

The economic opportunity of AI in the EU

Beyond the hype – boosting EU competitiveness with generative AI

An Implement Consulting Group study commissioned by Google



Beyond the hype

Boosting EU competitiveness with generative AI

AI has evolved rapidly with the technological breakthrough of generative AI in 2022 and the hype around the new possibilities that followed in 2023.

These rapid events have led many to believe that generative AI has the potential to become the most powerful technology in decades.

This report looks beyond the hype and assesses the potential of generative AI in relation to Europe's productivity challenge as pointed out in the recently published **Draghi report**.

To quantify the potentials, Implement has deployed economic modelling using the approach developed by the international investment bank Goldman Sachs.

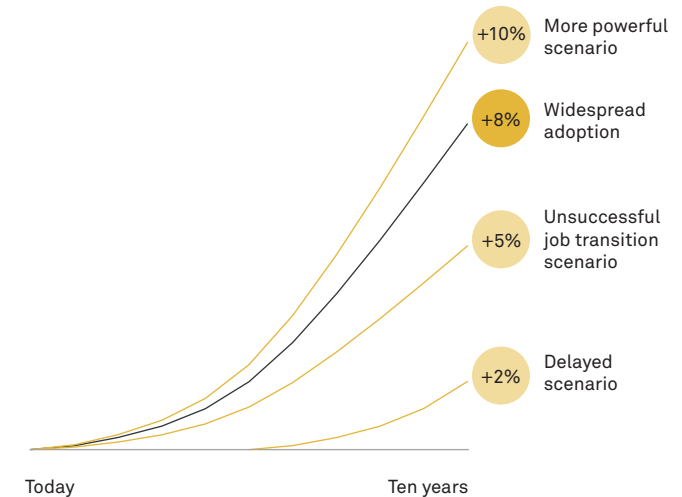
This research confirms the economic potential and shows how generative AI can boost productivity in key EU sectors. AI, and in particular generative AI, can make countries more prosperous, productive, innovative, creative and secure.

As also found in the Draghi report, the EU's weak position in AI development is part of a wider technological gap that Europe has encountered over the past 10-15 years. The report points to the crucial importance of addressing that gap.

On this journey, there will be plenty of pitfalls, paradoxes and tensions that decision-makers will need to navigate.

Making AI benefit society as a whole requires an adaptive, human-centric and trustworthy approach.

Estimated potentials of generative AI in the EU
% of GDP



We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.

Roy Amara, American scientist and futurist, Stanford Research Institute.

The EU continues to lose its global economic and technological position

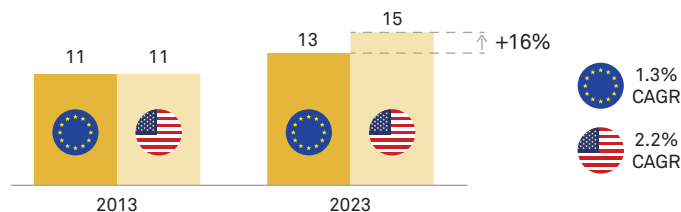
The EU's widening economic gap ...

The EU's economic and technological position in the global economy has weakened, raising concerns about the EU's economic security and global competitiveness. Since 2019, global GDP has grown more than twice the rate of the EU's. Comparing the EU economy to the US shows that:

- The US economy grew nearly one percentage point faster than the EU economy every year since 2010.
- The US economy is now 16% larger than the EU economy.
- The economic gap results from slow labour growth in Europe and a widening productivity gap with the US.
- During the ICT revolution from 1995 to 2010, US productivity grew more than twice as fast as Europe's (2.3% per year compared to 1.1% in Europe). After 2010, productivity growth in both economies slowed and converged to similar rates. The EU productivity gap has thus persisted for over a decade.

In the coming decade, capturing the opportunities from AI will be paramount to ensure that the EU's global position does not worsen further.

Gross domestic product (real GDP) € trillion, 2010 price level



Notes: According to the IMF, China's GDP (in PPP) is already larger than the EU's, and India's GDP is around half the size of the EU. Both China and India are growing much faster at 7.3% and 6.5%, respectively, for the same period. These countries are far behind the prosperity levels of Europe and the US and are on very different growth paths. Their strategic investments in critical technology areas are already challenging the EU's competitive advantage in these areas.

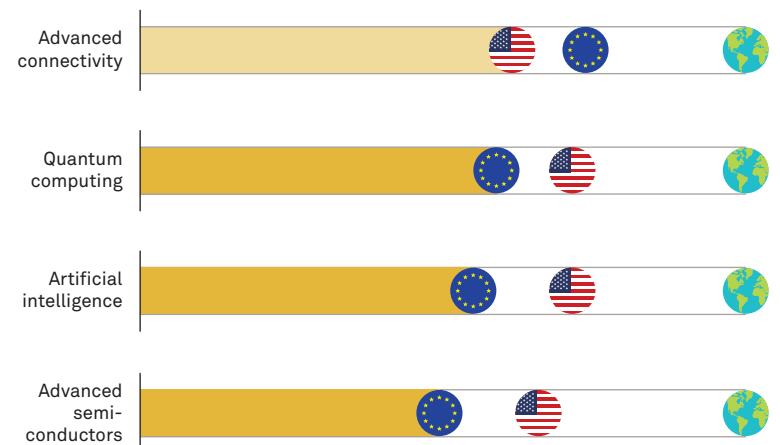
... will widen further if the EU's R&D and technology gap remains

The EU is behind on R&D spending and on three out of four critical technologies of the future.

Research and development expenditure % of GDP



EU's proximity to global best practice Index, theoretical global best practice = 100

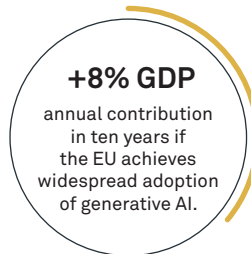


Generative AI holds large economic potential and can help the EU's international competitiveness

AI can increase prosperity beyond current forecasts

Generative AI technology is developing faster than previously anticipated, and the peak economic contribution could come sooner than expected – in around ten years.

In the peak year, generative AI alone could boost the EU's prosperity (GDP) by **€1.2-1.4 trillion**



The boost from the widespread adoption of generative AI is potentially so strong that European growth can exceed current forecasts. AI can exceed historical contributions from technology to economic growth.

Productivity boost and successful job transitions are key

1.4 percentage point annual productivity potential in the peak year.



Productivity boost from people working with generative AI.



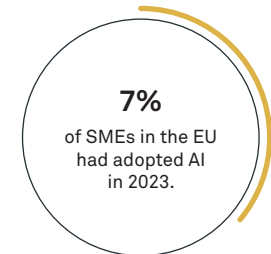
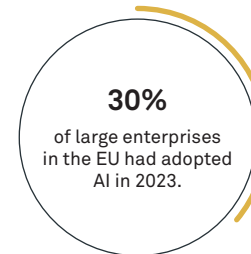
Freed-up time when generative AI helps to automate some tasks at work.



Re-prioritised and re-employed time to other value-creating activities.

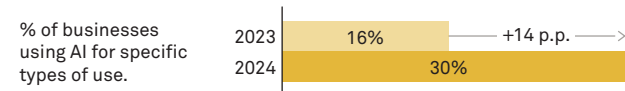
Productivity gains require widespread generative AI adoption

The EU needs to ensure that the newest AI technologies are available to everyone, including SMEs, which lag behind on AI adoption.

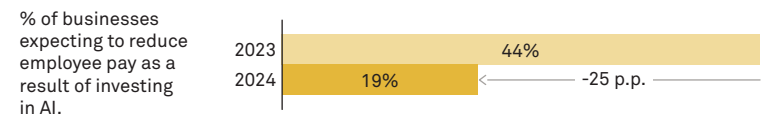


AI use in businesses shows signs of acceleration

Recent polling data shows that the use of AI has doubled in the EU since 2023 ...



... while concerns about jobs have declined



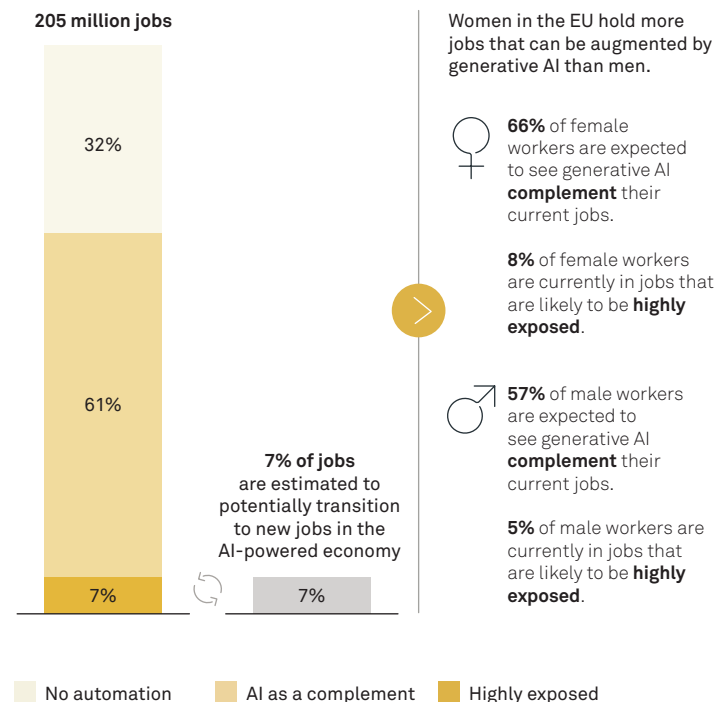
61% of jobs are expected to be augmented by generative AI and drive productivity gains, while only 7% of jobs could need long-term job transition

The EU economy has generated 20 million new jobs over the last 10 years.

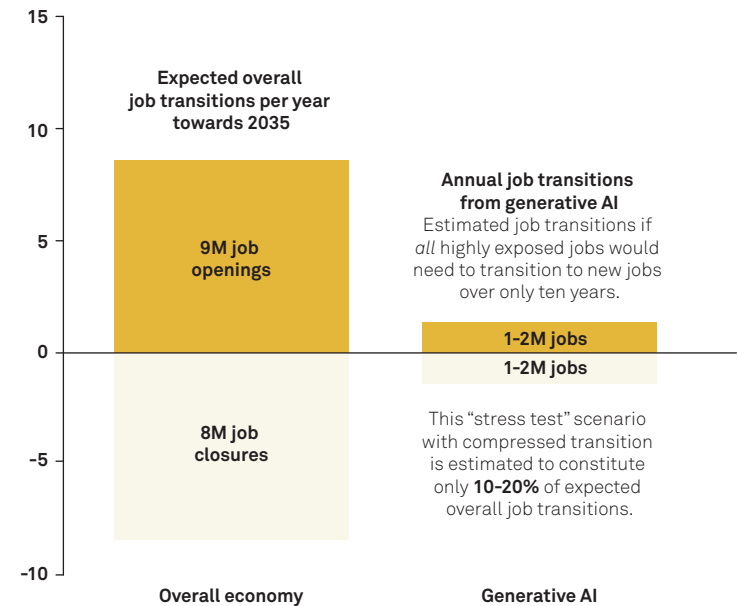
Conservatively, the study assumes **no change** in total employment.

Job openings and closures from generative AI are small compared to the expected total job transitions

Share of jobs and generative AI potentials
% of total employment at workplaces in the EU



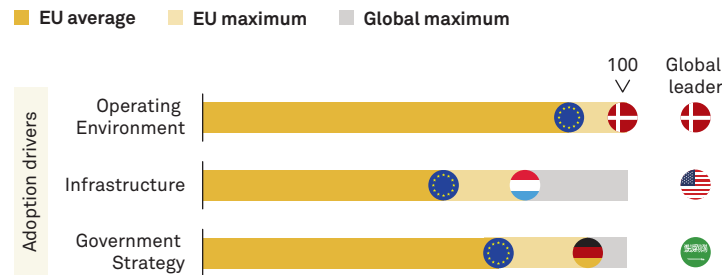
Estimated annual job openings and closures in the EU
Million jobs



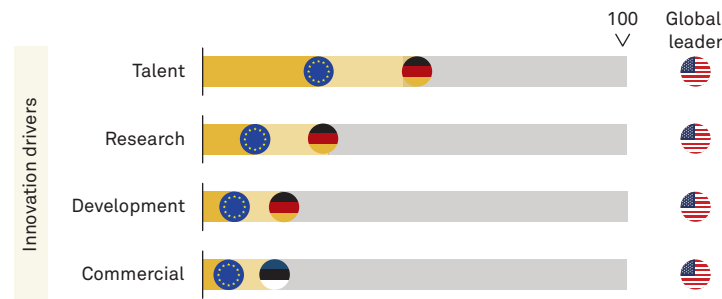
The EU has strong fundamentals for AI adoption but underinvestment in skills, innovation and research threatens its AI potential

The EU performs well on basic AI adoption drivers but lags behind the US on AI infrastructure ...

The EU's AI capacity according to the Tortoise Global AI Index
Global AI Index, score out of 100 (global leader)

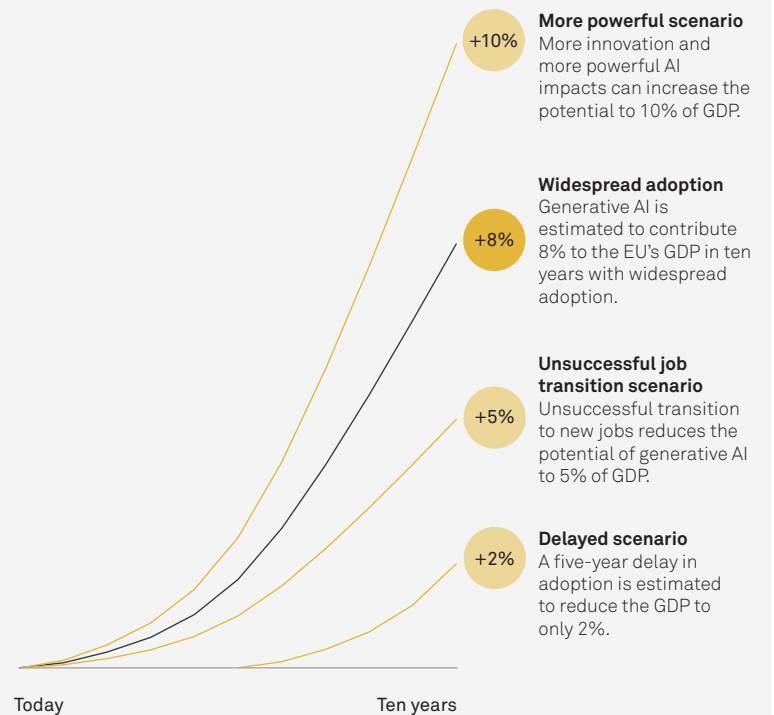


... and is significantly behind the US on AI-related R&D, innovation and talent



Investment in skills, innovation and research and successful job transitions will determine how much of the potential is captured

Estimated potentials of generative AI across scenarios
% of GDP



Note: The Tortoise Global AI Index is underpinned by 111 indicators collected from 28 different public and private data sources and 62 governments.

AI can help solve key societal challenges in the EU

Reduce labour shortages

AI can alleviate labour shortages and skill gaps in the EU

25% of EU job positions report persistent shortages.

The most severe shortages are in healthcare, electronics, software and metal trades.

Shortages will worsen with the ageing of the workforce.

Generative AI can help bridge the skills gap and free up much-needed labour.

40%

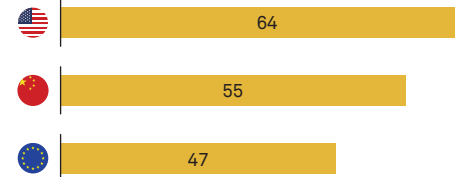
of staff shortages in healthcare in Europe can be alleviated by generative AI.

Boost scientific discovery

AI can accelerate scientific breakthroughs and innovation in the EU

The EU spends only 2% of GDP on R&D compared to 6% in leading countries. The EU also underperforms on innovation indicators.

Global Innovation Index (GII) 2023 Index



AI holds great potential for improving EU competitiveness through accelerated innovation:

- Data analysis and interpretation
- Experiment automation
- AI-enabled simulation
- Molecular predictions
- Literature-based discovery
- Genomics

Improve public services

AI can enhance quality and efficiency of public services

EU public institutions struggle to maintain service quality and meet growing demand. Generative AI offers the potential to:



Free up resources to alleviate bottlenecks or redirect to other services.



Improve service quality by enabling new offerings, greater transparency and accessibility.

Generative AI can improve public services and citizen satisfaction within existing budgets.

€250 billion potential from generative AI in public services in ten years.

To capture the benefits of the next wave of AI, the EU needs to promote innovation, invest in skills and ensure clear rules



Enable innovation and invest in AI research and development

- Bridging the gaps that prevent the transformation of research into successful ventures.
- Making compute capacity and AI tools more available to entrepreneurs and scientists for piloting.
- Supporting strategic EU-US AI research collaboration, technology transfer and mobility of researchers.



Create a conducive and aligned AI regulation and global governance

- Avoiding siloed approaches to AI regulation and ensuring copyright rules that support innovation and creativity.
- Providing greater clarity for developers, adopters and users on what uses are not allowed.
- Encouraging privacy and security principles to safeguard personal data.
- Reducing barriers to digital transatlantic trade.



Promote widespread adoption and universal accessibility

- Integrating sectoral AI applications in key European industries to increase productivity.
- Leading with the public sector adoption of AI solutions.
- Creating national strategies to spur AI adoption across the economy.
- Giving SMEs an “AI jumpstart” through technical assistance, training and guidance.



Build human capital and an AI-empowered workforce

- Using data analytics to identify skills gaps and adjust education and training systems.
- Focusing training and upskilling on how workers can work together with the AI.
- Reskilling workers in jobs with high AI displacement risk.
- Prioritising adult learning initiatives that enable workers to continuously update their skills.



Invest in AI infrastructure and compute power

- Ensuring the right incentives and regulations for private and public investments in compute capacity, such as high-performance computing (HPC).
- Enabling secure data flows in trade deals and promoting regulatory compatibility.
- Promoting cross-border AI infrastructure and subsea cables while advancing decarbonisation strategies for data centre electricity emissions.

Including:



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Barcelona	2	Salida	10:20
Valencia	3	Salida	10:25
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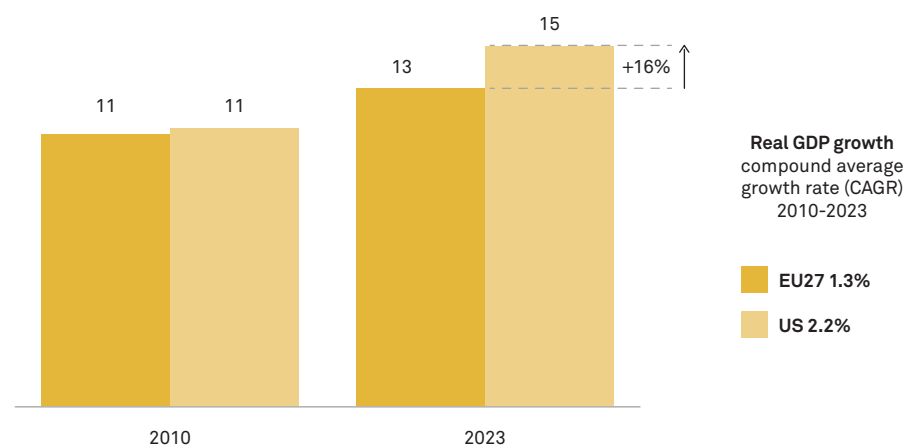
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The EU competitiveness gap

This report looks at the role of generative AI in relation to the EU's growing economic and technological gap.

The EU is gradually losing economic strength relative to the US

Gross domestic product (GDP)
€ trillion, 2010 price level



- As pointed out in the Draghi report, EU economic growth has been persistently slower than in the US over the past two decades.
- In 2010, the EU and US economies were almost the same size, namely EUR 11 trillion (or USD 15 trillion).
- Over the following 13 years, the US economy grew nearly one percentage point faster than the EU economy in real terms (i.e. constant prices).
- By 2023, the US economy had become 16% larger than the EU economy in real terms, which is consistent with the findings in the Draghi report of a growing gap since 2010.
- The emerging economic gap between the two leading Western economies is largely a result of a growing labour supply challenge in Europe and a persistent productivity gap with the US (see next page).
- The shift in relative economic size implies that the EU is beginning to see a weakened relative economic position, and this raises concerns about Europe's economic security and global competitiveness.
- This is also reflected in the **EU Commission's Economic Security strategy** from 2023, which aims to, among other things, improve competitiveness and economic resilience in the EU.

Note: Numbers are rounded. International comparisons of economic sizes over time should be handled with care. The standard GDP metric (normally expressed in current US dollars) is useful for measuring economic output at a point in time but not for evaluating relative time trends. This is because it is strongly influenced by exchange rate fluctuations, and it measures output in current prices, which differ across nations. A better metric for international comparisons is purchasing power parity (PPP)-adjusted GDP. This corrects for exchange rate fluctuations and differences in national prices. In this analysis, we correct for these issues to arrive at meaningful comparisons over time. In this analysis, we deliberately chose 2010 as a starting year for two reasons: First, 2010 is the standard base year for economic statistics, and real GDP is reported in 2010 prices by leading institutions such as Eurostat and IMF. Second, and just as important, in 2010, the EU and US economies were almost the same size by any measure of GDP (i.e. regardless of whether measured in current prices or PPP). For this reason, we use official GDP data for 2010 and report in trillion euros using the ECB average exchange rate for 2010 (1 EUR = 1.326 USD). We then apply real growth rates for each of the two economies, and our 2023 GDP is thus the real GDP reported in euro at the 2010 price level. Source: Implement Economics based on Eurostat, IMF and ECB. See also the Draghi report (2024), CER (2023) and Breugel (2023).

The GDP gap results from EU labour challenges and a persistent productivity gap relative to the US

Growing labour challenges in the EU ...

