there is no one-size-fits all solution, the Hungarian strategy calls for the development of **sector-specific regulatory frameworks**, ensuring that the regulatory needs for AI development are adapted to the relevant industry areas.

### 5.13.5 Infrastructure

Hungary's national AI strategy highlights that one of the core elements to foster the development and adoption of AI are data processing and data analysis. Against this background, there is a crucial need to support the collection of data and its secondary use in both the public and private sector. To this purpose, the Hungarian Government is setting up policy initiatives to **develop a solid data infrastructure** that enables data availability and encourages data sharing while ensuring necessary data protection of personal data where needed. The Hungarian strategy mentions its objective to support a minimum of 1000 agreements for the secondary use of data. To encourage data collection and use for AI developments, the Hungarian strategy includes:

- Establishing a **National Data Assets Agency**: the objective of this agency is to coordinate and stimulate the strategic management of the data. It does not perform data processing but aims to encourage and support data utilisation;
- Creating a **data market platform**: the aim of this platform is to raise awareness of the economic value of commercially viable data, and to encourage its secondary use. Its development will include three phases: 1) creating a marketplace for the transmission of non-personal data of high quality, 2) establishing commercial opportunities for the data assets including personal data and 3) broadening up the platform to all relevant stakeholders and integrating it with international data spaces;
- Setting up a **public data portal**: the aim of the [public data portal](#) is to encourage the use of non-personal data created in the public sector.

By establishing a national Data Assets Agency, complemented with a commercial and public data platform, the Hungarian Government aims to bring the national data ecosystem to its full potential. It aims to ensure that the data market platform and the public data portal are neatly connected and integrated.

In addition, the successful deployment of an AI-enabled economy can only be achieved in a well-developed and **cutting-edge infrastructure ecosystem**. To this purpose, Hungary's national AI strategy foresees:

- Enhancing **supercomputer capacities**: the Ministry for Innovation and Technology and the Governmental Information Technology Development Agency have the objective to increase the High Performance Computing (HPC) capacity to 5 petaflops in Hungary as of 2022;
- **Hybrid cloud development** for research purposes: the objective of this initiative is to ensure the availability of research hardware and software that is well connected with cloud service providers;
- Establishing **data centres** with large computing capacities.

### 5.13.6 AI to address societal challenges

#### Climate and environment

In order to reach the EU's long-term climate strategy goals, it is crucial to support efforts to reduce pollutant emissions and to encourage the proliferation of alternative technologies to this purpose. Understanding that the hydrogen economy is one of the foundations of climate protection, the Hungarian Ministry for Innovation and Technology financed the construction of a Hungarian-American hydrogen-fuel cell-powered aircraft suitable for passenger transport. This project belongs to the [Hungarian energy and climate strategy](#) alongside with AI, Industry 4.0 and 5G technological platforms.

In addition to these initiatives – and as part of its national AI strategy – the Hungarian Government foresees to launch transformative programmes in the field of AI with long term ambitious goals that offer direct benefits to citizens and the environment: climate-driven agriculture, energy grids focused on renewables, and fully autonomous systems.

#### COVID-19 pandemic

Concerning the COVID19 crisis the following initiatives are worth noticing:

- The Hungarian State, together with the European Union, funded a study on [COVID-19 pandemic prediction for Hungary: a hybrid machine learning approach](#). This study presents a hybrid machine learning approach to predict the COVID-19 infection and mortality rates in Hungary, and it suggests that machine learning can be an effective tool to model the outbreak;
- Scientific researchers at the Szeged Biological Research Centre ([SZBK](#)) have identified the receptor through which the COVID-19 virus enters into a host cell. The discovery of this receptor has been

found using AI algorithms. The outcome of this research constitutes a new milestone in the research towards a vaccine and opens new perspectives in the development of therapies for COVID-19;

- The phone application [VirusRadar](#) uses Bluetooth technology to acquire encrypted, anonymised data about users in order to notify individuals that have been previously in touch (at a non-safe distance) with infected ones.

#### **5.13.7 Monitoring and future update**

Hungary's national AI strategy sets goals up to 2030 and outlines a related action plan extending up to 2025. It is important to emphasise, however, that the strategy needs to be regarded as a living document and reviewed at least every two years due to rapid changes in technological developments.



## 5.14 Ireland

The Department of Enterprise, Trade and Employment (DETE) in Ireland is leading on the development of a national AI Strategy. The Strategy is expected to be released in Q2 2021 (subject to Government approval).

The National AI Strategy for Ireland, entitled “AI - Here for Good”, will provide a high-level direction to the design, development and adoption of AI in Ireland. It will present an integrated, cross-Government framework giving direction for the steps needed to ensure that Ireland’s use of AI will benefit the economy and society. In line with the EU and OECD approaches, it is envisaged that the main areas covered by the strategy will include: societal opportunities and challenges of AI; enterprise development and deployment of AI; RD&I; human capital considerations; data; digital and connectivity infrastructure; public sector use of AI; as well as ethics, governance, standards and regulatory framework.

The development of the strategy has involved significant stakeholder engagement, including with industry, with industry representative bodies, with academic and research communities and with a multi-stakeholder group of experts. Consultations are continuing across the Government system and an online public consultation has also been conducted. As part of the strategy development, a Top Team on Standards for AI has been established, led by the National Standards Authority of Ireland (NSAI).

An important flagship for the development of AI in Ireland is the [SFI Centre for Research Training in Artificial Intelligence](#) that was established in March 2019 with funding of over EUR 14 million from the Science Foundation Ireland and an additional EUR 3.3 million from the industry and academic partners. It serves as Ireland’s national centre for PhD-level training in AI, with a targeted uptake of 30 students per annum for the next four years. The centre brings together five of Ireland’s seven universities and a team of almost 60 supervisors across the country.

### 5.14.1 AI to address societal challenges

#### Climate and environment

Ireland has a wide range of policy initiatives to foster the role and contribution of AI in achieving EU’s climate change objectives. To ensure the provision of high-quality data and to enhance possibilities for data exchange, the Irish Centre for High-End Computing ([ICHEC](#)) has established various **national platforms**:

- Satellite Platform for Ireland ([SPÉir](#)): ICHEC has established the Satellite Platform for Ireland (SPÉir) offering access to curated and pre-processed high-quality persistent data from the ESA Copernicus programme Sentinel satellites for use by research, public sector and enterprise organisations;
- [ERDDAP](#) server: ERDDAP is ICHEC’s data server that provides a simple, consistent way to download subsets of scientific datasets in common file formats and make graphs and maps. This particular ERDDAP installation has oceanographic data (for example, data from satellites and buoys);
- Federated platform for Earth and urban systems data: ICHEC is aiming towards establishing a federation of State Bodies, including the likes of Geological Survey Ireland ([GSI](#)), Environmental Protection Agency ([EPA](#)), Agriculture and Food Development Authority ([TEAGASC](#)), Irish Meteorological Service ([Met Éireann](#)), [Marine Institute](#) and the Irish Centre for High-End Computing ([ICHEC](#)) to implement a federated and seamless national “data lake” on FAIR principles.

In addition, ICHEC has a wide range of ongoing projects involving **public sector** organisations:

- [National Wind and Solar Energy Forecasts](#): ICHEC has worked in collaboration with [Bord na Mona](#) and a number of national energy companies to improve the accuracy of wind and solar weather forecasts;
- Biodiversity analysis: ICHEC collaborated with NPWS (the Irish National Park and Wildlife Services), Bat Conservation Ireland and QUB (Queen’s University Belfast) to assess the effects of climate change on the natterjack toad and bat populations of Ireland, and to establish a relationship between their historical populations and climate fields;
- [Flood prediction](#) project: ICHEC uses ESA Sentinel-1 satellite data to monitor extreme weather conditions and the catchment areas to forecast floods by integrating it with hydrological information such as groundwater levels and stream flow;
- [INFER](#) project: ICHEC worked with EPA on remote sensing of Irish surface water to develop products for improved monitoring of water bodies such as lakes.

Lastly, ICHEC contributes to collaborative projects at European level, such as:

- [ESA AIREO](#) project: ICHEC is working with the European Space Agency ([ESA](#)) for developing community-driven standards, good practices and tools for developing AI-Ready Earth Observation (EO) datasets;
- ESA Space Networks: [Ubotica](#) and ICHEC are working with ESA to develop a [platform](#) for deploying optimised AI models on-board satellites and updating the models in-orbit to improve their accuracy and performance;
- [REDAP](#) project: The methods and tools developed in the REDAP project by ICHEC and a number of European partner organisations helps regions across Europe to gain clarity into the characteristics of energy demand in the building and transport sectors. Understanding the energy demand is a prerequisite for the development of green energy systems.

Furthermore, the **business ecosystem** is using AI for environmental sustainability. Several Irish SMEs and multinationals are developing AI solutions in the sustainable food chain, waste reduction, and sustainable farming, among others.

Finally, various **ministries and public agencies** are funding research centres and dedicated research projects using AI to create a more sustainable and green environment in the future.

#### *Projects under the Sustainable Energy Authority of Ireland ([SEAI](#))*

- Forecasting Renewable Energy with Machine Intelligence ([FREMI](#)): This project seeks to increase the accuracy of the current wind turbine forecasting methods and develop and deploy a tool capable of assisting energy traders under the new market rules posed by I-SEM;
- National Artificial Intelligent Dairy Energy Application ([NAIDEA](#)): This project aims to bridge the gap between Ireland's dairy farmers and policy makers to further encourage and support the decarbonisation of Ireland's agri-sector;
- Smart Electric Buses ([SEB](#)): Applying data analytics and AI techniques for optimal design and operation for electrification of the public bus transportation system.

#### *Projects under the Environmental Protection Agency ([EPA](#))*

- [National Landcover mapping](#) project: This project is using machine learning algorithms to classify the Landcover types in detailed boundaries, from aerial images;
- CoronaEU project: The purpose of this project was to confirm if machine learning could be used to screen air quality.

#### *Project supported by the Disruptive Technologies Innovation Fund ([DTIF](#))*

- Advanced Environmental Decision Support System for Coastal Areas: This [project](#) focuses on autonomous monitoring using sensors for environmental water management and decision support.

#### *Projects and research centres under the Science Foundation Ireland ([SFI](#))*

- Crop Optimisation through Sensing, Understanding & Visualisation ([CONSUS](#)): a collaborative research partnership between University College Dublin (UCD) and Origin Enterprises PLC that has been supported through the SFI;
- Tracking Adaptation Progress in Agriculture and Food Security Using an AI-powered Satellite Remote Sensing Platform ([TAPAS](#)): This project focus on quantitative monitoring of climate adaptation using AI methods;
- [AI for Anti-Greenwashing](#): This project develops AI-based methods to detect greenwashing;
- Marine Renewable Energy Ireland ([MaREI](#)): The SFI Centre for Marine Renewable Energy Research;
- Ireland's Big Data and Analytics Research Centre ([Insight](#)): Centre to undertake high-impact research on big data and AI-related research for the development of sustainable societies, among others;
- The Centre for Future Networks & Communications ([Connect](#)): the mission of this centre is to research and develop innovative solutions for the communications challenges facing society today;
- Irish Software Research Centre ([Lero](#)): Lero's research focuses on the tools, methods and good practices required to maintain software development leadership in a climate of accelerating change;
- [VistaMilk Centre](#): The objective of this centre is to generate and deploy innovative basic and applied science and technologies in the food-production chain;
- [Confirm Centre for Smart Manufacturing](#): the objective of this centre is to transform industry to become leaders in Smart Manufacturing.

## COVID-19 pandemic

Concerning the current COVID-19 pandemic, in March 2020 the Irish Government launched a [National action plan on COVID-19](#) with the aim to minimise the risk of illness for all people, to lower the impact on individuals at higher risk, and to reduce both social and economic disruption associated to the COVID-19 outbreak. As a key action in this plan, a coordinated [Rapid Response Research and Innovation](#) programme was launched to enable the research and innovation community to respond to the immediate and pressing needs of society arising from the pandemic. Several calls to apply for the funding in this programme have been developed by the Irish Research Council ([IRC](#)), the Health Research Board ([HRB](#)), the Science Foundation Ireland ([SFI](#)), the Enterprise Ireland ([EI](#)), and the Irish Agency for Foreign Direct Investment ([IDA](#)). Two calls with funding lines are foreseen:

- A [first](#) call (phase 1), with typically funding up to EUR 200,000 per project, focuses on research in the following areas: medical countermeasures, health service readiness, and social and policy countermeasures to COVID-19. A total of [36 projects](#) have been awarded in phase 1;
- A [second](#) call (phase 2) focuses on the following thematic areas: infection prevention and control, understanding the virus and host response, STEM-led solutions for stimulating and sustaining rapid economic recovery.

While the calls do not specifically target AI-related developments, several awarded projects do use artificial tools and algorithms in their innovative solutions to fight the COVID-19 virus. To maximise the relevance and the impact for society of ongoing research in the field of the COVID-19 outbreak, many research organisations have signed a [joint statement](#) to share research data and findings in this field.

Also Ireland's national centre for Applied Data Analytics & AI ([CeADAR](#)) has offered its [AI expertise](#) to help companies, government agencies, medical centres and research charities develop AI tools to help track the virus and monitor compliance of the general public. The centre can help organisations with large data sets to apply machine learning techniques.

At the end of June 2020 the Irish Health Service Executive ([HSE](#)) published new documents about the ongoing commitment to develop the [COVID-19 Tracker](#) application for Ireland. This national effort was carried out within an unprecedented global collaboration between governments, industry and the scientific community in order to fully align the results with the privacy principles and public health guidance issued by the EU Commission, the OECD, WHO and the European Centre for Disease Prevention and Control. In addition, the HSE organised [a Digital Academy Forum](#) in July 2020 for businesses and the research community to share their digital transformation experiences during the COVID-19 pandemic.

Furthermore, the ultraviolet light robot [Violet](#) is the output of 12 months research in UV light disinfection technology conducted at Trinity College Dublin and fast-tracked by the HSE that recognised its great potential in fighting the COVID-19.

Finally on the business side of the COVID-19 crisis, the [Border Enterprise Development Fund](#) – an initiative of the Government of Ireland administered by Enterprise Ireland – supports the international competitiveness of enterprises in the Border Region in the context of Brexit and other market challenges including COVID-19. The applicants' projects focus on AI, robotics, cobotics, machine learning, and big data.





## 5.15 Italy

In October 2020, the Italian Ministry of Economic Development released a draft version of its [National AI strategy](#) for public consultation (Italy, 2020). The strategy takes stock of policy recommendations from a [proposal for the Italian AI strategy](#) published in July 2020. The final version of the Italian AI strategy is expected for the first half of 2021.<sup>61</sup>

The draft AI strategy provides a long-term vision for a sustainable development of AI with the following actions to increase the development and competitiveness of AI in Italy:

- Improving AI education at all levels, and providing lifelong learning and reskilling opportunities to the labour force;
- Fostering AI research and innovation to enhance the entrepreneurial competitiveness;
- Establishing an ethical regulatory framework for a sustainable and trustworthy AI;
- Supporting (international) networks and partnerships;
- Developing a data infrastructure for AI applications;
- Improving public services through a wider adoption and use of AI systems.

The Italian strategy envisages a public investment of EUR 2.5 billion.<sup>62</sup>

### 5.15.1 Human capital

The Italian Government envisages the following initiatives to strengthen **AI education at all levels**:

- Supporting the progress of teachers' digital skills;
- Introducing applied AI courses in the Higher Technical Institutes (ITS);
- Fostering female participation in AI subjects;
- Setting up a challenge to promote AI courses among students in the last two years of upper secondary schools and in the first three years of university (i.e. 16-23 age group).

As for **higher education**, the Italian Government plans the following actions to integrate AI courses in Bachelors, Masters and doctoral programmes:

- Including AI credits in academic courses for Master and Bachelor degrees;
- Creating national training programmes in AI, and interacting with stakeholders in the labour market (companies, public services, tertiary education) to align education and required professional skills;
- Developing an investment strategy for doctoral studies, and training skilled professionals in cooperation with the industries where AI applications could most likely emerge.

In addition, **lifelong learning** will take the form of online courses in AI to upskill and reskill the workforce. The strategy highlights that e-learning platforms emerged during the COVID-19 pandemic to improve Italians' literacy in AI disciplines. This includes an initiative promoted by the Italian Ministry for Innovation (December 2020) based on the free-of-charge course "[Elements of AI](#)" created by the University of Helsinki. Participants will also have the possibility to obtain credits for their professional curricula through personal training accounts. In addition, the Italian strategy plans the following initiatives to foster AI education in both business and public sectors:

- Allowing tax credits for the participation costs of SMEs' management in AI executive courses;
- Consolidating the vouchers for advices on digital innovation from specialised managers;
- Promoting trainings on AI and related technologies within the public administration, and covering at least half of the civil servants in 3 years maximum.

Finally, as for the **needs of new skills** the strategy envisages an observatory for AI and related socio-economic impacts to monitor trends in the labour market and publish an annual report of policy recommendations.

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<sup>61</sup> As a tentative target date.

<sup>62</sup> This amount, mentioned in the [National AI strategy](#) released for public consultation in September 2020, may still be subject to change.

### 5.15.2 From the lab to the market

The **Italian AI research ecosystem** counts on a wide range of national centres of excellence like the Artificial Intelligence and Intelligent Systems Laboratory ([AIIS](#)) of the Italian Interuniversity Consortium for Informatics ([CINI](#)), the Italian Institute of Technology ([IIT](#)), and the Institute for Calculation and Networks for High Services ([ICAR](#)) of the National Research Council ([CNR](#)). In April 2021 the first laboratory dedicated to Pervasive Artificial Intelligence Laboratory ([PAI Lab](#)) was inaugurated in Pisa. The PAI laboratory was born from the need to aggregate skills, infrastructures and resources to face the scientific challenges of an AI that is transforming into a pervasive technology.

To **increase the competitiveness of AI industry**, the Italian Government will expand the public funding and will encourage public-private venture capitals. Furthermore, the government envisages advisory services with appointed innovation managers to accompany SMEs in the technological and digital transformation process. The Italian strategy also plans the following actions:

- Organising calls for new AI solutions, the first two calls are set up as pilot projects to test the methodology on 1) smart components (automation and robotics systems) and 2) the needs of the public administration;
- Increasing technology transfers to SMEs with vouchers to receive advisory services from incubators.

The Italian Government also put in place **regulatory sandboxes** to facilitate controlled experiments with innovative products, including AI. The initiative called [Sperimentazione Italia](#) grants the possibility to companies, universities, research bodies, university start-ups and spin-offs from any sector to test pilot projects in the field of digitalisation and technological innovation, derogating regulatory constraints.

**Priority sectors** for AI developments in Italy are: industry and manufacturing, food and farming, culture and tourism, health and well-being, environment, smart cities, and infrastructure and networks. In addition, the Italian strategy presents several policy initiatives to encourage the **uptake of AI in the public administration**. The Italian Government aims to enhance AI skills in the public sector (see Section 5.15.2), public-private partnerships (see Section 5.15.3), open data and common data spaces (see Section 5.15.4). In addition the Italian proposal envisages to:

- Increase the procurement of AI innovations to achieve the national objectives of sustainability;
- Introduce AI applications for administrative proceedings and public services.

### 5.15.3 Networking

In terms of **networking**, the strategy proposal encourages the above mentioned centres of excellence to set up an R&D network close to the industrial community. In total, 8 Competence Centres (set up by the Ministry of Economic Development) and 12 European Technology Clusters (set up by the Ministry of Education, Universities and Research) will be the basis of a national network of knowledge exchange and collaboration. These nodes appear in the [Digital Europe Programme for the period 2021-2027](#) and are a backbone of the pan-European networks together with the establishment of Digital Innovation Hubs.

The Italian city of Turin will be the headquarter of the **Italian Institute for Artificial Intelligence** ([I3A](#)), this structure will facilitate research and technology transfers and it will be the Italian reference in the development of AI technologies (including 5G, Industry 4.0, Cybersecurity).

The Italian proposal favours **pan-European initiatives** like the Confederation of Artificial Intelligence Laboratories in Europe ([CLAIRE](#)) and the public-private partnerships for electronic components and systems ([ECSEL](#)).

In addition, Italy takes part in the Global Partnership on AI ([GPAI](#)), an international initiative to spur a responsible development and use of AI in full respect of human rights, inclusion, diversity, innovation and economic growth. The GPAI collaborates with international organisations to connect experts from industry, civil society, governments and academia. This initiative accounts for two Centres of Expertise in Montreal and in Paris, and its secretariat is hosted by the OECD in Paris.

### 5.15.4 Regulation

The Italian strategy highlights that an **ethical regulatory framework for AI** has to ensure transparency, accountability and reliability in order to stimulate citizens' trust and engagement in a thriving AI ecosystem.

The [2020 Strategy for technological innovation and digitalisation](#) by the Ministry for Technological Innovation and Digitalisation foresees the creation of an ‘Alliance for Sustainable Artificial Intelligence’ with the aim to provide guiding principles for the development of trustworthy AI solutions. The national AI strategy also emphasises the importance of campaigns to inform citizens on the characteristics, opportunities and risks of AI as much as on its potential misuse.

For safe AI developments, it is as important to develop an ethics by design approach as much as to ground it in a **binding legislative framework** at national level to protect citizens and businesses. In this respect, the Italian strategy encompasses the following initiatives on legislation and related issues:

- Adapt the consumer protection framework to AI consumers and the new market reality of AI technologies;
- Introducing a compulsory insurance to cover liabilities and damages from the use of AI technologies;
- Encouraging out-of-court dispute resolution mechanisms based on the rules of unfair commercial practices.

Lastly, to increase citizens’ engagement, there will be a national platform, like the European AI Alliance, for consultations on ethical and social issues about AI.

### 5.15.5 Infrastructure

The Italian Government commits to **define a data policy** that promotes collection, exchange and re-use of data, while respecting privacy rights and ensuring interoperability based on standards. The Italian strategy foresees the following initiatives:

- Creating a data market platform to support SMEs’ data collection and exchanges;
- Encouraging data sharing agreements to promote the data economy;
- Fostering the provision and re-use of public data in public service;
- Providing financial support to create an Italian Data Space with private and public stakeholders.

Although not specifically mentioned in the national AI strategy, the Italian Government also supports the development of a **digital and telecommunication infrastructure**. The [CINECA](#) computing centre is a not-for-profit consortium made by the Italian Ministry of Education, the Italian Ministry of Universities and Research, 69 Italian universities and 21 Italian National Institutions. CINECA aims to provide information services to the Italian Ministry of Universities and Research, to the universities and the other consortium members, to the scientific community, and to the public education sector. This is done by guaranteeing high-performance infrastructure services for the Italian research system, and access to the European network of high-performance scientific computing centres. In addition, the Italian Government participates in the Joint Undertaking to develop a competitive European computing ecosystem ([EuroHPC](#)). In terms of connectivity, Italy is expanding its ultra-broadband optical fibre network and explores ways to extend its 5G network.

### 5.15.6 AI to address societal challenges

#### Climate and environment

In July 2020, the Italian Ministry of Economic Development released the [proposal for the Italian strategy for AI](#).<sup>63</sup> This final proposal includes a chapter on AI for Sustainable Development Goals (SDGs), which includes the environment and energy targets to reach by 2030. The policy report highlights that, although Italy worsened along the indicators of sustainable development, it also holds leadership positions in the development of AI-related technologies that could grant the country a recovery along the dimensions of sustainability. To this end, the Italian economy should exploit and further develop the following competitive advantages:

- **Key environmental areas:** key environmental areas in which Italy is excelling relate to the appraisal of hydrogeological risks, the management of seismic hazard zones, and critical infrastructures related to archaeological sites;

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<sup>63</sup> In October 2020, a draft version of the [National AI strategy](#) was released for public consultation.

- **Competitive AI technologies** the Italian economy can build on its competitiveness on soft robotics and on the development of cobots/companion robots, along with the opportunity to employ AI within industries;
- **Green energy and renewables:** the production and distribution of green energy together with the challenges of societal inclusion are key environmental priorities for the coming years.

To reap the benefits of these new technological shifts, the high-level working group that drafted the strategy proposal calls for improved legislative transparency and governance. More specifically, it invites the Italian Government to follow a **policy coherence for sustainable development** by means of three pillars: 1) better regulation; 2), demand-side innovation policies; 3) fiscal incentives and policies to stimulate AI investments for sustainable innovation and green energy. Specific recommendations also call for the inclusion of vulnerable citizens during the implementation of AI policies.

