

# The economic opportunity of AI in Portugal

Capturing the next wave of benefits from *generative AI*

An Implement Consulting Group study commissioned by Google

October 2024

# Generative AI has the potential to boost Portugal's GDP

AI has the potential to propel the competitiveness of the Portuguese economy by increasing productivity and enhancing innovation.

## The economic opportunity

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

In the peak year, generative AI alone could boost Mainland Portugal's GDP by

**€18-22 billion**

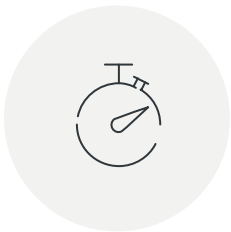
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**+8% GDP**  
annual contribution in the peak year if Portugal achieves widespread adoption.

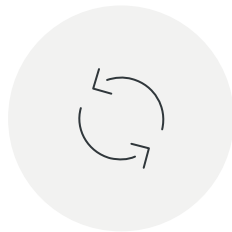
### Gains come from three sources ...



Productivity boost from people working with generative AI.



Freed-up time when generative AI helps to automate our work.

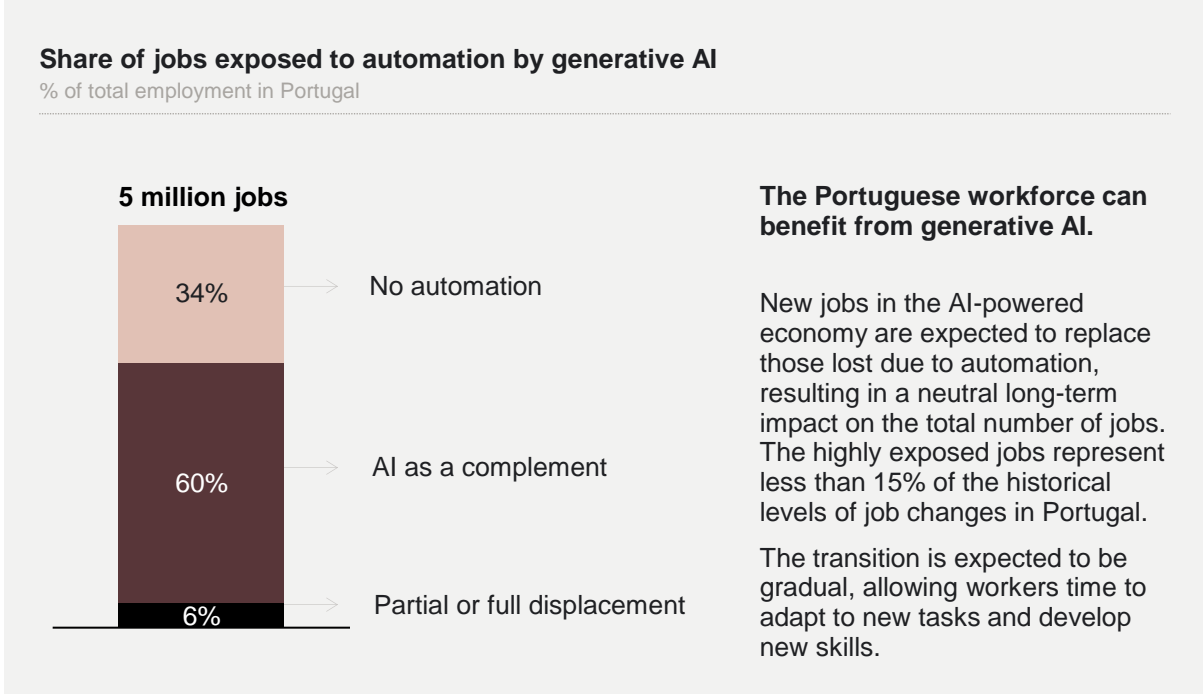


Re-prioritised and re-employed time for other value-creating activities.