Population

Average annual growth, 2010-2022



Employment share of population

Average annual growth, 2010-2022



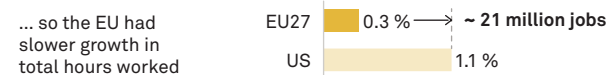
Average hours worked per year

Average annual growth, 2010-2022



Total hours worked per year

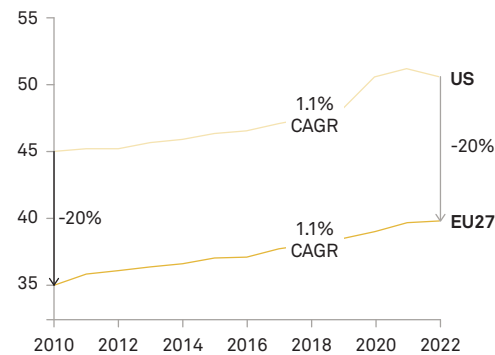
Average annual growth, 2010-2022



... and persistent productivity gap

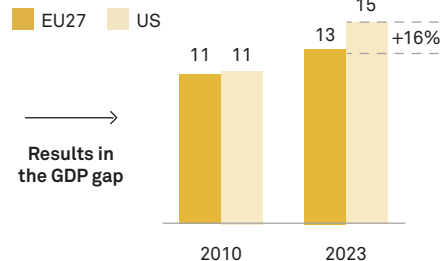
Hourly labour productivity

EUR per hour worked (2010 prices)



Gross domestic product (GDP)

Trillion euros, 2010 price level



Results in the GDP gap

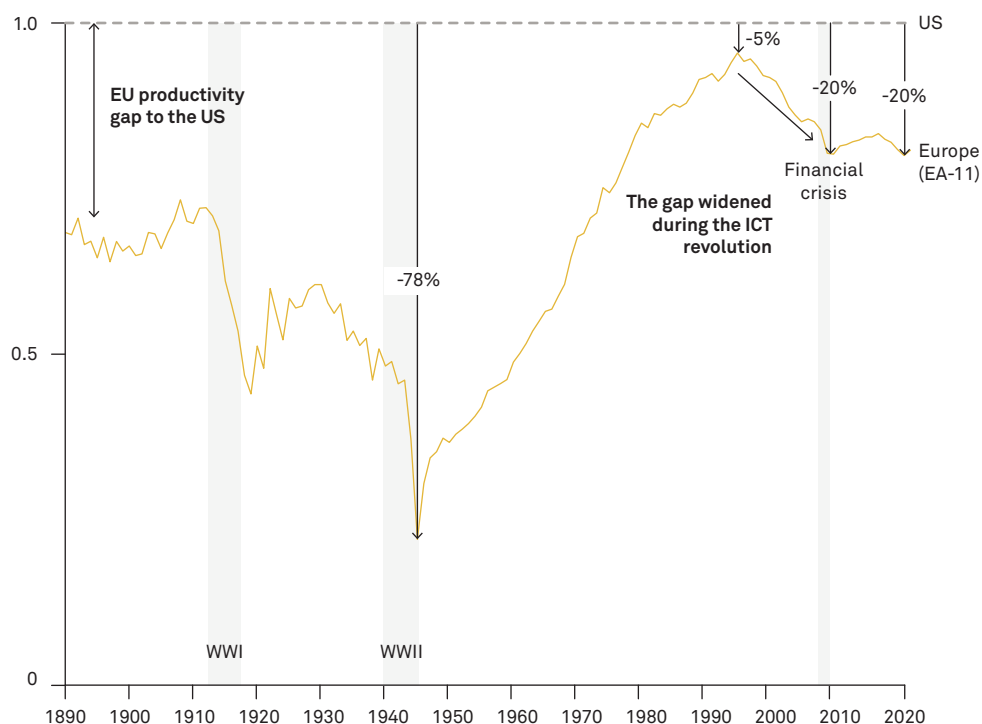
- The 16% gap in GDP between the EU and the US is a result of two trends – growing labour challenges in Europe and a persistent productivity gap relative to the US.
- Firstly, the EU's labour supply challenge stems from faster US population growth and a decline in average hours per worker in the EU:
 - The US population grew at 0.6% per year, while the EU population grew only 0.1% per year.
 - Both the EU and the US increased the number of people employed during the period and at almost the same pace.
 - The average US worker worked around 1,800 hours a year in both 2011 and 2022, whereas the average EU worker worked 60 hours less in 2022 compared to 2011 (or -0.3% per year).
- Overall, the EU's total hours worked grew by only 0.3% per year since 2010 compared to 1.1% in the US. This gap equals 21 million EU jobs.
- Secondly, productivity grew at similar rates since 2010 and the gap of around 20% has persisted since the financial crisis (see next page).
- Consistent with the stable productivity gap, real hourly labour productivity grew at the same pace in the EU and the US after the financial crisis.

Note: Numbers are rounded. Conversion of real GDP per hour worked denominated in 2010 prices and the average EUR/USD conversion rate for 2010 as per the ECB (1 EUR = 1.326 USD). According to the IMF, China's GDP (in PPP) is already larger than the EU's, and India's GDP is around half the size of the EU. Both China and India are growing much faster at 7.3% and 6.5%, respectively, for the same period. These countries are far behind the prosperity levels of Europe and the US and are on very different growth paths. Their strategic investments in critical technology areas are already challenging the EU's competitive advantage in these areas. Source: Implement Economics based on Eurostat, OECD, IMF and ECB.

The EU-US productivity gap increased during the ICT revolution in the mid-1990s and has endured since

Relative labour productivity Ratio of EU to US hourly labour productivity

The graph shows labour productivity in Europe relative to the US. A ratio of 1.0 would mean that European and American workers have the same hourly productivity. In 2022, the ratio was around 0.8, meaning that the average worker in Europe produced 20% less value per hour worked compared to an average American worker.



- After World War II, the large EU countries (11 countries, EA-11) experienced five decades of catching up to the US and saw continuous productivity improvements.
- By 1995, Europe had almost closed the productivity gap, reaching 95% of the US productivity level. Since then, the gap widened gradually until around the financial crisis in 2008.
- Hourly productivity grew by 2.3% per year in the US between 1995 and 2010 and only 1.1% in the 11 EU countries in the same period.
- According to the Draghi report, the main reason why EU productivity diverged from the US in the mid-1990s was Europe's failure to capitalise on the first digital revolution led by the internet – both in terms of generating new tech companies and diffusing digital tech in the economy.
- The 20% productivity gap has remained stable since 2010, with US and European productivity growing at similar rates.

“ Europe largely missed out on the digital revolution led by the internet and the productivity gains it brought. In fact, the productivity gap between the EU and the US is largely explained by the tech sector.

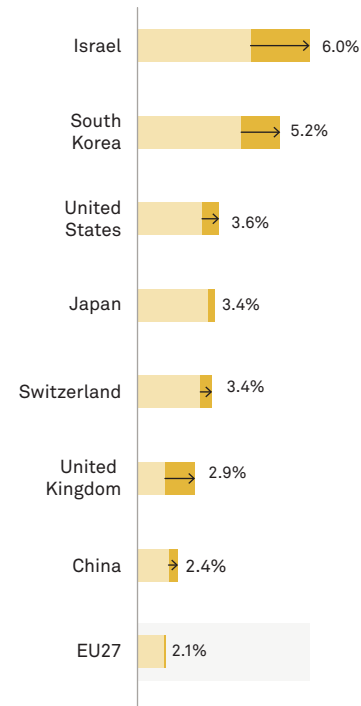
Mario Draghi report on The Future of European Competitiveness.

Note: The data for Europe covers 11 of the current euro area countries (EA-11), namely Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, the Netherlands and Portugal.
Source: Implement Economics based on data from Long-Term Productivity Database (A. Bergeaud, G. Clette and R. Lecat), which uses GDP per hour worked in USD 2010 PPP and Draghi (2024).

The EU is behind the US on R&D spending, digital innovation and future technologies

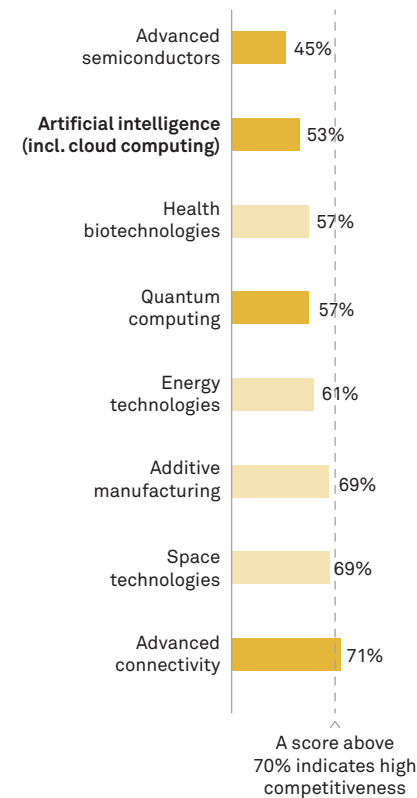
Research and development expenditure
% of GDP

■ 2022 or latest available year ■ 2012

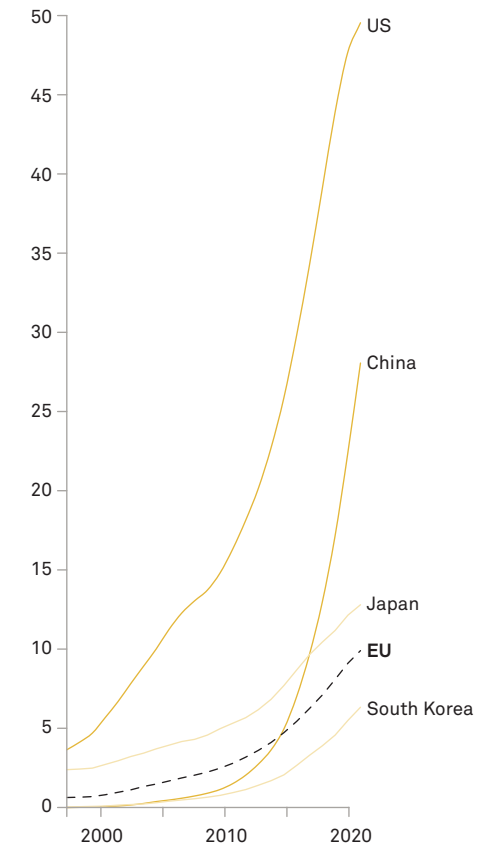


The EU's performance on critical technologies
Proximity to the theoretical global best practice = 100%

■ The EU Commission's priority-critical technology areas ■ Other technologies



Number of patents in advanced digital technologies
Thousands



Note: The EU's proximity is measured by analysing science (33% of the score) and industry strength (67% of the score), considering factors like start-up funding, global export market share and the proportion of global value added for related products to see how it compares to global leaders. Priority-critical technology areas according to the European Commission.
Source: Implement Economics based on OECD, Digital Europe, Frontier Economics and the Financial Times based on Association of the Bavarian Economy.



- Innovation and scientific breakthroughs are vital for economic growth and competitiveness.
- However, the share of GDP allocated to R&D in the EU has remained unchanged over the last ten years, whereas it has grown in most other countries.
- The EU allocates only 2% of its GDP to R&D, lagging behind the US (3%) and leading countries, such as South Korea or Israel (5-6%). This disparity will hinder the EU's economic growth and competitiveness.
- The EU is lagging behind on artificial intelligence and cloud computing, which is a key part of the AI value chain. 34% of EU businesses have adopted cloud computing, but this is less than half of the Commission's 2030 target of 75%.
- Moreover, while the US and China have made large advances in the number of patents for advanced digital technologies, the growth has been more modest in the EU. In the field of AI, China led global AI patent origins with 61% in 2022, significantly outpacing the US (21%) and the EU (2%).
- In terms of developing new AI models, the US is still the leading source of top AI models. In 2023, 61 notable AI models originated from US-based institutions, far outpacing the EU's 21 and China's 15.



02

The EU's economic opportunity from AI

The economic opportunity arising from humans working together with generative AI is key to Europe's competitiveness and economic security in the next decade.

AI can help humans solve tasks faster and better – and with generative AI, machines can now understand and interact in language, sound and images

Artificial Intelligence (AI)

- AI is a general term for anything that allows computers to carry out human-like behaviours, including rule-based programmes.

Machine Learning (ML)

- ML is a subset of AI where machines do not need to be explicitly programmed. They use algorithms to identify and learn patterns in data, apply that learning and improve themselves to make better and better decisions.

Deep Learning (DL)

- DL is a subset of ML where computers learn in a way that mimics the human brain. In deep learning, machines build layers of knowledge that are increasingly complex.
- These AI models are typically trained on specific data sets and used within a given field or industry.

Capabilities include:

Forecasting and prediction

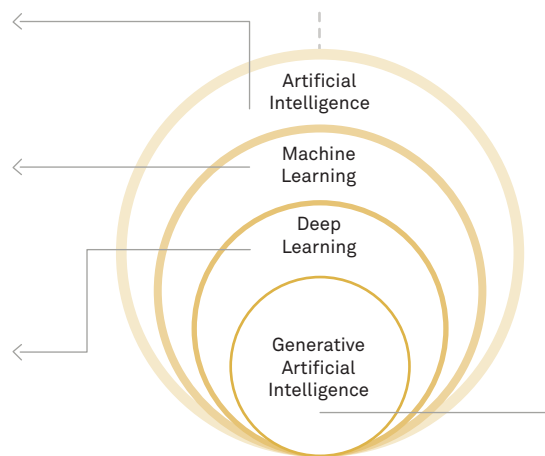
In addition to weather forecasting, similar predictive models are employed in managing warehouse inventories.

Categorisation and recognition

In addition to email spam filtering, AI can be utilised to categorise and recognise patterns in legislative documents.

Optimisation

When it comes to optimisation, AI not only aids navigation via GPS but also plays a crucial role in enhancing the efficiency of energy consumption in data centres.



Generative AI

- Generative AI is a new form of AI made publicly available in 2022. It can understand text, code, images, sound and video and use it to generate or synthesise new content.
- Generative AI models are trained on huge general data sets to gain a general comprehension of text, visuals, code and sound.
- Generative AI can be used generally across almost any field or industry.

New capabilities include:

Create new unique images

For example, generating an image of a product that does not yet exist based on user input in natural language.

Interact with voice and sound

For example, translating a doctor's memo into a structured text or following up with a customer in writing based on a phone conversation.

Analyse and revise text and code

For example, translating text and adapting it to a different target group or translating code between programming languages.

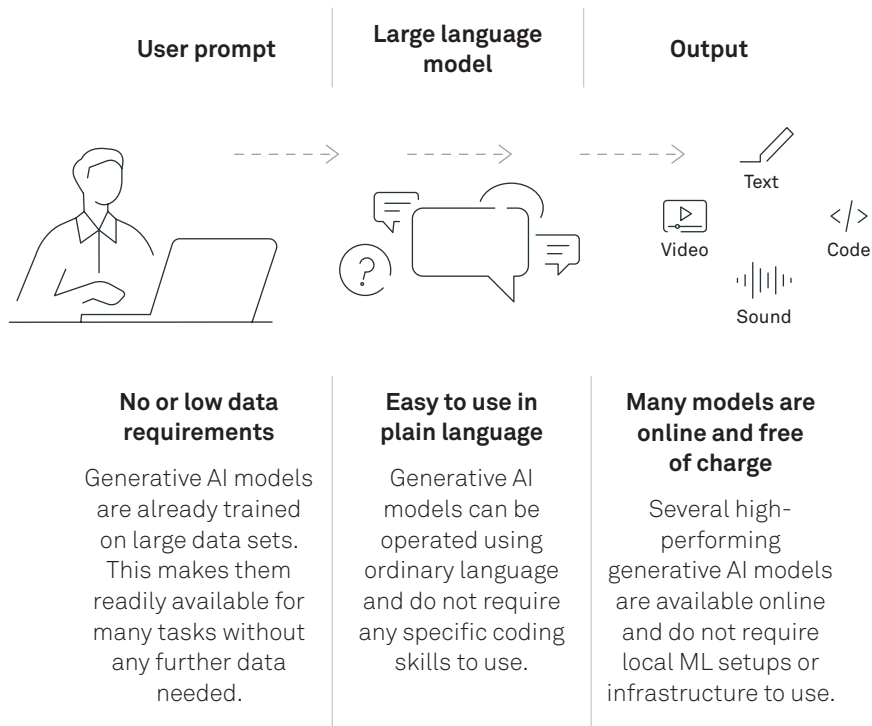
Do research and analyse data

For example, searching the web for relevant information and synthesising conclusions from large data sets.

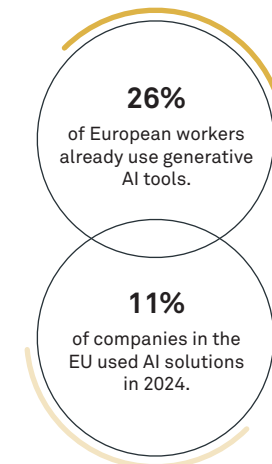
Note: An algorithm is a detailed set of instructions that a computer follows to carry out a task or solve a problem.
Source: Implement Economics based on expert interviews.

Recent developments have increased the capabilities and availability of AI models and have accelerated uptake

Generative AI models have strong built-in capabilities and are easy to work with ...



... and many users have already adopted the technology



Solutions adopted at a company level are driven by non-generative solutions today. Generative AI is still at an early stage and is yet to be widely adopted at a company or institution level.

Leveraging the full potential of AI will require further research, development and innovation

AI capabilities and requirements by level of development

	Organisational ML-based AI	Generic pre-trained models used online	Adaption of pre-trained models using APIs	Specialised fine-tuned models	Foundation models
Solvable tasks	Specific	General	General and moderately specialised	General and specialised	Most
Example	E.g. detection of flawed products in manufacturing	Online chatbots, e.g. Gemini or ChatGPT	Organisation-level automation solution, e.g. auto-replies	Pre-trained model like Llama trained further on context-specific data	Model trained from the ground on new data, e.g. BLOOM
Requirements					
Competences for use					
Competences for integrating solution					
Data and infrastructure					
	Pre-2022	Current fast-adopting models	Next level of adoption	Only adopted by few frontrunner organisations	New frontier of AI

Figure explanation
 No requirements
 Highest requirements

- Generative AI is still in its early phase using multi-purpose pre-trained models to solve general tasks.
- To fully harness the potential of generative AI, further development of models is essential for highly specialised tasks. This includes tasks that demand precise industry terminology, such as writing legal documents, adhering to specific protocols like medical practices or following brand guidelines to create commercial content for a particular company.
- In addition, models may need to be fine-tuned to operate effectively in specific sectoral or cultural contexts.
- Developing new or specialised models will require new organisational skills, more data, more computing power and better infrastructure.

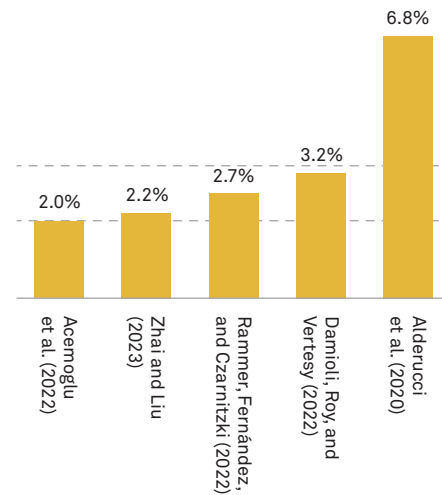
Note: Training or fine-tuning generative AI models generally requires significantly more computational resources compared to classic machine learning training. Source: Implement Economics based on OECD.

AI has great economic potential which can be further boosted by generative AI

AI can increase productivity

Academic studies conclude that labour productivity typically increases by 2-3 percentage points per year after firm-level AI adoption. The studies have been carried out on early adopters of AI technology and, as such, cannot be extrapolated to the general effects of AI on productivity.

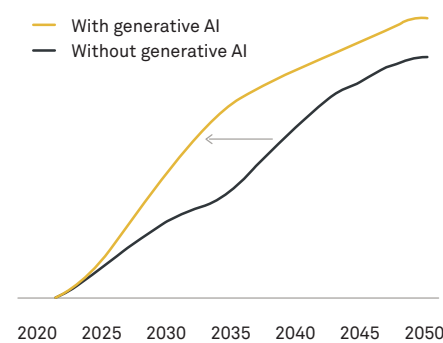
Growth in labour productivity from AI adoption
Percentage points



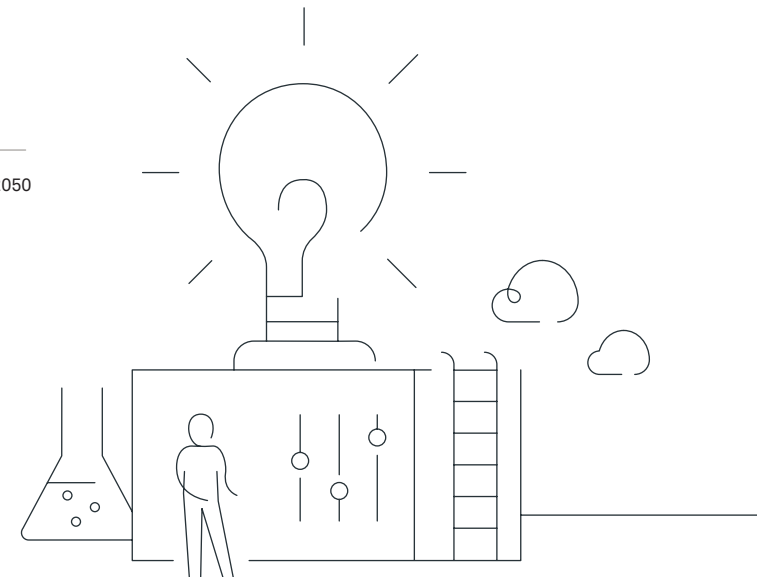
Generative AI advances automation

Generative AI can advance automation by nearly a decade because it is easier to use for individuals and organisations. However, significant uncertainty about adoption rates and speed of realisation of its benefits remain.