### COVID-19 pandemic

Along the initiating countries of France and Canada, Italy is among the countries that participates in the Global Partnership on Artificial Intelligence (GPAI). The various working groups of the GPAI are currently focusing on responsible use of AI, data governance, the future of work, and innovation and commercialisation. In addition, the experts involved also focus on [the role of AI](#) in response to the COVID-19 pandemic.

The Italian Institute of Robotics and Intelligent Machines (I-RIM) – a national non-profit association created to promote the development and use of Interaction Technologies for the benefit of citizens and society – is also contributing to fight against the COVID-19. Among other, it maps national and international [pilot projects](#) recently developed to respond to the COVID-19 necessities in the healthcare and related sectors. Projects are classified based on their application field, geographical region, Technology Readiness Level (TRL), development status and category (research or commercial project).

Furthermore, given the unprecedented challenges to government, industries and society in the COVID-19 outbreak, many Italian companies and start-ups are producing innovative products or repurposing their business, production and R&D capabilities to support the fight against coronavirus. Among these [innovative products](#) many employs 3D printing, robotics, sensors.

Italian hospitals are also participating in a collaborative project on [Imaging COVID-19 AI](#). The objective of this project is to enhance computed tomography (CT) in the diagnosis of COVID-19 by using AI. The project group will create a deep learning model for automated detection and classification of COVID-19 on CT scans, and for assessing disease severity in patients by quantification of lung involvement.

In addition, Italian businesses have participated in the pan-European [#EUvsVirus](#) hackathon, which aimed to collect and promote innovative ideas to fight against the coronavirus. Winning Italian projects proposing AI solutions include: 1) [aiLearning](#), which is an AI-based all-in-one platform aimed to simplify and improve exam preparation, execution and evaluation, and 2) [Jobiri](#), proposing an AI-based digital career advisor able to digitalise employment services.

Finally, Italy takes part in the EU-funded project [EXSCALATE4COV](#) that exploits the most powerful computing resources currently based in Europe to foster smart in-silico drug design while increasing the accuracy and predictability of Computer-Aided Drug Design. Specifically, the project involves three among the most powerful supercomputing centres in the EU: [CINECA](#) in Italy, the Barcelona Supercomputing Centre ([BSC](#)) in Spain and the Julich Supercomputing Centre ([JSC](#)) in Germany. The collaboration also includes pharmaceutical companies and major institutes of biology and bio-molecular dynamics from across Europe.

### 5.15.7 Monitoring and future update

The Italian Government will set up an inter-ministerial cabinet for digital transformation under the Presidency of the Council to implement the national strategy and to liaise with international organisations. The inception of a forum will foster the dialogue between policy makers and stakeholders from economy and society. Lastly, indicators will help to monitor the strategy implementation and they will feed in regular reports to the Parliament.



## 5.16 Latvia

In February 2020, the Latvian Government released its national AI strategy on [Developing artificial intelligence solutions](#) (Latvia, 2020). The objective of the Latvian strategy is to promote the uptake and growth of AI in the whole economy. The proposed strategy outlines policy actions in the following areas and devotes particular attention to the promotion of AI in the public administration:

- Raising the awareness of and competencies in AI across society through education reforms;
- Promoting the adoption and development of AI in the public and private sector;
- Engaging actively in national and international cooperation;
- Developing a solid legal and ethical framework for AI;
- Unleashing the benefits of a well-developed data ecosystem;
- Investing in a digital and telecommunication infrastructure to support AI developments.

The Ministry of Interior plans to spend approximately € 1.5 million on digitalisation with a focus on AI.

### 5.16.1 Human capital

Improving **skills and competencies in AI-related fields** is essential to accelerate the speed of AI deployment, use and development. To this purpose the Latvian strategy advocates the integration of AI themes in the general education system at all levels. The Latvian Government recognises the need to raise the awareness and understanding of AI among all citizens, and in particular students, researchers and professionals in the private and public sector. Taking the example of the Finnish course on [AI Elements](#), Latvia will develop an equivalent online course. The target audience of this course are expert level and management level specialists to help support digital transformation. Furthermore, the Latvian Government intends to prepare a National Research Programme and to reform the education system.

### 5.16.2 From the lab to the market

In terms of research, the Latvian strategy highlights that several universities and research centres are currently conducting several **research projects in the field of AI**. The [LU Institute of Mathematics and Informatics](#) is active in the following research strands: speech recognition, semantic analysis, image analysis, natural language analysis, computer vision and robotics. The [Riga Technical University](#) (RTU) carries out research among others in autonomous systems and robots, image and sound processing and smart sensor systems. It has a dedicated Chair in AI and Systems Engineering focusing on machine training and data mining. In addition, the RTU [Institute of Industrial Electronics and Electrical Engineering](#) is coordinating the NexIT project of the National Research Programme to foster ICT services in the public sector and to consolidate data collection and processing. Finally, Latvia's strategy presents a range of ongoing research projects in the field of AI that are supported by the European Regional Development Fund and Horizon 2020.

The deployment of AI solutions in the industry and public administration will be encouraged through an increased pace of digitisation. To this purpose, the Latvian Government is preparing Digital Transformation Guidelines by the second quarter of 2021 with policy measures to support the digital transformation. This will include financial provisions and support programmes for research and innovation in AI. The Latvian strategy identifies **priority sectors** with a high potential for AI applications in the country, such as transport (Intelligent transport systems), culture, justice (AI as support for decision making and drafting legislation), agriculture (automated control), and translation. AI is also mentioned as an effective tool to create a virtual assistant platform in the public administration and to establish an efficient information system in the healthcare sector.

The Ministry of Culture plans to supplement the machine translation system with new language pairs that will increase the availability of government content, e-services, and other content. In spring 2021, a machine translation tool for Latvian-Estonian languages will be developed. A machine-translator for all EU languages is expected to be completed within two years. The Ministry of Education plans to improve skills in the field of natural language processing. The Ministry of Environmental Protection and Regional Development plans to implement AI based proactive services model for citizens (based on real life situations and persons' socio-economic profile to proactively offer services).

Lastly, several **value chain ecosystems** are currently developed by the Ministry of Economics. Three strategic value chain ecosystem pilots are being implemented – on Smart materials, Biomedicine and Smart city – to enhance state-of-the-art research and innovation in these fields. These priority areas are based on

Latvia's [Smart specialization strategy](#). The ecosystems bring together innovation actors from private, public and academic sectors. AI is a key enabling technology to facilitate the implementation of above-mentioned ecosystems.

### 5.16.3 Networking

To foster innovations in AI, research and development should not be conducted in isolation but rather in collaboration, by bringing together competencies from national and international organisations. The Latvian Government encourages joint projects and increase opportunities for **public-private partnerships in AI**. To increase Latvia's international visibility and to attract foreign investments, the Ministry of Foreign Affairs is considering establishing a platform to present Latvia's achievements and good practices in AI. Networking opportunities are further channelled through Latvia's Digital Innovation Hubs, being the [Ventspils High Technology Park](#), the Latvian [IT Cluster Association](#) and the [Institute of Electronics and Computer Sciences](#).

### 5.16.4 Regulation

As the proliferation of AI technologies brings along **new regulatory challenges**, the Latvian Government calls for the development of a normative framework to define what is ethically and legally sound in the field of AI. Latvia is relying on its current national legislation and on EU Directives defining regulations on product safety ([Directive 2001/95/EC](#)) and liabilities ([Directive 1985/374/EEC](#)). However, the government recognises the need to provide more clarity on these issues, in particular on AI goods and services. Hence, it will work on a new legal environment for AI and will set up regulatory sandboxes to facilitate testing of AI concepts and ideas. Regarding ethics, the government adopts the European [ethical guidelines](#) outlined by the European Commission for the Efficiency of Justice.

### 5.16.5 Infrastructure

Given that data is an important driver for the development of AI applications, the Latvian Government has adopted guiding principles for e-government and data governance in the public administration. These [measures](#) aim to foster the development of new **information systems towards open data** and to facilitate the path towards the creation of single data centres. In June 2017, Latvia has launched an [Open Data Portal](#) to harmonise data collection and encourage data sharing. A survey targeting practitioners has also been launched in March 2019 to understand their data needs and to obtain recommendations and feedback on the data published in the open data portal. The Ministry of Environmental Protection and Regional Development ([VARAM](#)) has been appointed as national authority to coordinate open data policies and initiatives in the public administration. In the third quarter of 2019, an information report entitled "Latvian Open Data Strategy" was published. This report lays the foundations for strategic policy actions for the period 2019-2022 towards an open data governance in the public administration.

Latvia has currently two **High Performing Computing Centres**: the High Performance Computing Unit at the Ventspils International Radio Astronomy Centre ([VSRC](#)) and the RTU [Scientific Computing Centre](#). Besides these two centres, the Institute of Electronics and Computer Sciences ([EDI](#)), an independent scientific institute, has also invested in a high performance computer allowing to explore and analyse big data with cutting-edge techniques in AI. In addition, the Latvian strategy mentions the need to increase computing capacities through investments in cloud services and quantum computing.

### 5.16.6 AI to address societal challenges

#### Climate and environment

During a meeting at the European Parliament in January 2020, the Latvian President called for a responsible use of technologies and AI in the public and private sector to facilitate the European Green Deal and to counter the ongoing climate change.

In a similar vein, the [Latvian national AI strategy](#) foresees a high potential in Latvia to develop AI applications for the environmental protection. In particular, it highlighted the analysis of satellite images to detect the presence of hazardous substances in the environment. Changes in soil and foliar may be noticed in certain light spectra, which may indicate contamination. Drones (unmanned aircraft) could be used for the observation of protected areas and to detect changes to the climate.

Witnessing that data quality is essential for the training of AI systems, the Latvian national AI strategy recommends an open data governance across the scientific and business community. With respect to the



climate change, this includes data sharing initiatives of the data repository of the Latvian Environmental, Geological and Meteorological Centre ([VSIA](#)) containing meteorological radar images, measurements, and forecast data. Data should be made available in a structured, machine-readable format for the use of AI and machine learning algorithms.

#### **COVID-19 pandemic**

In March 2020, the Latvian tech start-up community HackForce organised a [virtual hackathon](#) and created solutions to help with COVID-19 crisis. The hackathon encompassed “medicine and healthcare – digital technology solutions and prototypes” among its key topics. Participants with the most innovative ideas were rewarded with funding to develop their projects. The Latvian Ministry of Economics and the Latvian Investment Development Agency contributed EUR 25,000 to the prize pool of the hackathon.

#### **5.16.7 Monitoring and future update**

The implementation of the Latvian strategy will be monitored and evaluated on a regular basis and adjusted with additional policy initiatives where needed. Currently planned key initiatives are digitalisation with a focus on AI, supplementation of new language pairs for machine translation systems, skill improvement in the field of natural language processing, analytical machine learning tools for crime investigation and development of an AI-based proactive services model for citizens.



## 5.17 Lithuania

In March 2019, the Ministry of Economy and Innovation released the [Lithuanian artificial intelligence strategy: a vision for the future](#) (Lithuania, 2019). The aim of the strategy (p. 4) is to "*modernise and expand the current AI ecosystem in Lithuania and ensure that the nation is ready for a future with AI*". The strategy has been drafted by a working group consisting of representatives of the private sector, academia and governmental institutions.

The strategy provides an overview of the current AI landscape in Lithuania and a range of policy recommendations in key areas with the aim to:

- Improving the skills and education in AI for all citizens;
- Strengthening the national research and innovation ecosystem in the field of AI;
- Increasing the deployment, development and use of AI in all economic activities, including both the private and public sector;
- Promoting national and international collaborations in AI and enhancing network opportunities;
- Developing an ethical and legal framework for a sustainable and transparent development of AI applications;
- Establishing a responsible and efficient data ecosystem for AI.

The Lithuanian strategy does not include concrete policy initiatives but merely serves as a guiding document for all actors in the country with policy recommendations. It does not outline financial provisions for the implementation of the strategy.

### 5.17.1 Human capital

With respect to education, the Lithuanian strategy advocates the **development of skills and competencies in AI at all education levels**, emphasising the need to start teaching AI foundations at an early age. Reforms to the primary and secondary education system could target AI basics for children as a learning objective, and could include more courses to develop technical skills. In addition, the Lithuanian Government recommends to modernise STEM teaching subjects and to provide dedicated support to teachers to foster the quality of their education duties in AI. Master programmes and PhD scholarships in AI should also be introduced in curricula of higher education systems. AI-related courses are particularly important for those study areas that are at risk of automation. Universities could develop a website portal to attract prospective students to AI-related programmes. Finally, the Lithuanian strategy highlights the need for **lifelong learning opportunities and vocational training programmes** in AI. Training in AI for citizens could be done by means of massive open online training courses. Overall, the main objective of education in AI is to prepare current and future workforces to the upcoming needs of the labour market.

At the moment of publishing this report (June 2021) there are two new undergraduate level AI programmes at Lithuania's universities, and five undergraduate and graduate level programmes are pending approval. Most of the higher education institutions incorporate AI modules in their IT and technology-related study programmes. Currently, there are nine higher education institutions and scientific institutes carrying out research in various fields of AI.

Since mid-2020, the [Elements of AI](#) course is available in Lithuania and accessible to all its citizens in Lithuanian. The Lithuanian partners of the project are the Kaunas University of Technology and the [AI Boost initiative](#) at the Agency of Science, Innovation and Technology. Around 20% of Lithuania's population has been actively invited to take on the course.

### 5.17.2 From the lab to the market

The Lithuanian strategy presents policy recommendations for the **growth of research and development in the field of AI**. To this purpose, the government will establish a national research centre in AI and increase the financial support to AI research by developing new funding programmes with the aim of meeting the standards set out by the European Commission (i.e. increasing funding for AI research by 70% by the end of 2020).

To **foster innovations in AI**, the government advances a range of policy recommendations towards increased adoption of AI in both the private and public sector. A vibrant entrepreneurial ecosystem could be encouraged by means of an AI start-up hub and Digital Innovation Hubs. Incentive mechanisms to increase

the visibility of AI leading firms through awards such as seals of excellence or an AI badge are also considered. In the **private sector**, the Lithuanian Government identifies the following **priority areas with high AI potential**: manufacturing, agriculture, healthcare, transport and energy. In the public sector, an Advisory Board will be created to advise on future AI policies and to foster an **innovative culture in the public administration**. Regulatory sandboxes will be established to provide optimal conditions for testing promising AI solutions. Lastly, guidance is foreseen to adopt and implement AI systems. The [AI Boost initiative](#) is consulting young companies about their AI products with the goal to help at least 50 start-ups in developing at least 20 working prototypes of their AI solutions.

### 5.17.3 Networking

The AI ecosystem is further strengthened with **policies towards networking and opportunities for partnerships** across all relevant stakeholders. Research centres, businesses and public organisations are encouraged to join forces and to increase knowledge transfers among each other. The strategy presents policy recommendations to stimulate both national and international collaborations. To promote networking within the country, the government will set up and promote AI meetings and conferences and will foster the creation of communities of AI experts. At international level, the strategy recommends to strengthen its ties with adjacent countries Latvia and Estonia and to set up shared initiatives with extended neighbours of the Baltic region. Finally, Lithuania should continue supporting initiatives at the European Union level and beyond, seeking among others to cooperate with global leading companies in AI.

The [AI Boost initiative](#) also organises outreach activities such as the [AI BOOST 2021 Conference](#), which is a two-day event with keynotes and panel discussions around various tracks, including AI for business, AI for society and AI for Government.

### 5.17.4 Regulation

To create a solid foundation for trustworthy developments of AI, the Lithuanian strategy sets out recommendations for the **creation of an ethical and legal regulatory framework**. To this purpose, the government will establish an AI ethics committee to develop a proposal for ethical guidelines. Lithuania strongly recommends the development of ethical principles and legal rules to overcome the current ethical and legal vacuum in the country. The development of this regulatory framework could take advantage of existing regulations at European level. Analyses of good practices could also be useful. Overall, new rules and regulations should aim to ensure explainability, transparency, fairness, trust, verifiability, safety and security against attacks. The creation of a national interdisciplinary centre on AI is also considered to promote discussions of surrounding issues on ethics of AI. In addition, guidelines for unbiased algorithms are being developed to assist developers and managers in assuring that their AI products do not discriminate women, disabled persons, and other disadvantaged groups. Finally, Lithuania adopted a [law on autonomous driving](#) that allows operation of self-driving cars without a driver being present.

### 5.17.5 Infrastructure

The Lithuanian strategy emphasises the need to create a **stable and AI-friendly data environment**, with focus on the public sector. The government highlights the existence of an open data portal [Open.data.gov.lt](#). This portal provides an initial step towards the establishment of an open data ecosystem, but the current version is still limited in usability due to a large portion of data being uploaded in closed format. Hence, the government encourages setting up a centralised hub for open data with enforced standards for data management and sufficient data literacy for a proper use of the data. Finally, the data infrastructure should aim at meeting international standards with respect to findable, accessible, interoperable and reusable (FAIR) principles, and General Data Protection Regulation (GDPR).

### 5.17.6 AI to address societal challenges

#### Climate and environment

In 2020, the Lithuanian Government has developed a [Long-term investment plan for economic stimulus](#). Specifically, The Ministry of Finance prepared this plan in cooperation with other ministries and with the Government Strategic Analysis Centre ([STRATA](#)). It identifies five priorities related to human capital, digital economy and business, innovation and research, economic infrastructure as well as climate change and energy.

The fifth priority about **Climate change and energy** explicitly focuses on increasing the use of renewable energy sources (RES) and on enhancing the efficiency and competitiveness of the energy sector. The objectives include: the development of offshore wind infrastructure; the installation of RES in households, industrial and public buildings of private and legal persons; the modernisation and development of heat supply networks and the renovation of buildings; the replacement of petroleum gas appliances in multi-apartment buildings by other energy sources; and the generation of electricity by using liquefied natural gas.

A non-negligible part of the initiatives planned for the development of a more sustainable economy will probably rely on AI and will benefit from the policies in the second pillar on digital economy and business. Investments in this pillar will target industrial digitisation, the support of new e-businesses, the development of innovation sandboxes and the preparation of 5G networks.

In addition to these initiatives, in 2019 the Agency for Science, Innovation and Technology ([MITA](#)) organised a conference on [GovTech Baltic Leaders](#) in collaboration with [GovTech Lab Lithuania](#). The conference objective was to bring together representatives from both the public and private sectors to discuss how tech start-ups can help to achieve sustainable development, and what role GovTech could have in solving the climate crisis.

More recently, in July 2020, MITA announced a [call for proposals](#) to support the development of Green industry innovation. The call foresees investments from EUR 10,000 to EUR 2 million per project. The innovation areas include bio-technologies, new products from recycled materials, environmental technologies and technologies to modernise production processes while reducing their negative impact on the environment, such as digitisation, automation, robotisation.

### **COVID-19 pandemic**

The Lithuanian [Long-term investment plan for economic stimulus](#) includes funding for a wide range of scientific and business activities to counteract the COVID-19 outbreak. Within this specific field, it includes funding for scientific research, the development of products, accelerating related start-ups, health infrastructure, advanced clinical trials, innovative treatment methods, digital health innovations and tele-health services.

The [Ministry of Economy and Innovation](#) introduced an AI-powered robot [ViLTė](#) providing official COVID-19 related information. This virtual conversation robot is now embedded in the [Government's website](#). Using AI algorithms it answers citizens' questions posed in Lithuanian or English about coronavirus related issues. Reinforcement learning techniques allow the robot to become smarter each time it receives an additional question.

It is worth noticing that ViLTė was actually ideated during the Lithuanian edition of the hackathon [Hack the Crisis](#), specifically designed to respond to the COVID-19 crisis and co-organised by a GovTech team from MITA. Specifically, the project [GovTech Lab](#) by MITA aims 'to boost the innovation ecosystem within the fields of GovTech and AI by increasing the number of GovTech and AI companies, encouraging organisations to integrate and use GovTech and AI solutions, focusing on raising awareness about such innovations and ensuring the accessibility of knowledge and experts for those, who aspire to create AI or GovTech products.

In June 2020, the Minister of Energy, the acting Minister of Economy and Innovation, and the Minister of Finance opened the four-day online conference [Fintech Week Lithuania](#). This event revolves around AI and data economy from a fintech perspective. It hosted the Lithuanian fintech company Bankera that was previously awarded - in the Digital Finance category - in the [#EUvsVirus](#) hackathon to develop innovative solutions to overcome COVID-19. In this latter hackathon, the Lithuanian awarded projects proposing AI-enabled solutions are:

- [Katana ML](#): a project aiming to forecast COVID-19 cases for 20 days ahead with machine learning techniques;
- [Teachers Lead Tech](#): a project to support the use of 3D modelling and virtual reality and as such to improve learning experiences at schools.

### **5.17.7 Monitoring and future update**

Lithuania is considering a review and, if necessary, an update of its national AI strategy in 2021. Investment measures are being planned to support the development of language resources for use in AI, as well as support schemes for AI start-ups, and for businesses performing AI transformations.



## 5.18 Luxembourg

In May 2019, the Government of Luxembourg published its national AI strategy, entitled [Artificial intelligence: a strategic vision for Luxembourg](#) (Luxembourg, 2019). The strategy is part of a broader policy programme called [Digital Luxembourg](#) aiming at coordinating and strengthening Luxembourg's efforts in the digital transformation towards the development of a solid digital society.

The strategy acts as a vision paper outlining the ambitions of Luxembourg in the field of AI and presenting strategic policy recommendations in key areas to achieve them. The policy vision of Luxembourg's strategy is to support the development of a human-centric AI based on an efficient and sustainable data-driven ecosystem. It aims at positioning Luxembourg as a leading digital society in the world. To achieve these objectives, the strategy advances a range of policy recommendations in the following key areas:

- Enhancing the skills and competencies in the field of AI and providing opportunities for lifelong learning;
- Supporting research and development of AI, transforming Luxembourg in a living lab for applied AI;
- Increasing public and private investments in AI and related technologies;
- Fostering the adoption and use of AI in the public sector;
- Strengthening opportunities for national and international networks and collaborations with strategic partners in AI;
- Developing an ethical and regulatory framework, with particular attention for privacy regulation and security to ensure transparent and trustworthy AI development;
- Unleashing the potential of the data economy, as a cornerstone of AI development.

The national AI strategy of Luxembourg does not disclose financial provisions or estimations for its implementation.

### 5.18.1 Human capital

With respect to **formal education**, the Government of Luxembourg recommends reforming the secondary and higher education systems and vocational training programmes to include AI-related courses in their curricula. The strategy also emphasises the importance to increase the digital literacy and basic AI knowledge of citizens to prepare them for the digital transformation. To optimise **lifelong learning opportunities** for the workforce, it is advised to develop tailor-made learning experiences. This could be done in collaboration with leading AI companies to make sure that newly acquired skills and competencies **fit the needs of the labour market**.

As outlined in the [Digital Luxembourg's progress report 2020](#), several initiatives to support advanced digital skills are currently ongoing in these directions. At the earliest education levels, initiatives such as [Kids life skills](#) and [Kniwwelino](#) aim to prepare pre-school and primary school children for computational thinking and coding. In 2020, the government presented [Einfach Digital](#), a new national approach to digitalisation in the classroom that centres on critical thinking, creativity, communication, collaboration & coding. In addition, the Luxembourg Tech School ([LTS](#)) has expanded its course offer in AI. Such initiatives are complemented with learning opportunities in AI for the labour force as offered by [AI academy Luxembourg](#) (training modules for decision makers, technical professionals, data scientists & engineers), [Lifelong-learning.lu](#) (platform with trainings in IT and telecommunication), and the [Elements of AI](#) course, among others.

To fully grasp whether the needs for AI-related skills for the public and private sector are met, the government is also planning to map the current education offer and to integrate AI courses in those disciplines that are subject to benefit most from AI. This mapping information could feed into existing policy programmes such as [Digital Skills Bridge](#) and the recently launched [Talent Attraction Strategy](#) to further improve the fit between workforce's skills and the needs of the labour market.

### 5.18.2 From the lab to the market

To foster the creation of marketable products and services in AI, the Government of Luxembourg has the ambition to transform the country into a **living lab for applied AI**. This will be done by encouraging a research culture in AI through the establishment of world-class testing facilities and regulatory sandboxes and through the development of research centres such as the Luxembourg [Digital Innovation Hub](#) hosted and managed by [Luxinnovation](#). To further **increase innovations in AI** with a particular focus on SMEs and start-ups, the strategy advocates the use and expansion of existing financial funds such as [The Future Fund](#), the

[Digital Tech Fund](#) and the Société Nationale de Crédit et d'Investissement ([SNCI](#)) bank. With the aim to **improve the quality and efficiency of public services**, the Government of Luxembourg is also setting up policy recommendations to foster AI innovations and use in the public sector. This is done among others by identifying potential projects that could provide human-centric AI solutions for citizens and by sharing good practices with the (international) AI community. A call for projects was launched for ministries to submit ideas for AI-based initiatives that would help them optimise or expand their services in November 2019. The call drew a total of 14 projects from seven different administrations: six winning teams received funds to kickstart its project along with guidance on procurement, design and service provider selection. After 6 to 9 months of development, a completed proof of concept and mock-up will help determine if the project should move forward. Also, a team of legal experts on data and technology evaluated and assisted the finalists. This learning experience brings lasting value to Luxembourg's public administration. A second call was launched in the beginning of 2021.