## The job implications

**60%** of jobs in Portugal are estimated to work **together with** generative AI.

**43%** of Portuguese companies expect **significant productivity effects** from generative AI in the next few years.



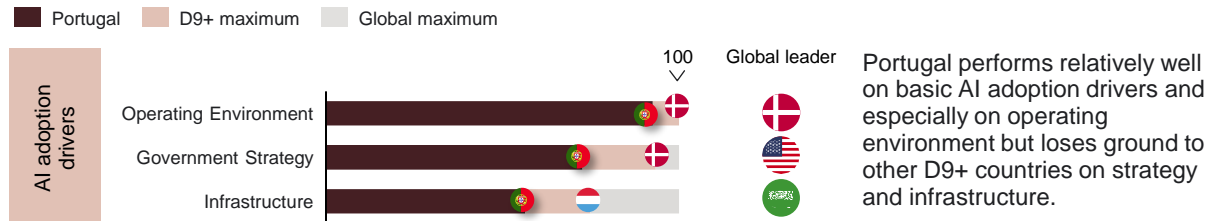
# Harnessing the gains from generative AI in Portugal requires enhanced efforts on basic AI adoption drivers and accelerated commercial uptake

## AI readiness in Portugal

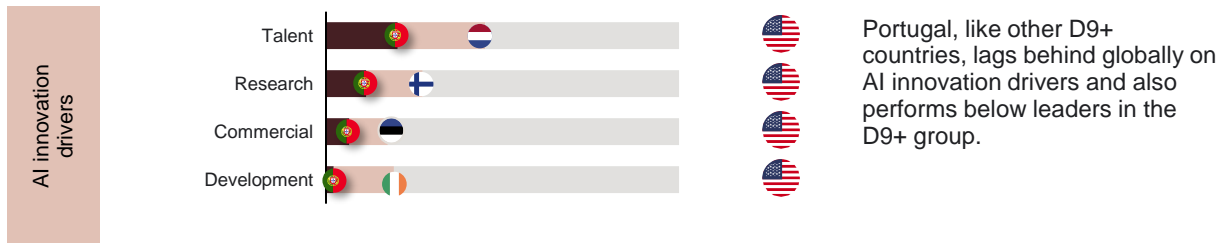
**Portugal performs well overall on foundational adoption drivers but lags behind comparable peers on strategy and infrastructure ...**

### Portugal's AI capacity according to the Tortoise Global AI Index

Global AI Index, score out of 100 (global leader)



**... and is, like comparable peers, significantly behind on AI innovation capabilities**



## Conclusions and policy implications

Generative AI can boost future economic growth in Portugal, exceeding current long-term GDP forecasts. Leading banks are raising growth forecasts from as early as 2028 due to the new expectations for generative AI.

The 8% boost to annual GDP at peak assumes that Portugal achieves widespread adoption in line with leading countries.

Given its current gap on key drivers of AI adoption, Portugal is likely to risk a five-year delay in adopting and developing generative AI. Such a delay would reduce the annual GDP potential from 8% to 2% of GDP, i.e. from €18-22 billion to €3-5 billion.

**Capturing the full economic gains requires innovation capabilities and a conducive regulatory framework.**



Retrain and upskill workforce



Grow R&D by local innovators



Accelerate commercial uptake

Note: The Tortoise Global AI Index is underpinned by 111 indicators collected from 28 different public and private data sources and 62 governments. The D9+ group is an informal group of 12 digital leaders in Europe, including Finland, Denmark, the Netherlands, Sweden, Ireland, Spain, Luxembourg, Estonia, Portugal, Belgium, the Czech Republic and Poland.

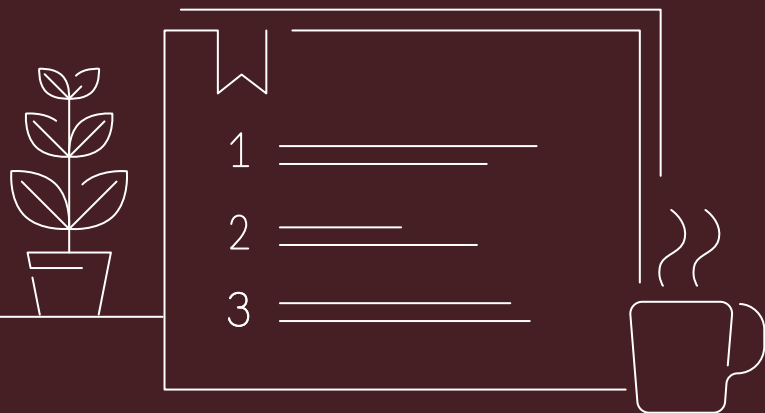
# Foreword

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

AI and the next wave of generative AI have the potential to be the most powerful technology in decades. Responsible AI can help solve global challenges like climate change and access to quality medical care.