Automation potential
Adoption of AI technology

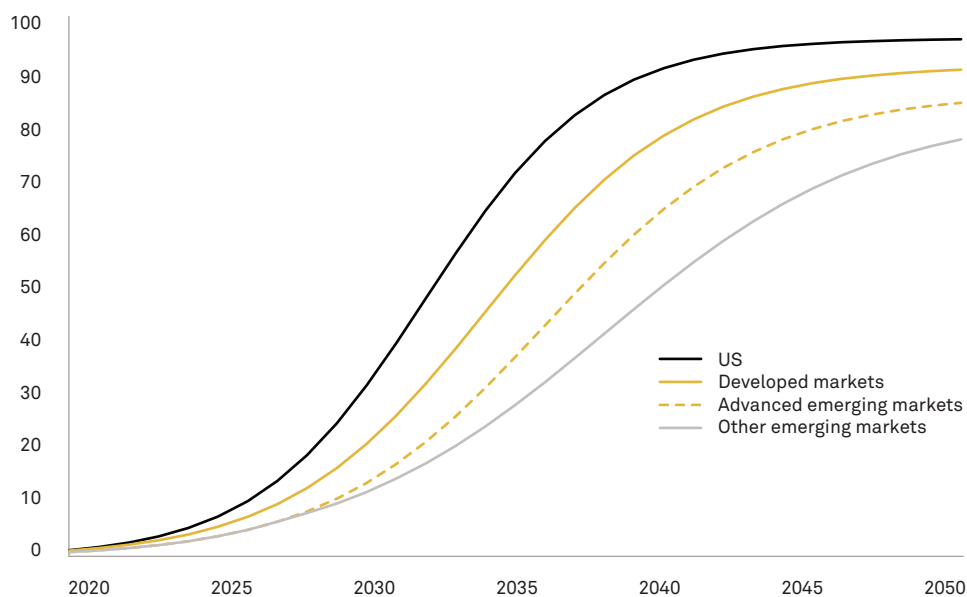


- AI has evolved rapidly with the recent break-through of generative AI. Due to its user-friendly nature, generative AI is expected to greatly accelerate the potential of AI to create economic impacts.
- Generative AI is only a part of AI's overall economic potential. Some studies estimate with some uncertainty that generative AI accounts for around one-third of the total effect of AI.
- This report estimates the macroeconomic potential of generative AI while recognising the significant economic potential of other types of AI.



Full adoption of generative AI is expected to take place over 20-25 years, with the EU expected to achieve adoption 2-3 years after the US

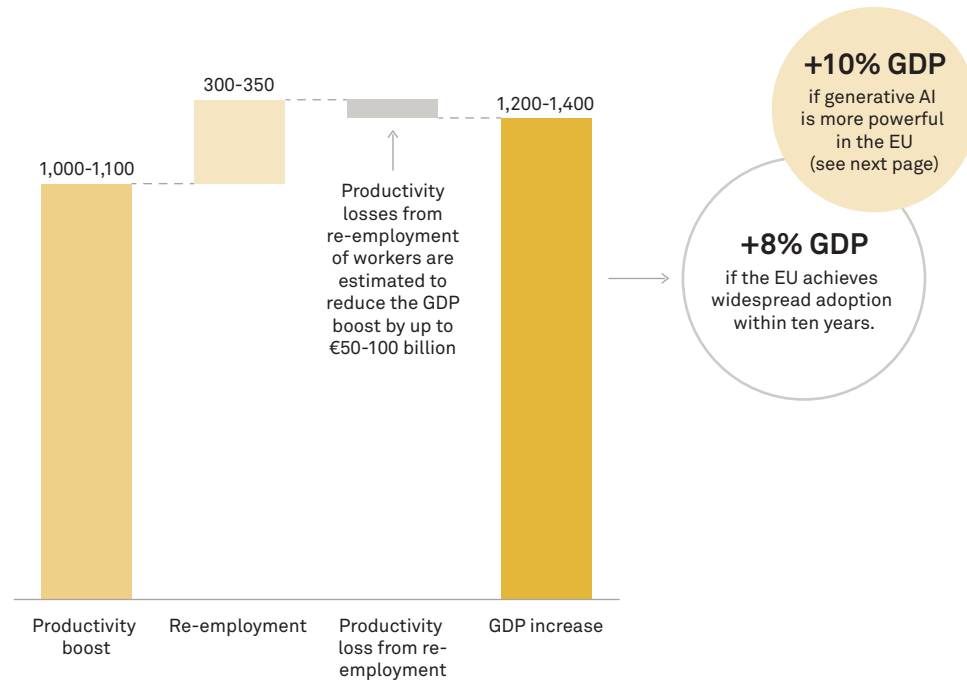
Adoption of generative AI
%



- Compared to other historical technological innovations, generative AI is more powerful, more user-friendly and easier to adopt.
- Widespread adoption (50% adoption) is expected to be reached in the mid-2030s. However, full adoption is expected to take place over a longer period, namely 20-25 years.
- The speed of adoption will be at its highest in the middle of the adoption period in about ten years from now, and this is when the impact on the economy will have its peak year.
- In line with other historical technological revolutions (e.g. electricity and the steam engine), new technology is expected to spread first in the country leading its development – in this case, the US.
- Developed markets in the EU are expected to follow the US adoption rate with a 2-3-year lag, with an expected peak in the mid-2030s.
- In line with Briggs and Kodnani (2023a), this report assumes that the eurozone and the Nordic economies (Denmark and Sweden) follow this trajectory.
- Emerging markets, including Central and Eastern Europe, are expected to adopt the new technology at a slower rate, expectedly peaking in the second half of the 2030s.

Fully pursuing the generative AI opportunity could boost EU productivity and free up much needed labour

The potential impact of generative AI on GDP in the EU in a widespread adoption scenario
 € billion increase from baseline GDP after a ten-year adoption period

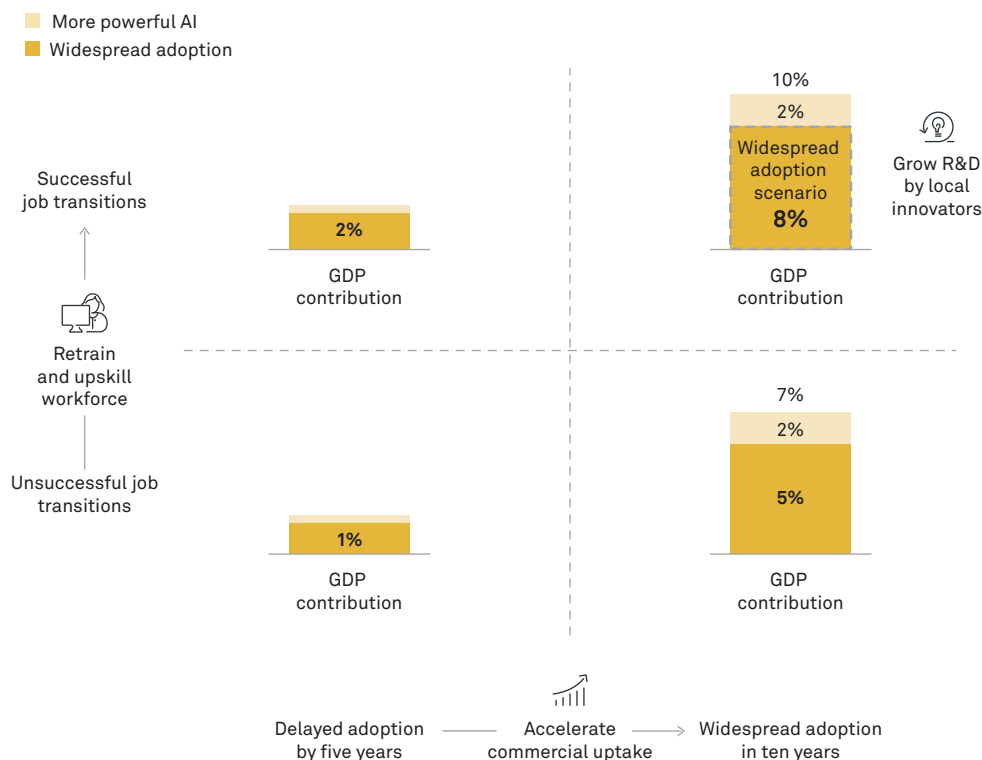


- If the EU widely adopts generative AI, we estimate a potential increase in GDP of €1.2-1.4 trillion in ten years.
- The dominant impact of generative AI is a productivity boost to the majority of workers (61%) by augmenting their capabilities, quality and efficiency, which is estimated at €1.0-1.1 trillion for the EU.
- The estimate includes impacts of re-employment of a small share of workers (7%), where generative AI is freeing up a significant share of work for other tasks. This is estimated at €300-350 billion in the EU.
- The estimate accounts for the possible productivity loss associated with re-employment to other occupations. This reduces the estimate for the EU by up to €50-100 billion.
- At its peak, the productivity effect of generative AI in the EU is estimated to be equivalent to 1.4% annually.
- Generative AI is so powerful that the EU's future economic growth could exceed current long-term GDP forecasts, and leading banks are raising growth forecasts from as early as 2028.

Note: The estimate assumes widespread adoption of generative AI over a ten-year period. There is much uncertainty around the capability and adoption timeline of generative AI. The size of the productivity boost depends on the difficulty level of tasks that generative AI will be able to complete and the number of jobs it can automate. GDP is in 2022 levels. The average number of work activities that potentially can be performed by generative AI across all types of tasks for both complemented and highly exposed workers corresponds to 20-25%. Our estimate is the isolated potential of generative AI. The estimated boost from generative AI may not be fully additive to GDP trends, as the GDP forecast already assumes a growth contribution from new technologies and generative AI may substitute some of that. Also, the boost from generative AI may be partially offset by an underlying growth slowdown. Source: Implement Economics based on Eurostat, O*Net, Briggs and Kodnani (2023a), BNP Paribas (2023) and Dell'Acqua et al. (2023).

Investment in skills, innovation and research and successful job transitions will determine how much of the potential is captured

The potential impact of generative AI on GDP in the EU
% annual contribution from baseline GDP after ten years

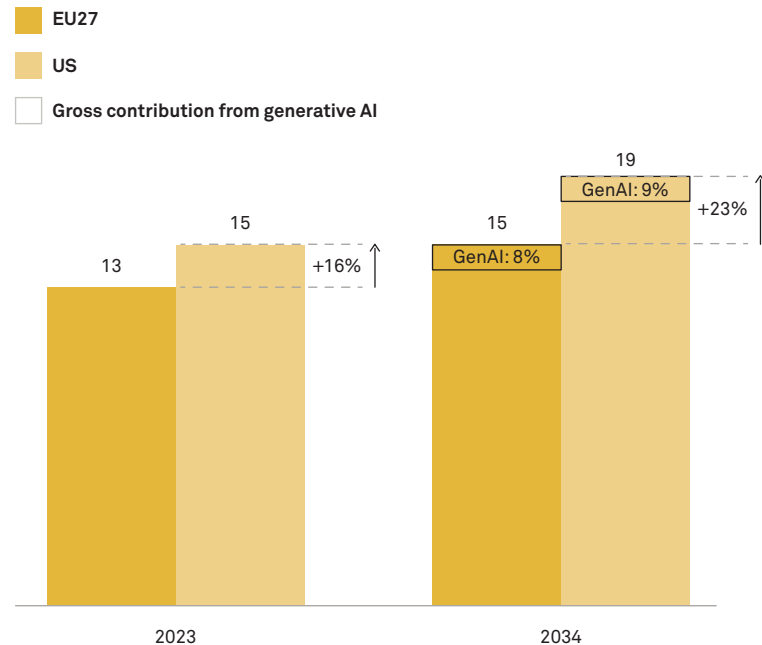


- The potential of generative AI is equivalent to 8% of GDP in our main scenario (widespread adoption). This assumes productivity gains, re-employment and technology adoption consistent with the assumed adoption curve.
- A five-year delay in capturing the benefits of generative AI is estimated to reduce the GDP growth potential in ten years from 8% to only 2%.
- If the EU achieves widespread adoption but fails to reskill and effectively reemploy its workforce, the potential impact of generative AI would drop from 8% to 5% of GDP.
- In an ideal scenario where the EU can significantly boost innovation, leading to the development of more powerful AI, while also ensuring widespread adoption and successful job transitions, the economic potential of generative AI could rise to 10% of GDP.
- This underlines the importance of succeeding in all three dimensions to fully capture the potential of generative AI in the EU:
 1. Accelerate commercial uptake.
 2. Grow R&D by local innovators.
 3. Retrain and upskill the workforce.

Note: GDP figures are expressed in 2022 levels. The "more powerful AI" scenario assumes a productivity boost from generative AI for complemented workers 1.5x larger than baseline assumptions. The "unsuccessful reskilling/re-employment" scenario assumes no or little reemployment of displaced workers and freed-up resources for complemented workers. Source: Implement Economics based on Eurostat, O*Net and Briggs and Kodnani (2023a&b).

The gap between US and EU GDP is set to widen – seizing the AI economic opportunity is essential to avoid further widening

GDP in the EU and the US
Trillion euros, 2010 price level



- A declining population will drag Europe's growth down in the coming decade.
- The World Bank projects that the EU's working-age population will decrease by 7% between 2023 and 2034 compared to a 1% increase in the US.
- For this reason alone, the gap in GDP between the US and EU will widen. Other factors will also play their part.
- In the main scenario in which generative AI is estimated to contribute 8% annually to the EU GDP and 9% to the US GDP in ten years, the GDP gap is expected to increase from 16% to 23%.
- In the optimistic scenario in which the EU can leverage generative AI more effectively to become even more productive (+10% GDP impact), the gap is expected to grow less – from 16% to 21% over the next ten years.
- Thus, generative AI represents a key opportunity for the EU to address its labour shortages and boost productivity growth.
- If the EU is delayed in adopting generative AI and/or fails to successfully manage the related job transitions, the GDP gap to the US will widen further.

Note: Numbers are rounded. Growth forecasts are based on Goldman Sachs' latest forecasts, including upgrades from the advent of generative AI. The upgraded forecasts take into account the estimated net effect of generative AI, which is only a share of the gross contribution. These may vary significantly as technological advances are already factored into many economic projections of GDP which generative AI may displace or surpass. Source: Implement Economics based on Briggs & Kodnani (2023b), IMF and the World Bank database.

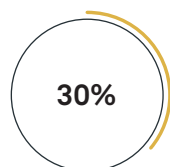
Generative AI models have the potential to boost SME AI adoption to new levels, but regulatory uncertainty and lack of skills can stand in the way

SMEs lag behind larger corporations on AI adoption

SMEs in the EU account for
~62% of total employment



However, there is a **large gap** in AI adoption between large enterprises and SMEs in the EU.



of large enterprises in the EU had adopted AI in 2023



of SMEs in the EU had adopted AI in 2023



AI can significantly accelerate our marketing and sales processes, which is crucial for our company's scaling efforts.

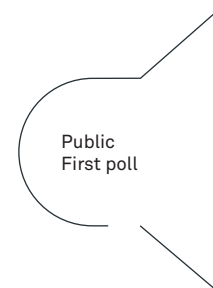
Andreea Purcaru, Head of Operations at **RAYSCAPE** (AI radiology start-up, Romania)

Generative AI could boost SME AI adoption ...

- **No or low data requirements** means that SMEs can readily use generative AI for many tasks without any further work needed.
- **Ease of use** in plain language means that SMEs can use many generative AI models without the need for coding skills.
- **Free online availability** means that SMEs do not need to invest in new computing power or new infrastructure to use generative AI.

... but SME uptake can be slowed down because ...

- **Lack of broader skills** required to fully leverage the potential of new generative AI technologies can hamper uptake.
- **Regulatory uncertainty** around generative AI can increase implementation risks and compliance costs, notably for SMEs lacking in-house legal capabilities. For example, Meta recently delayed the EU launch of its Llama AI model due to regulatory barriers.



Public First poll

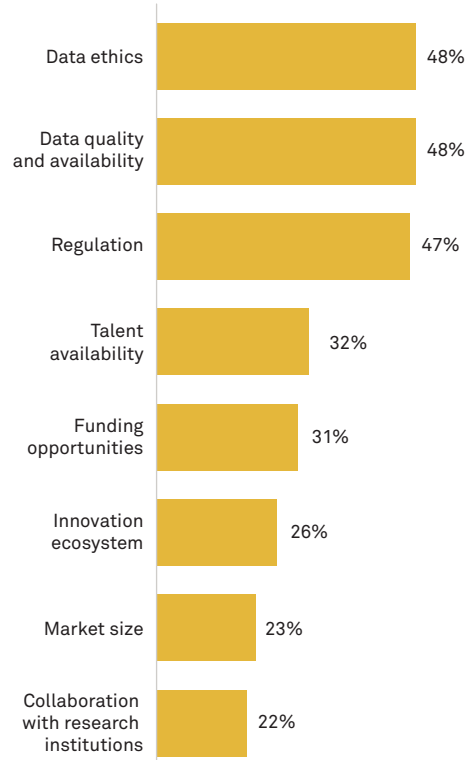
30% of SMEs in the EU say they need more data analysis skills to take full advantage of AI.

44% of SMEs in the EU have concerns about the current or future regulation of AI.

Note: According to the classification by the European Commission, SMEs are defined as enterprises with 1-249 employees, and large enterprises are defined as enterprises with 250+ employees. The percentage of total employment accounted for by SMEs is based on 2022 data. Source: Implement Economics based on Eurostat, Public First, Forbes and OECD (2024).

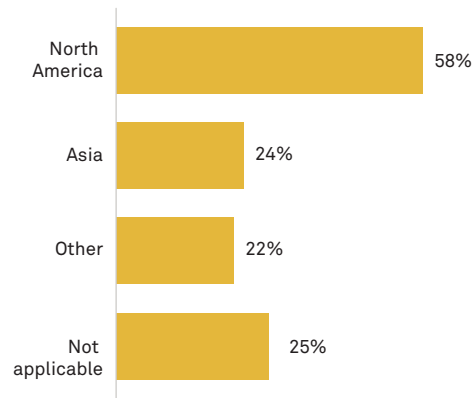
Europe's AI startups rely on AI developed outside the EU for their business, and European startups report being challenged by the EU's lack of good data and clear rules

What are the main challenges faced by European startups developing cutting-edge AI technologies?
% of respondents



Polling by Notion Capital shows that **45%** of surveyed startups felt that it was important for their companies to access AI technologies built by companies outside of Europe.

If important to your business, from which continent(s) do you source cutting-edge AI technologies?
% of respondents



- Startups and scaleups are key to Europe's future economy and society as highlighted by the EU's Digital Decade Policy Programme.
- Since the rise of the digital economy 30 years ago, 69 digital businesses worth more than USD 10 billion have been created but only five originated in Europe, accounting for less than 1% of the total value.
- The lack of digital innovation in Europe in an era in which most industries are expected to be driven by digital solutions puts Europe at risk of falling further behind.
- In recent polling by Notion Capital, 45% of startups report that access to cutting-edge AI technologies built by companies outside of Europe is extremely or moderately important to their business. Of these, 58% are sourcing cutting-edge AI technologies from North America, while 24% are sourcing from Asia.
- The main challenges for European startups developing cutting-edge technologies are data quality and availability (48%), data ethics (48%) and regulation (47%) according to surveyed startups.
- 59% of startups believe that European startups developing cutting-edge AI are able to become global leaders based on the current state of the ecosystem in Europe.

Note: Survey based on 867 respondents across 15 European countries. The category "Other" refers to South America, Oceania and Africa. Source: Implement Economics based on Notion Capital and Evans (2024).



03

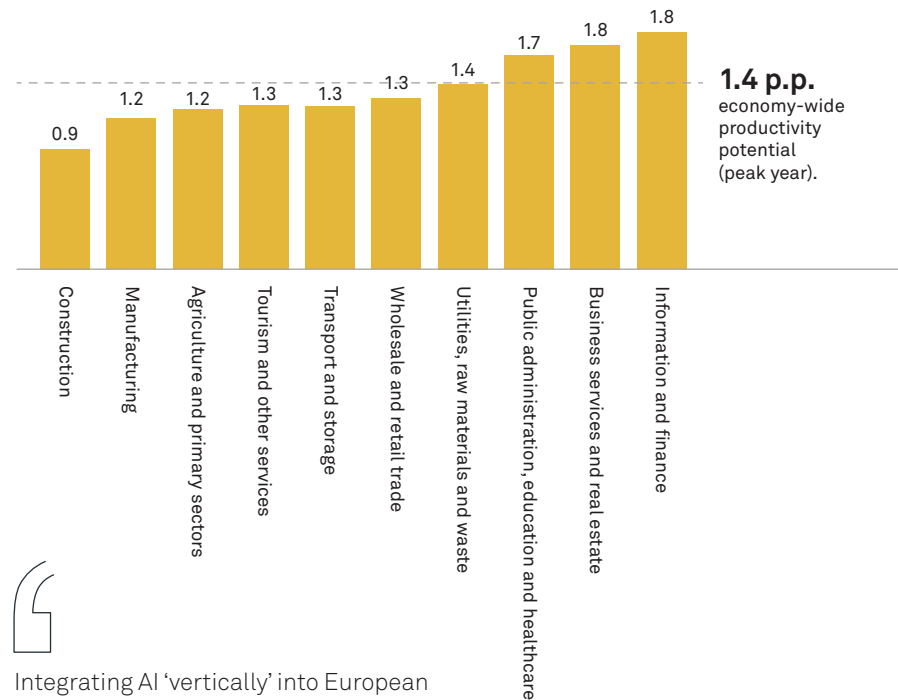
Productivity boost from AI in sectors

Some sectors are expected to gain more from generative AI, mostly owing to the types of tasks performed.

Generative AI can boost productivity across all sectors and the economy-wide potential is 1.4 percentage points in the peak year

Productivity boost from generative AI

Percentage points productivity growth p.a. at peak



Integrating AI ‘vertically’ into European industry will be a critical factor in unlocking higher productivity.

Mario Draghi report on The Future of European Competitiveness.