Other instruments at hand to reinforce customer-oriented services are the creation of a centralised data ecosystem for public data and the [Digital by Default](#) initiative that aims support the digitalisation and simplification of the public administration.

### 5.18.3 Networking

The strategy of Luxembourg also includes several policy recommendations for **increasing national and international partnerships in AI**. The National Research Fund has dedicated funding for collaborative public-private research in fields as advanced robotics and digital manufacturing. Through the use of public-private partnerships (PPPs) the government is also prioritising more multidisciplinary research. The government has for instance recently launched an [AI Laboratory](#) in Luxembourg in partnership with NVIDIA. In addition, the strategy mentions the active participation of Luxembourg into European-wide initiatives as [CLAIRE](#) and [Copernicus](#).

### 5.18.4 Regulation

A new **regulatory framework** will be put in place to remove barriers to AI development. To ensure **ethical guidelines** for a trustworthy, transparent and sustainable AI, the Government of Luxembourg is setting up a technology & ethics advisory committee. Collaborations among governmental bodies aims also to ensure the adoption of proper corporate governance in AI. The government will also engage with the National Data Protection Authority to develop regulations with respect to privacy and data protection. The regulatory environment will aim to **enhance quality, accessibility and transparency of data**. Finally, the Luxembourgish institute for standardisation ([ILNAS](#)) will be consulted to coordinate standardisation processes in AI.

### 5.18.5 Infrastructure

The successful development of cutting-edge AI technologies requires a well-developed **data and telecommunication infrastructure**. To this purpose Luxembourg is heavily investing in data centres, computing infrastructure and ICT resources. The Luxembourg Commercial Internet eXchange ([LU-CIX](#)) for instance provides access to six data centres, with a fast and reliable network stability and high-volume data transfer speeds. Luxembourg is also participating in the European initiative on High-Performance Computing ([EuroHPC](#)) aiming to develop expensive computing resources. In this respect, the supercomputer [MeluXina](#) will be developed. It will be a petascale supercomputer, capable of executing more than 10 Petaflops, 10 million billion calculations per second and powered by green energy from a cogeneration plant powered by waste wood. This new supercomputing system is expected to be operational early 2021 and will rank in the world's top 30 supercomputers. MeluXina is funded via a joint investment of about EUR 30 million from the European Union and Luxembourg.

### 5.18.6 AI to address societal challenges

#### Climate and environment

Luxembourg has set up the first European [national partnership](#) on AI with NVIDIA. The Government of Luxembourg together with the country's scientific community and NVIDIA will set up a joint research laboratory for AI. Focusing on using AI and high performance computing to search for solutions to **major**



**societal challenges** including space resources research, which could include green energy, climate and the environment.

In January 2021, the [Ministry of the Economy](#), among others, sponsored the event [Cleantech Forum Europe](#) that took place in Luxembourg. This forum deals with topics related to digitisation and data as the key to a cleaner future also investigating the potential of AI and data platforms as tools to collect and analyse data for a cleaner future. Furthermore, the [Luxembourg CleanTech Cluster](#) engages with transforming urban life globally by means of sustainability, quality of life and embedded intelligence.

### **COVID-19 pandemic**

The Luxembourg national innovation agency – [Luxinnovation](#) – plays a crucial role in countering the COVID-19 pandemic. First, it manages the [Luxembourg HealthTech Cluster](#) that brings together national players involved in innovative health technologies. Its aim is to promote the development of new and existing companies through innovation, thereby contributing to economic growth and job creation, notably in the area of digital health. Furthermore, Luxinnovation provides support to the Ministry of the Economy to launch a call for projects [StartupVsCOVID19](#) which will offer 20 selected start-ups up to EUR 150,000 in public funding. Although this call is not directly geared towards AI, it may contain AI-related projects among the selected applications.

Luxembourg is also headquarter to the [COVID-19 Smart Screening Tool](#) presented within the context of the [#EUvsVirus](#) hackathon. This project is jointly developed by Luxembourg and Greece with the objective to roll-out a generalised, scalable, yet resource-optimised strategy for de-confinement with a combination of COVID-19 testing and surveying based on machine learning, blockchain, and AI techniques. The result would be a risk-based approach for targeted COVID-19 testing that could be used in any de-confinement situation.

### **5.18.7 Monitoring and future update**

The inter-ministerial coordination group, under leadership of the Prime Minister, will set up a governance mechanism to continuously follow up on strategic initiatives that support Luxembourg's AI development. It will regularly assess the strategic vision and set up a framework for upcoming actions in the future.



## 5.19 Malta

In October 2019, the Maltese Government published [Malta's national AI strategy](#) (Malta, 2019a). The objective for Malta is to gain a strategic competitive advantage in the global economy in the field of AI. To achieve this objective, the policy report presents three pillars to lay the foundations for Malta's AI strategy:

- The creation of a solid AI ecosystem based on investments, start-up support and innovation;
- Support for increased adoption of AI in the public sector;
- Support measures for the adoption of AI in the private sector.

The successful achievement of these objectives relies on three horizontal enablers that cut across the three aforementioned areas: education and workforce, legal and ethical framework and infrastructure. The national AI strategy of Malta has been based on Malta's AI workforce [high-level policy document](#) that was released in March 2019 for public consultation (Malta, 2019b).

Malta's government has launched a dedicated web portal [malta.ai](#) to outline and present the progress made in implementing the national strategy in AI.

The Maltese AI strategy lacks inclusion of financial provisions or estimations for its overall implementation.

### 5.19.1 Human capital

With regard to human capital, Malta will introduce **fundamental changes to the educational system**. In first instance educational **courses and study programmes will incorporate AI** and will cross-link with other disciplines such as healthcare, marketing, sociology, and physics, among others. The Maltese strategy proposes a range of policies towards the reform of primary, secondary and higher education systems as well as support for teachers to enhance their course offerings in AI:

- At early age levels and for primary education levels, the Ministry of Education and Employment will support initiatives, such as 1) the AI Family Challenge: a programme for children with AI hands-on workshops and 2) the AI Olympiad: focusing on learning and using AI methods. The Ministry will also introduce AI trainings in the secondary education system;
- In higher education, several Master programmes, PhD scholarships and postgraduate programmes in AI will be introduced in the upcoming years. These will be developed and coordinated by the Malta College of Arts, Science & Technology ([MCAST](#)) and the University of Malta ([UoM](#)), among others;
- The Ministry of Education and Employment will provide support for teachers on how AI solutions could be incorporated in the education curriculum of teachers. This will be done in collaboration with the [Malta Union of Teachers](#).

With respect to education reforms, the Malta College of Arts, Science & Technology has released an [AI Strategy and action plan 2020-2025](#) in which it outlines policy actions towards the introduction of AI in education systems in Malta (2019c).

**Reskilling the workforce** is key to get prepared for the upcoming opportunities brought along by innovative AI technologies. Malta's AI strategy makes references to both lifelong learning and the screening of labour market for upcoming skills demand. The strategy proposes the following actions among others:

- Set up of a **think tank to assess the more vulnerable skills and jobs** due to automation and AI in order to propose a transition plan;
- Employment reforms and safeguards to offset the impact of automation;
- Creation of a **national reskilling programme** to facilitate peoples' transition into areas that are complementary to AI based tasks or that require stronger elements of creative thought and cognitive aptitude;
- Promoting access to training for the workforce through the [Investing in skills programme](#);
- The [eSkills Malta Foundation](#) can provide advice on reforms in the ICT educational offerings and AI-related courses for professionals;
- Promoting **continuous learning** and Massively Open Online Courses (MOOCs) to keep up with the speed of change due to AI technologies.

### 5.19.2 From the lab to the market

Malta's strategy foresees increased research activities, dedicated investment instruments, start-ups development and innovation support in both the public and private sector.

Both the University of Malta and the College of Arts, Science & Technology will be supported with public funding to **increase applied research output in AI**. According to Malta's strategy, financial support for AI-related research could be partially funded through the [R&I FUSION Programme](#) which has an annual budget of EUR 2.2 million.

The government will provide **additional funding** to governmental accelerators and incubators in order to support AI-related businesses and start-ups. The accelerator [YouStartIT](#), run by the MITA Innovation Hub, will be given funding to develop an AI-based programme to help the early start-up of AI businesses. Extra public funding will also be attributed to the [TAKEOFF Seed Fund Award](#), a seed funding initiative to researchers and entrepreneurs. In addition, the government will organise events where AI start-ups and scale-ups can meet and team up with angel investors and venture capitalists. Lastly, the government will establish an investment fund, and will encourage co-investments from the public and private sector. It has also reformed the [Seed Investments Scheme](#) with more favourable tax credit conditions for innovative AI firms.

Other policy measures to **accelerate private sector AI adoption** in Malta contain, among others:

- Creating a Private Sector AI Readiness Index to assess the digital and AI maturity of business and to identify where to provide government guidance and policy actions. This index will be updated annually;
- Increasing the awareness and knowledge of the private sector on the benefits of AI and improving their trust in AI (as outlined in the section on Regulation).

Malta's strategy emphasises that policy measures enabling the use, development and integration of AI will be targeting businesses of all sizes, but particular attention will be given to SMEs as it constitutes a large proportion of Maltese businesses.

With the **uptake of AI in the public sector** Malta aims to improve the economic and social well-being of citizens and businesses, to provide better services and to increase the efficiency of internal operations in the public administration. The responsibility for fostering the deployment of AI in the public administration will be done by respective Ministries and Chief Information Officers. In addition, a Technical Committee will be established to review the architecture of AI solutions in the public administration. Overall, the strategy foresees the following range of initiatives for the public sector:

- Promoting AI pilot projects in the public sector and providing support along the entire implementation phase, from use-case selection, prototype and testing until successful implementation. Malta's strategy highlights pilot projects on AI in traffic management, education, healthcare, customer service, tourism, better utilities and energy;
- Enabling automation and better use of data across public sector;
- Supporting public procurement for emerging technology solutions;
- Increasing training and awareness programmes to support AI in the public sector.

### 5.19.3 Networking

The AI strategy of Malta foresees the development of a detailed **framework for collaboration between industry, educational and research institutes**. This includes the design of a collaboration model, tools, guidelines, and relevant standards that facilitate interactions. The strategy highlights the need to promote collaborations at different levels of granularity (e.g. both nationally and internationally oriented) and emphasises the importance of collaborations across institutions of both public and private sectors, ranging from research institutes, private companies of any size level (with particular importance for start-ups), and educational institutions. Support actions for collaboration in AI includes, among others:

- Supporting cross-sector sharing, co-innovations with the (inter)national community;
- Increasing opportunities for collaborations with the government by opening up calls for proposals for researchers, businesses and public sector representatives on Maltese [web portal for AI](#);

- The launch of a Digital Innovation Hub with a focus on AI, which will serve as a collaboration platform to foster AI opportunities in the public and private sector by bringing research and innovation communities together.

Besides support for enhancing collaboration, the strategy of Malta is also proposing initiatives towards **increasing the international attractiveness** of the country for international talents, entrepreneurs and investors:

- The launch of a Start-up visa, which provides a simplified procedure for start-up founders and their families members from outside the EU to reside and work in Malta;
- Malta's [Key Employee Initiative](#) provides fast-track services to highly-specialised third-country professionals employed in Malta;
- The government has re-introduced the [Qualifying Employment in Innovation and Creativity](#) (Personal Tax) Scheme. This measure facilitates employment of non-residents in roles which are currently not addressed by the local labour market by temporarily easing the tax expenses incurred by such individuals through a fiscal incentive.

In terms of **dissemination and uptake of AI**, the Maltese high-level workforce suggests:

- To organise promotion campaigns and outreach programmes to highlight the benefits of AI. The Maltese strategy announces a public investment of EUR 1 million per year for this activity.

#### 5.19.4 Regulation

The **development of a legal and ethical framework** is a salient step towards a successful adoption and subsequent widespread deployment and use of AI across the economy. In October 2019, Malta published its [strategy towards trustworthy AI](#) (Malta, 2019d). It outlines Malta's vision for an ethical and trustworthy AI and sets out four ethical AI principles to achieve this:

- Human autonomy;
- Prevent harm;
- Fairness;
- Explicability.

Complementing this ethical framework, Malta's government has also set up the following policy initiatives towards the development of an ethical AI:

- The creation of a National Technology Ethics Committee to oversee the Ethical AI Framework and to ensure its monitoring and implementation;
- The launch of a national AI certification framework: a [certification](#) issued by the Malta Digital Innovation Authority ([MDIA](#)) that serves as a valuable recognition in the marketplace that the AI systems of successful applicants have been developed in an ethically aligned, transparent and socially responsible manner.

To encourage the adoption of AI, particular emphasis is placed to the development of **regulation and legislation**, including:

- A Technology Regulation Advisory Committee will be appointed to advise on legal matters and develop legal guidelines where needed (legislation to clarify IP ownership rights and liability in AI will be a priority);
- Malta is setting up a regulatory sandbox for AI providing regulatory exceptions to firms to foster testing of AI solutions. In addition, a Data sandbox will be developed to provide guidance on how data protection rules apply.

In terms of **standardisation**, Malta's AI strategy emphasises the importance to collaborate with international organisations on emerging standards and norms in AI. This goes along with the provision of a common definition on AI aligned with the one provided by the EU High-Level Expert Group on AI.

### 5.19.5 Infrastructure

The delivery of AI research, development and adoption can only be achieved in a well-developed and **cutting-edge data and ICT infrastructure**. As highlighted in Malta's strategy, an enabling infrastructure should be part of a holistic AI strategy and contains various dimensions such as data and connectivity resources, compute capabilities and data sharing platforms for all institutional players, ranging from research institutes, regulatory authorities, and start-up ecosystems to innovation hubs. Among others, the strategy proposes to set up the following initiatives:

- Investing in Maltese language resources to foster language technology solutions;
- Supporting data centres to meeting the growing needs of computing power and storage. [Malta Enterprise](#), Malta's economic development agency, will offer incentives and support measures in this regard;
- Increasing access to open data with the launch of [Malta Data Portal](#), an open data repository developed by the Malta Information Technology Agency ([MITA](#));
- Providing cost-effective access to computing capacity through various initiatives such as supercomputing cluster [A.L.B.E.R.T.](#), and Malta's participation in the European Initiative [EuroHPC](#) to develop a pan-European supercomputing infrastructure;
- Enabling access to cloud platforms for the public and private sector by means of initiatives such as [Malta Hybrid Cloud](#) procured by MITA.

### 5.19.6 AI to address societal challenges

#### Climate and environment

The Government of Malta has committed to establish itself as a centre of Climate Friendly Travel. In doing so, it puts itself on the forefront in addressing the climate change by promoting climate-friendly travel through **reduced emissions** with the ultimate objective of carbon neutrality. The Maltese Government made this statement during the SunX Malta's first [Annual Climate Friendly Travel Think Tank](#) in February 2020. SunX Malta has been established through support from the Ministry for Tourism & Consumer Protection, and Malta Tourism Authority (MTA). This company aims at contributing to the global effort of converting the threat of the ongoing climate change. In collaboration with the Swiss-based company Wisekey, it launched the [Tourist Digital Identity](#) using Blockchain AI and IoT technologies.

#### COVID-19 pandemic

During the COVID-19 pandemic, the [Mater Dei Hospital](#) deployed a new robot which can process 800 coronavirus tests per day and release the results within few minutes.

### 5.19.7 Monitoring and future update

The national AI strategy of Malta sets out a vision at long-term, aiming to transform Malta into a leading economy in the field of AI by 2030. The policies outlined in the strategy are meant to be undertaken in the period 2019-2022. Their implementation will be monitored and evaluated at regular basis. [Malta's web portal on AI](#) will be used to release forthcoming information on the progress of the strategy's implementation.



## 5.20 Netherlands

In October 2019, the Dutch Government has released its [Strategic action plan for artificial intelligence](#) (Netherlands, 2019). The strategy presents a range of policy initiatives to strengthen Netherlands' competitiveness in AI on the global market. The vision of the Dutch AI strategy relies on three strategic pillars, aiming at:

- Capitalising on societal and economic opportunities: policies encouraging the adoption, use and development of AI in the private and public sector and promoting the use of AI to tackle societal challenges;
- Creating the right conditions: policies supporting education and skills development in AI; fostering research and innovation in AI, facilitating the access to qualitative data and improving the digital infrastructure;
- Strengthening the foundations: including policy actions related to ethical issues, such as trust, human rights, consumer protection, and safety of citizens.

The strategy contains an extensive list of initiatives aiming at fostering AI in the economy through policies related to education, R&D and innovation, networking, regulation and infrastructure.

The Dutch strategy mentions in an annex that the yearly governmental budget for AI innovation and research is estimated at EUR 45 million per year. In 2019 this budget was EUR 64 million. In 2020 the Netherlands funded an additional EUR 23.5 million for the Public Private Partnership the Dutch AI Coalition. In April 2021 an investment programme was granted to maximise the possibilities of AI for the Dutch economy and society by investing an additional amount of maximum EUR 276 million in the upcoming years.

### 5.20.1 Human capital

Formal education and training reforms are foreseen through policies targeting increased digital literacy in primary and secondary education and providing more opportunities to develop skills and competencies in data science in higher education ([National Data Science Trainee programme](#)). A national [online course on AI](#) is also available for civil servants in the Netherlands. Vocational training initiatives funded by the [Regional Investment Fund](#) will target more closely the future (digital) needs of the labour market. Further training and lifelong learning are fostered with the [STAP-scheme](#) – a EUR 200 million investment to create training opportunities in AI and digital skills for individuals – and with a multi-annual programme for the improvement of [Lifelong Development](#), with a focus on digital skills.

### 5.20.2 From the lab to the market

In order to stimulate basic and applied research in AI, the [Dutch Research Council](#) is supporting a new research programme on AI. To complement this initiative, the Dutch AI-coalition proposes the establishment of an AI Competence Centre. In order to create favourable conditions for companies to invest in AI, the Dutch Government improves access to innovation funding and venture capital through [Innovation Credits](#), the [Seed Capital Scheme](#) and the [Dutch Venture Initiative](#). In addition, the Chamber of Commerce offers hands-on information on AI, which could support companies in their innovation efforts.

The Dutch Government also developed the Knowledge and innovation Covenant ([KIC](#)) funding. This funding is provided by knowledge institutions, the business community, governments and other public parties that jointly invest in innovation. KIC 2020-2023 supports fundamental and practical research in public-private partnerships and focuses on key enabling technologies such as energy transition and sustainability, agriculture, water and food, health care, and safety. AI is a key enabler in each of these areas.

Concerning R&D&I, five projects in the fields of AI, regenerative medicine, health data infrastructure, quantum technology and hydrogen/green chemistry received funding from the [National Growth Fund](#). The Netherlands AI Coalition ([NL AIC](#)), a public-private partnership consisting of more than 400 participants, received a share of EUR 276 million to fund the first phase of its project on AI, called the [AiNEd Programme](#) (Netherlands, 2021). It aims to accelerate the development and application of AI. It focuses on large-scale projects for 1) accelerating innovative AI applications, 2) strengthening the knowledge base of fundamental and applied research, 3) increasing the capacity for AI educating and training, 4) developing human-centred AI with ethical and legal frameworks and 5) making data available for AI.



### 5.20.3 Networking

The Dutch Government highly values collaborations and public-partnerships (PPPs) in AI, such as the Netherlands AI coalition, in which the government, the business sector, educational and research institutions, as well as civil society organisations collaborate to accelerate and connect AI developments and initiatives. Other examples include initiatives such as [Commit2Data](#) and [VWData](#) with a focus on big data.

Furthermore, the strategy highlights examples of national collaborations in using AI applications in the legal environment (e.g. document automation and due diligence based on AI) and the public domain (e.g. chatbots). Finally, collaborations across the national borders are encouraged by strengthening Netherlands' partnership in European AI consortia (e.g. [European Partnership on Artificial Intelligence, Data and Robotics](#), [AI4EU](#), [CLAIRE](#) and [ELLIS](#)) and international AI collaborations such as [Holland Innovation Network](#) and the [Coalition of the Willing](#).

In addition, the Netherlands takes part in the Global Partnership on AI ([GPAI](#)), an international initiative to spur a responsible development and use of AI in full respect of human rights, inclusion, diversity, innovation and economic growth. The GPAI collaborates with international partners and organisations to bring together experts from industry, civil society, governments and the academic world. This initiative is stirred by a secretariat, hosted by the OECD in Paris, and it accounts for two Centres of Expertise in Montreal and in Paris.

### 5.20.4 Regulation

Regarding regulation, the Dutch Government advocates an ethical, trustworthy and responsible use of AI with respect for human rights and consumer protection, and based on a well-developed legal framework. Policy actions relate to various research activities on ethical, legal and transparency aspects, and responsible use of AI. The Netherlands AI coalition has for instance developed the concept of [ELSA labs](#) (ELSA refers to Ethical, Legal and Societal Aspects) to enhance synergies between research, education and organisations on human-centric AI. The Dutch Government also highlights its active participation into High Level Experts Groups and European Directives on these issues.

Several reforms to the legislation are ongoing to support the protection of public values and encourage the use of AI in a trustworthy environment:

- Amsterdam's AI register (in partnership with the city of Helsinki): Amsterdam and Helsinki have launched open [AI registers](#) that track how algorithms are being used in the municipalities. A [White Paper](#) on the AI register was published on September 2020 to inspire other governments/organisations wanting to be transparent about their use of algorithms and AI;
- [Experimental Law on self-driving vehicles](#): In effect since July 2019, public road tests involving self-driving vehicles without drivers present are allowed under certain conditions;
- Principles of good governance and consumer protection for the use and development of AI have been amended in the Freedom of Information Act, the General Administrative Law Act and the General Data Protection Regulation (GDPR). The Dutch Government has also implemented the Law Enforcement Directive in its national legislation, which contains provisions regarding automated decision making for law enforcement. Related to this latter issue, the government has adopted a law to [prevent discrimination in recruitment](#) when automated systems are used;
- The Dutch Government has developed guidelines for [applying algorithmic data analysis](#), with the intention to translate them into legislation.

### 5.20.5 Infrastructure

The Dutch strategy includes policy initiatives to foster the data infrastructure and to provide foundations for data use and sharing. It includes the promotion of FAIR principles for private data sharing, the participation into the [Common European Data Space](#) and the creation of an inventory of data sharing solutions. In terms of digital and telecommunication infrastructure, the Dutch strategy mentions among others the [Digital Connectivity Action Plan](#) (aiming at setting up a high-quality connectivity) and the government investments in supercomputing power (e.g. supercomputer at [SURF](#)).

## 5.20.6 AI to address societal challenges

### Climate and environment

The [NL AIC](#) coalition highlights energy and sustainability as one of the key areas for AI applications. AI is a cornerstone technology to reduce energy consumption and develop innovative projects with positive climate impact. A dedicated Energy and Sustainability working group has been created to bring together ongoing initiatives and to create preconditions for cooperation in this field (e.g. by making agreements on data access and use).

The Dutch Water Partnership ([NWP](#)) is a network of Dutch organisations, including government agencies, from the water sector with the goal to collaborate on developing **sustainable water solutions**. This partnership [highlights](#) the importance of AI and machine learning to augment human-based know-how to improve efficiency and free up resources in the water sector, therefore positively contributing sustainability and environmental challenges.

In January 2016, the Royal Netherlands Meteorological Institute ([KNMI](#)) has created the [KNMI DataLab](#). This project aims to facilitate and coordinate innovations in the fields of climate change, weather forecasting and seismology. The KNMI Datalab brings value and support to collaborating partners by sharing its knowledge in these research fields and by providing access to the data available at KNMI. Big data management, data analytics including machine learning and deep learning are becoming increasingly important in the supported projects of the DataLab.

### COVID-19 pandemic

Emerging technologies as AI and big data spur the development of cutting-edge innovations and provide relief on many fronts to fight against the COVID-19. The [Invest in Holland](#) network, which provides support to the Dutch Ministry of Economic Affairs, identifies various application areas in which AI is used in the Netherlands to overcome COVID-19:

- Using AI in medical imaging for diagnosis;
- Using AI to assess risk;
- Using AI to flatten the curve.