AI can make countries more prosperous, productive, innovative, creative and secure. At the same time, there are plenty of pitfalls, paradoxes and tensions that decision-makers will need to navigate.

AI has evolved rapidly with the breakthrough of generative AI in 2022 and its fast adoption in 2023. This report estimates the economic potential of generative AI while recognising the significant economic potential of other types of AI.



# Contents

1	Introduction to AI	5
2	Economic opportunities from AI	9
3	Key sectors benefitting from AI	15
4	Job implications of AI	19
5	AI's impact on societal challenges	28
6	AI readiness in Portugal	31
7	The way forward to capture the benefits of AI	36
8	Annex	41



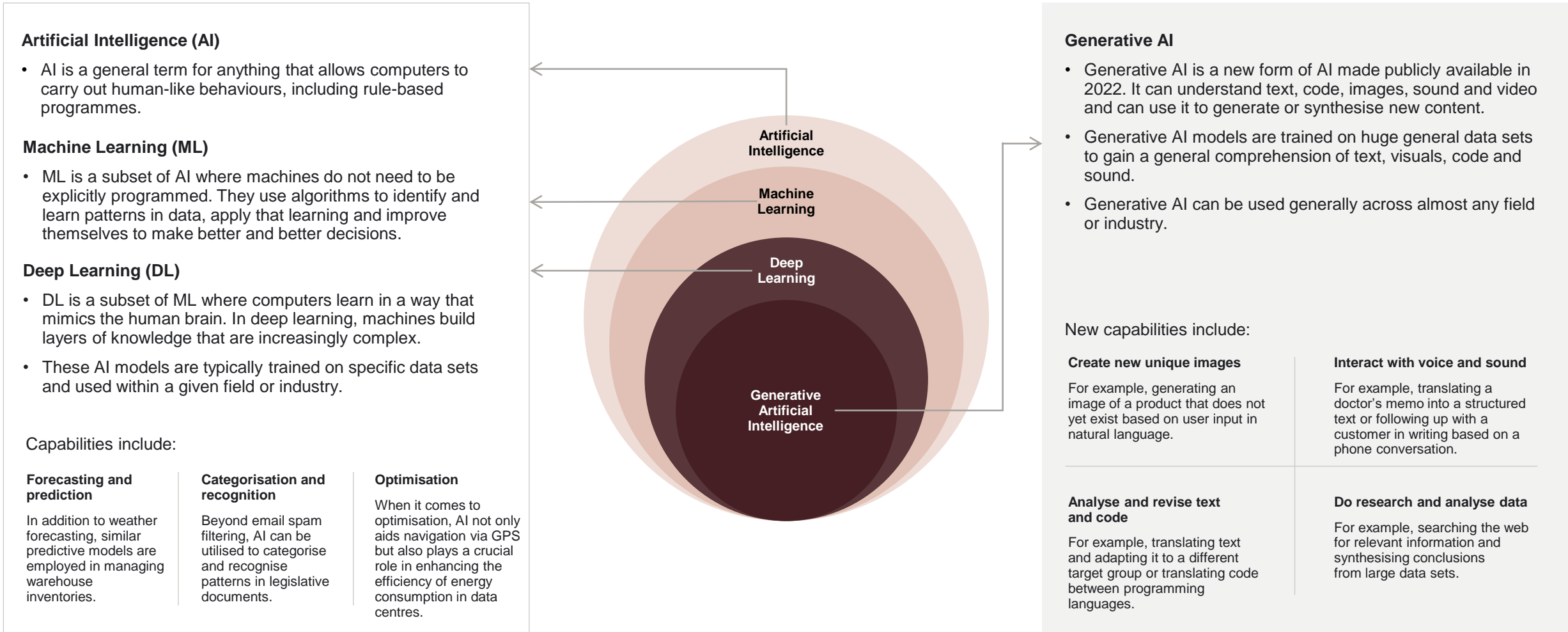
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# Introduction to AI

This report covers all types of AI with a particular focus on generative AI.