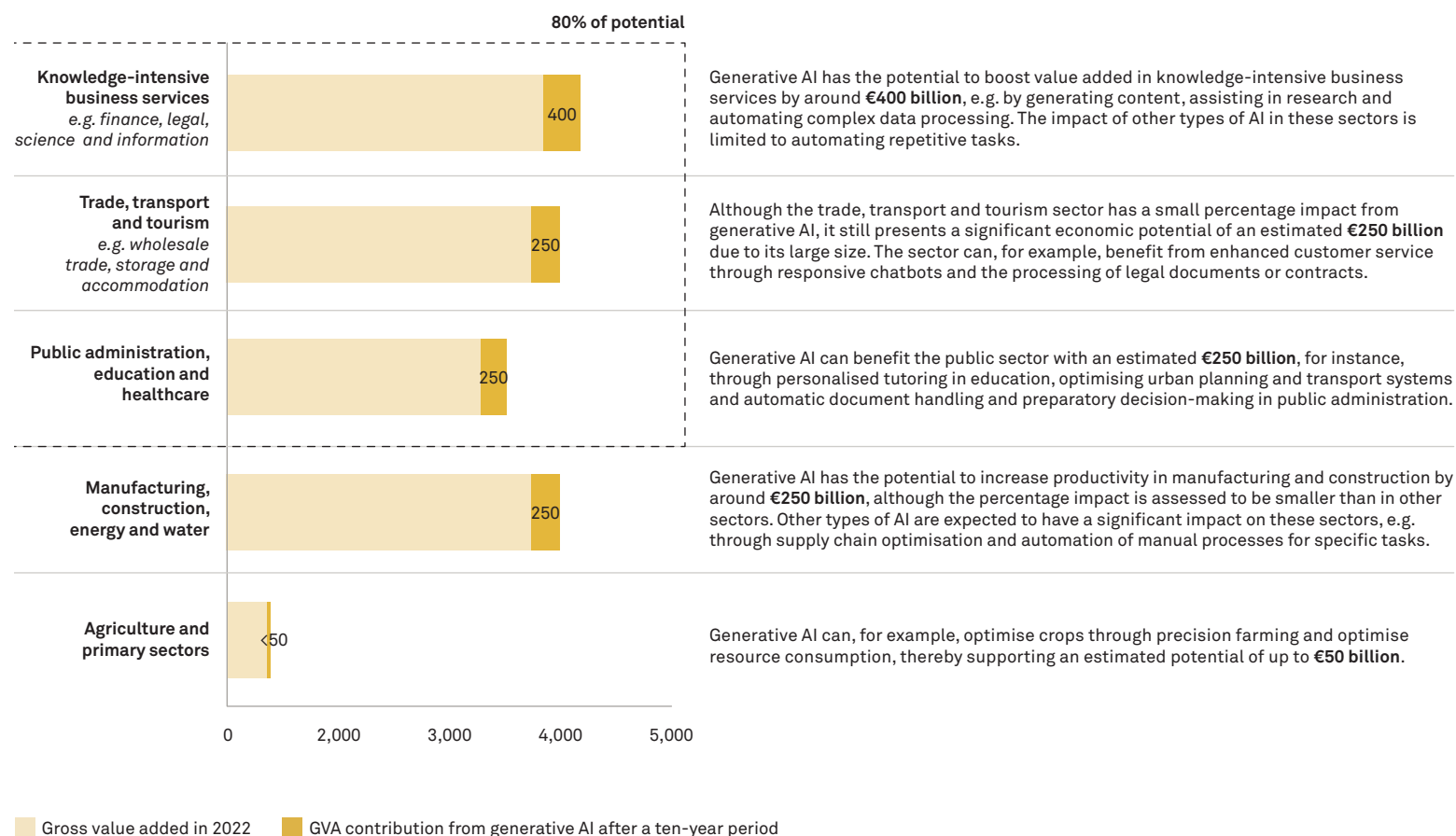
- The complementary role of generative AI prevails in most industries, meaning that most occupations are estimated to use AI to augment and improve human capabilities, providing a large productivity boost.
- Generative AI is potentially so powerful that the productivity boost could reverse the EU’s low and declining long-term productivity.
- In contrast to past automation, such as robots, generative AI has the ability to boost productivity in the service sector, which is prone to have low productivity and is gradually accounting for an increasing share of overall GDP.
- In the service sector, productivity increases can be achieved when humans are assisted by generative AI. This can drive productivity and is estimated to free up time for other valuable tasks.
- As an example, lawyers can be assisted in reviewing and summarising long documents and drafting basic documents. Some journalists even use AI to suggest headlines.
- In public administration, employees can be assisted by AI chatbots that offer personalised guidance to citizens on services such as tax returns, social benefits and public health advice tailored to individual needs.

Note: Sectors are aggregated according to NACE categorisation. “Information and finance” is a combination of information, communication, financial and insurance activities. “Tourism and other services” comprises accommodation, food and other services. Gains in labour productivity are mapped one to one to GDP if total employment (as here) is assumed constant and the capital stock increases to match productivity improvements. The estimates take into account that the growth impact of generative AI may not be fully additive to the current GDP trend. First, AI-related gains may substitute for growth that would otherwise occur in a non-AI baseline. Second, underlying productivity growth has slowed over the past decades. The estimated boost from generative AI may be partially offset by an underlying growth slowdown.

Source: Implement Economics based on Eurostat, OECD, O*Net and Briggs and Kodnani (2023a), European Commission (2023).

Around 80% of generative AI's economic potential lies in service sectors, but manufacturing and other sectors can also benefit from generative AI

Gross value added by sector
€ billion



Generative AI has the potential to boost value added in knowledge-intensive business services by around **€400 billion**, e.g. by generating content, assisting in research and automating complex data processing. The impact of other types of AI in these sectors is limited to automating repetitive tasks.

Although the trade, transport and tourism sector has a small percentage impact from generative AI, it still presents a significant economic potential of an estimated **€250 billion** due to its large size. The sector can, for example, benefit from enhanced customer service through responsive chatbots and the processing of legal documents or contracts.

Generative AI can benefit the public sector with an estimated **€250 billion**, for instance, through personalised tutoring in education, optimising urban planning and transport systems and automatic document handling and preparatory decision-making in public administration.

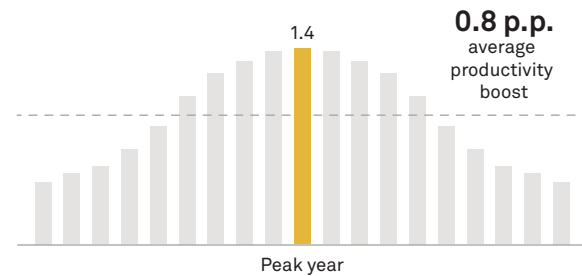
Generative AI has the potential to increase productivity in manufacturing and construction by around **€250 billion**, although the percentage impact is assessed to be smaller than in other sectors. Other types of AI are expected to have a significant impact on these sectors, e.g. through supply chain optimisation and automation of manual processes for specific tasks.

Generative AI can, for example, optimise crops through precision farming and optimise resource consumption, thereby supporting an estimated potential of up to **€50 billion**.

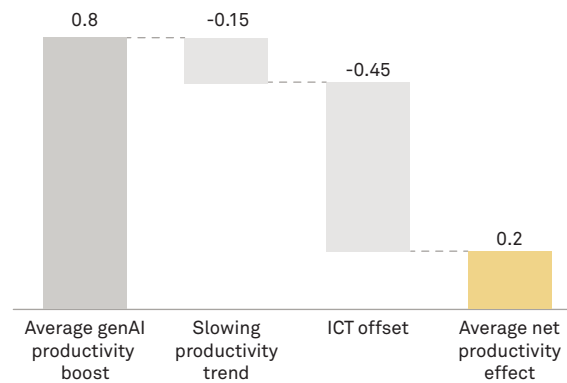
Note: Sectors are aggregated as follows: "Knowledge-intensive business services": NACE sectors J-M. "Public administration, education and healthcare": NACE sectors O-R, U. "Trade, transport and tourism": NACE sectors G-I, N, S-T. "Manufacturing, construction, energy and water": NACE sectors C-F. "Agriculture and primary sectors": NACE sectors A-B. Source: Implement Economics based on Eurostat, O*Net and Briggs and Kodnani (2023a).

Generative AI is potentially powerful enough to boost GDP growth in the coming decade

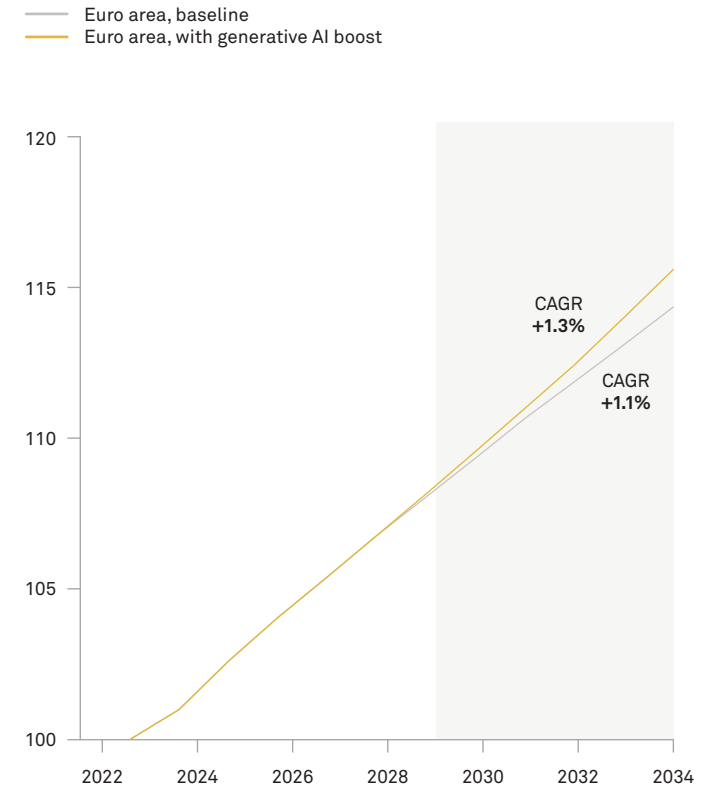
Productivity boost in the EU during the adoption period
Percentage point productivity growth p.a. during generative AI adoption period



Net productivity boost from generative AI effect after offsets
Percentage point productivity growth p.a.



Euro area GDP, baseline and with generative AI boost
Indexed to 2023 GDP



Note: The offsetting effect refers to generative AI displacing investment in other ICT technologies. However, it still results in a net positive impact on productivity and economic growth. Source: Implement Economics based on Briggs and Kodnani (2023b), European Central Bank, European Investment Bank (2024) and European Commission (2023).



- Hourly productivity grew by 2.3% per year in the US between 1995 and 2010 and only 1.1% in Europe in the same period. After 2010, productivity growth slowed in both economies and converged to similar rates.
- To prevent further widening of the productivity gap, capturing opportunities from generative AI in the coming decade is crucial.
- The potential boost from widespread adoption of generative AI is forecasted to surpass the historical contributions from technology to economic growth.
- Reviewing the potential of generative AI, Goldman Sachs has recently raised their long-term GDP growth forecast for the euro area by +0.1 percentage points per year in 2028-2030, +0.2 percentage points in 2031-2033 and +0.3 percentage points in 2034, which is the expected peak year.
- On average, this raises the long-term average GDP growth rates in the euro area from 1.1% per year to 1.3% per year when including the updated estimates.
- The boost from generative AI is significant enough to outweigh the otherwise slowing productivity trend (-0.15% percentage points p.a.) – even considering its offsetting effect on the contribution from other ICT.



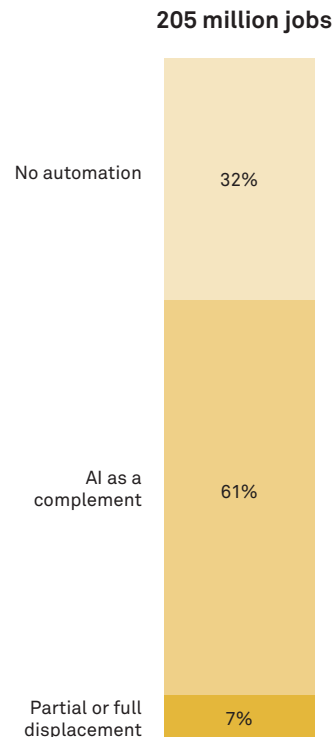
04

Job implications of AI

Generative AI will introduce job changes in the EU – the nature and degree of which depend on economic and demographic factors.

Generative AI augments most jobs

Share of jobs exposed to automation by generative AI
% of total employment in the EU



~ 32% of jobs are unlikely to be exposed to automation

An estimated 65 million jobs in the EU are likely to remain largely unaffected by generative AI. These jobs include manual labour, outdoor tasks, such as construction and cleaning, and human-to-human tasks, such as personal care and food services.

~ 61% of jobs are likely to be augmented by generative AI

Most jobs (roughly 125 million) are expected to be assisted by generative AI by automating a limited share of their tasks and helping to create content (text, code and images), collaborating with workers on complex problems and contributing to product design.

Unlike previous waves of automation that mainly impacted manual workers, generative AI is expected to primarily affect office-based professionals.

~ 7% of jobs are likely to be fully or partially displaced

A smaller number of jobs (around 15 million) are expected to have over half of their work activities exposed to automation by generative AI, e.g. in occupations such as clerical support workers, contact centre salespersons and translators. These workers are likely to see their jobs fundamentally change and may need to be re-employed in new occupations.

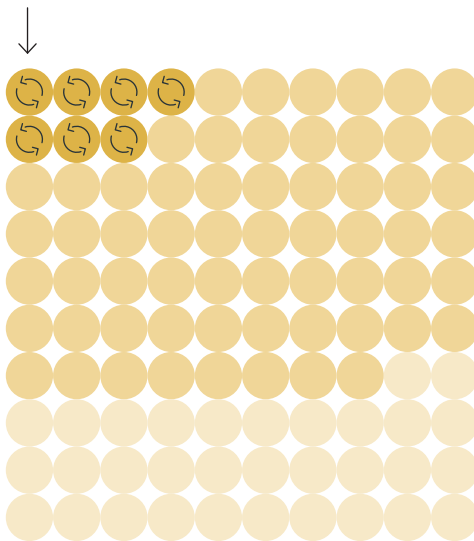
Note: Based on 2023 employment data. In accordance with Briggs and Kodnani (2023a), "No automation" are occupations with less than 10% exposure, "AI as a complement" are occupations with 10-49% exposure and "Partial or full displacement" are occupations with exposure of or above 50%. Note that percentages and absolute numbers are rounded.
Source: Implement Economics based on Eurostat, O*Net and Briggs and Kodnani (2023a).

AI is expected to shift some jobs around, but increased demand and new job types are expected to ensure successful job transitions

Share of jobs exposed to automation by generative AI
% of total employment in the EU



7% of jobs in the EU are estimated to be highly exposed to generative AI, leading to some job transitions.



- Highly exposed to generative AI
- Generative AI as a complement
- No generative AI automation

Meanwhile, 61% of jobs are expected to see a boost in productivity. This will create new jobs due to:

I. Increase in general demand for goods and services

With higher GDP growth, the AI-powered economy will demand more labour across a wide range of occupations and skill levels.

II. Creation of new AI-related tasks

Widespread use of AI will also create new jobs such as AI prompt engineers, AI-assisted creative professionals and AI application specialists – and create jobs we cannot preconceive.

III. Demand within occupation

Generative AI will also make highly exposed occupations, such as translators, more efficient, and hence at lower costs, which in turn can increase the demand for those occupations.

Even with accelerated and broad adoption of generative AI over a ten-year period, only around 1 million people in highly exposed job are estimated to need re-employment per year, which is low compared to the 9 million expected future job openings each year towards 2035 according to CEDEFOP (see page 40).



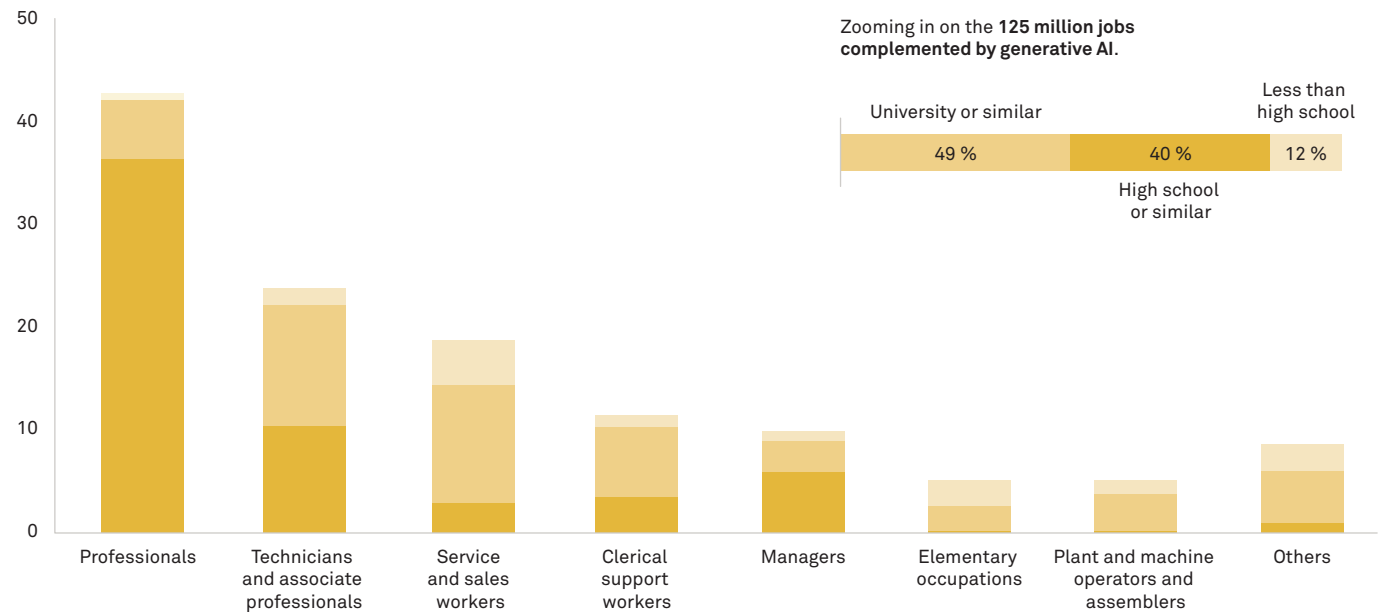
- The job transitions in the EU over the next decades will depend on a range of factors.
- The isolated impact of generative AI depends on the speed of adoption and size of the productivity boost relative to the size of the displacement effect for the jobs that are highly exposed to generative AI.
- This report assumes full re-employment of highly exposed workers over a ten-year period. This means no net change in total employment or unemployment.
- This assumption builds on the large size of the productivity boost compared to the relatively small share of displaced jobs. This suggests that the demand for new jobs will be sufficiently strong to create jobs for those exposed.
- Furthermore, economic theory suggests that long-term employment is determined by the labour supply and skill mix of the workforce.
- Thus, automation could greatly benefit the European labour market, where an ageing population challenges the future labour supply in many countries (see more in section 5).
- The short-term job impacts will depend, among other things, on the flexibility of the labour market to adjust to changes as well as re-training and skilling opportunities for workers.

Note: The assumption that labour supply predetermines employment is widely applied by economists. See, for example, *Principles Of Economics* by N. Gregory Mankiw (2020).
Source: Implement Economics based on based on Eurostat, O*Net, Briggs and Kodnani (2023a) and CEDEFOP.

125 million jobs are expected to be complemented by AI – mainly highly educated professionals and technicians

Jobs complemented by generative AI
Million jobs

■ University or similar
 ■ High school or similar
 ■ Less than high school



Examples of jobs include:

Research, analysis and advising services (including legal)

Engineering technicians, robot controllers and air traffic safety technicians

Caterers, housekeepers and travel agents

Secretaries, record keepers and information suppliers

Executives and supply and general managers

Cleaners, washers and delivery

Train drivers and machinery operators

Police services and farmers

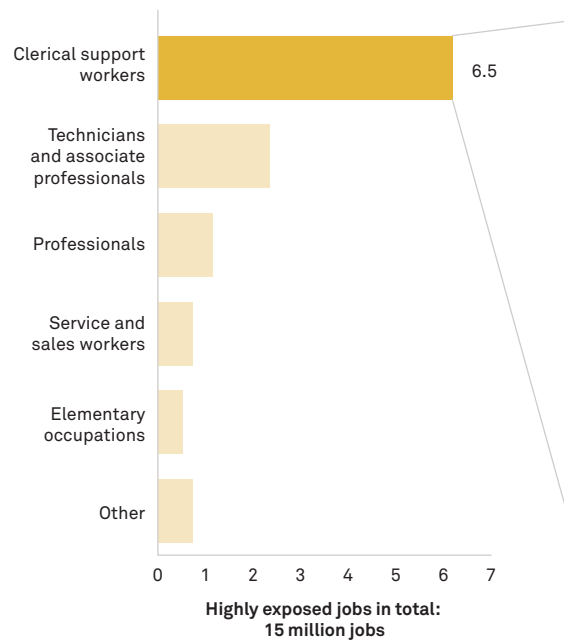


- Generative AI is estimated to augment the capabilities of around 125 million jobs in the EU at full adoption and around half of these over a ten-year period.
- Of the complemented workers, 49% are estimated to hold higher educational attainment, such as lawyers, scientists and engineers.
- Generative AI can perform complex cognitive tasks and complement human abilities, creating opportunities for individuals to work with generative AI to create new content and free up time for other tasks.
- Unlike previous waves of automation, generative AI is less relevant in jobs carried out by those with lower levels of educational attainment.

Note: Based on 2023 employment data.
Source: Implement Economics based on Eurostat, O*Net and Briggs and Kodnani (2023a).

7% of jobs in the EU are highly exposed to generative AI – primarily in occupations where repetitive administrative tasks make up a large share of the workload

Jobs highly exposed to generative AI in the EU
Million jobs



Example: The EU clerical support workers and job transition

Of the 6.5 million highly exposed clerical support workers, only around half are assumed to be affected by generative AI over ten years, and all of these are assumed to be employed either outside or within the occupation.

Most are expected to be re-employed in other occupations through three channels:

- I. **Increase in general demand for goods and services** due to increased income in the AI-powered economy, leading to job opportunities in other sectors.
- II. **New types of AI-related tasks created** arising from the introduction of generative AI, such as AI prompt engineers, AI-assisted creative professionals and AI application specialists.

A smaller share is expected to be employed within occupation because:

- III. **Not all highly exposed workers will be displaced.** Some will continue to hold employment with new tasks replacing the exposed tasks.

Increased demand within occupation due to the increase in productivity and lower costs.

The proportion of employment within occupations and in new occupations is uncertain.