Overall, the following initiatives and innovative applications of AI have recently appeared in the Netherlands towards COVID-19:

- The National Institute for Public Health and the Environment ([RIVM](#)) leads the way in using novel tools to track and model the spread of the virus with AI and machine learning. The national institute uses the [Infection Radar](#) that employs statistical analysis techniques falling into the machine-learning and AI category. The Infection Radar belongs to [Influenzanet](#), a European partnership among several universities and governments in Europe;
- A team from the Netherlands Cancer Institute ([NKI](#)) prompted more than 30 other [EU hospitals](#) to submit longs' radiographs in order to develop a powerful algorithm that could accurately diagnose coronavirus cases through CT scans within seconds. This initiative is a response to the ongoing European campaign to develop a deep learning-based model for the automated detection of abnormalities on chest CT and for quantifying lung involvement. Specifically, [Imaging COVID-19 AI](#) is a collaborative European project to enhance computed tomography (CT) in the diagnosis of COVID-19 by using AI. The project group will create a deep learning model for automated detection and classification of COVID-19 on CT scans, and for assessing disease severity in patients by quantification of lung involvement;
- The [Maasstad Hospital](#) in collaboration with [Holland AI](#) developed an algorithm based on AI in order to assess the portion of affected lung tissue in patients potentially positive to the COVID-19;
- An [initiative](#), coordinated by Amsterdam UMC hospital together with VU University Amsterdam and Maastricht UMC, aims at increasing the use of AI to combat the corona virus. The objective of the initiative is to include all Dutch hospitals and the National Intensive Care Evaluation Foundation (NICE) to jointly step into novel AI-based researches to predict whether a patient infected with COVID-19 will become in need of ventilation;
- Within [CLAIRE](#), a large European network of AI experts, the [University of Leiden](#) have developed AI applications that take advantage of the enormous amounts of health data generated by intensive care departments. Specifically, this data feed into self-learning algorithms meant to help doctors making forecasts and taking decisions, for example about patients' future needs of intensive care;

- The Dutch Water Research Institute ([KWR](#)) employed AI techniques to create a measurement method that monitors sewage water and detects the presence of RNA traces of the virus which would come from infected people. Specifically, the software combines machine learning with wastewater monitoring. This method was developed as part of the [Sewers4COVID](#) project within the [#EUvsVirus](#) hackathon teaming up with Greek, Spanish, and British participants;
- The [Delft University of Technology](#) implements algorithms using available data to forecast future COVID-19 outbreaks. Specifically, they proposed the Network Inference-based Prediction Algorithm (NIPA) to forecast the future course of COVID-19;
- Medical researchers from the University of Amsterdam Medical Centre and the Maastricht University Medical Centre are collaborating on a [project](#) using AI and big data to find out how patients can be treated for coronavirus;
- A [Medical Drone Service](#) was delivering medical goods during the COVID-19 outbreak.

#### **5.20.7 Monitoring and future update**

The Government of the Netherlands is implementing the actions from the national strategic action plan on AI. An overall update of the national strategy for digitalization (and AI) will follow in Q2 2021. Focus will be on requirements for human-centric AI, a vivid research and innovation ecosystem (public private partnership), human capital, international cooperation, deployment (SMEs) and applications: public sector use, smart industry and AI for societal challenges: health, energy transition, agriculture, mobility.



## 5.21 Norway

The Norwegian Government presented its [National AI strategy](#) in January 2020 (Norway, 2020a). The objective of the strategy is to outline the policy actions for the coming years in order to maximise the opportunities that AI can bring along for Norwegian individuals, for businesses and industry, and for the public sector. To achieve this outcome, the national AI strategy highlights the following policy initiatives:

- Expanding the offer of education programmes and workplace trainings in the field of AI in order to create a solid basis of digital skills and capabilities;
- Strengthening the Norwegian research in AI;
- Enhancing the innovation capacity in AI in both the private and public sector;
- Outlining ethical principles for AI in order to allow fair, reliable and trustworthy AI-related developments;
- Establishing digitalisation-friendly regulations as to define the legislative framework in which AI developments take place;
- Constructing a strong data infrastructure ensuring open data and data sharing across sectors and business areas. Dedicated opportunities for language data resources are established through [The Norwegian language bank](#) at the National library;
- Deploying a telecommunication infrastructure that provides high-capacity connectivity and computing power, and that ensures security in AI-based systems.

While the national AI strategy mentions various provisions to finance specific projects, it does not provide the total amount of funding for the implementation of the strategy.

### 5.21.1 Human capital

The AI strategy strongly emphasised the need for increased digital competence at all levels of education and for those already employed. In order to prepare the current and ongoing workforce with the appropriate digital skills and technological literacy, the Norwegian Government has started reforming education programmes at all education levels. At the **primary and secondary education** level, the Norwegian Government foresees the following:

- Increased prominence of digital skills at schools: curricula of primary and secondary education have been reformed as to include more programming and computational thinking.

At the level of **tertiary education**, the Norwegian Government are setting up support funding to which universities and higher education institutions can apply to develop further education programmes. In addition to introducing education reforms, it is equally important to establish a solid knowledge base of the available programmes in AI and to monitor the offer and trends in study places and candidates in AI. Policy initiatives towards the adaptation of education programmes include among others:

- Expanding ICT-related programmes. The number of new study places for ICT has increased by more than 2,150 compared to 2014. The seats of higher learning are developing dedicated programmes in the field of AI at bachelor and master level, with subjects as algorithms, robotics, machine learning, computer vision, deep learning and big data analysis. The number of student places in these areas are increasing each year as a result of rising demand both from students and industry;
- Offering comprehensive education opportunities to schoolteachers in AI through the Centre for Computing in Science Education ([CSSE](#)) and Centre for Teaching and Learning in Science and Technology ([KURT](#)). An example of such course is [ProFag programming](#) course in AI-related subjects for schoolteachers;
- Increasing opportunities for PhD positions on AI-related topics and allowing employees ([Industrial PhD scheme](#)) to undertake a PhD project that is relevant to their company's profile.

As AI is expected to bring about changes in many jobs, the Norwegian strategy also highlights the importance of anticipating the pace of change to the labour market and preparing for the future labour demand. Hence, opportunities for **upskilling, reskilling, and lifelong learning** are put in place. In particular, the following initiatives are presented:

- A [report](#) to the Storting – the supreme legislature of Norway – on skills reforms and lifelong learning (in Norwegian only). The report outlines a concrete action plan and policy initiatives to close the gap between what the labour market needs in terms of skills and the skills that employees actually have;
- Funding for the development of flexible continuing education schemes that are geared towards the needs of the jobs market, particularly the skills that are required to digitalise businesses. In 2021, initiatives that will enhance digital competencies, Cyber security and green transition / sustainability skills will be prioritised;
- Leveraging the benefits of massive open online courses (MOOCs). In this respect, the online course on [Elements of AI](#) has been launched in Norwegian in 2020 in cooperation with the Norwegian University of Science and Technology ([NTNU](#)). The Minister for Regional Development and Digitalisation has also endorsed the follow-up course [Building AI](#) in Norway;
- Preparing a strategy for digital competence in the public sector.

Overall, the provision of study programmes and workplace trainings in AI should aim to anticipate the needs in the labour market and to integrate AI into established study programmes and job positions where relevant.

### 5.21.2 From the lab to the market

The **promotion of scientific research** is essential to achieve ground-breaking innovations in AI. To this end, the Norwegian Research Council allocated a budget of EUR 145.7 million to research, innovation and advanced ICT applications in 2018.<sup>64</sup> Although the Research Council has no dedicated programme towards AI funding, 40 percent of budget allocations to ICT research in 2019 have been targeting projects related to AI, robotics and big data, which represents a total amount around EUR 40 million. The following policy initiatives and action plans are proposed to leverage AI research in Norway:

- The Norwegian Centre for Research-Based Artificial Intelligence Innovation ([SFI NorwAI](#)) has been launched in 2020. It is a new research centre on AI and big data. The purpose of the centre is to develop cutting-edge theories, methods and technologies for efficient and responsible use of data-driven AI in innovative industrial solutions. NorwAI is run as an integral and complementary part of the Norwegian Open AI Lab ([NAIL](#)), both of which are formally hosted by the Department of Computer Science at [NTNU](#).
- Increasing long-term research opportunities in AI-relevant technologies through dedicated research centres, such as the programme [BigInsight – Statistics for the knowledge economy](#) and [Sirius – Centre for Scalable Data Access](#) and [dScience – Centre for Computational and Data Science](#) at the University of Oslo (UiO). Among others these centres address topics of statistical and machine learning methodologies, scalable data access and high-performance computing;
- Stimulating private investments in research through deductible tax schemes for donations to scientific research;
- Increasing the participation in European research programmes. To this end, the Research Council of Norway has established the Norwegian Artificial Intelligence Network for Europe ([NAINE](#)). The goal is to promote Norway's priorities and increase its participation in [Horizon 2020](#) and [Horizon Europe](#).

Besides stimulating scientific research in AI, the Norwegian Government takes a strong position in **enhancing the country's innovation capacity** using AI. At the level of the private sector, policy instruments aim to support businesses in developing and adopting AI technologies. While the Research Council of Norway is more dedicated towards promoting research, other institutions are more directed to the encouragement of innovation, value creation and growth in businesses and industry:

- [Innovation Norway](#): supports companies in developing their competitive advantage and enhancing innovation. In recent years, Innovation Norway's portfolio has seen a growth in the number of digital projects. In 2020 the number of ICT projects tripled compared to 2019. In terms of AI, it has established the Tech City Executive Accelerator ([TEA](#)) initiative providing international scaling and support for companies oriented towards AI and IoT;
- The Industrial Development Corporation of Norway ([Siva](#)): a governmental corporation that aims to unleash the national innovation capability through support from incubators, business gardens and accelerator schemes (e.g. [Norwegian Catapult scheme](#));

<sup>64</sup> The average exchange rate of 2018 has been used to convert Norwegian Krone in Euro.

- [Investinor](#): state-owned venture capital company providing various types of venture capital support schemes.

The national AI strategy provides various examples of projects in which policy support was given to promote innovation efforts. Earth Science Analytics AS leads an industry innovation project on machine learning in seismology that received governmental funding through the [PETROMAKS 2](#) programme.

Furthermore, innovation efforts are encouraged through the tax incentive scheme [SkatteFUNN](#). Although not specifically directed towards AI, SkatteFUNN allows all businesses to apply for a tax deduction for their R&D expenses. It is a rights based scheme that favours SMEs in particular.

Lastly, in 2018 the national government has released a comprehensive [review of business policy instruments](#) (in Norwegian only) directed to promote value creation and sustainable innovation throughout the country. The recommendations from the review aim to make the policy instruments simpler to understand and accessible to businesses.

With respect to the **public administration**, the national government emphasises the tremendous potential of AI in disrupting the way in which the public sector will work in the future. In particular AI in the public sector can contribute to enhance decision-making, and improve the efficiency and quality of services through the use of e.g. natural language processing and predicting tools. To fully **leverage the benefits of AI in the public sector**, the national AI strategy foresees the following policies:

- Facilitating the experimentation with and adoption of AI in public administration. Examples of projects using AI in the public sector:
  - AI in residence verification: A project conducted by the Norwegian State Educational Loan Fund ([Lånekassen](#)) for the residential verification process of students using machine learning tools;
  - Automatic posting of invoices: The Norwegian Government Agency for Financial Management ([DFØ](#)) is testing solutions of automatic posting of invoices using AI technologies;
- Enhancing the possibilities of innovative public procurements.

### 5.21.3 Networking

To increase the networking and collaboration opportunities, following policy initiatives are proposed:

- Facilitating the development of Digital Innovation Hubs (DIHs): During Horizon 2020, Norway established four DIHs, affiliated with [GCE NODE](#) in Agder, [SINTEF](#), [Oslo Cancer Cluster](#) and [Digital Norway](#), acting as enablers for SMEs. A new generation of DIHs will be launched soon, from which some will be directed to leverage the potential of AI;
- Providing support to networking opportunities, such as the informal learning arenas: Eik idéverksted, which is a platform that brings together academics and business communities and offers a range of courses, workshops, seminars and projects on technological innovation;
- Strengthening the Norwegian AI Research Consortium ([NORA](#)): a consortium that comprises Norwegian universities and research institutions engaged in research and education in AI;
- Encouraging sharing of good practices across sectors and enterprises and facilitating public-private partnerships. It is a crucial policy to unlock the innovation potential of AI. One initiative in the pipeline is the establishment of the Digital Clearinghouse Norway, a cooperation forum for consumer, competition and data protection enforcement bodies. In addition, the Norwegian Digitalisation Agency ([Difi](#)) can serve as a pivot institution in establishing common use cases/user journeys and sharing of good practices;
- Supporting organisations that facilitate networking and collaborations such as [DigitalNorway](#), which helps businesses in their digital transformation and provides guidance throughout the innovation process. It cooperates with research and educational institutions, business clusters and innovation communities;
- Forum for AI in the public sector – a forum for practitioners working on AI in the public sector.



#### 5.21.4 Regulation

The national AI strategy aims to encourage the development and use of AI based on ethical principles and with respect for human rights and democracy. This does not only call for a strong ethical framework, but also requires a solid regulatory governance to ensure that individual and collective rights are enforced.

In terms of **ethical principles**, the Norwegian Government aims to promote responsible, accountable, transparent, and trustworthy AI, while safeguarding the integrity and privacy of individuals. To this purpose, the following policy initiatives are foreseen:

- Developing guidelines for trustworthy use of AI, in line with the recommendations made by the High-Level Expert Group on Artificial Intelligence set up by the European Commission;
- To complement these ethical principles, a [report on research ethics](#) has been recently published by the National Committee for Research Ethics in Science and Technology. It outlines ethical guidelines related to the responsible use of autonomous systems, social responsible research and big data;
- Encouraging the educational institutions to consider how privacy and ethics can be given a central place in their programmes in AI;
- Participating to European and international forums to promote a trustworthy AI environment, notably aligning efforts to and engaging with international institutions such as the European Commission, the United Nations, the OECD, the Council of Europe and the Nordic Council of Ministers and Nordic-Baltic cooperation;
- Stimulating the public debate on the ethical use of AI.

In terms of regulation, the national AI strategy emphasises the need to **modernise the existing legislative framework** to adjust to the coming needs of new technological developments such as AI. It is important to develop a legislation that is technology-neutral where possible. Where legislation cannot be generalised, sector-specific or technology-specific rules should be put in place. The following policy initiatives address regulation that is relevant to AI:

- Developing digitalisation-friendly regulations that solves challenges of semantic interoperability across sectors. The access and control of data is for instance regulated through the Personal Data Act and other sector-specific regulations such as the Health Register Act;
- Expanding the regulations in the health care sector regarding the use of health data. Two proposals have been put forward to make secondary use of health data easier for analysis and decision making. The first proposal to enable the Health Data Programme and the Health analysis data platform took effect in January 2021. The second proposal proposes amendments to the Health Personnel Act regarding the Duty of confidentiality and the right of disclosure in order to enable the use of algorithms for decision support on health data. This is still ongoing;
- Proposing regulatory sandboxes in AI: specific legislation to allow for testing, developing and monitoring AI concepts in a protected environment. In 2020 the Norwegian Data Protection Authority (DPA) established a [regulatory sandbox for AI](#) in order to promote the development of ethical and responsible AI solutions. A call for projects received 25 applications, from which four projects have been chosen to work together with the DPA in the sandbox in the first round;
- During the COVID-19 crisis, a temporary regulation that authorised fully automatic processing was added to the National Insurance Act. Many of the new solutions that were established by the Labour and Welfare administration ([NAV](#)) to tackle the challenges associated with COVID-19 are fully automatic. In the autumn of 2020, the Storting adopted a government proposal to permit fully automatic case processing in NAV on a permanent basis. The statute was added to the NAV Act and entered into force on 4 December 2020;
- Developing a regulatory framework for the public sector, building on the recommendations of the [Digital strategy for the public sector 2019-2025](#) (Norway, 2020b);
- Considering the recommendations from the [Law Commission on the Archival Act](#) (in Norwegian only) and the [Law Commission on the Public Administration Act](#) (in Norwegian only). These legislations aim to provide transparency and accountability in public administration systems where AI is used.

Besides the development of a legal framework and ethical rules for AI, the national strategy of Norway highlights the importance of **standardisation to foster interoperability** and coordination among various economic players. To this aim, the following policies are essential:

- Developing guidelines on standardisation, including IPR, to facilitate collaborations in AI in the business sector;
- Promoting and participating to international standardisation activities related to AI, in particular for Norwegian SMEs.

### 5.21.5 Infrastructure

As highlighted in the national AI strategy, data is a vital element for AI as it acts as the cornerstone on which AI technologies are built upon. This calls for the **development of a strong data ecosystem** to improve the collection of quality data, to facilitate data sharing and to promote open data policies. The national AI strategy foresees the following policies:

- Promoting and further expanding open public data and data sharing between public-sector agencies through initiatives such as National Data Directory on <https://data.norge.no/>, the Health analysis platform with national health data and geospatial data on [Geonorge.no](https://geonorge.no/);
- The Agency for Digitalisation ([Digdir](https://digdir.no/)), in cooperation with Digital Norway, created a Data Factory that serves as a knowledge hub to promote data sharing industry. The Data Factory supports small companies to develop business ideas and create value from data and data sharing;
- Encouraging data sharing between businesses in the private sector by providing clear guidance on issues related to data protection, privacy and security;
- Supporting and developing data sharing methods and standards.

A [report](#) to the Storting on the data-driven economy (in Norwegian only) was presented to the parliament in March 2021.

Understanding that the deployment of AI will need the support of a solid infrastructure, the national AI strategy presents a range of policies to **foster the quality and capacity of the telecommunication and ICT infrastructure** in Norway. In April 2021 the government put forward a [report](#) to the Storting on mobile, broadband and internet services (in Norwegian only), focusing especially on the need for secure and robust electronic communication services:

- Expanding the high-speed broadband network and supporting the rollout of 5G infrastructure;
- Setting a new target that 100 per cent of households and businesses should have access to 100 Mbit/s by 2025. The old target of 90 per cent being offered high-speed broadband of more than 100 Mbit/s was reached in 2020;
- Participating in pan-European initiatives for the development of high-performance computing such as the [EuroHPC](#) initiative;
- Establishing data centres with cutting-edge telecommunication infrastructure to facilitate the access to computing power and cloud services.

The increasing use of data and computing power in the digital society requires appropriate policy mechanisms towards security. The national AI strategy of Norway foresees the following policies to **maximise the efficiency of cyber security**:

- Developing Norway's capacity to detect and respond to cyber-attacks using AI, in line with the recommendations made in the [National strategy for cyber security](#) and the [National strategy for cyber security competence](#) (in Norwegian only);
- Expanding the role of the Norwegian National Security Authority ([NSM](#)) to the provision of guidance to enhance security in AI-based systems.

### 5.21.6 AI to address societal challenges

#### Climate and environment

The Norwegian [National AI strategy](#) explicitly envisages investments in AI within areas Norway has distinctive advantages like health, seas and oceans, public administration, oil and gas, energy and mobility. The Norwegian Government wants to facilitate the development of data centres in Norway. Norway offers scalable access to renewable energy for such enterprises. Several initiatives are ongoing or planned and use AI to promote a more sustainable environment:

- Supporting the creation of educational programmes both for **digital skills** and for employees who must adapt their skills as a result of digitalisation and the transition to a green society;
- Encouraging investments in autonomous ships: the Norwegian shipping industry is moving towards **autonomous shipping**. These ships will be fully autonomous as they will be remotely controlled using AI-related technologies and will emit fewer greenhouse gas emissions, improve local air quality and produce less noise. The state-owned institution [ENOVA](#) has for instance provided around EUR 11 million to establish an autonomous transport chain across the Oslo fjord.

Efforts to lift Norwegian companies into the future and to support AI-based technologies promoting sustainable development, include the creation of the [Cluster for Applied AI](#). It is a specialised industrial cluster initiated by [Smart Innovation Norway](#) and the Norwegian Institute for Energy Technology (IFE) among other research partners. Kjell Reidar Mydske, Head of the Cluster for Applied AI, highlights several successful **use-cases from the industry** that develop sustainable AI solutions:

- The company [Völur](#) is using AI to obtain smarter and greener food value chains in the food production industry. AI helps to increase the efficiency of meat production, which can reduce the climate footprint from agriculture;
- The company [eSmart Systems](#) is transforming the landscape of energy provision through the development of AI-powered electricity grids. AI is used to detect and geo-locate defections to the grid which significantly improves the maintenance of the distribution infrastructure and energy consumption;
- The company [Spacemaker](#) develops an AI-based solution that generates building sites with a more sustainable urban planning, and companies such as [Loopfront](#) and [Material Mapper](#) use AI to facilitate re-use of building materials from demolishing sites, thus facilitating the circular economy; Companies [Scantrol Deep Vision](#) and [CreateView](#) are both active in the fish industry. The former developed an AI-powered tool for a more efficient and sustainable fish catch, while the latter uses AI-driven image sensors to reduce both production costs and the ecological footprint in aquaculture.

Also within the **scientific research community**, Norway is increasingly using AI in the fields of energy and climate. Researchers from the national Centre for International Climate and Environmental Research-Oslo ([CICERO](#)) has for instance started to employ machine learning to deepen climate and environmental issues. Finally, [SINTEF](#), established a whole cluster of [AI projects](#) among which [SEAVENTION](#) is about the management of operations underwater and resource management by means of autonomous functions.

### **COVID-19 pandemic**

Within the scientific research community, the Norwegian Centre for E-health Research ([NSE](#)) has the goal to accelerate the development and implementation of policy on eHealth, especially employing technologies of AI to enable the reuse of data for the creation of an intelligent healthcare system that learns from its own data and can shape healthcare into a continuously improving system.

From the business perspective, NEC Oncolmmunity ([NOI](#)) has for instance adapted their cancer-fighting AI technology to combat COVID-19. This company has received advice and support from the community of the [Oslo Cancer Cluster](#) Incubator, which is supported by the Norwegian Government.

Finally, COVID-19 has been highlighted as a catalyst for digitalisation in a [report](#) released in May 2021 by the Norwegian Ministry of Local Government and Modernisation (Norway, 2021). The report showcases initiatives that can contribute to or inspire digital business development in all parts of the country.

### **5.21.7 Monitoring and future update**

The Norwegian strategy is intended to unlock the full potential of AI for citizens, business communities and public administration. Its implementation and progress will be regularly monitored and adjusted where needed with additional policies in the field of AI. The strategy does not mention the frequency on which updated strategy reports will be released.



## 5.22 Poland

In December 2020, the Council of Ministers adopted the Polish national AI strategy, entitled [Policy for the development of artificial intelligence in Poland from 2020](#) (Poland, 2020). The progress and milestones in developing the national AI strategy were highlighted in a [roadmap](#) released by the Ministry of Digital Affairs.

It is focused on actions on society, education, science, business, public affairs and international relations under the strategic mission of protecting human dignity of people and supporting condition of fair competition in global rivalry. Poland implements the Trustworthy AI ethical framework and launches mechanism of flourishing polish ecosystem of AI in ethical, legal, technical-operational and international dimensions.

In particular, the Polish strategy is providing strategic guidance and policy initiatives to develop a holistic AI ecosystem with the aim of meeting the following objectives:

- Reforming the educational system and providing lifelong learning opportunities in AI-related fields;
- Encouraging growth and innovation of AI companies through dedicated support in AI research, including the provision of sufficient financial resources;
- Increasing national and international partnerships in AI;
- Creating a data ecosystem with trustworthy and high-quality data and increased data exchange mechanisms;
- Reinforcing the digital infrastructure, regulatory framework and test environments to foster the development of AI innovations.

In terms of funding, the Polish strategy presents the main public programmes supporting the development of innovation and innovative enterprises, which also enable financing projects related to the development and implementation of AI-based solutions.

Poland established a governance centre for the national AI strategy, located at the Chancellery of the Prime Minister and under the chair of the Minister of Digital Affairs and the Council of Ministers Committee for Digital Affairs. The centre includes the Task Force on AI Policy enforcement, the Scientific Council for AI, the AI Observatory for the Labour Market, the Observatory of international AI Policy, as well as the Legal Task Force for changing regulations.