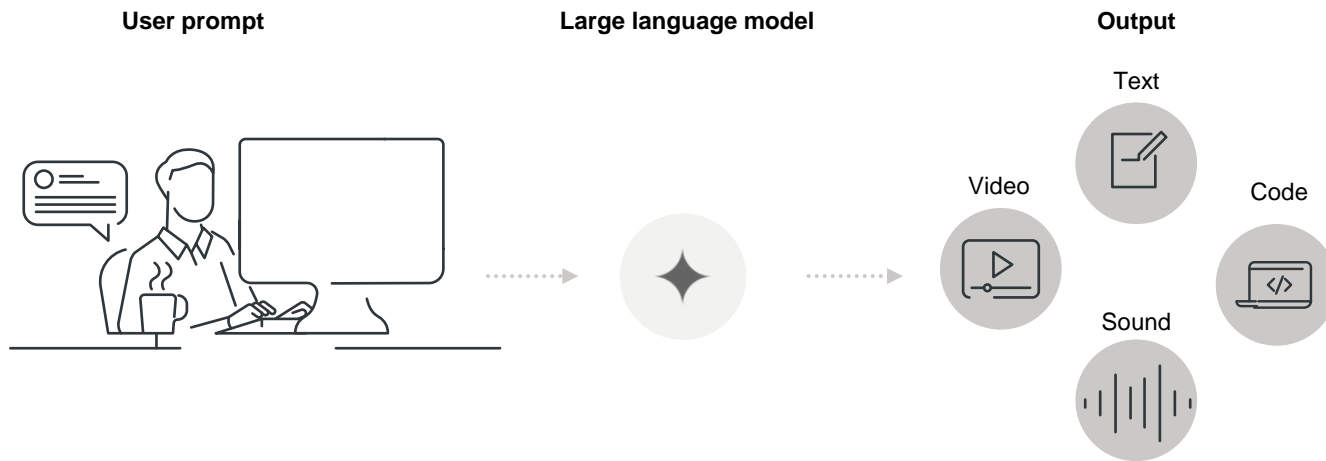
# AI can help humans solve tasks faster and better – and with generative AI, machines can now understand and interact in language, sound and images



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

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



## No or low data requirements

Generative AI models are already trained on huge data sets. This makes them readily available for many tasks without any further data needed.