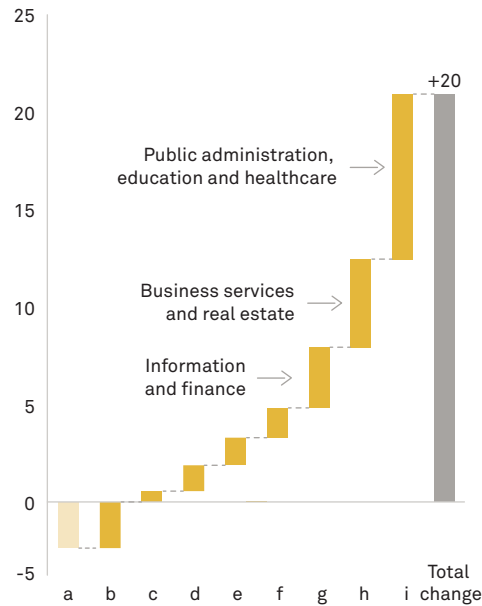


- 7% of jobs in the EU are estimated to be highly exposed to generative AI at full adoption, and around half of these are expected to be affected over a ten-year period.
- Historically, worker displacement from automation has been offset by the creation of new jobs, and the emergence of new occupations following technological innovations accounts for the vast majority of long-run employment growth.
- This report assumes full re-employment of displaced workers. This means no net change in total employment or unemployment.
- The EU economy is thus assumed to be able to sustain at least the current level of employment in the coming 10-15 years as also predicted by EU forecasts from CEDEFOP.
- Clerical support workers, technicians and service and sales workers are highly exposed to generative AI and up to a third of these jobs are expected to see significant change.
- The transition is likely to be gradual, allowing workers time to adapt to new tasks and skills.
- Through three channels described to the left, the AI-powered economy will gradually lead to new jobs and support employment within the occupation or re-employment in other sectors.

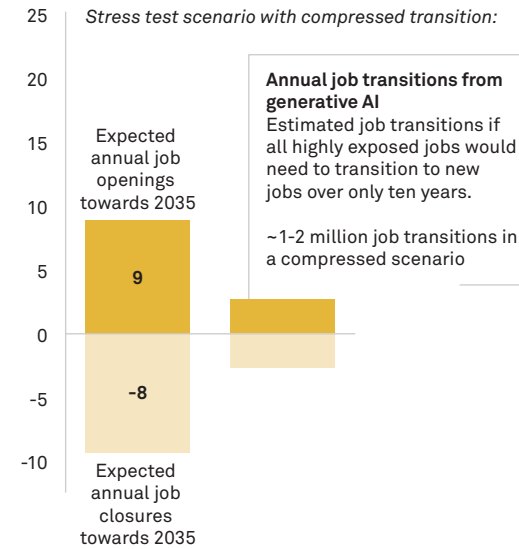
Note: Based on 2023 employment data. High exposure to AI does not automatically imply full displacement of all workers in that occupation. In the GDP estimates, we make a conservative assumption, assuming low automation to avoid overestimating GDP impacts. In the job exposure and potential displacement assessment, we show the full size of the potential displacement to avoid underestimating the job implications. The size of each re-employment channel is uncertain and depends on how the technology is adopted and the interplay between increased efficiency and how unmet demand translates into increased or decreased employment in various occupations. Source: Implement Economics based on Eurostat, O*Net and Briggs and Kodnani (2023a).

Job changes from generative AI are small compared to expected future job openings and closures

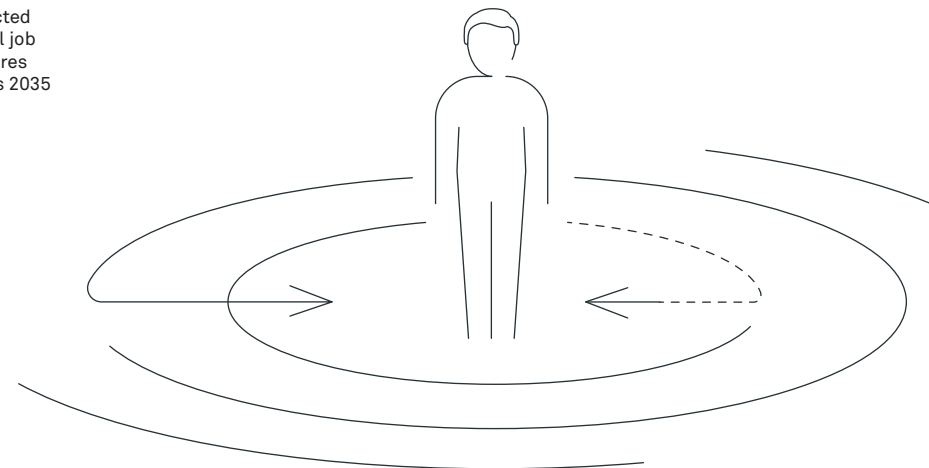
Change in employment across sectors in EU27, 2013-2023
Million jobs



Estimated annual re-employment in the EU from generative AI
Million jobs



Note: a. Agriculture and primary sectors; b. Manufacturing and construction; c. Utilities, raw materials and waste; d. Wholesale and retail trade; e. Transport and storage; f. Tourism and other services; g. Information and finance; h. Business services and real estate; i. Public administration, education and healthcare. Our GDP estimate makes conservative assumptions around the scope of tasks for generative AI and the speed of adoption as in the base scenario in Briggs-Kodnani (2023a). The compressed scenario used to gauge the potential job market implications assumes faster adoption (full adoption over ten years) and/or more broad application of generative AI (as in the Briggs-Kodnani scenario with "more labour displacement"). Source: Implement Economics based on Eurostat and CEDEFOP.



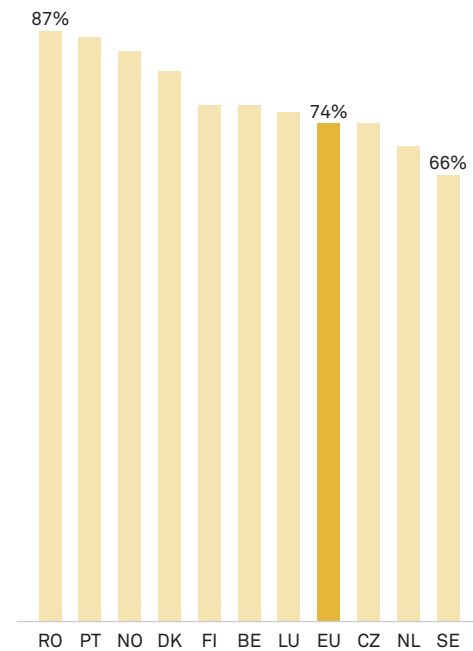


- The EU economy has added around 20 million jobs over the last 10 years. Only the agriculture sector has contracted, while most other sectors have added significant amounts of new jobs, e.g. tourism, information and finance and the public sector.
- In addition, numerous new jobs are created and closed every year within each sector to adapt to changing needs and demands.
- According to CEDEFOP, the EU economy is expected to see around 9 million job openings and 8 million job closures every year until 2035.
- In a “stress test” scenario with compressed transition of all highly exposed jobs over only ten years, we estimate that the jobs that are highly exposed to generative AI can lead to around 1-2 million annual job openings and closures over ten years. This is around 10-20% of the expected future annual number of job openings in the EU.
- The labour market effects stemming from the impact of generative AI on highly exposed jobs are therefore small compared to historical levels of job change.

74% of workers in European countries see productivity-enhancing effects of generative AI, and 43% of workers in European countries expect AI to positively impact their job

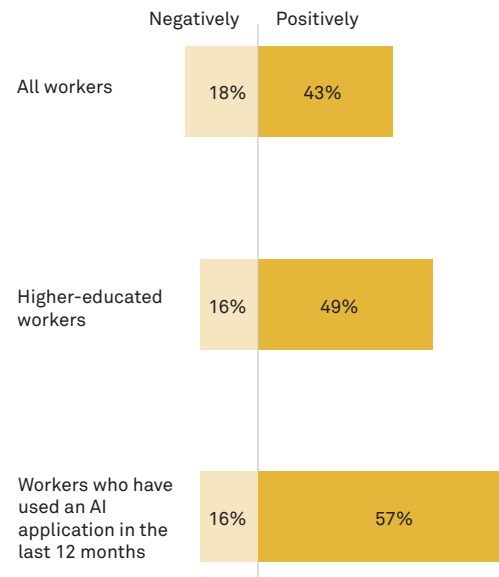
Workers in Europe think that generative AI makes them more productive

Generative AI will help improve my productivity at work
Workers who agree, %



Workers in European countries think that AI will positively impact their job

How will AI impact your job over the next five years?

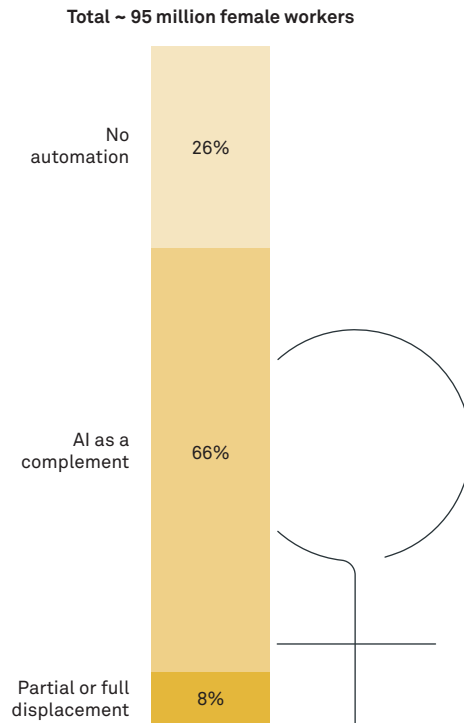


- Polling conducted by Public First shows that an average of 74% of EU workers think that generative AI will help them be more productive. This could, for example, be through optimising workflows, automating certain tasks and enhancing capabilities.
- A recent Ipsos survey on attitudes towards AI reveals that 43% of workers in the surveyed European countries expect AI to have an overall positive impact on their job while only 18% expect a negative impact.
- The positive expectations are more pronounced for higher-educated workers with 49% expecting a positive job impact.
- Workers who have used an AI application in the past 12 months have the most positive expectations, with 57% expecting AI to have a positive impact on their job in the future.

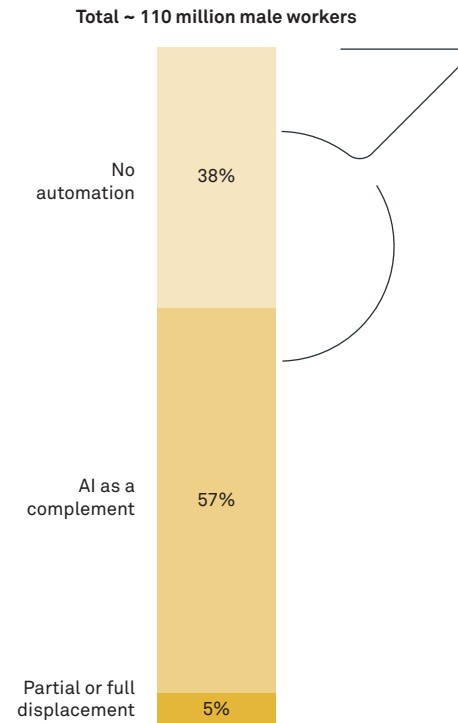
Note: Public First survey conducted in summer 2023. Nationally representative consumer and business polling. Respondents of the survey include Sweden (SE), Denmark (DK), the Netherlands (NL), Belgium (BE), Luxembourg (LU), Finland (FI), Norway (NO), Portugal (PT), Czechia (CZ) and Romania (RO). Averages across countries are computed as arithmetic means. The surveyed European countries in the Ipsos survey are Belgium, France, the Netherlands, Spain and Sweden. Source: Implement Economics based on Public First country surveys and Ipsos survey.

Upskilling and reskilling for successful job transitions should consider gender differences in AI usage

Share of jobs held by women exposed to automation by generative AI in the EU
% of total employment among female workers



Share of jobs held by men exposed to automation by generative AI in the EU
% of total employment among male workers



- Relatively speaking, women in the EU hold more jobs that can be augmented by generative AI than men. The new technology therefore represents an opportunity for women to increase their productivity in the workplace.
- 66% of female workers are expected to see generative AI augment their current job, whereas the share is 57% for male workers. Female workers are, to a higher degree than men, employed in jobs such as teachers and lawyers, where generative AI is expected to complement human capabilities and make workers more productive.
- 8% of female workers and 5% of male workers in the EU are currently in jobs such as clerical work, call centre workers and technicians that are likely to be highly exposed to automation by generative AI and hence more at risk of seeing their current job being fully or partially displaced.
- However, various surveys suggest that women are less likely to use generative AI than men – and believe that generative AI will hinder their job mobility more than men.
- Upskilling and reskilling efforts should thus consider differing tendencies and trends in technology usage across genders to maximise the potential of generative AI.

Note: Based on 2023 employment data. In accordance with Briggs and Kodnani (2023a), "No automation" are occupations with less than 10% exposure, "AI as a complement" are occupations with 10-49% exposure, "Partial or full displacement" are occupations with exposure of or above 50%. Note that percentages and absolute numbers are rounded. The share of male-to-female workers reflects domestic payroll employment by gender. Source: Implement Economics based on Forbes, Flexjobs, Deloitte, Eurostat, O*Net and Briggs and Kodnani (2023a).



05

AI alleviating labour shortages in the EU

AI can help free up resources to address labour supply challenges and skills shortages in the EU.

The EU faces significant labour and skills shortages which can be a hindrance to future economic growth and competitiveness

Persistent labour shortages in the EU by occupation

	Employment 2021 % of total	Number of EU countries reporting labour shortages within occupation in 2022
Medical doctors	1%	17
Cooks	1%	16
Heavy truck and bus drivers	2%	16
Electrical equipment installers and repairers	1%	13
Waiters and bartenders	1%	13
Nursing and midwifery professionals	1%	12
Software and applications developers and analysts	2%	12
Building finishers and related trades workers	1%	11
Building frame and related trades workers	2%	9
Sheet and structural metal workers	1%	9
Personal care workers in health services	2%	9
Machinery mechanics and repairers	2%	9
Domestic, hotel and office cleaners and helpers	3%	8
Shop salespeople	5%	4
Total	25%	

For example, the digital association Bitkom recently estimated that Germany has a record-high 149,000 vacancies for IT specialists, indicating significant shortages.



Addressing labour and skills shortages is crucial in boosting sustainable economic growth in the EU, seize the opportunities of the green and digital transitions, foster the creation of quality jobs and increase our economic and social resilience.

The European Commission

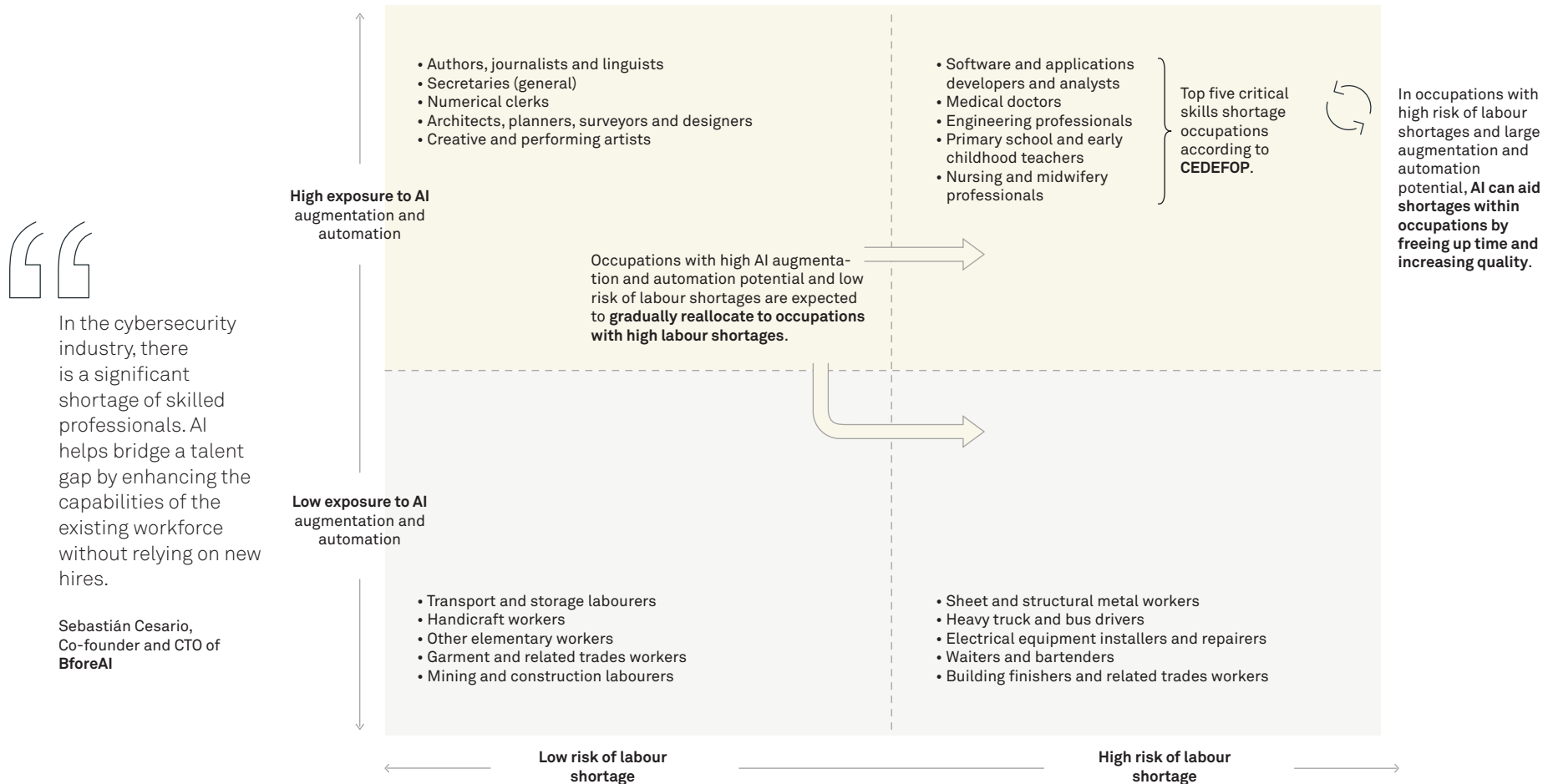
- The EU has already seen slower growth in total number of hours worked in the past 10-15 years.
- Labour and skills shortages are expected to increase in the coming decades. An aging population and shrinking workforce are intensifying these shortages, particularly in healthcare and social services.
- **The European Commission** identifies 14 occupations with persistent labour shortages within health professionals, electrical installers and ICT professionals. These 14 occupations account for around 25% of jobs in the EU.
- The European Employment Services (EURES) **2023 report** on labour shortages and surpluses shows that 17 of the 27 EU countries reported shortages for medical doctors, including generalist and specialist medical practitioners in 2022.
- High vacancy rates and low unemployment in the EU also indicate that labour shortages are a major issue for the EU.
- Addressing these labour and skills shortages is crucial for:
 - Securing a high quality of life
 - Sustainable economic growth
 - Succeeding with the green and digital transitions

Note: Employment numbers are by ISCO code digit-3 level. To aggregate occupations at ISCO 4-digit level to ISCO 3-digit level, at least half of the occupations at ISCO 4-digit level needed to be in shortage in the recorded year. An occupation at ISCO 3-digit level was considered to face persistent labour shortages if it experienced shortages in at least three of the years between 2016 and 2021. See the EU Commission's report on **Employment and social developments in Europe 2023** for further details. The pillar diagram shows the mean (arithmetic) number of countries reporting widespread labour shortages at the ISCO 4-digit level based on EURES data.

Source: Implement Economics based on the European Labour Authority, **State of Health in the EU, EC, 2023, Progress Report on the Digital Decade, EC, 2023.**

Generative AI can alleviate labour shortages by freeing up resources and boosting productivity

Labour shortage and automation potential in selected occupations, 2022



“ “

In the cybersecurity industry, there is a significant shortage of skilled professionals. AI helps bridge a talent gap by enhancing the capabilities of the existing workforce without relying on new hires.

Sebastián Cesario,
Co-founder and CTO of
BforeAI

Notes: “Low risk of labour shortage” is defined as 3 or fewer EURES countries reporting a shortage in the given occupation. “High risk of labour shortage” is defined as 9 or more EURES countries reporting a shortage in the given occupation. Source: Implement Economics based on European Labour Authority and Felten et al. (2023)

AI is already helping to complement workers and free up time in occupations with shortages across the EU



Medical doctors



Nurses and midwives



Educators



IT professionals



Engineers

Documentation:

- Charité University Hospital in Berlin has developed an AI tool that uses speech-to-text technology to **transcribe doctor-patient interactions**. The tool then uses a large language model to analyse the transcriptions and generate summaries, which are used to update patient records.

Diagnostics:

- The European Commission has invested in an AI tool for **COVID-19 diagnosis**, which has been implemented in ten hospitals across Europe. It uses CT scanner images to detect suspicious cases, aiding faster patient treatment.

Patient monitoring:

- In **Martini Hospital in Groningen**, AI algorithms are used to predict patient deterioration by continuously analysing patient data from electronic health records. This allows nurses to pay increased attention to the right patients at the right times.

Patient communication:

- Nurses at Karolinska University Hospital use AI-driven virtual assistants to handle patient enquiries and provide timely responses about treatments and hospital procedures. This technology helps streamline communication, ensuring that patients receive accurate information quickly and reducing the administrative burden on nurses.

Individual tutoring:

- The **AI4EDU project** focuses on developing AI-powered educational assistants that can interact with students and teachers. These assistants, like the “Study Buddy”, help students summarise textbook content and explain key concepts, freeing up teachers’ time to assist more students.

Curriculum development:

- European Schoolnet**, a network of 34 European ministries of education, uses AI through its Future Classroom Lab initiative to automate routine tasks like lesson planning and grading. This significantly reduces the administrative workload, freeing up teachers’ time to focus more on interactive teaching and student engagement.

Code generation:

- Cognizant and Google Cloud** have expanded their AI partnership to enhance software development productivity. Cognizant is integrating Google’s AI technology, Gemini, into its operations, training more than 70,000 associates. This collaboration aims to accelerate code writing, testing and deployment, improving reliability and cost efficiency.

Code modernisation:

- IBM** is modernising its mainframe software by utilising generative AI, which transforms outdated COBOL code into modern Java. This enhances performance, compatibility and reduces costs while simplifying the upgrade process and expanding the IT talent pool by decreasing reliance on specialised COBOL skills.

Industrial copilot:

- Siemens** leverages generative AI to improve productivity and efficiency with its Industrial Copilot. This tool optimises automation code, reduces development times and minimises errors.