### 5.22.1 Human capital

Educating the population to gain awareness of the benefits of AI and to acquire the necessary competencies and skills to develop AI applications is an essential element to prepare for the transformations and challenges that AI will bring along. To this purpose, the Polish Government is setting up a range of policy initiatives to reform the educational system. To foster AI and digital competencies of students in **preschool, primary and secondary education**, the Polish Government proposes to increase courses in IT, to create traineeship programmes in AI in various disciplines, to develop programming and coding courses (such as R and Python) and to train students in data processing. Winter and summer schools in the field of AI are also considered for younger students to prepare them with basic knowledge in AI. **The revision of children's' and students' curricula should not only focus on acquiring technical skills but should equally target soft skills such as critical thinking, empathy and interpersonal skills.**

In terms of **higher education**, the Polish strategy foresees the development of Master programmes in AI with modular courses to prepare students to particular key sectors such as healthcare and logistics. An Academy of Digital Applications will be set up to develop courses in AI, machine learning and cybersecurity at university level and will target around 1000 students. This initiative will be complemented with the 'Algorithm and Programming' championships that challenges above-average students of higher education to solve complex algorithmic and programming problems. Finally, the Polish Academy of Sciences has established a Doctoral School on Information Technology and Biomedicine providing PhD scholarships in AI related fields. To facilitate the transition of PhDs to the labour market, the Ministry of Science and Higher Education is providing grants to doctoral students to be employed by an entrepreneur while he/she is still conducting its basic research at the university.

Besides policy initiatives to support formal education in AI, the Polish Government is aiming to raise the awareness of AI to the citizens in general and to foster a **culture of lifelong learning** for the workforce in particular. **Raising the public awareness** will be encouraged among others through the development of Massive Open Online Courses (MOOCs) and the creation of an online platform providing an overview of the

educational offerings in AI. Entrepreneurs will be informed about the available competence programmes for lifelong learning trainings in AI. Finally, the upgrade of AI competencies will also be encouraged in the public administration.

### 5.22.2 From the lab to the market

To foster basic and applied research in AI, the Polish Government will set up a **Virtual Research Institute for Artificial Intelligence (VIR)**, in collaboration with businesses, academia and non-governmental organisations. The VIR for AI will support the Council of Ministers Committee for Digital Affairs in coordinating research challenges of the Polish AI Strategy. The [NASK Public Research Institute](#) will take up this role as a Centre for CyberSecAI. This institute is primarily focused on monitoring, testing and responding to threats on AI systems and on standardising and certifying cyber security procedures for AI systems. Furthermore, research and innovation in AI will be encouraged through a wide range of **funding mechanisms**, supported by funding programmes of the Polish Development Fund ([PFR](#)), the Digital Poland Project Centre ([POPC](#)), the National Centre for Research and Development ([NCBR](#)) and the Polish National Science Centre ([NCN](#)). It includes funding instruments such as public procurement (with the objective to earmark at least 10% of budgets of governmental entities to AI) and other dedicated funding in the field of AI. In addition, the Council of Ministers Committee for Digital Affairs will set up guaranteed credit and loan programmes to foster AI developments in Polish industries. These instruments could be complemented with European funding schemes (e.g. Horizon2020, Horizon Europe and Digital Europe), venture capital and crowdfunding initiatives. The Polish strategy identifies the following **priority sectors** with the highest potential to benefit from AI applications: industry, healthcare, transport and logistics, agriculture, energy, public administration, trade and marketing, construction and cybersecurity.

With respect to the public sector, the Polish strategy highlights the need to further develop support programmes such as [GovTech Polska](#) to increase the implementation of AI in the public administration.

### 5.22.3 Networking

To foster the competitiveness of the Polish industry and to strengthen the research competencies of the scientific community, the Polish strategy proposes various policy initiatives to encourage a **culture of collaborations in AI developments**. The [Future Industry Platform](#), the [Virtual Research Institute](#) and the [GovTech programme](#) have recently been created to respond to the traditional lack of cooperation. The objective of these programmes is to create synergies across the research and industry community and to serve as a platform for sharing expertise and partnership opportunities. The development of a collaborative AI ecosystem will be further encouraged through Digital Innovation Hubs which aims at fostering the dialogue between the public administration, the industry and scientific community. Lastly, AI Challenges Platforms similar to kaggle.com will be set up to foster collaborative research and developments of AI applications.

In addition, an [Innovation Map](#) has been established to monitor the scale and deployment of newly applied technologies in local government, scientific research centres and public administration. The data registry contains innovations based on new technologies, such as the Internet of Things (IoT) and AI. The map is a collection of good practices that can be a source of inspiration for other economic players and potentially lead to research collaborations.

In addition, Poland takes part in the Global Partnership on AI ([GPAI](#)), an international initiative to spur a responsible development and use of AI in full respect of human rights, inclusion, diversity, innovation and economic growth. The GPAI collaborates with international partners and organisations to bring together experts from industry, civil society, governments and the academic world. This initiative is stirred by a secretariat, hosted by the OECD in Paris, and it accounts for two Centres of Expertise in Montreal and in Paris.

### 5.22.4 Regulation

In order to create a **trustworthy and sustainable environment for the development of AI**, the Polish Government will set up a range of observatories and chairs to tackle ethical and legal issues. An AI Observatory for the Labour Market will be established to analyse the impact of AI on the labour market and to propose legislative and regulatory reforms for social policies. An Observatory of international AI policy and Digital Transformation will be formed to monitor European and international policies and regulations. Its task will be to coordinate and formulate recommendations for international initiatives.

As part of the Virtual Research Institute for AI, a Department of Ethics and Law will be set up to analyse the challenges related to law and ethics in AI and to come up with recommendation for legislative reforms and ethical guidelines. The Council of Ministers Committee for Digital Affairs will be entitled to set up a legal task force to analyse and formulate legal initiatives.

The Polish Government will support mutual recognition of interoperability standards and certification or compliance procedures of trustworthy AI. The priority of this policy will be securing trade secrets.

### 5.22.5 Infrastructure

Recognising that data is an essential enabler for the development of AI solutions, the Polish Government is setting up **data policies** to ensure the availability of high-quality data and to improve interoperability and data sharing. To this purpose, the strategy foresees to further extent the [open data platform](#) containing open data collections of the public administration. In the same vein, virtual data warehouses will be created in which companies can share their industrial data in trustworthy and cyber secured data spaces. These warehouses will act as API interfaces with transparent interoperability rules and clear data protection regulations to foster cooperations across companies in decentralised networks of like-minded members. The government will also investigate the use of data trusts. Overall, the governments' objective will be to incentivise public institutions and businesses towards data collection and data sharing. To do so, the Ministry of Digital Affairs will create an inventory of available data sources, which could be classified by sector (e.g. medical, energy, industrial, agricultural or transport). To facilitate data analyses, the Polish Government intends to invest in **cutting-edge digital and telecommunication infrastructure**, such as high computer performance centres and increased connectivity through 5G networks.

### 5.22.6 AI to address societal challenges

#### Climate and environment

As a part of the National Recovery Fund, Poland plans to invest in AI initiatives, which support the aims of the European Green Deal. It focuses on the convergence of energy sources, shifting factories to circular production, making green and smart buildings and infrastructure, reducing emissions of transportation, and launching the Space, Earth and Seas Observatories for climate change. The aim is also to make development more sustainable in cooperation with local governments.

#### COVID-19 pandemic

Global trends and threats, such as the COVID-19 pandemic, are significantly accelerating the digitalisation of many areas of society. In this respect, it is crucial to take advantage of all the opportunities and benefits associated with the development of AI, and at the same foster the creation of regulations and laws on the operation of robots and self-learning devices for a better health environment.

Poland participates in the development of AI-based solutions to fight the COVID-19. The polish website for govTech initiative, the [GovTech Polska](#), presents the output attained by Polish teams in the context of the [#EUvsVirus](#) hackathon. Specifically, the results relate to:

- Analysing SARS-CoV-2 mutations in order to frame stochastic models and employing machine learning to predict the future genome modifications. This project ([COVID-19 Genomics](#)) can increase the chance of successful vaccines;
- Identifying fake news with a community-driven platform, [Dubio](#), which employs machine learning algorithms to detect identifying suspicious content. Poland in this case collaborated in a team from Belgium and Germany, and from other non-EU countries (USA, Canada, UK, Israel, Venezuela);
- The Polish Press Agency (PAP) and GovTech Polska have decided to offer an open source code to fight disinformation. This tool, [FakeHunter](#), which is AI-based and can verify fake information almost immediately.

### 5.22.7 Monitoring and future update

The Polish strategy will be monitored and evaluated on a yearly basis.





## 5.23 Portugal

In June 2019, the Portuguese Government presented the national strategy [AI Portugal 2030](#) (Portugal, 2019) to set out challenges and opportunities of the growing AI ecosystem in Portugal. This strategy presents the plan to foster the use of AI in the public and private sector during the coming years. The plan concentrates its actions on inclusion, education, qualification, specialisation and research as people are the main engine of a successful AI deployment.

The national AI strategy of Portugal does not disclose financial figures, or estimations, for its implementation.

### 5.23.1 Human capital

One of the main strategic objectives is **human development**, particularly the enablement and reinforcement of the population vis-à-vis challenges and priorities set by the AI technologies. This objective will go along of its main axes: increasing the overall level of AI education, upgrading the labour force qualifications, and fostering the specialisation in AI fields.

The strategy emphasises the importance of digital and AI education for the future generations. In this respect, a well-developed education infrastructure will include training in AI for earlier educational levels as much as for higher ones like bachelors, masters, post-graduates and PhDs. Finally, the strategy aims to encourage students' specialisation in computer, data science and STEM subjects to create a highly qualified labour force in AI related areas.

The following actions aim to nurture talent and skills in AI:

- Teaching young students fundamentals of machine learning through the [Ciência Viva Clubs](#);
- In 2019, as part the programme [Ciência Viva no Laboratório - Criar Futuro](#), 270 high school students have participated in a two-weeks summer school aimed at gaining literacy on AI applications and societal impacts, data science and machine learning;
- In 2019, as part of the [6ª Conferência Professores Espaciais](#), the European Space Education Resource Office (ESERO Portugal) along with Ciência Viva promoted a lecture on Data Science and AI and a workshop on AI applications for space education. A hundred teachers participated in the lecture and sixty teachers participated in the workshop;
- In 2020, the Director-General for Education and the SeguraNet Awareness Centre have launched a [MOOC](#) on AI in education. The first session counted about 2000 participants. The second session is ongoing;
- In the last two years, public higher education institutions have launched about twenty graduate and postgraduate degrees on data science and AI. Specific courses have also been introduced in ongoing "classical" postgraduate degrees;
- In 2020, higher education institutions have launched several executive programmes, advanced courses, summer or winter schools on AI-related (e.g. big data, machine learning, business analytics, computer vision).

The strategy targets the most skilled individuals as the labour force to enrol in AI and data science qualification programmes. Increasing the stock of active employees with digital and AI skills is crucial to meet the new labour demand in AI. The strategy supports actions to increase digital and science competencies in the public sector.

The following actions aim to **re-skill and up-skill citizens** and to offer **lifelong learning** opportunities:

- Creating Regional/local Networks for Digital Qualification to re-skill and up-skill professional training, e.g.: the Portuguese polytechnic institutes (located in different Portuguese regions) are offering short courses under the [Upskill Programme](#). This programme involves different stakeholders (e.g. companies, higher education, public administration institutions) and aims at upskilling qualified people who are unemployed to meet the ICT-oriented labour market demands. The first edition covered training areas relevant to AI, such as Systems Applications and Products (SAP) – Analytics (e.g. competences on data processing for Business Intelligence and Data Analytics), and Customer Relationship Management (e.g. competences on supervised and unsupervised learning and automatic processing);
- Setting up e-learn platforms with courses on AI and other specific application domains: in 2019 the [NAU](#) – a massive open online course platform – developed by the National Foundation for Scientific

Computation – was launched for the Portuguese-speaking communities. Higher education institutions, and research centres can disseminate their courses through this platform;

- In 2019, the National Institute of Administration ([INA](#)) has defined digital skills as one of its three new strategic areas. [The Training Programme for Digital Transition in Public Administration](#) – one of the four programs under the digital skills strategic area – aims to empower works with skills in the emergent digital technologies essential to public service (i.e. AI, big data and innovation in digital environment);
- Supporting [HPC Competence Centers](#) - national centers that offer education and training opportunities on HPC and related advanced computing tools.

### 5.23.2 From the lab to the market

Supporting AI products and services from the lab to the market will stimulate knowledge-intensive research and the entrepreneurial ecosystem on AI. Policy actions aim to create a community of young, vibrant, knowledge-intensive companies that can develop AI cutting-edge technologies. To this purpose, the following policy initiatives **establish a strong research and entrepreneurial ecosystem in AI**:

- Supporting application-oriented and fundamental research, e.g.: in 2020, an [International Research Programme](#) together with an Observatory were launched in Montesinho. Earth observation is one of the five strategic areas of the Observatory, which includes the use of satellite information integrated in advanced processing systems and AI;
- Developing a Centre of excellence for AI R&D;
- Promoting new and innovative solutions to simplify the public administration ([SIMPLEX](#) programme). Since 2018, public funding has also been specifically allocated to AI research and innovation aiming at public services and processes optimisation (i.e through projects such as [DSAIPA](#) and [SAMA](#));
- In 2020, under a call on [advanced computing](#), launched by the Portuguese Foundation for Science and Technology (national funding agency), eighteen AI-related projects out of 129 approved projects had access to [RNCA](#) supercomputers and Cloud infrastructure;
- Launching Innovation funding programmes;
- Creating sandboxes and testing facilities;
- Refining the innovation vouchers;
- Reinforcing the national funding management and identifying KPI for investment evaluation.

In addition, the Portuguese strategy promotes research and innovation in specific scientific areas. Accordingly, the following **priority sectors will be promoted to "living labs"** for experimentations in AI:

- Urban transformation (sustainable cities);
- Sustainable energy networks;
- Biodiversity (green and blue economy);
- Autonomous driving;
- Cybersecurity;
- Quantum materials;
- Adaptive learning curricula for students.

**Specialised AI services** will also make use of:

- Natural Language Processing (for automatic translation and other automatable services);
- Real time AI (for securing business and financial transactions);
- AI for software development;
- AI for edge-computing.

Other policy initiatives not explicitly mentioned in the AI strategy report, may contribute to the creation of a vibrant enterprise ecosystem in Portugal, such as [incentive systems](#) for technological R&D in companies, [Startup Portugal](#), [Incubation vouchers](#), [Industry 4.0 national strategy](#), and the [Action plan for the digital transition](#) among others.

Policy actions towards advanced use and deployment of AI in the public administration include among others, [LabX](#) – aiming to create a culture of experimentation and innovation in the public sector –, and [InnoLabs](#) to share good practices across the public administration.

### 5.23.3 Networking

There is a widespread consensus that AI will profoundly transform the world with powerful solutions to many societal and economic challenges. To fully leverage this transformation, **a collaborative and networking approach is essential**. The Portuguese strategy favours the establishment of partnerships between public and private institutions, and it advocates that joint undertakings should include European and international collaborations. Support actions to networking and collaborations include:

- Extending collaborative laboratories ([CoLabs](#)) and Digital Innovation Hubs ([DIHs](#)). A renewed national DIH network will shortly be announced;
- Increasing partnerships with Member States through collaborations on electronics and systems (Key Digital Technologies), high-performance computing ([EuroHPC](#)), Smart Networks and Services (5G and beyond), and the Quantum Technologies (H2020);
- Fostering long-term collaboration between academia and companies through framework contracts and data/technology sharing platforms;
- Increasing the participation of the Portuguese entities in the European Framework Programme, Horizon Europe and Digital Europe Programme;
- Participating to European Networks (e.g. [Big Data Value](#) Public-Private Partnership), European AI excellence centres and other European DIHs (e.g. DIH on cybersecurity at Leon or the DIH on IoT in Salamanca). Portugal also participates in the [EuroCC](#) project on high-performance computing, the National Network on Advanced Computing ([RNCA](#)) and joint AI-related projects funded under the [FCT-UTAustin Programme](#) on Advanced Computing.

The strategy also emphasises dissemination campaigns to **promote Portuguese AI** in and out the national borders. These campaigns are essential tools of digital inclusion as they inform the whole population on the benefits of AI technologies. International campaigns instead are crucial to attract international AI and ICT talents to study and work in Portugal. Hence, the following actions will sponsor the national and international attractiveness of AI:

- Promoting the attractiveness of Portugal for foreign talents, students, researchers and experienced professionals, while reducing border obstacles;
- Supporting national stakeholders' participation in the [AI4EU platform](#), the EU AI on-demand platform and ecosystem;
- In February 2021, AI Portugal 2030 launched [Forum IA](#), an online platform to raise awareness on AI among citizens and relevant stakeholders of the public and private sector. This forum also aims to foster networking among the participants.

### 5.23.4 Regulation

**Legal, regulatory and ethical frameworks** are essential to develop standards in AI as for transparency, accountability, liability and ownership. In this respect, the Portuguese strategy proposes the following actions:

- Creating an ethical committee to define guidelines for AI and Automation;
- In December 2020 the Agency for Administrative Modernisation ([AMA](#)) has launched a [guide](#) (in beta version) for ethical, transparent and responsible AI;
- Supporting the development of a legal and regulatory framework to identify liabilities when AI decision making;
- Supporting companies and regulators to find appropriate legal frameworks.

As proposed in the [Action plan for the digital transition](#), general principles have been established for the creation and regulation of Free Zones for Technology (FZTs). FZTs are physical spaces to support the demonstration and testing of new technologies, through the creation of specific and adapted regulatory regimes. These regimes aim to promote a culture of experimentation in Portugal, including for AI-based solutions and robotics. The government is finalising the legislative process for the creation of FZTs.

### 5.23.5 Infrastructure

The Portuguese strategy envisages the following actions to support the AI infrastructure:

- Creating the National Data Infrastructure, a centralised repository for administrative data. This action also provides guidelines about data sharing in the scientific community, likewise the [Open Data Policy](#) of the Portuguese Foundation for Science and Technology (FCT);
- Establishing supercomputing and quantum computing facilities thanks to the [Advanced computing Portugal 2030](#) (Portugal, 2018) that defines the objectives of high-performance computing in Portugal;
- In 2021 the new [Vision](#) supercomputer was installed at the University of Evora. It is designed to enhance the application of AI methodologies to the various national strategic domains. With a maximum performance of 10 petaflops, this supercomputer allows machine learning and deep learning techniques to be tested and optimised within the National Network of Advanced Computing;
- Infrastructures for piloting and testing will be created for several technologies, including AI and robotics;
- The [Sines 4.0](#), Hyperscaler Data Centre and EllaLink submarine cable contribute to foster interoperability and connectivity between Europe and Latin America.

### 5.23.6 AI to address societal challenges

#### Climate and environment

The [Portugal Space Agency](#), together with the Foundation for Science and Technology (FCT), the European Space Agency and Unbabel Labs, launched the [AI Moonshot Challenge](#) with a EUR 500,000 award for combining AI and space technologies to tackle the major sustainability issues. Specifically, this competition calls participants to find solutions for the detection, location and monitoring of maritime waste along the water column on a planetary scale. Teams will have access to AI resources, Earth Observation Data from satellites and supercomputing capacities.

The [MIT Portugal Programme](#) collaborates with several partners to the [Mission Control for Earth Challenge](#) that envisages accelerating positive change for Spaceship Earth's ocean and land subsystems to address the urgent needs of a changing planet and climate. This collaboration aims to employ AI tools, science and technology for the 'betterment of humanity'.

#### COVID-19 pandemic

The Portuguese National Funding Agency for Science, Research and Technology (FCT), within the general context of its supports to R&D activities in the field of Data Science and AI in Public Administration, has launched a new [competition](#) aimed at data processing within the current pandemic of the COVID-19. The objective is to support R&D projects with an emphasis on supporting citizens and health care services. Twelve projects were approved, of which six with access to [RNCA](#) resources.

[Connect Robotics](#) from Portugal operates with the support of the European Space Agency, and during the COVID-19 offered a service of urgent delivery by means of drones. Connect Robotics could deliver within minutes goods that would take much longer to reach quarantined or locked-down populations. The solution consists of autonomous drones and a web platform for operation, using Galileo satellite constellation in addition to GPS, Connect Robotics attains a higher precision in locating individuals.

### 5.23.7 Monitoring and future update

The Portuguese AI strategy will undergo annual reviews and updates by the Ministry of Science, Technology and Higher Education and the Ministry of Economy and Digital Transition.



## 5.24 Romania

Romania has initiated various efforts for the development and implementation of a national policy framework on AI. In 2020, Romania endorsed an EU-funded project for the creation of this framework for the period 2021-2027. The forthcoming AI framework will target the development of education and skills in AI, the increase of AI R&D and innovation in the public and private sector, the establishment of networks and collaborative platforms in AI, the adoption of ethical guidelines and measures to govern data protection and ensure cybersecurity. The development of the framework involves governmental institutions, academia and the private sector, and is supported by consultancy services. The implementation of the AI policy framework will start in the period 2021-2022.

### 5.24.1 AI to address societal challenges

#### Climate and environment

By June 2021, date of publication of this report, Romania lacks policy initiatives for this section.<sup>65</sup>

#### COVID-19 pandemic

Romania collaborates with Germany, France, Switzerland, Italy, Spain, India, USA, Colombia, Latvia, United Kingdom, New Zealand, Turkey, Greece, to the project [Dattum.ai](#), a global collaborative ecosystem to facilitate the sourcing of trusted COVID-19 data. Dattum aims to employ high granularity data to provide analytics for treatment schemes, medical experiments, and vaccine evolution. This project was awarded within the Health and Life Challenge of the [#EUvsVirus](#) hackathon organised by the European Commission.

In addition, the Rumanian Government set up a [National Emergencies Platform](#) to inform citizens about all sorts of issues (from updates on the alert status to domestic violence and more) coming out during the COVID-19 pandemic. A specific [platform](#) to fight fake news and divulgate correct information was also established by the Government to correctly update citizens during the pandemic.

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<sup>65</sup> The [AI Watch](#) portal will be updated to include AI policies for this section as they come available.



## 5.25 Slovakia

Slovakia includes AI policies into a broader digitalisation strategy. In July 2019, the Slovakian Government published the [Action plan for the digital transformation of Slovakia for 2019–2022](#) (Slovakia, 2019a). This action plan contains concrete steps to build a sustainable, human-centric, and trustworthy AI ecosystem within the long-term [Strategy of the digital transformation of Slovakia 2030](#) (Slovakia, 2019b). While the strategy provides the broader picture, the action plan details concrete policy measures over the period 2019–2022.

The Slovakian Action Plan sets out the following list of short-term policy initiatives:

- Supporting the digital transformation of schools and education to promote skills for the digital era;
- Strengthening the digital basis of the data economy;
- Improving the capacity of public administrations to use data for the benefit of citizens;
- Supporting the AI ecosystem.

With regards to funding, the [Analysis for budgetary implications for public administration](#) (i.e. Analýza vplyvov na rozpočet verejnej správy) accompanies the Action plan with general information on government budget for the coming years. Precise estimates of AI budgets will come at a later stage.

### 5.25.1 Human capital

The Slovakian strategy aims to stimulate an AI education in line with current and forthcoming needs of both public and private sectors. It proposes **formal education and training reforms** along the following initiatives:

- Reforming the education system to **train employees for new professional requirements** and satisfying the future labour demand. The plan is to explore and analyse emerging needs in order to make informed changes in educational paradigms and systems (e.g. teaching of algorithmic thinking, creativity and problem solving, teaching support, transformations at all levels of education);
- The Ministry of Education envisages a **programme to digitalise the education until 2030** by means of updated ICT infrastructure for the education system and qualitative improvements to its programmes. On the latter point, AI subjects will enter educational programmes to stir digital competencies and skills;
- The Ministry of Education and the Ministry of Investments, Regional Development and Informatisation of the Slovak Republic (MIRRI) are setting up an **expert group to coordinate educational activities on AI**. This expert group will examine international and Slovakian educational programmes in order to frame suitable reforms. Consultations with relevant stakeholders as school, public authorities and business sector will also feed the educational reforms;
- The MIRRI is launching in-house, off-the-shelf, and customised introductory courses on AI for the employees of the public sector. At present, these courses entail proof of concepts and they have various aims like – among others – building a national vocabulary of existing and emerging AI terms, and helping public employees to familiarise with the main AI concepts and regulatory trends.

Besides the strong emphasis on reforming the formal education systems, the Slovakian strategy also focuses on creating **lifelong learning opportunities and vocational training in AI** with the following actions:

- The Ministry of Education and the Ministry of Labour are planning a policy initiative to support **lifelong learning opportunities for employees**. These ministries will collaborate with universities to scrutinise the new requirements (e.g., new technological and digital knowledge associated to AI) of the labour market and formulate specific trainings for both employed workforce and job seekers;
- The MIRRI will collaborate with relevant ministries to analyse the digital skills inside Slovakian SMEs and formulate standards to increase the digital literacy of SMEs' employees.