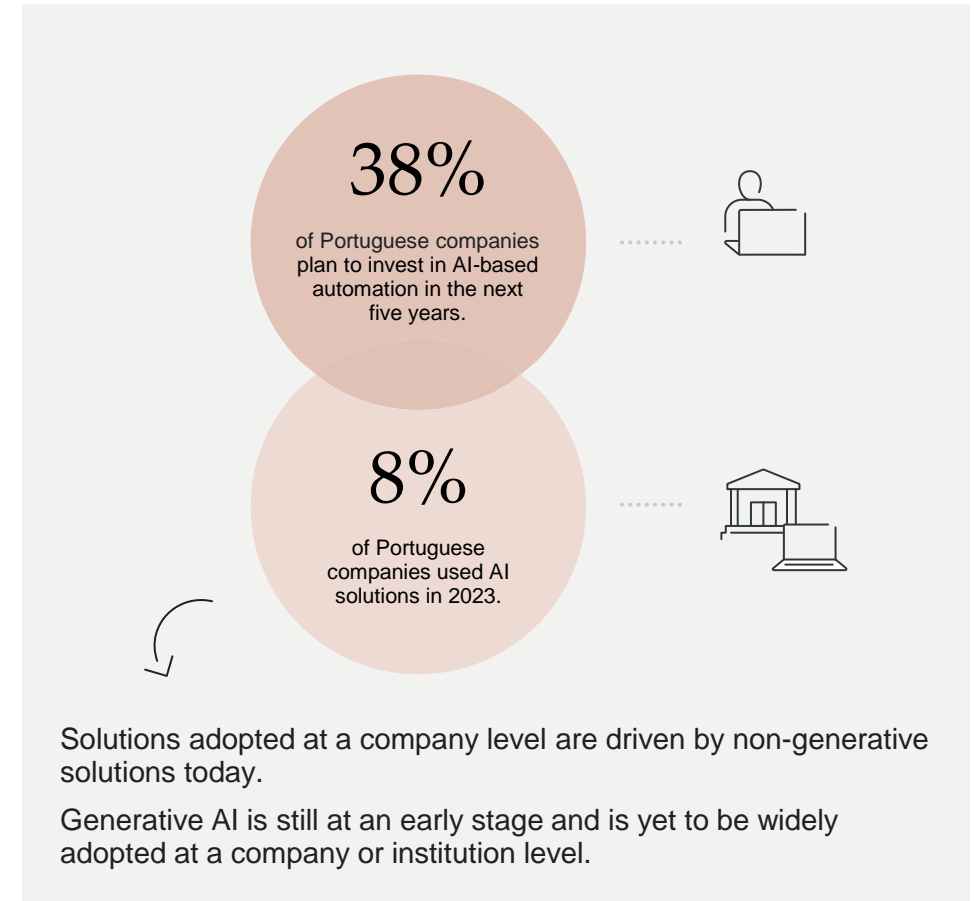
## Easy to use in plain language

Generative AI models can be operated using ordinary language and do not require any specific coding skills to use.

## Many models are online and free of charge

Several high-performing generative AI models are available online and do not require local ML setups or infrastructure to use.

... and many Portuguese companies plan to invest in the technology in the coming years



# 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	<i>E.g. detection of flawed products in manufacturing</i>	<i>Online chatbots, e.g. Gemini or ChatGPT</i>	<i>Organisation-level automation solution, e.g. auto-replies</i>	<i>Pre-trained model like Llama trained further on context-specific data</i>	<i>Model trained from the ground on new data, e.g. BLOOM</i>
<b>Requirements</b>	<hr/>				
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



- Generative AI is still in its early phase using generic pre-trained models.
- Future value creation from AI requires more advanced models than the pre-trained models that are available online today.
- Leveraging the full potential of AI technology requires more advanced and specialised models.
- This requires new organisational skills, more data, more computing power and better infrastructure.

**Figure explanation**

- No requirements
- Highest requirements

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.