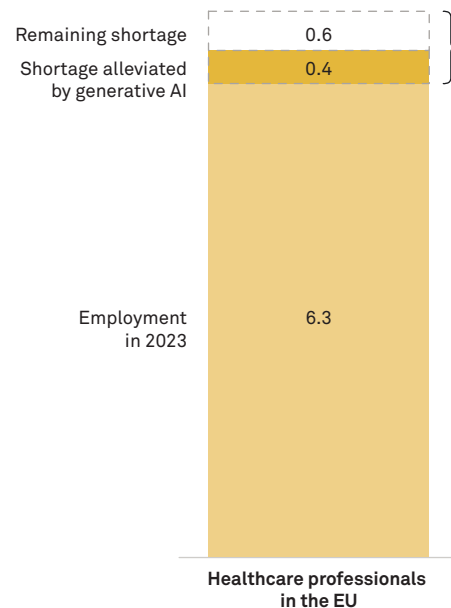
Generative design:

- Airbus** utilises AI for generative design, which significantly accelerates the design process. AI generates thousands of component designs based on specified criteria, reducing the time required for engineers to test new ideas. This allows engineers to focus on refining and innovating the designs rather than spending time on initial drafts.

Generative AI can help tackle healthcare worker shortages by increasing efficiency and the quality of care

Employment of healthcare professionals in the EU Millions

According to the **European Commission**, there is a shortage of nearly 1 million healthcare workers in Europe.



40% of the shortage of healthcare workers in Europe can be alleviated by generative AI.

Studies show that roughly half of doctors' and healthcare workers' time is spent on administrative tasks, e.g. electronic record-keeping. These are tasks that can be partially or fully automated by generative AI.



We cannot wait any longer to address the pressing challenges facing our health workforce. The health and well-being of our societies are at stake – there is simply no time to lose.

Dr Hans Henri P. Kluge, WHO
Regional Director of Europe

- According to the European Commission, Europe is facing a shortage of nearly 1 million healthcare workers.
- Europe's ageing population will dramatically increase healthcare demand, with the number of people over 65 nearly doubling in 50 years.
- Coupled with a decrease in the number of informal carers due to changing family structures, this will necessitate new care delivery models, skill mix and working methods for healthcare professionals to manage the increasing number of elderly individuals with multiple chronic conditions.
- Generative AI offers the potential to free up a significant number of resources currently devoted to administrative tasks, e.g. by automating routine documentation, streamlining patient communication and enhancing diagnostic accuracy.
- This can lead to improved patient outcomes, reduced workload for healthcare professionals and more efficient use of healthcare resources.
- For the 6.3 million healthcare professionals in the EU, this potential for freed-up time is equivalent to addressing 40% of the shortage experienced today.

Note: The calculation of shortage alleviation is based on freed-up time of complemented workers in the "Health Professionals" ISCO 2-digit occupation, which constitutes 6.3 million jobs in the EU in 2023.

Source: Implement Economics based on Eurostat, Tai-Seale et al. (2017), Sinsky et al. (2016) and the European Commission.

Generative AI may increase job opportunities for disabled people, potentially boosting labour supply in the EU

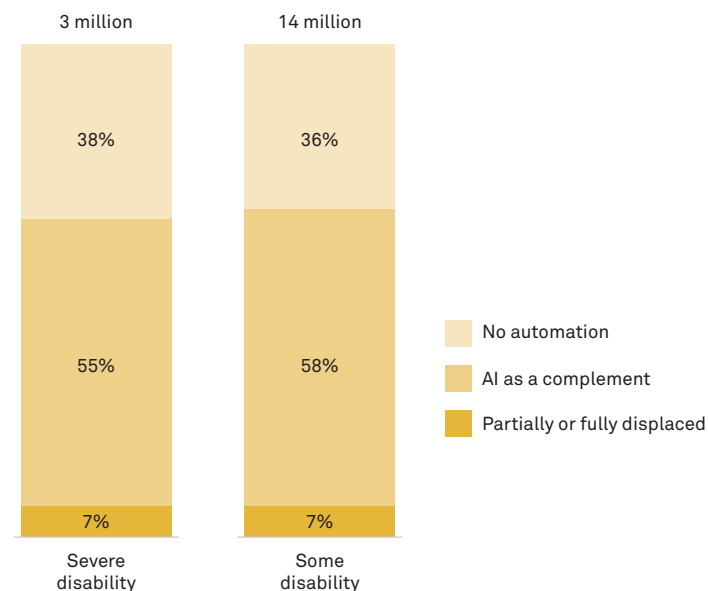
Generative AI can make the labour market more inclusive ...

		Examples:
Enhancing accessibility	AI can describe visual content and convert it to Braille for the visually impaired and generate context-aware captions for images and videos to enhance digital media understanding, thus making the Internet more accessible.	Devices like Google Home enable users with mobility or visual impairments to control home appliances, access information on the Internet, manage schedules etc. through voice commands without needing to physically interact with a device.
Facilitating communication	AI can transcribe speech in real-time and translate it into text, enhancing communication accessibility. It also helps those with speech impairments by converting text or gestures into synthesised speech.	Google's Live Transcribe app offers real-time speech-to-text services that allow users with hearing impairments to follow along with conversations as they happen, with high accuracy and low latency.
Improving mobility and navigation	AI can enhance mobility for people with physical disabilities by optimising route planning for accessibility and controlling assistive devices like robotic prosthetics with adaptive responses.	AI-driven robotic prosthetics, such as those from Open Bionics , use sensor data to provide responsive movement that adapts to the user's environment and intentions, enhancing the user's ability to perform daily tasks independently.
Enabling personalised learning	For those with cognitive disabilities, AI can customise educational content to fit individual learning styles and needs. It can adjust difficulty levels, provide interactive aids and create engaging, game-like educational activities.	Grammarly offers writing assistance to people with dyslexia by not only correcting spelling and grammar but also explaining the reasons behind these corrections, thereby supporting the learning process.

... but efforts should be made to ensure that they also benefit from upskilling programmes on the labour market

According to the **European Commission**, there are 101 million people in the EU with some form of disability. Of these, around 17 million are working and more than half of them are estimated to be impacted by generative AI.

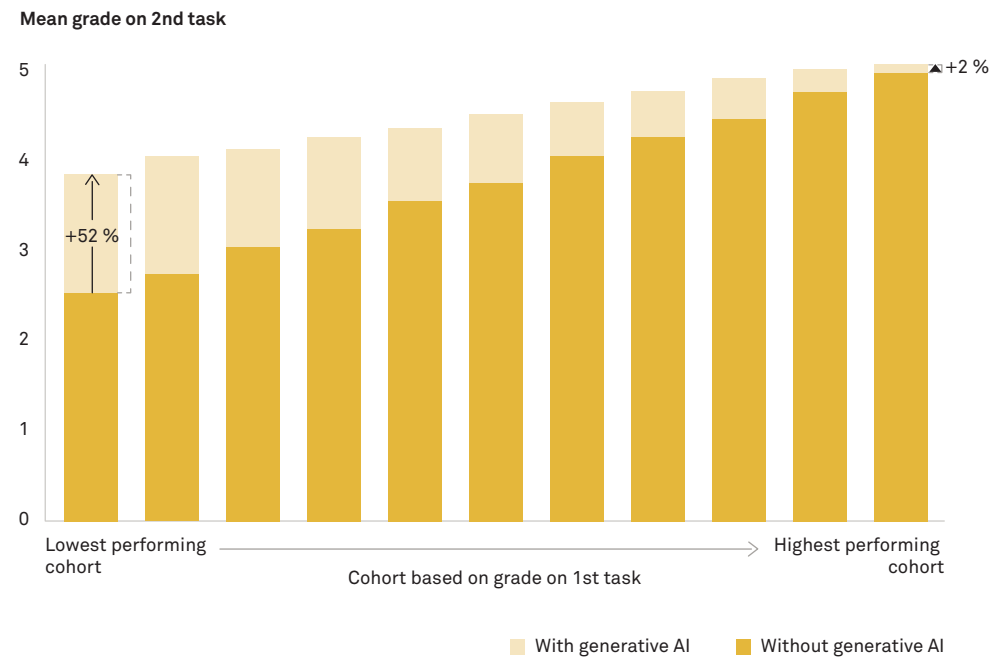
Share of jobs held by disabled people exposed to automation by generative AI
% of total employment



Generative AI holds an opportunity both for the disabled people already working and for those seeking to enter the workforce. It can improve accessibility, communication and enable personalised learning. However, disabled people will still have unique needs that should be addressed by policymakers when designing upskilling efforts.

Generative AI can help close the skills gap for those with the lowest skill levels

Grades with and without generative AI
Estimated mean grade on 2nd task



- AI requires a broad skill set to reap the benefits. However, AI as a tool can itself augment the performance of human skills.
- Furthermore, generative AI can help close the skills gap by increasing the performance of those with the lowest skill levels.
- An experimental study by Noy and Zhang (2023) tested experienced professionals' writing skills with and without access to generative AI.
- Participants were given tasks such as writing press releases, short reports and emails, which were graded by evaluators on a 1-7-point scale.
- The results showed that, on average, all professionals were able to boost their grades on their written tasks with the use of generative AI – in this case, a large language model.
- The AI augmentation effect was highest among those with the lowest performance on the first task.
- The lowest-performing group increased their average grade by more than 50% when allowed to interact with a large language model, whereas the best-performing group increased performance by 2%.
- This study is an early indication that generative AI has the potential to boost skills for everyone and reduce skill inequalities in the labour market.

Note: The graph shows mean estimates for cohorts.
Source: Implement Economics based on Noy and Zhang (2023), Brynjolfsson et al. (2023) and Dell'Acqua et al. (2023).

Workers need a broad set of skills to reap the benefits of generative AI

Skill needs to develop and use AI

Relative to earlier advancements in information and communication technology (ICT), generative AI adoption requires limited digital skills due to its ease of use via normal language prompts.

Fully leveraging generative AI requires skills beyond basic digital skills, i.e. creative, managerial and analytical skills.

Skill needs in the age of AI according to the OECD:



Skills required for adopting, using and interacting with AI applications:

- Elementary AI knowledge (e.g. principles of machine learning)
- Digital skills (e.g. ability to use computer/smartphone)
- Other cognitive skills (e.g. analytical skills, critical thinking)
- Transversal skills (e.g. creativity, communication)

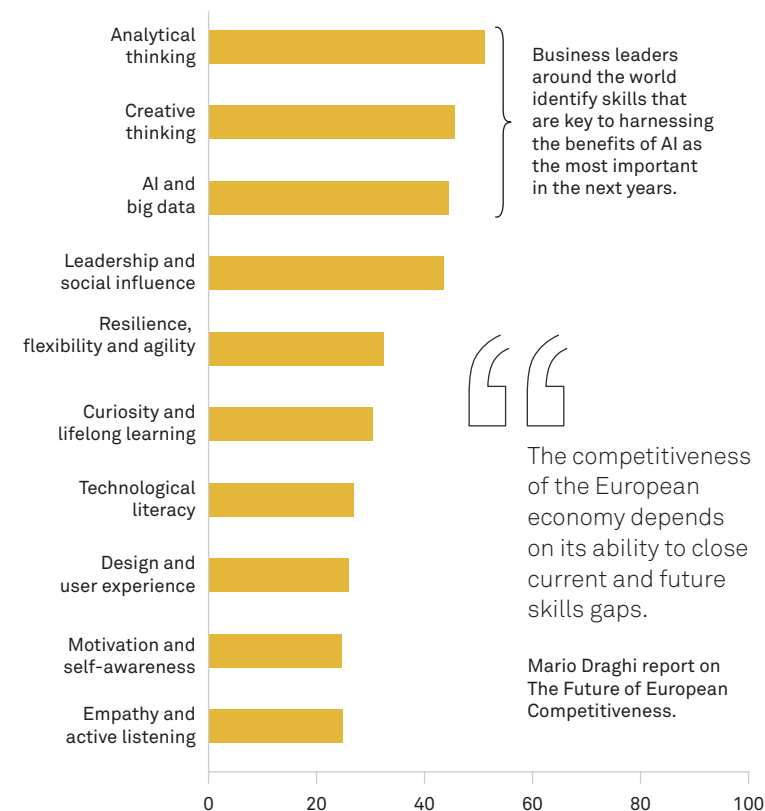


Skills for developing and maintaining AI systems:

- Specialised AI skills (e.g. machine learning capabilities)
- Data science skills (e.g. model tuning)
- Other cognitive skills (e.g. creative problem-solving)
- Transversal skills (e.g. social skills and management skills)

Evolution of the skills needed to participate in the future labour market

Businesses' top 10 skill priorities for 2027 (World Economic Forum)
% of companies, including each skill in their reskilling and upskilling strategies for 2023-2027



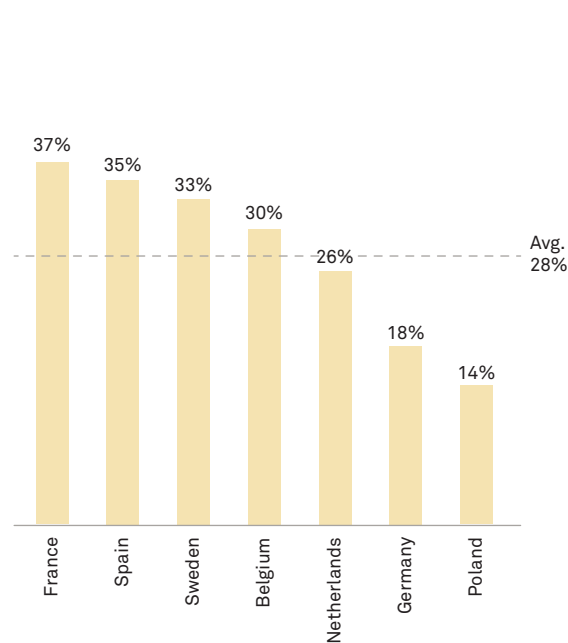
Note: Businesses' top 10 skill priorities for 2027 are based on a comprehensive global survey from the World Economic Forum's Future of Jobs report 2023, which includes insights from 803 companies across 27 industries, with a significant presence in 46 countries.
Source: Implement Economics based on OECD Employment Outlook (2023) and World Economic Forum's Future of Jobs report (2023).

Reskilling and upskilling are key for the economic opportunity – around €500 billion of the potential GDP gains depend on it

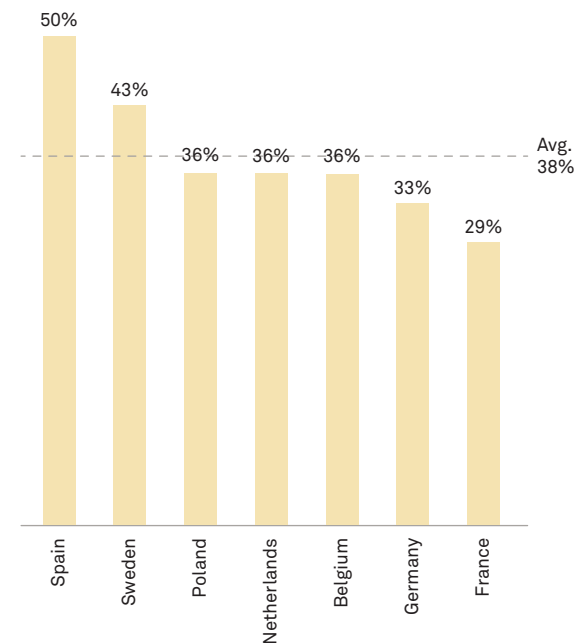
What will you do in the next five years as a result of AI?

% of respondents who are employed and think that AI will slightly or completely transform the way they do their job.

I will have to reskill or take some type of course

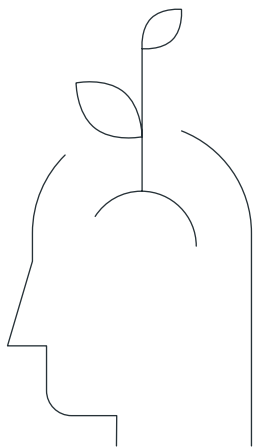


I will have to learn how to use AI



- With an evolving skill mix required of European workers, many are already expressing a need for upskilling and reskilling.
- Of the polled European workers indicating that AI will completely or slightly change their job, an average of 28% expect to have to reskill or take some type of course within the next five years as a result of AI.
- OECD studies suggest that companies that offer ICT training to their employees have, on average, 3-5% higher growth in their annual labour productivity.
- The literature highlights that companies that combine technology/ICT adoption with employee training have higher implementation and financial success.

The potential of generative AI is reduced from 8% to 5% of GDP if labour forces in EU countries are unable to successfully reskill and thus reemploy resources that are displaced by generative AI, including both displaced workers and freed-up time for complemented workers (see page 25). The difference corresponds to around €500 billion of potential GDP gains.



Source: Implement Economics based on Ipsos survey, the European Commission, Mosiashvili and Pareliussen (2020), Borowiecki et al. (2021), Gal et al. (2019), Andrews et al. (2018), Jiang et al. (2020) and Ouyang et al. (2022).

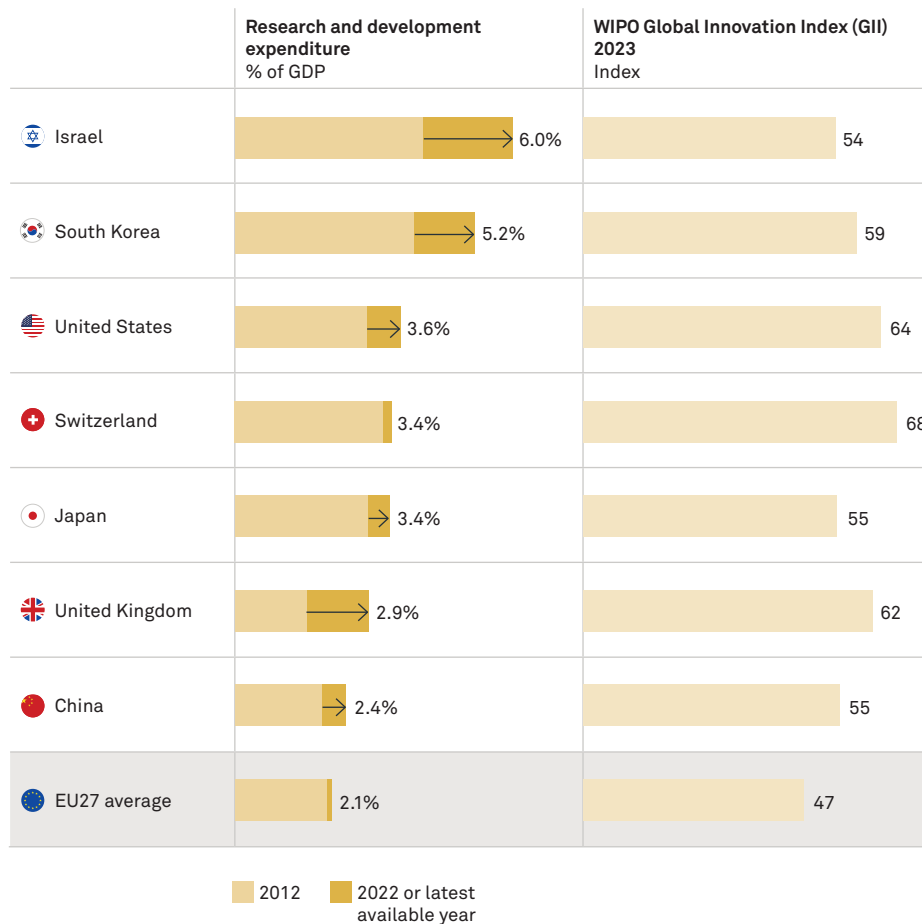


06

AI accelerating scientific breakthroughs and innovation in the EU

AI can accelerate and improve scientific breakthroughs in the EU, increasing competitiveness and improving the lives of European citizens.

The EU spends less on R&D than leading countries and underperforms on innovation indicators

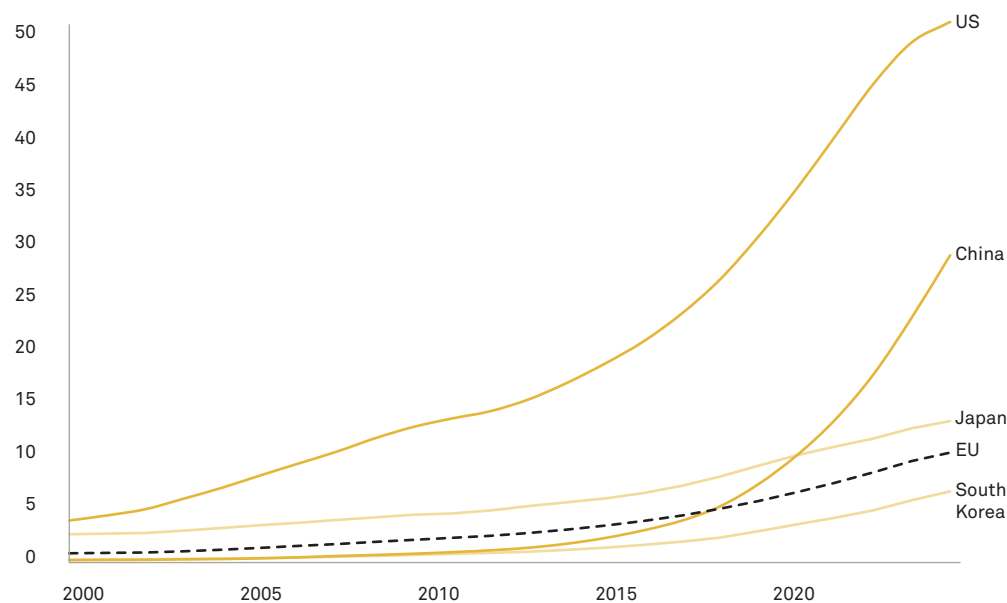


- Innovation and scientific breakthroughs are key components to competitiveness, prosperity and well-being.
- However, the EU spends only 2% of its GDP on research and development, whereas the US spends over 3% and leading countries spend up to 6% on research.
- Compared to similarly advanced economies, the EU underperforms on global innovation indicators that include infrastructure, technology and creative outputs.
- This is partly due to a fragmentation of research efforts, barriers to collaboration between academia and industry and the need for greater investment in digital infrastructure (see the **European Commission** for more information).
- These differences may play a significant role in future economic growth and competitiveness, where the EU risks falling further behind (see section 1).
- AI can help address the increasing complexity of scientific knowledge and the growing volume of research literature, helping scientists to stay on top of the latest developments and identify breakthrough opportunities.

Notes: The Global Innovation Index (GII) is a composite indicator that ranks countries based on their innovation performance, incorporating a range of metrics across seven pillars: institutions, human capital and research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs and creative outputs. Source: Implement Economics based on WIPO, European Commission and OECD Main Science and Technology Indicators database.