### 5.25.2 From the lab to the market

The Slovakian strategy proposes the following policies to **increase the research potential in AI** of both public and private sectors:

- The MIRRI and other relevant ministries support the creation of a number of **national platforms for AI research and usage**, e.g. the [Kinit.sk](#) and the [Slovak.AI](#) platform, which will strengthen AI



research and education further to attract international talents, increase networking opportunities and develop AI ethical principles;

- The MIRRI and relevant ministries will prepare and disseminate **calls for grant on basic and applied research in AI**. Direct financial support of this kind aims to increase the Slovakian's research capacity in AI;
- The MIRRI will collaborate with the Ministry of Education and the Ministry of Economy to **increase private sector research in AI** by creating investment opportunities for AI companies and encourage the AI start-up ecosystem;
- The National Security Authority and the MIRRI are establishing a national **competence and coordination centre for cyber security** to develop new technologies like encryption and to evaluate the use of AI in automating security procedures.

Since turning high-potential ideas into successful products and services is as important as AI research, the Slovakian strategy envisages the following policies to **increase the innovation potential in AI**:

- The Ministry of Transport is establishing a range of **policies to support smart mobility** (e.g. self-driving cars and sophisticated transport services) allowing collaborations between public and private sectors to innovate in this particular field. An action plan will better define tasks, responsibilities and priorities of participating stakeholders. The Ministry is also:
  - Assessing the need to review regulations for smart mobility;
  - Setting up a Smart Mobility Lab to increase basic and applied research opportunities;
  - Facilitating proofs of concepts in smart mobility and creating test environments for self-driving cars.
- The MIRRI and the Ministry of Economy are developing a **manual to deploy AI** with guidelines and hands-on support to companies that start using AI, this will improve the long-term innovativeness of Slovakian companies in AI;
- Finally, the Slovakian Government supports the following policies to foster innovations in the public sector:
  - Establishing a platform, like the US public platform [challenge.gov](https://challenge.gov), where public administration could launch calls for innovative digital and AI solutions to fix issues they may be facing;
  - Creating an open API platform to increase the variety of services for citizens, and to open data to a wider public enhancing the innovation potential of AI matters.

### 5.25.3 Networking

Many of the previous policies indirectly increase **networking opportunities** and partnership, however the Slovakian Government supports hubs and platforms also with the following direct actions:

- The MIRRI collaborates with the Slovakian Ministry of Economy and the IT Association of Slovakia, on a feasibility study to create the European **Digital Innovation Hub** in Slovakia;
- The creation of a civil organisations, such as [Kinit.sk](https://kinit.sk) and [Slovak.AI](https://slovak.ai), to build an AI ecosystem by enhancing collaborations and networking.

The Slovakian strategy also has a dedicated policy to increase the **international visibility of AI education** by making it more accessible to foreign students:

- The Ministry of Education is launching an **education initiative on AI** to teach AI courses in English and with “blended learning” methods that would attract talented foreign students.

The MIRRI launched a [web portal](#) to collect AI project proposals from public sector institutions, so to measure the **dissemination and uptake of AI** in Slovakia. Soon the portal will also include analyses and summary details of the submitted projects. In addition, there will be a survey to measure AI uptake by companies and companies' attitude towards AI.

Finally, the Slovakian strategy will use AI to prevent dissemination of fake news and disinformation:

- The Security Council will establish a **working group on disinformation and fake news** which is going to use AI technologies against disinformation and fake news.
-

#### 5.25.4 Regulation

Building trustworthy AI systems requires proper **ethical guidelines** aiming to define concepts of integrity, explainability, and reproducibility in AI. To this purpose, the Slovakian Government proposes to work on:

- Principles for a **transparent and ethical use of AI**: the objective of this policy launched by the MIRRI and the Ministry of Economy aims to define guidelines for a trustworthy use and responsible deployment of AI. Among others, the policy initiatives related to ethical guidelines will include:
  - The launch of a public survey to obtain the point of view of citizens and companies on ethical AI. The results of the survey will help policy makers to define ethical guidelines;
  - The MIRRI delivers on its commitment to ethical and trustworthy AI by appointing members of the [Standing Committee on Ethics and Regulation of AI \(CERAI\)](#). The **Commission** was established as an independent, professional and advisory body of MIRRI;
  - The MIRRI collaborates with international and European platforms, such as the Ad hoc Committee on Artificial Intelligence ([CAHAI](#)), to address gender and algorithmic biases to enhance societal equality and to work on an international framework of solutions.

In addition, the action plan emphasises the need for a modernisation of regulations and legislation. In general, the Slovak Government advocates the creation of a **goal-oriented and dynamic regulation** that leaves more freedom for experimentation. Such a dynamic regulation would enhance the scope for innovative developments and would be less restrictive in an environment that is rapidly changing due to constant evolving technologies. To this purpose, the strategy proposes:

- The development of a **legal framework for data**: the MIRRI is currently preparing a new Act on Data to better define regulations on data protection, disclosure principles, data access and open data regulations;
- A revision of the **regulatory environment for AI**: an advisory group consisting of experts from academia, businesses and governmental institutions will be set up to provide dedicated recommendations on the need to revise the current legislation, in particular on issues such as data management, cyber security and intellectual property;
- The MIRRI coordinates national efforts across ministries and public bodies in response to the recently published European proposal for a legal framework on AI.

#### 5.25.5 Infrastructure

One of the main goals of the Slovakian strategy is to become a **dynamic data economy** since data is the fuel for a successful development of AI. To this purpose, the Slovakian Government will put in place digital data platforms to let high-quality and trustworthy data accessible for the needs of AI. The strategy includes the following policy initiatives for the data economy:

- Creating an **Institute for trustworthy data** to provide open access to high value databases from the public administration after controlling validity, constancy and credibility of the data;
- The MIRRI will **provide public administration with analytical tools for data management**. So, the public administration will receive user-friendly SQL and machine learning tools for data simulations, visualisations and statistical calculations to facilitate policy making. With this help, end-users in the public sector can run data analytics without technical issues on data management;
- Setting up a **Personal Information Management System (PIMS)**, a centralised data repository with data collected by the public administration about citizens. The PIMS will comply with data protection and data sharing regulations by allowing citizens to give their consent on these issues;
- The Ministry of Environment is setting up a **platform for sharing harmonised spatial data** in compliance with the INSPIRE directive.

Lastly, the Slovakian strategy envisages actions to boost the digital and telecommunication infrastructure:

- Setting up a national **high-performance computing** competence centre, and participating to the European [EuroHPC](#) that pools European resources to develop supercomputers;
- Supporting the completion of a **gigabit fibre infrastructure** and the **5G for Europe Action Plan**. Both initiatives aim to increase internet connectivity and achieve the goals of the EU gigabit society.

## 5.25.6 AI to address societal challenges

### Climate and environment

The non-profit institute [KlnIT](#), founded in 2020, is dedicated to intelligent technology research. It brings together and nurture experts in AI and other areas of computer science, with connections to other disciplines, such as information security, web and user data processing (including false information and malicious behaviour modelling), processing and comprehension of natural language, **data analysis for green energy**, ethics and human values in intelligent technologies.

The Slovak Research Centre for Artificial Intelligence, [SlovakAI](#) was created in 2019 to support excellence in the field of AI by bringing together all relevant stakeholders such as businesses, research communities, and governmental institutions. In this endeavour, the platform highlights the increasing importance of AI in solving major societal challenges such as **climate change**, safety, health, and food security.

In July 2020, the President of the Republic of Slovenia was on a visit in Bratislava to strengthen the relationship between Slovakia and Slovenia. During his visit, a [Slovenian-Slovak business forum](#) was held with individual business meetings between participants from both countries. Both Slovenia and Slovakia attach great importance to sustainable development, with an emphasis on the green agenda and digitalisation and in particular on the **circular economy**, smart technologies, e-mobility and **AI**. Slovak companies will exchange views with Slovenian companies on breakthrough solutions in these areas.

### COVID-19 pandemic

A government page provides [digital screening tools](#) to check symptoms and find relevant information about COVID. A [portal](#) for education also guides pupils and their families throughout the school trainings interrupted by the pandemic.

## 5.25.7 Monitoring and future update

The Slovakian Government will monitor policy implementations on annual basis. It will update the AI measures of the national Action Plan in accordance with the 2021 review of the Coordinated Plan on AI.

The Slovakian Government recently published a [strategy and action plan](#) to improve Slovakia's position in the Digital Economy and Society Index ([DESI](#)) until 2025, which covers and extends part of the existing measures of the national AI strategy outlined above.



## 5.26 Slovenia

In May 2021, the Slovenian Government adopted its [National programme](#) (NpUI) promoting the development and use of AI in the Republic of Slovenia by 2025 (Slovenia, 2021). The programme results from consultations among relevant ministries, national experts, industrial representatives through the ICT Association of Slovenia ([ZIT](#)) of the Chamber of Commerce and Industry of Slovenia ([CCIS](#)), researchers and practitioners in the field of AI through the Slovenian Artificial Intelligence Society ([SLAIS](#)), and stakeholders of the Strategic Research and Innovation Partnerships on Smart cities ([SRIP CS&C](#)), Factories of the future ([SRIP FoF](#)), and civil society through the Slovenian Digital Coalition ([SDC](#)) to mention some.

The NpUI entails a programme of strategic objectives and concrete measures to foster Slovenia's research and innovation capacity and international competitiveness in the field of AI from 2020 to 2025. The programme encompasses holistic strategic actions since AI is a multidisciplinary field, therefore the strategic targets are:

- Creating a supportive ecosystem for research, innovation and AI deployment;
- Strengthening technological and industrial capacities in the field of AI;
- Implementing reference AI solutions in the industry, public sector, public and state administration and society;
- Enhancing international cooperation;
- Ensuring an appropriate ethical and legal framework to increase public trust in AI;
- Launching a National AI Observatory;
- Establishing a cutting-edge data and computing infrastructure for AI.

Slovenia has earmarked EUR 110 million of public funding to implement these strategic objectives until 2025.

### 5.26.1 Human capital

The NpUI aims to reinforce human resources in AI along three lines by means of the following actions: 1) updating formal educational curricula at all levels providing AI related knowledge and skills, 2) supporting professionals in acquiring AI skills at work, 2) raising general awareness, understanding and knowledge of AI in the entire population.

The Slovenian Government aims to **update the education system**, from primary school to secondary level, to include relevant digital and computational thinking topics, and promote and integrate AI related topics to tertiary level curricula. The objective is to provide future generations with the necessary skills and competencies in AI and to anticipate labour market trends. In this respect, the NpUI emphasises that education should be equally accessible by all social groups, and it envisages developing platforms for distant learning methods and trainings. In particular, the programme places utmost importance on the following policy initiatives:

- Systematically reviewing and modernising the primary and secondary education programmes, by including new digital technology related courses and by expanding existing courses on computer and information technology;
- Introducing and showcasing AI use across many disciplines (e.g. history, biology, art) in primary and secondary schools to show usefulness and benefits of AI;
- Systematically reviewing the curricula of tertiary education to integrate relevant AI courses and programmes;
- Introducing inter-disciplinary programmes within tertiary education to integrate AI in key disciplines like data science, humanities and law.

**Life-long learning and upskilling opportunities** are foreseen to keep pace with the evolving needs of the labour market. The following policies will help both public and private sector to embrace a professional upgrade towards AI:

- Supporting general training and re-skilling programmes for employees to acquire new skills and professional qualifications in AI;
- Supporting training for decision makers in private and public sector about opportunities and threats of AI;
- Launching AI training programmes for professionals using AI models, methods and algorithms in the development and implementation of products and services in priority areas;

- Introducing educational programmes for companies and public administration on the advantages and disadvantages of AI, and on the need of a legal and ethical framework that facilitates AI development and use;
- Developing a web platform with online courses to acquire advanced professional digital skills, especially in the fields of AI and data sciences.

### 5.26.2 From the lab to the market

The Slovenian Government promotes research excellence and increases the **scientific and innovation capacity in the field of AI** in both the public and private sector. The following policy measures target all industry areas with demonstrated potential for AI developments, and they aim to support innovative ideas across all technological readiness levels (TRL):

- Public co-financing to support AI centre of excellence and basic AI research (TRL 1);
- Support to collaborative projects (TRL 2-4) in the intersection of AI technologies and related technologies (e.g. big data, HPC, IT security, language technologies, IoT, blockchain, quantum computing);
- Support to inter-disciplinary innovation projects at final stage of development (TRL 5-8) in various areas (e.g. public administration, culture, environment, energy, agriculture, smart cities, transport, smart manufacturing);
- Support to reference implementation projects in selected priority areas (health and medicine, Industry 4.0 and robotics, culture & language technologies, public administration, sustainable food production and environment and spatial planning).

The NpUI also supports the Slovenian stakeholders that participate in the EU framework programmes for research, innovation and deployment such as [Horizon Europe](#) and [Digital Europe](#). Furthermore, specific support addresses Slovenian firms and institutions that develop standards in the field of AI. Besides targeting research and innovation on AI standards, the Slovenian Government also promotes collaborations with national, EU and international standardisation organisations.

According to the Slovenian Government the **key priority areas** (i.e. with the highest potential for successful reference implementations of AI technologies) for the development of AI solutions are: Health and Medicine, Industry 4.0 and robotics, culture & language technologies, public administration, sustainable food production and environment, and spatial planning.

Finally, the Slovenian NpUI highlights the importance of proper technical data and computational infrastructure (e.g. HPC, Edge AI) and **testing and experimental facilities** to facilitate the development of AI tools and algorithms. The current Open data platform for data sharing ([QPSI](#)) remains the central hub for further development of data sharing infrastructure and practices. The first EuroHPC world-class supercomputer Vega remains the main computational infrastructure for further adaptation to AI use. On the other hand, Edge-AI infrastructure has been developed for the Factory of the Future (FoF) digital twin demonstration centre at the Faculty of Mechanical Engineering (University of Ljubljana) within the FoF Strategic Research and Innovation Partnership.

### 5.26.3 Networking

The NpUI presents a wide range of policy initiatives to foster **networks and collaborations** across the business community, public sector, academia and public research centres. Networking will encourage multidisciplinary cutting-edge research and innovation projects, and it will enable synergies and cross-fertilisation among all players by promoting knowledge dissemination and transfers. National and international collaborations will benefit from the following actions:

- Establishing a central coordination body, like the [Slovenian Digital Coalition](#), to support collaborative efforts among all relevant national stakeholders in the development of AI;
- Creating a supportive environment for a Digital Innovation Hub (DIH) on AI;
- Strengthening Strategic Research and Innovation Partnerships (SRIPS) that have AI-related projects like Smart cities ([SRIP CS&C](#)) and Factories of the Future ([SRIP FoF](#)) among others;
- Supporting the Slovenian researchers and institutions to engage actively in the European programmes for AI like [CLAIRE](#), [ELLIS](#), [AI4EU](#), and in the national smart specialisation platforms (S3);
- Encouraging active collaborations with international organisations such as the Council of Europe, the European Commission, the OECD, and UNESCO;

- Supporting the work of the International Research Centre on Artificial Intelligence ([IRCAI](#)) located in the premises of the Jožef Stefan Institute in Ljubljana. The IRCAI operates under the auspices of the United Nations Organisation for Education, Science, and Culture (UNESCO) to develop AI-based tools, products and services and provides policy support to AI so that UNESCO Member States will attain the Sustainable Development Goals (SDGs) sooner.

In addition, Slovenia takes part in the Global Partnership on AI ([GPAI](#)), an international initiative to spur a responsible development and use of AI in full respect of human rights, inclusion, diversity, innovation and economic growth. The GPAI collaborates with international partners and organisations to bring together experts from industry, civil society, governments and the academic world. This initiative is stirred by a secretariat, hosted by the OECD in Paris, and it accounts for two Centres of Expertise in Montreal and in Paris.

The Slovenian Government also envisages the following policies to raise the **trust, awareness and knowledge about AI**, to enhance public trust in AI, and its dissemination and uptake in the economy:

- Establishing and strengthening the dialogue with media and opinion leaders that can inform and raise awareness around activities, opportunities and risks of AI;
- Organising conferences and workshops to spread knowledge about AI, and establishing an AI Ambassador to inform about the national activities on AI;
- Launching a communication platform to collect and disseminate good practices and case studies on the deployment and use of AI in society;
- Supporting NGO networking and coordination for participation in activities of research, development, deployment and use of AI at national and EU level.

Finally, the Slovenian Government envisages a **national AI Observatory** to monitor the development and uptake of AI in Slovenia with a suitable methodology and indicators. This activity could be coordinated and implemented in cooperation with the Statistical Office of the Republic of Slovenia ([SURS](#)).

#### 5.26.4 Regulation

The successful deployment of AI lies on defining principles for a human-centred, trustworthy, fair, transparent and sustainable development of this emerging technology. This requires a clear **ethical framework** backed by a **strong legal environment**. To this purpose, the Slovenian NpUI proposes the following main measures:

- Analysis of the appropriate legal and ethical framework for the development, implementation and application of AI-based systems, especially in decision-making systems on the rights and obligations of natural and legal persons in terms of the adequacy of different AI models;
- Establishing an ethical framework to supervise and certify ethically sound AI solutions;
- Creating a national supervisory mechanism to verify the compliance of AI systems with both the EU legislation and the EU's ethical guidelines;
- Including humanities, social sciences, legal and security experts and NGO representatives in activities related to AI, in the support pillar of the Slovenian Digital Coalition.

The NpUI highlights that the design of both ethical and legal frameworks should emerge from the collaboration of relevant international organisations (e.g. EU, UNESCO, Council of Europe) to ensure conformity with supra-national legislation and regulations. In addition, the NpUI foresees an annual conference to inform citizens and relevant stakeholders about regulatory frameworks in place.

The NpUI also mentions that a legal and ethical AI would enhance cybersecurity by detecting frauds and cyber threats, and by enabling authorities to enforce laws and fight crimes more effectively. On this point, the Slovenian Government envisages pilot projects to use AI in cybersecurity and one to enhance the efficiency of police work.

#### 5.26.5 Infrastructure

An appropriate data and telecommunication infrastructure is crucial to collect, share and analyse big data that feed into AI algorithms. This infrastructure should provide reliable and high-quality data that a wide range of users could share in robust and accessible ways.

A **well-developed data infrastructure** to deploy AI includes the following policies:



- Creating national data spaces to develop AI in different areas (e.g. production, environment, mobility, health and medicine, finance, energy, agriculture, public administration, skills), and setting up a national platform with AI tools and algorithms developed in Slovenia;
- Supporting the integration of data spaces at EU level;
- Raising awareness on risks and opportunities of sharing data across economy, public sector and research community;
- Equipping the national infrastructure portal [clarin.si](#) with linguistic resources and technologies;
- Establishing a national IoT platform to deploy AI to the benefit of smart cities and communities.

With respect to **telecommunication infrastructure**, the Slovenian Government highlights the importance of high-performance computing, cloud services, and broadband infrastructure to manage large amounts of data. To this purpose, the NpUI foresees the following policy:

- Supporting the pan-European initiative for high-performance computing ([EuroHPC](#)), and setting up HPC facilities in Slovenia, to develop AI algorithms and applications. On this point, Slovenia is rolling out the HPC project [RIVR VEGA](#) to establish a national high-performance computing infrastructure.

Access to the national supercomputing infrastructure is based on the principle of open science – open research infrastructure and is free of charge for all researchers working in Slovenia. The new infrastructure enables Slovenian researchers to cooperate on an equal footing at international level and provides them a competitive advantage.

## 5.26.6 AI to address societal challenges

### Climate and environment

At the 50<sup>th</sup> [annual meeting](#) of the World Economic Forum in Davos in January 2020, the Slovenian Prime Minister remarked the relevance of AI in modernising the public sector and in addressing the key societal challenges including climate and health.

In May 2020, the [agreement](#) to establish the International Research Centre on Artificial Intelligence ([IRCAI](#)) in Ljubljana was signed by the Slovenian Minister of Education, Science and Sport and the Deputy Prime Minister with the UNESCO Assistant Director-General for Communication and Information as the representative of the Director-General. The activities of the IRCAI should not only maximise the benefits of AI **to achieve the sustainable development goals** (including the one on climate action), but also accelerate a multi-stakeholder mechanism to put AI under the verification of ethical, legal, openness and policy challenges.

In July 2020 a [delegation](#) of 15 Slovenian companies and institutions in the **field of green technologies** and innovations accompanied the President of the Republic of Slovenia on his official visit to Bratislava. During the visit a Slovenian-Slovak business forum was held with individual business meetings between participants from both countries. Both Slovenia and Slovakia stress the importance of sustainable development, with an [emphasis](#) on the green agenda and digitalisation in the context of circular economy, smart technologies, e-mobility and AI. Slovenian companies could exchange views with Slovak companies on breakthrough solutions in these areas.

In July 2020, SPIRIT Slovenia in cooperation with the Embassy of the Republic of Slovenia in Tokyo and Sumitomo Mitsui Banking Corporation, prepared a [web conference](#) for Japanese companies interested in investing in Central and Eastern European countries. The content of the conference especially revolved around:

- The current economic situation in Slovenia and the consequences caused by the COVID-19 pandemic;
- Business opportunities in the field of mobility, smart grids, and fintech;
- Slovenian high-tech research institutions (energy storage, AI, robotics).

### COVID-19 pandemic

Within the framework of the GPAI, to which Slovenia is participating, a working group on AI and pandemic response ([AIPR](#)) has been formed to promote cross-sectoral and cross-border collaboration in this area. In November 2020, the working group released a [report](#) outlining its mandate and providing recommendations to foster and support the responsible development and use of AI-enabled solutions to address COVID-19 and future pandemics.

The IRCAI in Slovenia has also launched an "intelligent" media watch on coronavirus called [Corona Virus Media Watch](#) which collects global and national news from a selection of media with open online information. The

tool, also developed with the support of the OECD and the [Event Registry](#) information extraction technology, is a useful source of information for policy makers, the media and the public to observe emerging trends related to COVID-19. As part of the platform Corona Virus Media Watch, the [University of Ljubljana](#) developed a [social distancing simulator](#) which allows an interactive exploration of social distancing on the spread of contagious diseases. Other functionalities proposed by the Virus Media Watch are similarity measures between countries in people [mobility patterns](#) and [search engines](#) on scientific medical literature.

From April 2020 to October 2020, the [National COVID-19 Prevalence Study](#) determined the number of people infected with COVID-19, the number of asymptomatic individuals who did not know they were infected, and the number of recovered people. The study used Bayesian approaches, machine learning and AI methods for data collection and analyses.

Several research projects use AI algorithms to analyse and fight against the COVID-19 virus. Researchers of the Department of Knowledge Technologies ([KT](#)) at the Jožef Stefan Institute have developed models to [predict dynamics](#) of the COVID-19 pandemic in Slovenia. Using computational scientific discovery methods and machine learning, the model simulates and predicts the dynamics of the infected population in the future. Other research projects focus on the influence of weather, humidity and other factor on the speed of the coronavirus progress, and on the effectiveness of various approaches for curbing the coronavirus infection. The latter two projects use machine learning, data mining, and advanced statistical methods. Researchers from the Department of Intelligent Systems at the Jožef Stefan Institute have also participated to the [Pandemic Response Challenge](#) focusing on the development of data-driven AI systems to predict COVID-19 infection. The team developed accurate predictors of COVID-19 infections using a combination of a SEIR epidemiological model and machine learning and modelled the necessary trade-offs when weighing public health interventions and economic impact.

Finally, the [COVID-19 tracker](#) is a project relying on crowdsourcing funding to collect, analyse and publish data on the spread of the COVID-19 virus in Slovenia. Employing this tracker data, researchers of the Jožef Stefan Institute are [predicting](#) the workload of the epidemiological service with AI-related methods.

#### **5.26.7 Monitoring and future update**

The Slovenian Government highlights that the implementation of the NpUI is dynamic, therefore there will be periodic updates and reviews about the achievement of objectives. Policy actions will likely evolve over the coming years and new policies could supplement existing ones, in particular to support the EU priority measures.



## 5.27 Spain

The Spanish Government released its [National AI strategy](#) in December 2020 (Spain, 2020a) with the objective to develop a policy framework defining the various actions that the governmental administrations will undertake to facilitate the development and deployment of AI in the economy and society. This strategy adopts a multidisciplinary approach to address economic, social, environmental, public management and governance challenges, and it includes perspectives for a wide range of sectors and disciplines. It seeks to boost the growth of AI in the Spanish economy in the coming years with concrete AI-directed policies at the national level, while ensuring a smooth alignment with EU policy.