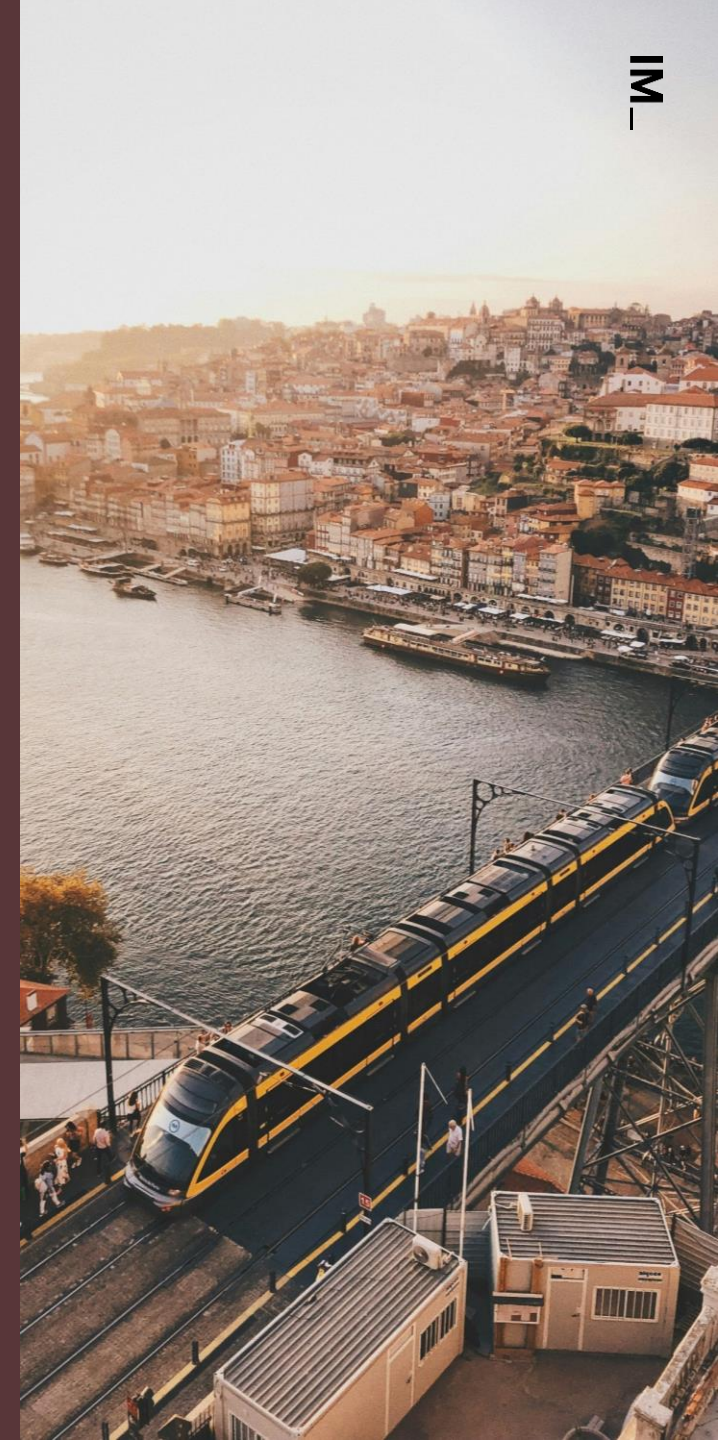


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# Economic opportunities from AI

The main economic opportunity in Portugal arises from humans working together with generative AI.



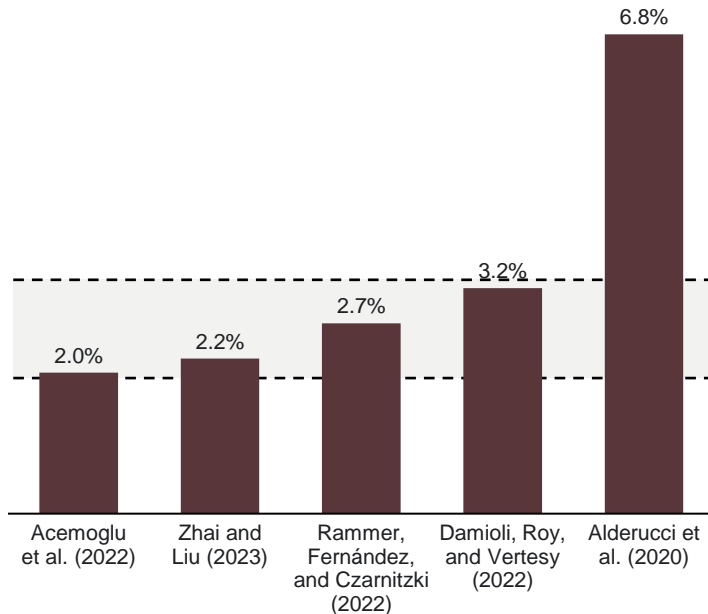
# AI has great economic potential which can be further boosted by generative AI