The gap within digital innovation continues to expand between the US and China and the EU, which may threaten economic growth in the coming decades

Number of patents in advanced digital technologies
Thousands



- The EU is behind on patents in advanced digital technologies, which can hamper future economic growth.
- In AI specifically, China has already taken the top position according to Stanford University's AI Index.
- In 2022, China accounted for 60% of global AI patent origins, significantly more than the United States, which accounted for 20% of AI patent origins.
- However, the US still dominates as the leading source of AI models with 61 notable AI models originating from the US and only 21 from the EU and 15 from China.
- Digital innovation and adoption are key to future GDP growth, with estimates by Deloitte on behalf of Vodafone Group showing that GDP per capita in the EU could increase by 7% if the EU reaches a Digital Economy and Society Index (DESI) of 90 (up from just over 50 today).

The EU aims to strengthen its scientific and technological base, and AI can help speed up scientific breakthroughs and innovation



The EU has defined multiple ambitions and programmes with the aim to “strengthen the scientific and technological bases of the Union and foster its competitiveness.”

European Commission

Horizon Europe

The EU’s **key funding programme** for research and innovation, running from 2021 to 2027 with a budget of €95.5 billion. It aims to drive scientific excellence, tackle societal challenges and enhance Europe’s global competitiveness by supporting groundbreaking projects across various disciplines.

Digital Europe Programme

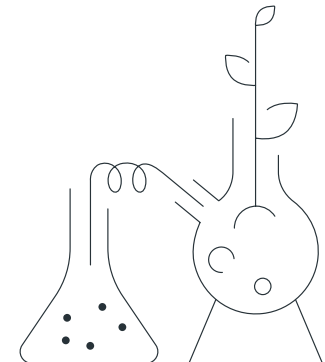
The **Digital Europe Programme** is an EU funding initiative aimed at advancing Europe’s digital transformation. Running from 2021 to 2027 with a budget of €7.5 billion, it focuses on building digital capacities in areas such as supercomputing, artificial intelligence, cybersecurity and advanced digital skills to enhance the digital infrastructure and competitiveness of the European economy.

European Innovation Council (EIC)

The **European Innovation Council (EIC)** is an EU funding initiative designed to support high-risk, high-impact innovations with the potential to create new markets and scale up internationally. Operating under Horizon Europe, it provides funding through EIC Pathfinder for advanced research, EIC Transition for developing market-ready innovations and EIC Accelerator for startups and SMEs.

AI can help accelerate innovation and scientific discovery by:

- **Synthesising knowledge**
AI can help understand and build on pre-existing knowledge.
- **Analysing and building data**
AI can help analyse, generate and annotate ever-larger data sets.
- **Simulating experiments**
AI can help simulate expensive, time-consuming experiments through, for example, molecular prediction. This can increase efficiency and reduce the risk of human error.
- **Modelling complexity**
AI can model complex systems and how their components interact, e.g. with genomics.
- **Discovering solutions**
AI can identify optimal solutions from large search spaces, e.g. through literature-based discovery (LBD).



AI is already helping to propel scientific innovation in Europe, supporting the EU's ambition to strengthen its scientific and technological base

Bayer AG (DE)

AI helps **Bayer** map the chemical space to identify new drug candidates more efficiently. By using knowledge graphs for patient subtyping and in-silico target identification, Bayer accelerates the discovery of treatments, such as for heart failure.

VIB-KU Leuven (BE)

Researchers at the **VIB-KU Leuven Center for Brain & Disease Research** have used AI to create synthetic DNA sequences. Their deep learning model deciphers enhancer codes to create functional enhancers that activate specific genes, with significant positive implications for gene therapy and gene regulation.

European Space Agency (FR)

The **ESA** is using AI to propel space exploration. AI helps in autonomous navigation for lunar rovers and other space missions. ESA's Hera mission uses AI for self-driving navigation towards asteroids.

Aalto University (FI)

Aalto University has combined atomic force microscopy (AFM) with machine learning to study materials at the smallest scale. This method enables detailed 3D molecular imaging and chemical analysis, which is crucial for developing sustainable materials. AI trained on AFM data allows faster and more reliable interpretation of complex molecules, impacting materials science and sustainability.

University of Vienna (AU)

Research at the **University of Vienna** is demonstrating that quantum technology can significantly accelerate AI learning processes, highlighting how integrating quantum mechanics with AI is enhancing the development of autonomous machines. This work underscores the potential for quantum artificial intelligence to continuously drive scientific innovation by enabling faster decision-making and more efficient learning in robots.

AlphaFold (Google, Europe-wide)

AlphaFold is an AI system developed by Google DeepMind that predicts 3D structures of proteins from their amino acid sequences. It was used to model the structures of proteins related to SARS-CoV-2, the virus causing COVID-19. Now, with **AlphaFold 3**, AlphaFold's capabilities have expanded from proteins to predicting the structure and interactions of all of life's molecules, including DNA and RNA



AI has revolutionised our efficiency and productivity, especially in developing clinical trial protocols.

Dr Siddharth Agrawal, Co-founder and CEO of **Labplus**

Leveraging AI in innovation and scientific research can help the EU increase competitiveness, boost the innovation ecosystem and solve real-world problems



Increased global competitiveness

- Generative AI can significantly reduce the time required for research and development, enabling faster advancements in critical fields like biotechnology, renewable energy and material science in which Europe can solidify its competitive advantage.
- By investing in AI-driven research, the EU can attract researchers and engineers from around the world.
- Integrating AI into key sectors such as pharmaceuticals and aerospace can ensure that these industries continue to drive economic growth and remain at the forefront of technological advancements.



With the aid of generative AI, the EU could improve its status in science and technology, attracting both intellectual and financial capital, thereby enhancing its overall competitiveness on the world stage.



Boosting innovation ecosystems and SMEs

- Generative AI can improve the efficiency and capabilities of research institutions, including universities and innovation hubs. This leads to a more robust and interconnected research ecosystem throughout the EU.
- The integration of AI into scientific research can support the growth of startups and small to medium-sized enterprises (SMEs) by helping smaller labs and science startups with fewer resources access cutting-edge research tools and create a more inclusive innovation landscape.
- AI-driven innovation can stimulate economic development in emerging markets. By fostering local innovation ecosystems, the EU can ensure more balanced and inclusive economic growth across its member states.



The EU could create a thriving innovation ecosystem that supports the growth of startups and SMEs, enhances research infrastructure and promotes regional development, leading to a more dynamic and equitable economic landscape.



Solving important societal challenges

- AI-driven advancements in biomedical research can lead to the development of more effective treatments and personalised medicine, improving healthcare outcomes and the quality of life for EU citizens.
- Generative AI can accelerate research in sustainable technologies, such as carbon capture, nuclear fusion, battery optimisation and renewable energy.



The EU could benefit from economic growth and societal well-being through the downstream effects of AI-driven scientific advancements, creating a more prosperous and sustainable future for its citizens.

The EU can act within a pro-innovation framework that responsibly leverages AI in scientific research and discovery



Support EU member states in uncovering and resolving obstacles to infrastructure advancement

Innovation in – and enabled by – AI will require appropriate digital infrastructure (e.g. high-speed Internet, cloud computing platforms and advanced data storage solutions) to unlock the benefits of this new technology.



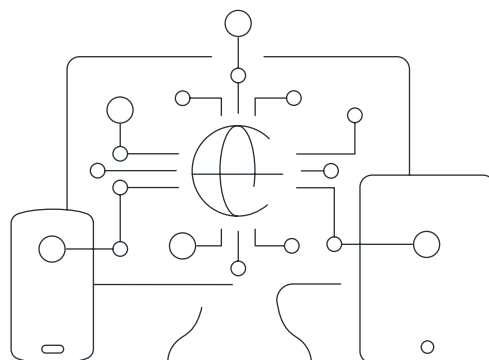
Ensure that the EU's regulatory landscape enables the full potential of AI

Implementing a streamlined and forward-looking regulatory framework can accelerate AI adoption in scientific research by ensuring clarity, safety and ethical standards, thereby attracting global research talent and investment. The EU aims to deliver on these points through the EU AI Act.



Continue collaboration with international organisations on developing AI standards

AI is inherently a cross-border technology in terms of how it is researched, developed and deployed. It is critical for EU member states to work together and with allies on the development and governance of AI. This can be achieved by, for example, sharing best practices, developing common evaluations and benchmarks or improving the accessibility of public datasets and their ease of use for machine learning.





07

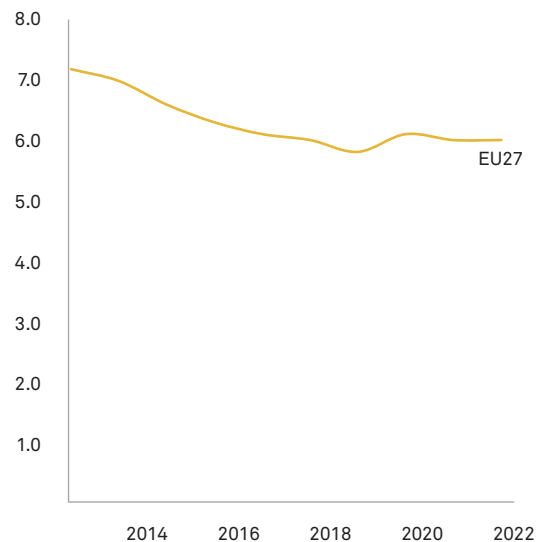
AI enhancing quality and efficiency of public services in the EU

AI can improve transparency, efficiency and accessibility of EU public services, boosting public trust.

Public institutions across the EU face challenges in maintaining quality and timeliness in their public services due to financial limitations and increasing demand

Government spending on general public services has decreased as a share of GDP ...

Government spending on general public services
% of GDP



... while the increasing complexity of public tasks leads to strained public administrations and potentially an erosion of public trust.

Changes in public administrative complexity

- Increased regulatory complexity
- Growing demand for accessibility
- Greater need for personalised services

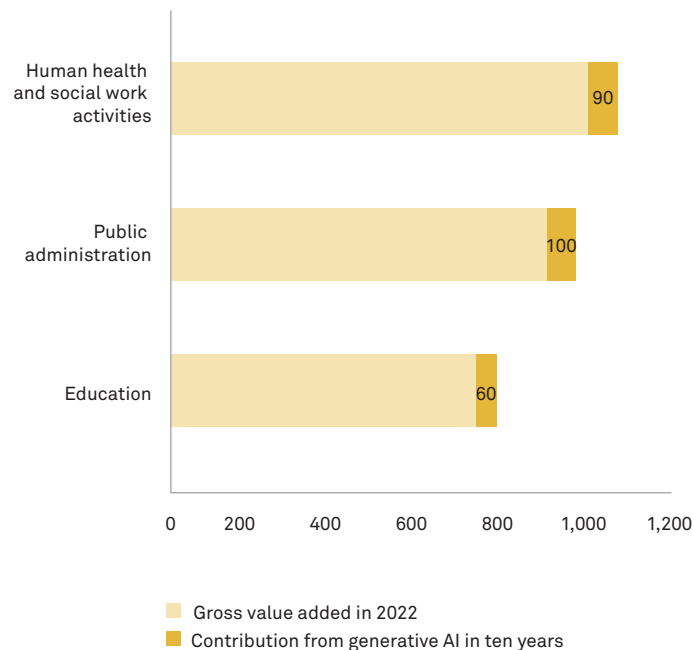
Implications for public administrations

- Delays and congestion in providing services
- Deterioration in the quality of services
- Erosion of trust in public institutions

- Across the EU, public administrations are facing reductions in government spending on public services relative to GDP.
- Meanwhile, public administrations are experiencing an increase in the complexity of tasks driven by increased public expectations and a complex regulatory landscape.
- Together, these effects strain public administrations and could reduce their ability to deliver services efficiently. Consequently, these factors could collectively result in delays, congestion in service provision and deteriorating service quality.
- This decline in service quality and timeliness, along with diminished accessibility, may gradually erode public trust in governmental institutions.

Generative AI could mitigate resource shortages and growing demands on public institutions in the EU by enhancing efficiency and quality of public services

Gross value added in the public sector
€ billion



€250Bn
Overall potential in public administration, education and healthcare

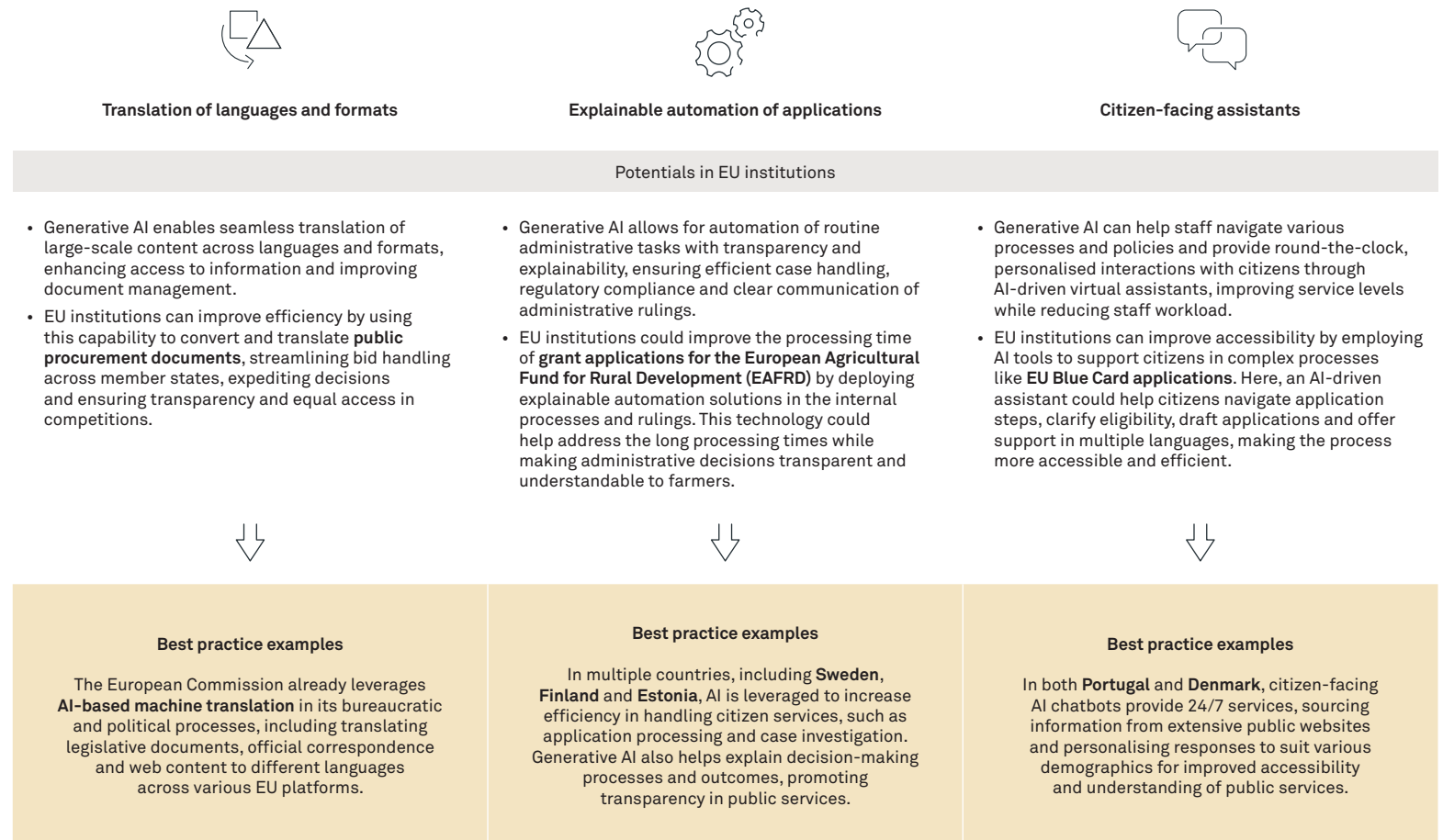
Gross value added in public industries can take the form of:

- 1. Freed-up resources** that can be leveraged to reduce bottlenecks or can be reallocated to other public services.
- 2. Increased quality** of public services, allowing for new types of services and increasing personalisation, transparency and accessibility of current services.

- Generative AI can help address the challenges of declining funding and increasing demands for public services.
- Generative AI has the potential to drive efficiency and quality in public services. The use of generative AI can result in better citizen satisfaction, shorter response times and better services within a given budget. The potential in public services corresponds to an estimated €250 billion in value added in ten years.
- By allowing public employees to complete their tasks more quickly, generative AI can alleviate bottlenecks and reduce waiting times in areas with scarce resources. Alternatively, the resources freed up can be reallocated to improve other public services.
- Additionally, generative AI can improve the quality and variety of public services by introducing new functionalities and services, enabling increased accessibility, transparency and personalisation of existing ones. It can also enable public service institutions to leverage their large data pools, helping improve citizen services.
- Overall, generative AI has the potential to support public services across the EU that are under increasing strain, thereby maintaining public satisfaction and trust in EU institutions.

Note: "Public administration" comprises Public administration, defence and compulsory social security.
Source: Implement Economics based on Eurostat, O*Net and Briggs and Kodnani (2023a).

The EU can also leverage AI to improve the efficiency and quality of its own institutions by drawing on national and international best practice examples





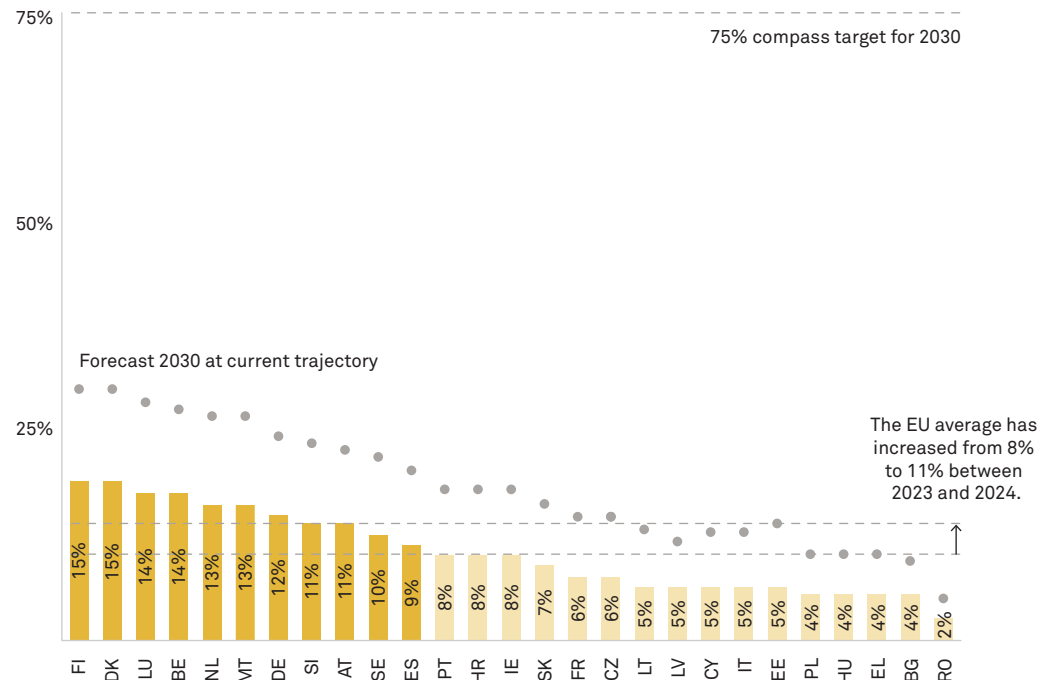
AI readiness in the EU

The EU's capacity to leverage the potential of AI can be evaluated based on several factors and compared to European and global frontrunners.

Even the EU's frontrunner countries are far behind the EU 2030 Digital Decade target of 75% AI adoption

Adoption of AI in 2023

% of enterprises using at least one type of AI technology

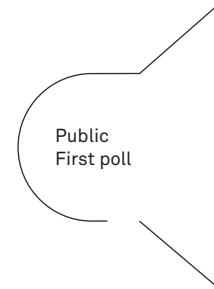


- The European Commission aims to empower businesses and people in a human-centred, sustainable and more prosperous digital future as part of their Digital Decade 2030 policy programme.
- The Digital Decade programme sets out concrete targets for skills, public services, businesses and infrastructures. Specifically, the target for AI adoption aims to ensure that by 2030 at least 75% of businesses are using AI.
- On average, 11% of EU companies had adopted at least one type of AI technology in 2024, up from 8% in 2023.
- In the leading countries, Denmark and Finland, 15% of companies have adopted AI.
- In its most recent assessment, the European Commission concludes that the EU is set to fall significantly short of its target on AI adoption for 2030.
- Firm-level adoption data underestimates actual use in business settings as many instances of individual-level AI use are not captured.

Note: Current adoption is from 2023 and includes enterprises with ten or more employees, excluding financial services. Forecast for 2030 is based on European Commission-forecasted AI adoption. Source: Implement Economics based on Eurostat, Draghi report and the European Commission.

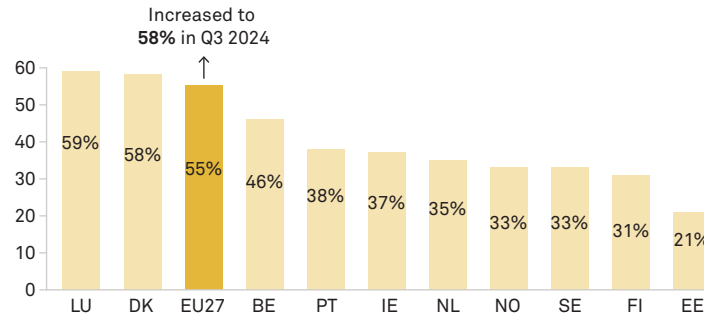
New survey data points to accelerated adoption

Survey responses from companies on their five-year outlook on generative AI
% weighted average of enterprises, 2023

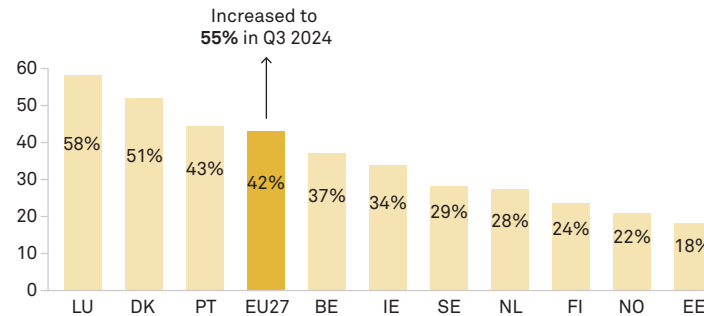


58%
of SMEs in the EU plan to invest in AI-based automation in the next five years compared to **88%** of large enterprises.