In defining the concrete action plans in accordance to the national AI strategy, the Spanish Government takes stock of the priorities and policy recommendations of the [RDI strategy in artificial intelligence](#) (Spain, 2019), the [Spanish digital agenda 2025](#) (Spain, 2020b) and the [Recovery, transformation and resilience plan](#) (Spain, 2020c). The RDI strategy, published in March 2019, mainly focuses on the creation of a framework for a competitive Research, Development and Innovation (R&D&I) ecosystem in AI, and it provides a solid foundation for the RDI part of the national AI strategy. The Spanish Digital Agenda 2025, presented in July 2020, outlines the strategic approach for digital transformations in Spain, focusing on 1) the deployment of networks and services for digital connectivity; 2) the digitisation of the economy; 3) the improvement of e-governance, and 4) training in digital skills. Lastly, the Recovery, Transformation and Resilience Plan, released in October 2020, emphasises the importance of AI and presents policy initiatives to boost innovations in this field.

In particular, the national AI strategy highlights the following objectives:

- Promoting the development of human capital in AI through the development of a large base of skilled employment, the provision of training and education opportunities, the stimulation of Spanish talent and the attraction of global talent towards Spain;
- Developing solid scientific excellence in the field of AI to promote Spain as a leading country in AI;
- Placing Spain as a leader in the development of tools, technologies and applications for the projection and use of the Spanish language in AI;
- Boosting the deployment and use of AI technologies in both the public and private sector, including also cross-cutting sector activities and grand challenges;
- Guaranteeing an ethical framework that outlines individual and collective rights and builds an environment of trust in AI;
- Ensuring inclusiveness in the AI-driven economy, by reducing gender gaps and digital divides while supporting ecological transition and territorial cohesion.

In terms of financing, the Spanish Government foresees a public investment of EUR 600 million for the development and the implementation of the national AI strategy over the period 2021-2023.

### 5.27.1 Human capital

As the Spanish strategy emphasises, human capital is an essential cornerstone and driver for the successful deployment and development of AI in Spain. To this purpose, one of the main priorities is to provide the necessary technical skills to both the current and upcoming workforces. Within both the private sector and the public administration, current workforces benefit from modern work-related trainings and life-long learning initiatives. To guarantee the skills of upcoming workforces, the Spanish Government foresees a wide range of education and training policies to stimulate and prepare next generations towards mastering digital skills and capabilities to understand and develop AI technologies and applications. Overall, the national strategy presents policy actions about education and digital skills for the entire population throughout their lives. The foundations of the various policies is the [National digital competence plan](#), released in January 2021.

In terms of policies targeting **the primary and secondary education**, the national AI strategy foresees the following actions:

- Introducing the foundations to understand computational thinking, critical and creative thinking;
- Strengthening the orientation towards ICT technologies and AI of early education cycles and training of teachers;
- Promoting and adapting education in science, technology, engineering, maths and humanities (STEM), also within the tertiary education.

In line with these objectives, the Spanish Informatics Scientific Society ([SCIE](#)) and the Spanish Royal Society of Mathematics ([RSME](#)) have drawn up a joint report entitled [Towards a new education in mathematics and informatics in secondary education](#). In the same vein, the Ministry of Education has published a study on [Robotics and computational thinking](#) in the education system in Spain. As an outcome of this study, the [School on Computation Thinking and Artificial Intelligence](#) is ongoing in cooperation with the Autonomous Communities.

At higher education levels, such as **tertiary education**, the following initiatives aim to strengthen the technological content towards AI:

- Expanding postgraduate studies, Master's and doctoral programmes that offer AI trainings;
- Promoting an inter-multidisciplinary approach in which all educational disciplines.

The Spanish AI strategy also announces an action plan to combat gender discrimination, and to promote gender equality in both scientific education fields and AI-related jobs. Besides the gender gap, social cohesion is a general target to address also the inequalities due to disability and social exclusion.

These policies include also specific trainings for professionals, particularly **lifelong learning, vocational training and reskilling opportunities**. The promotion of continuous training refers to all job occupations throughout the entire professional life. It aims to keep competencies in line with future labour market demands. In particular, the national AI strategy foresees:

- Actions to upgrade professional skills and competencies are presented in the [Strategic plan for vocational training of the education system 2019-2022](#). This plan provides actions to modernise the offer of vocational training to match actual and upcoming skill demands, notably in AI;
- Novel AI training opportunities for the current workforce in both the private sector and public administration.

### 5.27.2 From the lab to the market

The development of AI goes along with both a solid scientific research in AI and the subsequent efforts to transform science into marketable products and services. To coordinate the governance of scientific research activities in Spain, the Spanish Government has developed the Spanish System of Science, Technology and Innovation ([SECTI](#)). This system integrates and coordinates general State policies with the policies of Autonomous Regions on research, development and innovation (R&D&I). In collaboration with various ministries, it focuses on the creation, the implementation, the monitoring and the evaluation of R&D&I policies, including those promoting AI developments.

The following policy initiatives aim to foster **scientific research in AI**:

- Policy recommendations presented in the [RDI strategy in artificial intelligence](#): with respect to scientific research this report highlights the following priorities:
  - Fostering the development of AI technologies in key sectors of the Spanish economy;
  - Facilitating AI research across all sectors, with special attention to cross-cutting activities;
  - Encouraging the adoption of AI applications in all sectors, while allowing for different speed rates of proliferation;
- Creation of a **Spanish network of excellence in AI** to maintain research and training programmes in cutting-edge knowledge areas on AI;
- Strengthening pre-doctoral and post-doctoral research contracts and creating attractive programmes for senior researchers in AI;
- Supporting a flexible scientific trajectory of AI research staff to ensure scientific diversity and permeability across the public and private sectors while favouring knowledge transfers;
- Promoting the creation of new national technology development centres in multidisciplinary fields;
- Creating a programme of AI R&D projects that will focus in National Missions, addressing great social challenges in Spain.

The creation of a **prosperous innovation environment** further encourages the development of AI technologies. To this aim, the Spanish national AI strategy foresees the following policy instruments to support the digital transformation of businesses and public administration:

- **Support programmes** for companies providing AI solutions. These programmes aim to encourage the uptake of new technologies in companies' production processes, and to foster data intensive use for the development of emerging technologies;
- **Programmes to boost innovation on AI** as part of the [Recovery, transformation and resilience plan](#), in line with the frameworks of the Spanish Entrepreneurship Strategy and the Industrial Policy Strategy 2030;
- **Map of AI capabilities** in Spain: this [initiative](#) highlights the ongoing technological and scientific activities in AI in technological centres, academic institutions and public research organisations;
- **Test areas and innovation sandboxes** to facilitate experimentation in real-life conditions, in particular the [Sandbox Financial Act](#) targeting technological innovations in the financial sector.

With respect to the private sector, the national AI strategy calls for the **integration of AI in the business value chain**, in particular for SMEs. AI-related technologies and robotics integrate more and more in sectors, like the fashion industry, tourism and construction, in which Spain has a comparative advantage. The Spanish Government also recommends the adoption of AI in essential industries such as telecommunications, energy, mobility, health care and financial services. A wide range of **programmes and initiatives with financial support** are in place to foster the adoption and development of AI in the private sector. These initiatives span from grants, credits, venture capital to other risk-taking financial aids that encourage technological innovation. In particular, the following policy initiatives are ongoing or planned:

- Launching a public-private venture capital fund to boost digital entrepreneurship and the creation of highly innovative technology-based businesses, in the field of AI and digital enabling technologies;
- Strengthening existing financial support programmes such as:
  - The [NEOTEC](#) programme provides venture capital, seed capital or direct grant support to technology businesses;
  - The financing lines highlighted in the [ENISA](#) programme, directed to (young) entrepreneurs, and growth support;
  - The state-owned bank [ICO](#) that promotes the creation of private management risk capital funds.

Witnessing the potential benefits of **AI in the public sector** and citizens as a whole, the national AI strategy also foresees a wide range of policies to foster the adoption and use of AI in the public administration. AI can help to improve decision-making with reliable and high-quality data, and it can increase the efficiency of service processes. The following actions will help to achieve these goals:

- Embedding AI in public administration to improve efficiency towards citizens, industry, and society at large;
- Increasing AI skills in public administration in order to encourage the use of AI applications;
- Launching an innovation laboratory to study the uptake and use of AI in public administration (GovTech Lab).

The new [plan for the digitalisation of the public sector in 2021-2025](#) further stimulates the use of AI in the public administration by presenting policy initiatives to foster digitalisation and automation in the public sector to finally improve the quality of public policies and service to citizens.

### 5.27.3 Networking

An efficient knowledge sharing across stakeholders is crucial for the development of AI. Given the advantages of **networks and collaborations in the development and uptake of AI**, the Spanish Government highlights the following policy initiatives:

- Developing platforms that foster collaborative research on AI and knowledge transfers, while promoting and exploiting synergies between universities and businesses by means of cooperation programmes like the [Co-incident Programme](#);
- Strengthening the Digital Innovation Hubs (DIHs) network;
- Supporting the Spanish participation in European RDI programmes.

In addition, Spain takes part in the Global Partnership on AI ([GPAI](#)), an international initiative to spur a responsible development and use of AI in full respect of human rights, inclusion, diversity, innovation and economic growth. The GPAI collaborates with international partners and organisations to bring together

experts from industry, civil society, governments and the academic world. This initiative is stirred by a secretariat, hosted by the OECD in Paris, and it accounts for two Centres of Expertise in Montreal and in Paris.

The Spanish Government is committed to **increase the international attractiveness** of the country in the field of AI. To this aim, the national AI strategy proposes the following initiatives to attract international talents in AI (i.e. individuals and businesses):

- Creating the **Spanish Talent Hub**, a programme in collaboration with [ICEX Spain Trade and Investment](#) to attract both academic and professional talents with a specific focus on attracting foreign investment, social impact investments, and promoting women entrepreneurship;
- Launching a programme for the international accreditation/equalisation of educational certificates to facilitate the attraction of international talents.

#### 5.27.4 Regulation

The proliferation of AI across the economy and society needs a well-developed ethical and regulatory framework that protects individual and collective rights, and that safeguards inclusion and social welfare.

With regards to the **legislative framework**, the national AI strategy stipulates that the development of AI has to comply with the constitutional values and principles of accountability, equality, individual freedom, and privacy. To achieve this, the Spanish Government will work on:

- A new **legislative framework** for AI applications and technologies to include, among others, laws that guarantee data integrity and security.
- A **charter of Digital Rights** (released for [publication consultation](#)) to guarantee individual and collective rights of citizens.

These initiatives take stock of prior work like the 2018 book on [Digital Society and Rights](#) by the Ministry of Industry, Trade and Tourism and financed by [Red.es](#). This book already presents the challenges of regulating AI, and it reflects on its advantages and risks concerning rights.

Besides a solid legislative framework, it is also crucial to support AI development that is also **ethically sound** and that conceives AI-systems that are human-centred, trustworthy, fair, transparent and sustainable. In order to create an ethical framework, the Spanish Government envisages the following action lines:

- Launch of a monitoring model for ethics in AI developed by the AI Advisory Board, in collaboration with the [Digital Transformation Advisory Board](#);
- Developing a trustworthy AI certification (i.e. quality label) for AI practitioners that develop ethically sound AI;
- Creating forums for national and international dialogue to discuss the impact of AI on human rights and public freedoms;
- Strengthening the National Observatory on Telecommunications and Information Society ([ONTSI](#)) from the public corporate entity [Red.es](#) to promote digital development in Spain. With regards to ethics, the Observatory published a policy report on [The network society: digital transformation in Spain, annual report 2018](#). Among others it highlights the importance of the development of AI in the improvement of the welfare of citizens and the economy, alerting about its risks and ethical dilemmas.

#### 5.27.5 Infrastructure

Since the collection of data is an essential driver of digital transformation and of AI-related applications, the Spanish national strategy incorporates dedicated policies to develop data platforms. While the digital economy increasingly relies on large volumes of data, it also requires investments in high-performance telecom and IT infrastructure. Spanish policies related to data platforms and technological infrastructure are targeting three key areas: 1) the use and sharing of data across economic players and public administrations, 2) AI innovation through increased cybersecurity and cutting-edge infrastructure, and 3) AI technologies in the field of natural language processing.

The following policies will ensure the **availability of high-quality data** to foster the development of AI-based technologies:



- Creating a **central data governance body** (Data Office) at the national level and appointing a **Chief Data Officer** who will actively participate in initiatives to create secure data repositories in the EU and in coordinating AI applications in public administrations;
- Creating a decentralised and accessible **data repositories** to provide added-value services based on data infrastructures and innovative AI applications;
- The creation of an interdisciplinary **Working Group on Open Data** in the public sector. Furthermore, also the launch of the **Data for the Common Good** programme encourages the use and governance of open data;
- Promoting the **access to public data**, through initiatives as [Red.es](#) that stimulates openness and re-use of public administration data, and the open data portal [APORTA](#);
- The creation of new value-added services based on data in line with the [European data strategy](#) that promotes **data sharing** among businesses, public administrations, governmental institutions and citizens;
- Fostering the infrastructure for **AI in natural language processing**, in particular for Spanish. To this purpose, the Royal Spanish Academy ([RAE](#)) recently joined other main operators of digital platforms in the project on the Spanish Language and AI ([LEIA](#)) to promote and enable the use of the Spanish language in the digital world and in AI systems. These policy efforts advance the action lines of the [National plan for advancement in natural language processing](#).

To support **infrastructure**, the national AI strategy foresees policies in a wide range of areas, such as high-performance computing and cybersecurity:

- Supporting the pan-European [EuroHPC](#) initiative with high-performance computing facilities;
- Further expanding the National Centre of supercomputing in Barcelona ([BSC](#));
- Launching an experimental computing laboratory in quantum computing to enhance new computational modes and explore their potential applications;
- Enhancing cybersecurity through a better coordination between involved economic partners and the Spanish National Cybersecurity Institute ([INCIBE](#)) in charge of promoting companies' cybersecurity.

Concerning (cyber-)security, the Ministry of Defence also published a [Security and defence document nº 79 about applied AI to defence](#) to present challenges and opportunities of AI for defence, evaluating suitable uses of robotics, computer vision and natural language processing.

Additionally, other plans, such as the 5G action plan and the Connectivity Plan, will foster high-speed connectivity deployment and uptake, which will underpin the development of the AI market.

## 5.27.6 AI to address societal challenges

### Climate and environment

In line with the efforts outlined in the **European Green Deal**, the national AI strategy proposes to encourage the development of a national programme for “efficient and sustainable algorithms (green algorithms)” to maximise the energy efficiency of AI systems and foster the use of AI as a part for solving problems related to the environment.

### COVID-19 pandemic

With respect to the COVID-19 outbreak, the national AI strategy highlights the importance of drawing lessons from the crisis, to take corrective actions in the future and to better prepare healthcare systems for these types of events. AI is for instance being applied to **support the diagnosis and treatment** of coronavirus outbreaks, to screen severity of diseases of patients, to disinfect healthcare facilities and to help minimising social contacts. For the latter, multiple applications for smartphones have been developed, while predictive modelling and simulation systems are often used for disease detection and prevention. Concrete action plans and initiatives developed or supported by the Spanish Government include:

- The launch of a [COVID-19 fund](#): in June 2020 the Spanish Government approved COVID-19 Fund of EUR 16 billion for regional governments to finance costs stemming from the pandemic, particularly for the health system, together with an increase in items for education. A part of the budget will be allocated to support platforms for teachers, pupils and education authorities through the application of AI;

- The assessment of lockdown measures: in April 2020, a new project by the National Scientific Research Council ([CSIC](#)) employed computer science and data science techniques to [assess](#) the effectiveness of lockdown measures in halting the spread of COVID-19. The project uses AI tools and data science, and integrates big data in real time on human mobility, geo-localised surveys and computational models;
- The development of a conversational assistant [Hispabot-COVID19](#) function via WhatsApp. This is an automatic channel, set up by the government, for enquiries that uses AI and natural language to respond to concerns from the public about COVID-19 with official, precise and updated information;
- In April 2020, the project [DataCOVID](#) was developed in collaboration with the National Statistics Institute ([INE](#)). DataCOVID employs big data to analyse anonymous data compiled on movements of the population during the state of alarm to enhance an efficient data-based decision-making in different regions during the pandemic;
- The [AsistenciaCOVID-19](#) - an official self-diagnosis application - was created by the State Secretary for Digitalisation and Artificial Intelligence ([SEDIA](#)) to free up the healthcare hotlines in the different regions and offer official information and convey trust to people;
- The development of a [personnel assistant application](#) using AI technology to respond to frequently asked questions about COVID-19. This natural language processing tool is developed by [SEDIA](#) through the [National plan for advancement in natural language processing](#).

Spanish hospitals are also participating in a collaborative project on [Imaging COVID-19 AI](#). The objective of this project is to enhance computed tomography (CT) in the diagnosis of COVID-19 by using AI. The project group will create a deep learning model for automated detection and classification of COVID-19 on CT scans, and for assessing disease severity in patients by quantification of lung involvement.

In March 2020, Carlos III Health Institute launched a [funding initiative](#) to finance projects that improve knowledge about the COVID-19 virus and how to handle the disease in the short term. Among the envisaged fields of research there is the use of AI and integrated big data analysis tools aimed at the epidemiological control of COVID-19.

In addition, Spanish businesses have participated in the pan-European [#EUvsVirus](#) hackathon, which aimed to collect and promote innovative ideas to fight against the coronavirus. [PoCOVIDscreen](#) is one of the winning projects headquartered in Spain, proposing a tool for detecting COVID-19 from ultrasound recordings with AI.

Finally, Spain takes part in the EU-funded project [EXSCALATE4COV](#) that exploits the most powerful computing resources currently based in Europe to foster smart in-silico drug design while increasing the accuracy and predictability of Computer-Aided Drug Design. Specifically, the project involves three among the most powerful supercomputing centres in the EU: [CINECA](#) in Italy, the Barcelona Supercomputing Centre ([BSC](#)) in Spain and the Jülich Supercomputing Centre ([JSC](#)) in Germany. The collaboration also includes pharmaceutical companies and major institutes of biology and bio-molecular dynamics from across Europe.

#### **5.27.7 Monitoring and future update**

The development and the implementation of the Spanish AI strategy involves a wide range of governmental bodies, and [SEDIA](#) is in charge of coordinating and monitoring the AI strategy. This newly-established body harmonises the actions of ministerial departments, public and private stakeholders. Furthermore, the Advisory Council on Artificial Intelligence, a new consultative body, supports the development and implementation of the AI strategy by providing advice and recommendations on the policy measures to develop AI in Spain.

Since policy needs in the field of AI may change quickly over time, the national AI strategy is a living and flexible document. For this reason, the Spanish Government will revise and update the national AI strategy within two years.



## 5.28 Sweden

In May 2018, the Swedish Government released its national AI strategy [National approach for artificial intelligence](#) (Sweden, 2018). This strategy points out the general direction for AI in Sweden in order to create a basis for future policy actions and priorities. In this sense, this strategy serves as a reference for the government to outline forthcoming policy initiatives with the aim to strengthen Sweden's welfare and competitiveness by means of AI. To this purpose, the Swedish strategy focuses on the following priority areas:

- Education and training;
- Research;
- Innovation and use;
- Framework and infrastructure.

Prior to the release of the strategy, [Vinnova](#) – Sweden's innovation agency – published an extensive [policy report](#) outlining the opportunities and challenges of AI in Sweden, and Sweden's capabilities to embrace the full potential of AI (with concrete examples of ongoing AI projects).

This section presents the policy recommendations of Sweden's AI strategy. Where possible, it aims to incorporate new policy initiatives that have been rolled out since the launch of the strategy in May 2018.

In terms of funding, Vinnova funded AI projects for SEK 675 million (approx. EUR 67.5 million) in 2020. The total sum for AI projects that Vinnova helped fund was SEK 1,350 billion (approx. EUR 135 million), 50% of this could be private founding or funding from other national programs. In the national budget for innovation and research until 2024 at least SEK 550 million (approx. EUR 55 million) has been assigned to research and innovation in digital technologies and AI and its use and impact on society.

### 5.28.1 Human capital

The Swedish Government addresses the need of **formal education and training as well as lifelong learning in AI** by means of the following policy recommendations:

- Education institutions need to provide a sufficient number of people with AI education and training, including continuing education for professionals. Swedish universities have started proposing bachelor's and master's programmes in AI fields, e.g.:
  - Master programmes on [Data engineering](#), [Machine learning and statistics](#), [Image analysis and machine learning](#) at Uppsala University;
  - Master programmes on [Design for Creative and Immersive Technology](#) at Stockholm University;
  - Master programmes on [Machine learning](#), and [Systems, Control and Robotics](#) at KTH Royal Institute of Technology;
  - Master programmes on [Language technology](#) and [Logic](#) at the University of Gothenburg;
  - Three newly launched [AI-related](#) master programmes on [Data science and AI](#), [High-Performance computer systems](#) and [Physics](#) at Chalmers University;
- Non-technical programmes should include a strong AI component to foster a broad and responsible understanding of the use of AI;
- The links between research, higher education and innovation should reinforce in the field of AI;
- Continued and further education for professionals should be ensured (e.g. by offering MOOCs such as the [Elements of AI](#) course).

The following initiatives will serve to evaluate **changes in skill needs on the labour market** due to AI developments, and to get ready for them:

- The Agency for Economic and regional Growth together with the Swedish Higher Education Authority analyse the evolution of the supply of competencies in advanced digital technologies in both short and long term, and they make recommendation about it. The work aims to improve the supply of such competencies as well as improve statistics and forecasts of future needs in the Swedish labour market;
- A [pilot project](#) to identify the need for AI skills in companies and organisations from the southern region to better use new smart technologies based on AI. The aim is to develop AI courses depending on the needs that emerge.

Lastly, the platform [AI Competence for Sweden](#) lists university courses for working professionals in AI-related fields. The goal of this initiative is to improve the competence in AI of both academia and industry.

### 5.28.2 From the lab to the market

To transform innovative ideas into market products and services, the Swedish strategy emphasizes the need for:

- A strong basic and applied research environment in AI;
- A strong relation with leading international AI research environments;
- Pilot projects, testbeds and environments for development of AI applications;
- Efforts to prevent and manage risk associated with AI.

Some policy initiatives to address these needs are:

- [AI Sweden](#): an ambitious holistic programme to foster the development of AI applications in Sweden. With funding from [Vinnova](#), among others, it is organised as a national centre for applied AI research and innovation with almost 70 partners from the industrial and public sectors, research institutions, and the academic world. AI Sweden initiated and runs a number of projects supporting AI research and innovations. It also provides a platform for collaborations, and technology/data infrastructure;
- [AI-related innovation projects](#) financed through [Vinnova](#). On 1 April 2021, a total of 256 ongoing projects matched the keywords “artificial intelligence” and “AI” in Vinnova’s project database;
- [Startup AI activities](#): Vinnova also funds SMEs and public organisations when they start the first innovation project in AI. In a recent call for projects’ proposals participants could apply for a maximum of SEK 500,000 (approx. EUR 48,800);
- Vinnova is the national coordinator to strengthen [testbeds and demonstration](#) activities in Sweden. To this purpose it disseminates information on hundreds ongoing testbeds in Sweden, among others in the field of AI.

### 5.28.3 Networking

In terms of networking, the Swedish Government is setting up policies to:

- Foster strong collaborations and partnerships among business, the public sector and research in AI;
- Develop collaboration and partnerships on the use of AI applications with other countries.

The [AI Sweden](#) programme for instance envisages [nodes and co-location areas](#) across Sweden to boost and to enable collaborations and partnerships for AI innovation.

Another example is the Analytic Imaging Diagnostic Arena ([AIDA](#)), which is a Swedish arena for research and innovation on analytic image-based diagnostics. AIDA is a **cross-disciplinary and cross-sectoral collaboration** aiming to largescale usefulness of AI in healthcare.

Lastly, the [AI agenda](#) is a **collaborative, stakeholder-driven, approach** to suggest and formulate a national roadmap to accelerate the AI uptake in Sweden. This work is stakeholder-driven, bringing together academia, research institutes, public and private sector representatives as well as other organisations. There are six working groups looking into different aspects of AI such as: infrastructure, industry, public sector, education and more. The work is coordinated by the [RISE](#).

In terms of **international attractiveness** the Swedish strategy (p. 5) claims that “*if Sweden can strengthen policy conditions across all policy areas, it will be well placed to offer an internationally attractive working environment for business, researchers and others interested in AI research, development and use*”.

### 5.28.4 Regulation

To foster AI regulation, the Government has identified the need to:

- Develop rules, standards, norms and ethical principles for an ethical and sustainable AI and its use;
- Push for Swedish and international standards and regulations that promote a risk-free use of AI.

With regard to **ethical and sustainable AI**, it is important to develop ethical guidelines to ensure a transparent, explainable, and non-discriminatory development of AI. This is particularly important in systems that closely interact with the physical world, such as self-driving vehicles or AI applications in health care. To

this purpose, the Swedish Government established the Committee for Technological Innovation and Ethics ([KOMET](#)) in August 2018. The Committee aims to release annual interim reports.

The launch of the following initiatives means to foster the creation of ethical and sustainable AI:

- The establishment of the AI sustainability centre: a [hub](#) co-founded by companies, universities and public authorities with a specific focus on social and ethical aspects of AI;
- Academic [seminars](#) on the ethical challenges of AI in business, administration and across various sectoral areas.

The Swedish strategy recommends to establish a **legislation** that fosters the use of AI and prevents risks for both society and individuals. In this sense, the new legislation should safeguard privacy, ethics, trust and social values. At the time of writing this report, the new legislation was starting hence the Swedish legislation on data protection and ownership, for instance, was still largely based on the EU law.

The Government has established the Committee for Technological Innovation and Ethics to identify policy challenges, contribute to reducing uncertainty on existing regulations and accelerate the policy development on new technologies. Automation and AI are both natural areas of interest for this committee.

The Swedish strategy also suggests to frame appropriate **(international) standards**. In terms of standardisation, Sweden has the following organisations and bodies:

- The Swedish Institute for Standards ([SIS](#)): an international organisation specialised in national and international standards;
- The Swedish Standards Council: the principal body for all Swedish standardisation. Its task is to promote interest in standardisation and to encourage the use of standards.

## 5.28.5 Infrastructure

The Swedish strategy emphasizes the need for a digital infrastructure to harness the opportunities that AI can provide, including both a **high-quality data infrastructure and a well-developed digital and telecommunication infrastructure** in terms of computer power, connectivity and network capacity. The AI Sweden programme cover both the development of the data infrastructure – by improving data quality, data availability and data sharing opportunities, and the setting up of the IT infrastructure.

The AI Sweden programme makes datasets accessible via the [Data Factory](#). It aims to provide horizontal resources to all research partners, ensuring that data sets are available across industries and application areas in order to accelerate AI innovation and applications.

With regard to AI in the public sector, the Swedish Agency for Digital Government ([DIGG](#)) supports AI uptake and deployment in public administrations. In a [policy report](#) from the 14<sup>th</sup> of January 2020, the agency points out that the economic gains resulting from AI could be potentially large for the Swedish public sector. The report includes a mapping exercise on how the Swedish public sector currently uses AI, and it presents suggestions to increasingly use AI in the future. The DIGG is also supporting open data policies to foster data-driven innovations and technology developments.

## 5.28.6 AI to address societal challenges

### Climate and environment

In October 2019, the Swedish Government and academia met representatives from U.S. academia, Google, Ericsson, USAID and UN agencies UNDP and UN Global Pulse to explore the extent of AI in accelerating innovations that help reaching the UN Sustainable Development Goals (SDGs). The event marked the beginning of the [AI, People & Planet](#) collaborative research initiative. This initiative is hosted by the Beijer Institute of Ecological Economics (at the Royal Swedish Academy of Sciences), Princeton University (Princeton Institute for International and Regional Studies), and the Stockholm Resilience Centre. It aims to deepen how AI can help expand the planetary support systems – climate stability, biodiversity, and living oceans.

In April 2020, [Vinnova](#) launched the call on [AI in the service of climate](#), in collaboration with the government agency Formas. This call aims to support projects using AI to help Sweden having no net emissions of greenhouse gases by 2045 or to adapt society to the climate changes.

## COVID-19 pandemic

The Swedish Innovation Agency [Vinnova](#) is supporting businesses and public enterprises in their innovative efforts. Among other support initiatives, it is also promoting innovation projects in AI. In April 2020, the agency announced its funding support for a [project](#) on how AI can provide more effective strategies for future pandemics.

Open science initiatives boosting access and sharing of data are essential to leverage the benefits of AI. Data and algorithms constitute key elements of AI systems. To this purpose, the Swedish COVID-19 [Data Portal](#) provides information, guidelines, tools and services also from [AI](#) to support researchers to use Swedish and European infrastructures for data sharing. To further expand this initiative, SciLifeLab, the national centre for molecular biosciences in health and environmental research, is recruiting data engineers with expertise in AI to operate the Swedish national COVID-19 research data portal and reinforce open science, and data driven life science.

Finally, the Upplands-Bro municipality on the outskirts of Stockholm is an interesting use-case of the employment of AI [recruitment robots](#) to reduce the risk of contamination at the interview stage during the COVID-19 pandemic.

### 5.28.7 Monitoring and future update

The Swedish national strategy on AI will be reviewed on a regular basis to assess the policy progress and to foster the development and use of AI.

Sweden is working on a strategy for secure access to open data and the use of data as a strategic resource, with respect for rules on data protection and privacy and based on the premise that data is a basic prerequisite for being able to use the potential in AI and other digital innovation. The strategy will be published in 2021 and is an important complement to the previously published national AI strategy.





## 5.29 Switzerland

Although Switzerland does not intend to release a national AI strategy, there is ongoing effort to promote framework conditions for research and deployment of AI in the Swiss economy and society. In December 2019, the Swiss Federal Council acknowledged the [Report](#) of the Interdepartmental Working Group on Artificial Intelligence (Switzerland, 2019a). This Working Group was established in fall 2018 by the Federal Department of Economic Affairs, Education and Research ([EAER](#)) on behalf of the Federal Council. The report provides evidence that Switzerland benefits of good conditions to encourage the deployment of AI and to tackle the numerous challenges brought about by this technology. This report analyses the existing policy initiatives in Switzerland to propose - where needed - concrete lines of actions to enable the Federal Government to fully leverage the benefits of AI. Specifically, this report provides recommendations in various policy areas and presents policy actions along 17 thematic fields.<sup>66</sup> Mainly, it includes:

- Improving AI-related skills and competencies at all education levels and creating lifelong learning and reskilling opportunities for the labour force;
- Fostering AI research and innovation to enhance the competitiveness of the entrepreneurial ecosystem;
- Enhancing public services through a wider adoption and use of AI applications;
- Supporting (international) networks and partnerships and ensuring the exchange of information and knowledge between all economic and institutional players;
- Establishing a regulatory and ethical framework to ensure a sustainable and trustworthy AI;
- Developing a data infrastructure to fuel AI developments;
- Reinforcing the telecommunication infrastructure, in particular with respect to cybersecurity.

In tackling these challenges for concrete policy actions, the Working Group on AI recommends close coordination and integration of policies outlined in the Digital Switzerland Strategy. Some aspects in the application of AI are addressed in the new [Digital Switzerland strategy](#) of September 2020, in particular on data use (Switzerland, 2020).

In addition, the Swiss Government adopted specific guidelines for AI in November 2020, which are intended to provide the federal administration and the agencies entrusted with administrative tasks with a general orientation framework and ensure a coherent AI policy. Regular evaluation of the application and further development of these guidelines is planned.

### 5.29.1 Human capital

The State Secretariat for Education, Research and Innovation ([SERI](#)) has released a report on [Artificial intelligence in education](#) (Switzerland, 2019b) to enhance human capacity in AI. This report presents the policies for the adoption of AI in education, and it highlights opportunities and challenges that AI brings into the education system. Among others, it emphasises the need to develop courses to acquire the **necessary skills for the deployment of AI in the primary, secondary and tertiary education** systems. It includes the following policies:

- Ensuring the transfer of skills necessary for the use of AI at all levels of the education system. The State Secretariat for Education, Research and Innovation ([SERI](#)) will ensure this in close coordination with the cantons;
- Guaranteeing a transparent and responsible use of AI in education.

In addition to the need of students' education, it is essential to guarantee that AI skills support the workforce across all sectors. **Lifelong learning programmes for continuous education and training, and re-skilling and up-skilling opportunities** can make this possible. These types of training have a tremendous potential and their importance will continue growing in the future.

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<sup>66</sup> 1) International bodies and AI, 2) Swiss intelligence of interests in the European AI (Digital Europe Programme) activities, 3) Changes in the world of work, 4) AI in industry and services, 5) AI in education, 6) Application of AI in science and research, 7) AI in cybersecurity and security policy, 8) AI, Media & Public, 9) Automated mobility and AI, 10) AI in healthcare, 11) AI in the financial sector, 12) AI in agriculture, 13) Energy, climate, environment and AI, 14) AI in administration, 15) Further development of the general legal framework on AI, 16) AI in justice, 17) AI, data and intellectual property law.

The Working Group also recognises that the AI will change the labour market in a different way from previous technological developments. In this sense, skills and competencies of the workforce need to **adapt quickly to the changing needs of the labour market**. Existing measures are already in place to actively screen and monitor the skills demanded in the labour market. The State Secretariat for Economic Affairs ([SECO](#)) monitors the challenges and addresses emerging issues within the existing competencies in AI. Furthermore, in November 2017, the Federal Council decided to monitor the impact of the digital transformation on the labour market. A report will publish the results of the monitoring by the end of 2022.

### 5.29.2 From the lab to the market

The Working Group on AI highlights that Switzerland has good quality research and innovation in AI, although challenges are high.

In terms of **scientific research in AI**, existing activities and challenges on AI are presented in the SATW report on [Artificial intelligence in science and research](#), prepared for the SERI. Switzerland can rely on the dynamic research environment of well-known and long-established research centres, such as the Swiss AI Lab [IDSIA](#), the [IDIAP Research Institute](#), the [ETH Zürich Competence centres](#), and the [Centre for Intelligent Systems](#) at EPFL. In addition, private research initiatives and universities complement this research context. At present, the experts of the Working Group on AI suggested that the existing policy initiatives are providing the appropriate support and the Federal Government can avoid taking further policy measures. In this sense, the research capacity around AI receives support by existing policies as the [Federal education, research and innovation policy 2021-2024](#), the [Digitalisation action plan for education, research and innovation](#), open and competitive federal instruments, and the strategic planning of universities for 2021-2024 that identified digitalisation and AI as key priorities.

To enhance **innovation in AI**, the SATW report on [Artificial intelligence in the industry and public administration](#), prepared for the SERI, presented a detailed overview of overarching challenges on AI in industry and public administration. The performance of Switzerland as for the amount and quality of AI patents, and the number of Swiss AI start-ups – reported by the Working Group on AI – reveal a strong and competitive position. As such, the Working Group concludes that the industry itself is addressing quite well the challenges of AI. However, besides self-regulation by the industry, the Working Group highlights numerous policy initiatives in **priority areas** such as media, mobility, healthcare, finance, agriculture and energy and climate.

#### Media and public

The Working Group highlights the need to govern the role of intermediaries due to the increasing use of AI in the media and to the challenges that it may bring along (e.g. fake news). A governance report outlining concrete policy actions will be submitted to the Federal Council by the end of 2021. Other actions will tackle the monitoring of media developments and the use of AI in the media.

#### Autonomous mobility

The report on [Autonomous mobility and artificial intelligence](#), prepared in 2019 for the SERI, presents governance efforts on autonomous mobility. In this respect, both the Federal Roads Office ([FEDRO](#)) and the Federal Office of Transport ([FOT](#)) are following-up the development on automated vehicles to promote data exchange (e.g. report on [Provision and exchange of data for automated road driving](#)), ensure data protection and revise the legislative framework (revision of the Road Traffic Act ([SVG](#)) and the Railways Act ([EBG](#))).

#### Health care

AI is bringing many opportunities to the health system by means of data-driven medicine that can improve prevention, prediction and monitoring. The development of data-driven analytical techniques and the introduction of AI in the health care sector increase the need for data and privacy protection. Due to this, the Federal Office of Public Health ([FOPH](#)) monitors the impact of AI on medicine and healthcare also to include potential revisions to the existing legislation on the [Human Research Act](#) for data protection and privacy, and on the [Federal Act on Medicinal Products and Medical Devices](#) for the use of AI in the clinic process.

#### Finance

The use of AI is automating and accelerating labour-intensive processes in the financial industry too. Therefore, the need of a proper governance emerges as the use of AI in this sector expands. The Federal Department of Finance ([FDF](#)) monitors AI developments in the financial sector to fix emerging issues through

proper regulatory reviews. Among others, it regulates the operational risks and it outlines the behavioural obligations to use AI methods in the financial sector.

#### Agriculture

In the context of agriculture, AI facilitates precision farming through image recognition and harvesting robots, among other cognitive computer technologies. The Federal Office for Agriculture ([FOAG](#)) monitors developments in agriculture on an ongoing basis. To this end, it has set up a Business Intelligence Competence Centre, which is active in the field digital data and predictive analyses. In addition, the Federal Department of Economic Affairs, Education and Research ([EAER](#)), and the [FOAG](#) launched a [Charter on the digitisation of Swiss agriculture and the food industry](#) in 2018. This Charter aims to nurture a shared awareness and promotes cooperation among relevant stakeholders.

#### Energy

The deployment of AI can enable significant efficiency gains in energy supply. It can support the development of renewable energies, provide energy savings and thus contribute to climate protection. Overall, it can simplify the existing complexity of energy supply operations. In this respect, the Swiss Federal Office of Energy ([SFOE](#)) monitors and tackles the AI challenges in the energy industry (see Section 4.29.6).

To foster innovations in the private sector, the creation of testbeds is recommended for cyber security and the energy sector. To increase the use of AI in cybersecurity, The National Cybersecurity Centre ([NCSC](#)), and the Federal Department of Defence, Civil Protection and Sport ([DDPS](#)), in cooperation with the Federal Department of Foreign Affairs ([FDFA](#)) and the [EAER](#), are launching a study to evaluate the potential of a Swiss AI test centre in this field. In the energy sector, the Federal Office for Energy offers a [Pilot and Demonstration Programme](#) to promote the development and testing of new technologies, including AI-related projects.

In addition to the demonstrated tremendous potential of AI in the private sector, the **use of AI is also an effective means to increase the quality and efficiency of services in the public administration**. To this aim, the Federal Customs Administration ([FCA](#)), the Swiss Federal Statistical Office ([FSO](#)) and the State Secretariat for Migration ([SEM](#)), support various projects, e.g.:

- The development of a chatbot solution to reduce the costs of border crossing and the establishment of a data analytics projects to conduct risk analysis and controls in smuggling of goods. Both projects are part of the [DaziT Programme](#), which aims to modernise and digitalise the Federal Customs Administration;
- The [Arealstatistik Deep Learning – ADELE](#) project is a deep learning application for land use and land cover classification managed by the FSO;
- The project on [Automation of NOGA coding](#) (NOGauto) proposes machine-learning methods to encode data already available at the FSO;
- The FSO project on [Machine Learning – Sosi](#) conducts data analyses on the social security system with machine-learning approaches;
- The project on [Data validation with Machine Learning](#) aims to extend and speed up data validation in the FSO by means of machine learning algorithms and at the same time to improve data quality;
- The SEM project [Job algorithm for asylum seekers](#) is a pilot test of a machine learning system to distribute asylum seekers among the cantons while optimising the labour market.

To foster similar types of projects, the Working Group on AI recommends that the federal administration encourages data exchanges and exploits the large data collections available in public administrations by means of AI-related technologies. To this purpose, a cross-administrative recording of processes and shared access to data between public departments should be envisaged. In addition, the creation of an AI competence network with a specific focus on technical aspects of the application of AI in the federal administration could facilitate the sharing of good practices.

#### 5.29.3 Networking

The following policy initiatives are ongoing or recommended to promote better networking and cooperation between AI-relevant actors:

- Developing platforms to ensure dialogue and exchange of information and knowledge. The Working Group suggests that the Swiss "[Plateforme Tripartite](#)" established by the Federal Office of

Communications ([OFCOM](#)) could become an interdisciplinary national competence network on AI issues;

- Strengthening collaborations between AI players by further developing hubs for digital policy debates, such as the Geneva Internet Platform ([GIP](#)). This platform has been launched by the OFCOM and the Federal Department of Foreign Affairs ([FDFA](#)) and it could act as a centre for digital governance, including AI. Strengthening the importance of Geneva and the Geneva Internet Platform as hubs for global digital and technology policy is also a main objective in the new [Foreign policy strategy 2020-2023](#);
- Supporting the participation in the pan-European initiatives such as [Horizon Europe](#) and [Digital Europe Programme](#), aiming to improve Europe's competitiveness in the global digital economy through support schemes on supercomputing, Digital Innovation Hubs, and advanced digital skills among others;
- Strengthening the international cooperation for cybersecurity: the [FDFA](#) has set up the Office of the Special Envoy for Cyber Foreign and Security Policy. This targeted multilateral cooperation regularly discusses the influence of AI. At technical level, the international cooperation helps to exchange information on incident management, and at the same time the Federal Intelligence Service maintains intensive contacts with the Swiss cantons whose infrastructures are also affected by cyber-attacks.

#### 5.29.4 Regulation

The regulation concerns legislations and recommendations to foster AI innovations, create standard of AI adoption and application, while caring of principle of ethics and inclusion.

With respect to the **development of ethical guidelines** for a trustworthy, reliable, responsible and fair deployment of AI, the Swiss Government is actively involved in international discussions and committed to ensure the respect of established values and standards in the use of AI. To this purpose, it is important to guarantee principles of traceability, transparency, and inclusion (i.e. avoiding social biases and discrimination).

Towards a **regulation for AI**, the Working Group on AI recommends to keep the general regulatory framework to enable the development of AI in Switzerland. This framework will accommodate some clarifications and adaptations in specific thematic fields and policy areas like media, mobility, healthcare, finance, agriculture and energy and climate. The identification of these thematic areas goes along with the need to adapt sectoral regulation. However, effective regulations should target as many technologies as possible. Therefore, the Federal Government is keen to continue with a **technology-neutral policy**, which avoids the promotion of specific technologies and of technology-specific regulations as far as possible. While the establishment of the legal basis is ensured by a wide range of institutions, the [FDFA](#) will specifically focus on the following policies to further develop the general legal framework on AI:

- Examining the emergence of AI-specific international law and its impact on Switzerland;
- Following-up developments with regard to the visibility of AI systems in interaction with consumers;
- Monitoring developments in AI-based decision-making in the justice system (predictive justice).

In line with legislative reforms, the Working Group on AI recognises that a general **improvement of standardisation and a higher interoperability** would encourage AI-related research and innovation between relevant stakeholders.

#### 5.29.5 Infrastructure

The interdepartmental Working Group on AI includes the implementation of a suitable infrastructure among its challenges. The possibility to finance the infrastructure to increase the capacity in the field of AI is a challenge of technical nature. It relates to both a strong data infrastructure (i.e. data collection, data sharing practices) and a solid telecommunication infrastructure (i.e. high-speed connectivity and appropriate cyber security).

In terms of **data infrastructure**, following policies are mentioned:

- Supporting data exchange infrastructures in the areas of Open Access to Publication and Open Research Data. These initiatives could link up with the European electronic computer infrastructure for open science ([BEAT platform](#)) and the European Open Science Cloud ([EOSC](#));

- Ensuring the security and protection of data through on the recently revised [Federal Act on Copyright and Related Rights](#);
- Supporting sector-specific measures towards data collection, data sharing and data protection, e.g.:
  - Releasing the [Energy strategy 2050](#), which includes targets to building the data infrastructure to deploy AI within the energy sector (see also Section 4.29.6). By the end of 2027, smart metering systems (so-called smart meters) will be introduced in the electricity sector. They allow digital and fine-granular data collection of electricity production/consumption;
- Establishing a digital platform (Datahub) could be envisaged to make data exchange more efficient and to make data more easily available. Standardised machine-readable interfaces (APIs) play an important role in this process as platforms and machine-readable interfaces could be at the core of the data infrastructure.

In terms of **telecommunication infrastructure** and associated cyber security measures, the Working Group on AI refers to a detailed report on [Artificial intelligence in cybersecurity and security policy](#). It highlights the following initiatives:

- The **National Cyber Risk Protection Strategy (NCS)** presents ongoing and planned activities (2018-2022) to strengthen the protection against cyber-risks related to AI. In particular, the National Cybersecurity Centre ([NCSC](#)), formerly known as MELANI, and Governmental Computer Emergency Response Team ([GovCERT](#)) have capabilities to analyse new cyber risks related to AI;
- The **National strategy for Critical Infrastructure Protection (CIP)** contains 17 actions to improve the protection of critical infrastructure and thereby to ensure the availability of essential goods and services (e.g. information and communication services). This strategy also aims to grasp new AI opportunities to deliver critical services (e.g. cyber supply chain risks) and an overall better protection (e.g. AI-based monitoring and decision-making processes);
- The **Cyber Defence Action Plan (CDAP)** aims to systematically strengthen cyber capabilities. In addition to self-protection, the main objective is to implement the cyber aspects of the Intelligence Act and the Military Act to be able to support operators of critical infrastructure under cyber-attacks. Since 2019, the [Cyber Defence Campus of Armasuisse](#) is a platform to anticipate, detect and monitor new technologies including AI developments. The campus operates in close cooperation with both universities and economic actors;
- The **Swiss Drone and Robotics Centre (SDRC)** explores the opportunities and risks of combining robotics and AI for the security of Switzerland in national and bilateral projects.

## 5.29.6 AI to address societal challenges

### Climate and environment

The objectives to cut greenhouse gas emissions in the next 30 years constitute a strong incentive for Switzerland to employ the full potential of AI to achieve environmental objectives. Issues around environmentally sound production, recycling and disposal of the necessary infrastructure and equipment for the circular economy will increasingly gain momentum.

The Working Group on AI explicitly recognises **AI as key technology to meet the ecological requirements** of nutrition, housing and mobility systems. To this purpose, there is an attempt to make necessary data (e.g. availability of raw materials, state of ecosystems at production sites or information in production processes) easily available and integrated into the information flows of value chains and markets. In this respect, the Federal Council released a report on [Swiss Hub for Energy Data](#), as part of a national energy data infrastructure, which paves the way for energy strategy 2050, climate action and digital innovation. This policy report highlights that a national data infrastructure in the energy sector is essential for digitisation and innovation that enables the development and integration of renewable energy, improves energy efficiency, counters climate change and, last but not least, supports new business models.

The [Federal Office for Environment](#) ensures that environmental information is openly available within digital datasets that can possibly be used for AI applications. This institution also accompanies the environmental challenges related to AI vis-à-vis the circular economy challenges.

AI technologies can help to predict demand for energy, food or consumer goods. Furthermore, AI has the potential to reduce inefficiencies in production planning, by managing information about raw materials as much as integrating information about the production ecosystems including environmental and social aspects.

Finally, AI can distribute this information to consumers in order to identify and purchase not only the cheapest but also the most environmentally friendly product for given individual consumption needs.

In sum, AI will play a key role in the energy sector, especially in the transformation from a centrally organised system to a decentralised and renewables-based one, as it optimises network planning results with forecasts of consumption and production. AI technologies can be promoted either through the targeted development of environmental applications or indirectly through the provision of large amounts of environmental data (push approach).

### **COVID-19 pandemic**

Concerning the current **pandemic of COVID-19**, the Federal Office of Public Health launched the [SwissCOVID app and contact tracing](#), this institutional page provides information about many dimensions (e.g., relevance to citizens, how to install) of the app as much as about its technical aspects (e.g., using Bluetooth and the API of Amazon and Google, using Amazon Cloud Front, using Replay attacks and AEM-tempering). Another digital initiative of the Federal Office of Public Health is the [Coronavirus online check](#).

Furthermore, the Swiss Tropical and Public Health Institute (Swiss TPH) has a whole web page related to [COVID-19 Activities at Swiss TPH](#) and encompassing the use of AI and machine learning. The Swiss TPH is an associated institute of the University of Basel, and as a public organisation, is partially supported by the Swiss Federal Council and the Canton of Basel-Stadt. The greater part of its funding comes from competitively acquired project funds. Specifically, the following initiatives are presented:

- Mitigation strategies for communities with COVID-19 transmission in Lesotho using AI on chest x-rays and novel rapid diagnostic tests ([Mistral](#));
- COVID-19 Outbreak Response combining E-health, Serolomics, Modelling, Artificial Intelligence and Implementation Research ([CORESMA](#));
- Using model-based evidence to optimise medical intervention profiles and disease management strategies for COVID-19 control ([MODCOVID](#)). This approach combines mathematical models and machine learning with product development decision processes;
- Providing real-time clinical data to improve risk assessment and response, deploying an established mHealth Surveillance Outbreak Response Management and Analysis System ([SORMAS](#)).

### **5.29.7 Monitoring and future update**

The progress of the development and deployment of AI in Switzerland will be monitored and evaluated on a regular basis.



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