Planned firm-level adoption of AI automation
% of companies that plan to invest in AI-based automation in the next five years



Expected productivity boost from generative AI
% of companies that think that generative AI will significantly improve the productivity of their business in the next five years

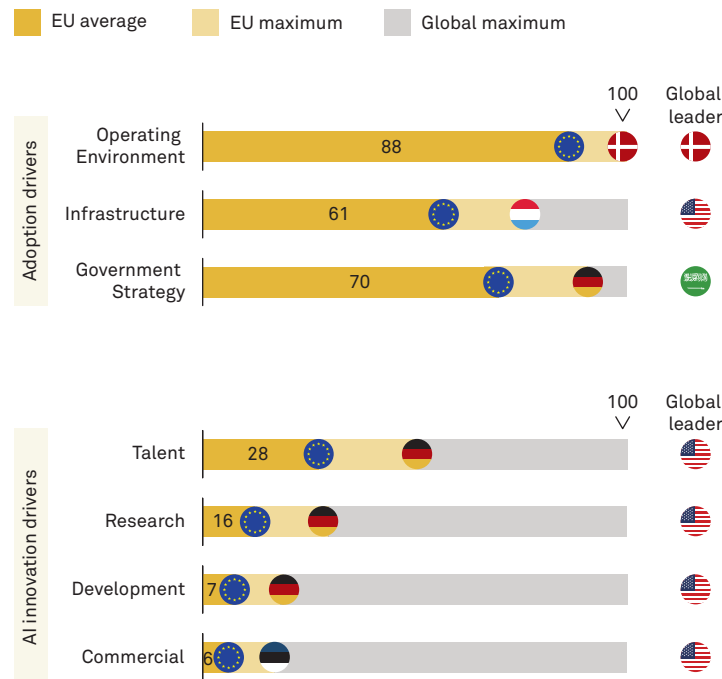


- Recent polling data from Public First indicates a particularly optimistic outlook on generative AI in the EU compared to Northern Europe – countries that are among the most digitalised in Europe.
- 59% of companies in the EU claim that they plan to invest in AI-based automation in the next five years. In 2023 Q3, this result was 55%.
- 55% of companies in EU countries anticipate significant productivity impacts from generative AI on their business in the next five years. This is a significant increase from the previous year's result of 42%.
- Recent polling from Notion Capital shows that 59% of startups believe that AI has led to increased efficiency in their company, and the greatest efficiencies have been achieved in data processing.
- While this generally suggests a fast pace of adoption, AI adoption is still in an early phase, and more complementary innovations, investments and commercial ventures in AI are needed to capture the full economic potential.

Note: Public First surveys for the EU conducted in Q3 2024 and Q3 2023. Surveys for countries shown were conducted in Q3 2023 and Q1 2024 for Estonia and Ireland. Nationally representative consumer and business polling. Respondents of the survey include the EU, Sweden (SE), Denmark (DK), the Netherlands (NL), Belgium (BE), Luxembourg (LU), Finland (FI), Norway (NO), Portugal (PT), Estonia (EE) and Ireland (IE). Notion Capital survey conducted in Q3 2024. Source: Implement Economics based on Notion and Public First country surveys.

Indicators suggest that the EU performs well on basic adoption drivers but lags behind on innovation drivers

The EU's AI capacity according to the Tortoise Global AI Index
Global AI Index, score out of 100 (global leader)



The EU is generally well placed for generalised AI use and early phases of AI adoption. The EU countries are at the global forefront in terms of operating environment.

The EU lags behind on innovation drivers required for more specialised AI applications compared to global leaders in the field.

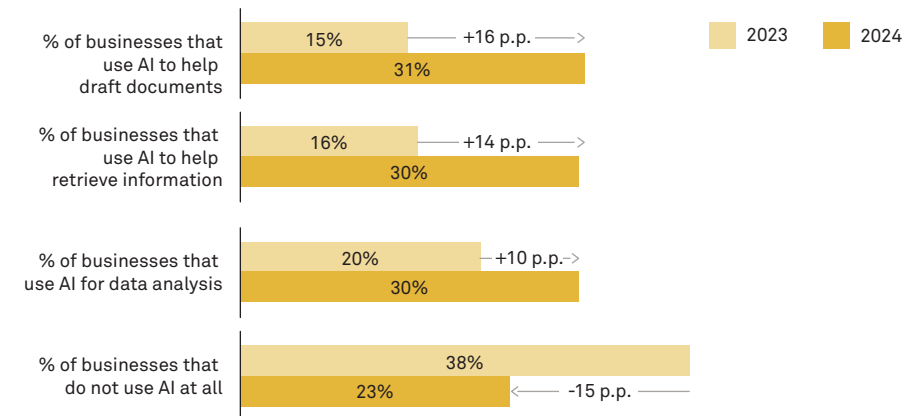
- The EU performs well on the early foundational drivers of AI adoption that ensure a safe and reliable AI-ready environment: operating environment (e.g. trust, data governance), government strategy and infrastructure (e.g. supercomputing, download speed).
- Denmark and Germany are at the global forefront in terms of operating environment and government strategy, respectively, serving as best practice examples.
- More specialised AI applications and the realisation of full productivity gains will additionally require further investments in cohesive and competitive innovation ecosystems that are conducive to development and commercial uptake.
- The EU should make strategic efforts to increase AI-related R&D activity and promote skills required for AI development and innovation, incentivising greater public-private collaboration and ensuring an even larger offering of courses and a higher uptake of aspiring AI professionals, data scientists and engineers. We offer more concrete ways forward for Europe in the following section.
- Present gaps indicate that the EU risks falling behind the next wave of AI and needs to ramp up its efforts to remain competitive.

Note: The Global AI Index looks at seven sub-pillars for AI capacity: talent (availability of skilled practitioners in AI solutions, including IT and STEM graduates, data scientists, AI professionals etc.), infrastructure (download speed, supercomputing capabilities etc.), operating environment (regulation, cybersecurity etc.), research (AI publications and citations etc.), development (fundamental platforms and algorithms etc.), government strategy (national funding commitments to AI etc.) and commercial ventures (AI start-up activity, investments etc.).
Source: Implement Economics based on Tortoise Media.

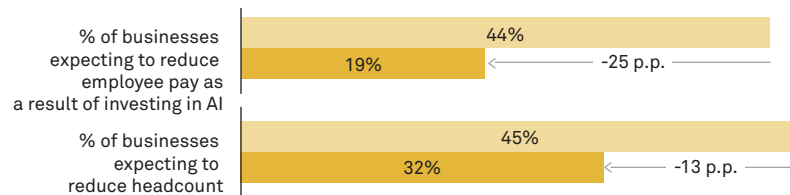
Business use of AI is accelerating in 2024, and concerns over jobs are declining

Survey responses from European companies
% of businesses

Use of AI for specific purposes has doubled in Europe ...



... and European businesses now have a more positive outlook for employees in the AI age



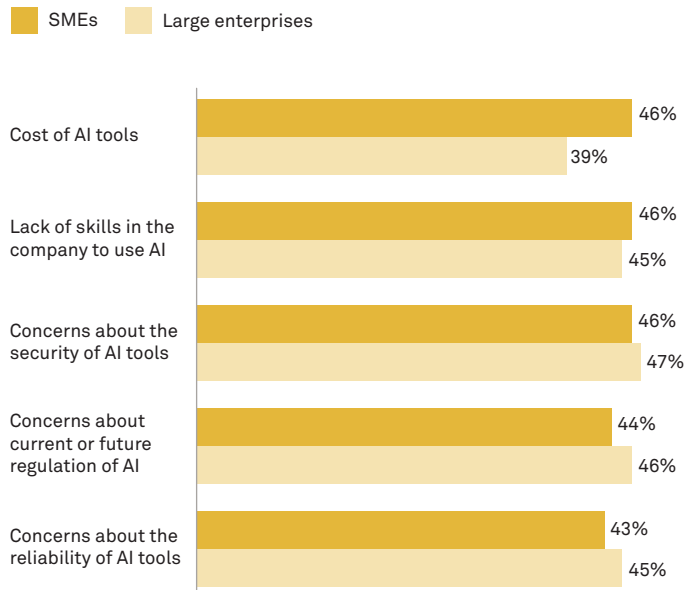
- Recent polling data from Public First provide an early insight into the evolution in the use of and attitudes towards AI over the past year.
- The results show that the share of businesses using AI for purposes such as drafting documents, retrieving information and analysing data has doubled (from 15-20% to 30-31%).
- Moreover, the share of businesses reporting that they do not use AI at all has decreased from 38% to 23%.
- As an early indicator of adoption, these figures of business usage of AI suggest that the EU is on track to achieving widespread adoption within the coming decade.
- The share of companies reporting that they expect to reduce employee pay as a result of AI investment has more than halved from 44% to 19%, and the share of businesses expecting to reduce headcount has reduced from 45% to 32%.
- Similar positive attitudes are reported from startups in the EU. According to recent polling from Notion Capital, 61% of startups have not changed head count due to AI, and for 25%, there have been an increase in head count.

Note: Public First survey conducted in Q3 2024 and Q3 2023. Nationally representative consumer and business polling. Respondents of the survey include Germany (DE), Belgium (BE), Finland (FI), Ireland (IE), France (FR), Italy (IT), Denmark (DK), Poland (PL), Spain (ES), the Netherlands (NL), Sweden (SE) and Norway (NO). Notion Capital survey conducted in Q3 2024. Source: Implement Economics based on Notion Capital and Public First country surveys.

SMEs and large enterprises face similar barriers to AI adoption, and large enterprises indicate a greater need of skills to harness AI's potential

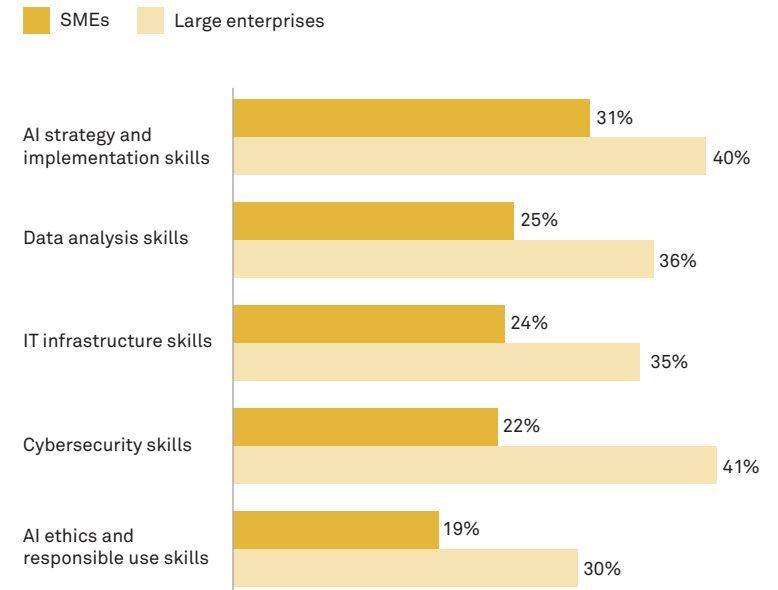
SMEs and large enterprises generally point to the same barriers to AI adoption

What are the barriers to your business making more use of AI?
% weighted average of enterprises, 2024



Large enterprises indicate a greater need for specific skills to fully leverage AI's potential compared to SMEs →

Which skills would you say your business needs more of to take full advantage of AI?
% weighted average of enterprises, 2024



Note: Public First survey conducted in Q1 2024.
Source: Implement Economics based on Public First survey and European Investment Bank.



- Polling conducted by Public First reveals that SMEs and large enterprises face similar barriers to AI adoption.
- Both SMEs and large enterprises identify lack of skills as well as concerns about security, reliability and regulation as significant obstacles.
- More SMEs (46%) cite the cost of AI tools as a barrier compared to large enterprises (39%).
- The polling further indicates that large enterprises generally have a greater need for specific skills to fully capitalise on AI. For instance, 41% of large enterprises report a higher demand for cybersecurity skills compared to only 22% of SMEs.
- As highlighted in the Draghi report, an EIB report showed that more than 60% of EU companies see regulation as a barrier to investment.



The way forward to capture the benefits of AI

The EU can consider several options to capture the benefits and navigate the dilemmas of AI.

Potentials, pitfalls and paradoxes

AI has the potential to be the most powerful technology in decades

- AI enables us to do things better and work more efficiently. It also enables us to do better things. With AI, we can focus on the best parts of our jobs and leave the rest to AI. Yet, AI is still in its infancy and how it is applied is highly uncertain.
- To make AI benefit humans and society as a whole will require pursuing the potentials, avoiding the pitfalls and navigating the paradoxes.
- The future of AI should not be reduced to a simple one-dimensional question: Should we have more AI or less AI – or even ban AI?
- AI is not a fixed thing with a predetermined future that can come quickly or slowly. AI is new, uncertain and malleable and will require wise choices by all stakeholders across business, governments and civil society.

Potentials	Pitfalls	Paradoxes
<ul style="list-style-type: none"> • The estimated economic potential assumes widespread adoption of generative AI within ten years. • The estimate includes both narrow labour-saving impacts and broader value-creating impacts that enable workers to do something novel or powerful. • It assumes that AI lives up to its promise of being the most radical technological breakthrough in decades. • Moreover, we estimate that AI will complement the majority of workers and free up time to spend on non-routine, creative and inventive tasks. • The result is an economy not simply at a higher level of productivity, but at a permanently higher growth rate. 	<ul style="list-style-type: none"> • Displaced workers might end up in less productive jobs (than already assumed). • AI may end up being less promising or less ready to bring to market than initially hoped. • Time to market may be challenged by a legal regime not designed for AI. • Companies may miss out on the benefits of AI due to a lack of competences or failure to change organisations and habits. • National regulators, driven by any number of concerns, may impose strict regulations that slow the speed of AI development. • Regulatory uncertainty and lack of clarity on future rules may delay the uptake. 	<ul style="list-style-type: none"> • How can policies encourage the types of AI that complement human labour and best prepare those at risk of losing a job to AI? • What choices will encourage the development and deployment of AI that companies of all sizes can access? • What kind of investment in AI research and development might unleash the most interesting new ideas, innovations and applications in support of overall societal value? • What kind of high-performance computer infrastructure is needed to power the new technology, and how is that best provided?

AI innovation is constrained by inconsistent and restrictive regulations

Regulatory overlaps and inconsistencies can undermine AI adoption and development

The Draghi report points to:

- Differences among Member States in the implementation and enforcement of the GDPR rules.
- Overlaps and areas of potential inconsistency between the GDPR rules and the provisions of the AI Act.

Accordingly, European companies risk being excluded from early AI innovations due to regulatory uncertainty and higher costs for EU researchers and innovators to develop home-based AI.

The EU needs simplified rules and harmonised implementation

The Draghi report calls for developing simplified rules and enforcing harmonised implementation of the GDPR in the Member States while removing regulatory overlaps with the AI Act.

This would ensure that EU companies are not hampered in the development and adoption of frontier AI.

Regulatory barriers to scaling up are particularly burdensome in the tech sector, especially for young companies

The Draghi report points to five regulatory barriers that may deter young, innovative tech companies from operating in the EU:

1. Complex and costly procedures and fragmented national approaches discourage inventors from filing Intellectual Property Rights (IPRs).
2. The complexity of EU regulation of tech companies hampers innovation: the EU now has around 100 tech-focused laws and over 270 regulators active in digital networks across all Member States.
3. Digital companies are dissuaded from doing business across the EU via subsidiaries, as they face heterogeneous rules, a creation of multiple regulatory agencies and “gold plating” of EU legislation by national authorities.
4. Restrictions on data storing and processing generate high compliance costs and impede the creation of large, integrated data sets for training AI models.
5. Numerous different national rules in public procurement create high ongoing costs for cloud providers.

The net effect of this burden of regulation is that only larger companies have the financial means and incentive to bear the costs of complying.



Innovative companies that want to scale up in Europe are hindered at every stage by inconsistent and restrictive regulations.

Mario Draghi report on *The Future of European Competitiveness*.



Unlocking the AI opportunity by creating trust and preserving the incentive to invest

The benefits of new waves of technology do not come automatically. As with past waves of technology, it takes time for people to trust the technology. Regulators across the world are set to ensure the safety of the technology while achieving its benefits. The EU's **AI Act** aims to lead on this. In the urgent efforts to achieve broad-based trust, regulators may create fragmentation, misalignment and uncertainty about future rules, which can hamper investment and adoption.

Developers and early technology adopters will need clarity on future rules. Clarity is needed regarding, for example, the requirements for transparency in the functioning of the generative AI models, the data used to train them, issues of bias and fairness, potential intellectual property issues, possible privacy violations as well as security concerns.

To navigate these choices, this report offers five perspectives:

Enable innovation and invest in AI research and development	Create a conducive and aligned AI regulation and global governance	Promote widespread adoption and universal accessibility	Build human capital and an AI-empowered workforce	Invest in AI infrastructure and compute power
<ul style="list-style-type: none"> • Bridge the gaps that prevent the transformation of research into successful ventures. • Foster industry, government and university innovation partnerships to undertake pre-commercial AI research projects. • Support innovation on top of already developed foundational models and findings, e.g. by leveraging the new EU AI innovation package. • Make compute capacity available to entrepreneurs and scientists so they can develop and use AI in support of other discoveries and innovations. • Support strategic EU-US AI research collaboration, technology transfer and international movement of researchers. 	<ul style="list-style-type: none"> • Avoid siloed approaches to AI regulation to minimise the risk of misalignment and fragmentation through increased international co-operation. Alignment on AI governance should be pursued on a global scale. • Ensure copyright rules that support innovation and creativity and preserve the incentive to generate new content. • Adopt a risk-based approach to AI regulation to provide clarity to developers, adopters and users about which uses are disallowed. • Encourage privacy and security principles so that individuals' personal data is safeguarded. • Reduce barriers to digital transatlantic trade. 	<ul style="list-style-type: none"> • Integrating sectoral AI applications in key European industries to increase productivity. • Promote widespread adoption and universal accessibility by helping governments, small businesses and all sectors of the economy adopt and use AI. • Lead with the public sector adoption of AI solutions, which may require overcoming procurement roadblocks that often appear when public entities aim to adopt new technologies. • Give small businesses an "AI jumpstart" through technical assistance, training and guidance to help them understand and leverage AI for their businesses. 	<ul style="list-style-type: none"> • Use data analytics to identify skills gaps and adjust education and training systems. • Build an AI-empowered workforce by investing in human capital, education and training systems. This means treating AI as a core component of the education system. • Focus training and upskilling where AI enhances and augments worker capabilities. • In the types of jobs where AI risks displacing workers, efforts should be devoted to reskilling workers for other jobs. • Ensure a flexible labour market and continuous lifelong training enabling new opportunities. • Prioritise adult learning initiatives that enable workers to continuously update their skills. 	<ul style="list-style-type: none"> • Ensure incentives and regulation for public and private investment in AI infrastructure and compute capacity, such as high-performance computing (HPC), graphics processing and EU data centres needed to drive the powerful AI models. • Enable trusted cross-border data flows in trade agreements and ensure regulatory interoperability and non-discrimination in the EU. • Support the building of cross-border AI infrastructure and subsea cables through initiatives such as the G7 partnership for global infrastructure and investment. • Reduce electricity emissions from data centres by promoting ambitious decarbonisation strategies such as 24/7 Carbon-Free Energy.

Note: For more details on policies, see OECD AI principles, OECD AI Observatory, EU's ethic guidelines for trustworthy AI, EU's AI innovation package, Google's AI principles and paper on "An Opportunity Agenda for AI". For more details on carbon-free energy and digital decarbonisation, see the European perspective and global perspective.



10

Annex

Modelling the impacts of
generative AI in the EU.

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Modelling the economic opportunity for the EU

Overview of the methodological approach to calculating economic growth and productivity impact from generative AI

The economic effects are calculated in the following steps:

1

Automation potential of work activities: First, the exposure to generative AI is calculated by breaking down the automation potential of 39 different work activities/tasks in the occupational task database O*NET. The database includes an estimate of the share of each activity (e.g. getting information, performing administrative activities etc.) that can be automated by generative AI (if the activity is above level 4 on an O*NET-defined scale of difficulty 1-7, no automation potential is assumed).

2

Mapping automation potential of work activities to occupations: The automation potential of the work activities is mapped in ten European industry aggregates in two sub-steps. First, the 39 work activities for 900 US occupations are mapped using importance-average activities for each occupation, providing an estimate of the share of each occupation's total workload that AI has the potential to automate. Secondly, this number is projected from US to European occupations through the European Commission's crosswalk between ESCO and O*NET and finally compiled into aggregated occupations (using the sub-occupation employment). This leaves us with the three shares that describe how big a share of the work activates for each occupation is expected to see: No automation, AI complement and Likely replacement.

3

Quantifying productivity gains in each sector: Generative AI is assumed to affect the productivity of the work activities for each occupation as follows (see section 3 for further details). The "No automation" share of work activities is assumed to be unaffected by generative AI. "AI complement" work activities experience a productivity boost from automation. "Likely replacement" is the share of work activities in a sector that is expected to be entirely automated/replaced. These workers are expected to be re-employed in slightly less productive jobs. The three effects are calculated across sectors and scaled by each sector's value added to determine the full productivity potential/generation of new jobs from generative AI across the economy, once the technology adoption peaks.

4

Aggregate GDP impact: Based on the estimated increase in labour productivity resulting from AI adoption, the result is aggregated to an overall GDP. Only part of the total long-run productivity increases from generative AI is expected to materialise in the economy during the initial ten-year period of technology adoption following an S-curve adoption trajectory.

The method used to calculate productivity and GDP effects of generative AI in this paper is in line with the methodology developed by Briggs and Kodnani (2023) in "The Potentially Large Effects of Artificial Intelligence on Economic Growth".

Note: Methodology is based on Briggs and Kodnani (2023).
Source: Implement Economics based on the European Commission, Eurostat and O*Net.

Disclaimer

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Authors

Martin H. Thelle

Anders Thor Lundberg

Bodil Emilie Hovmand

Hans Henrik Woltmann

Laura Virtanen

Nikolaj Tranholm-Mikkelsen

Sofie Tram Pedersen

Alexander Jagd Oure