## 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

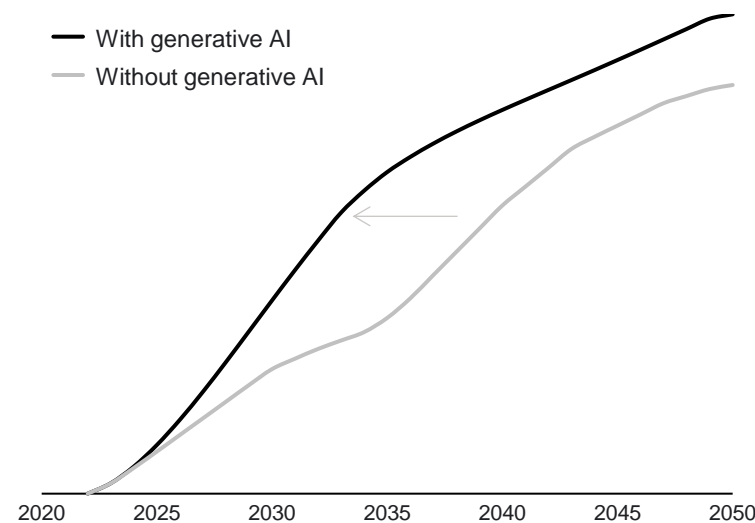


## Generative AI advances automation

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



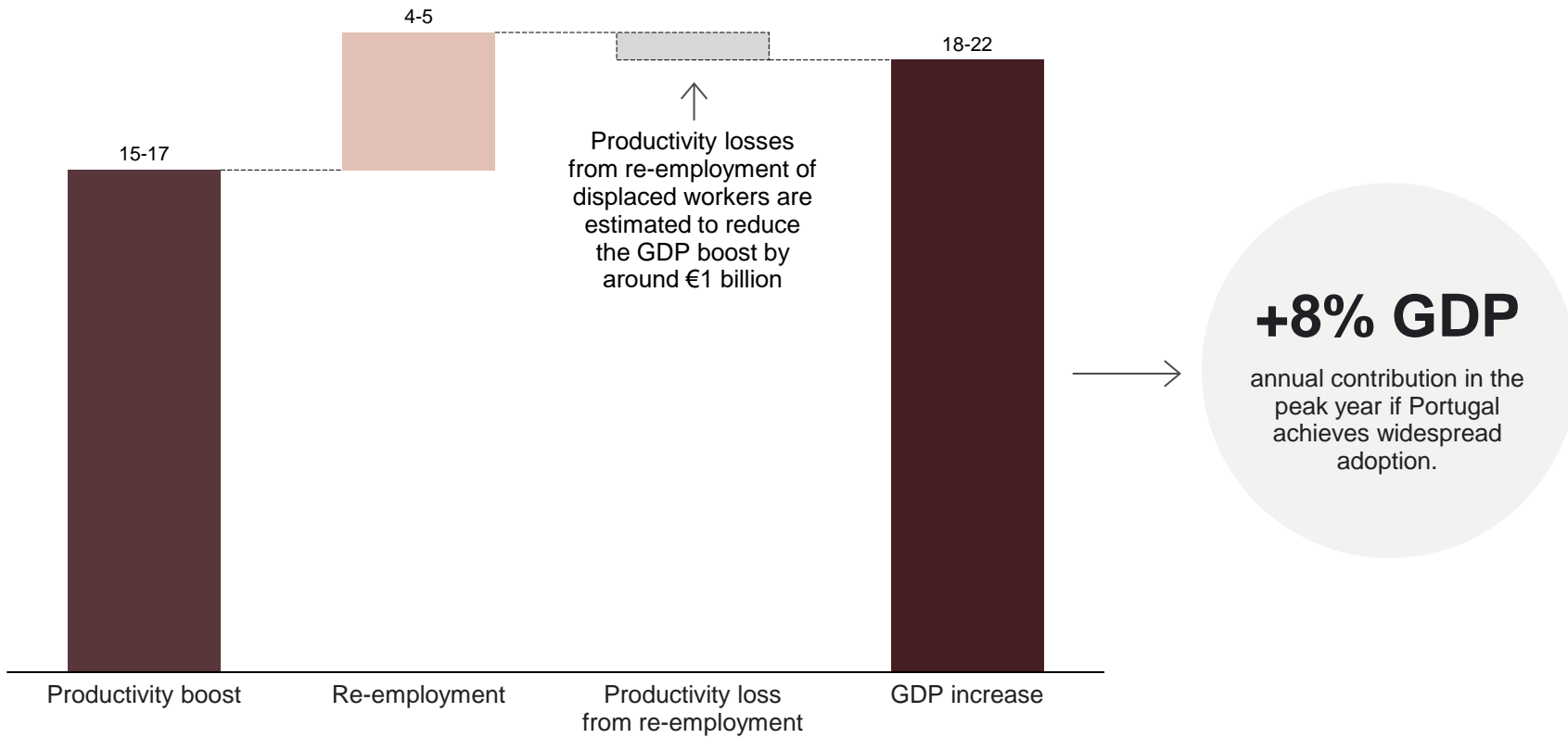
- AI has evolved rapidly with the recent breakthrough of generative AI. Due to its user-friendly nature, generative AI is expected to greatly accelerate the potential of AI to create economic impacts.
- Generative AI is only a part of AI's overall economic potential. Some studies estimate with some uncertainty 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.



# Generative AI could increase Portugal's GDP by 8% in ten years

## GDP potential of generative AI in Portugal

€ billion annual increase from baseline GDP after a ten-year adoption period



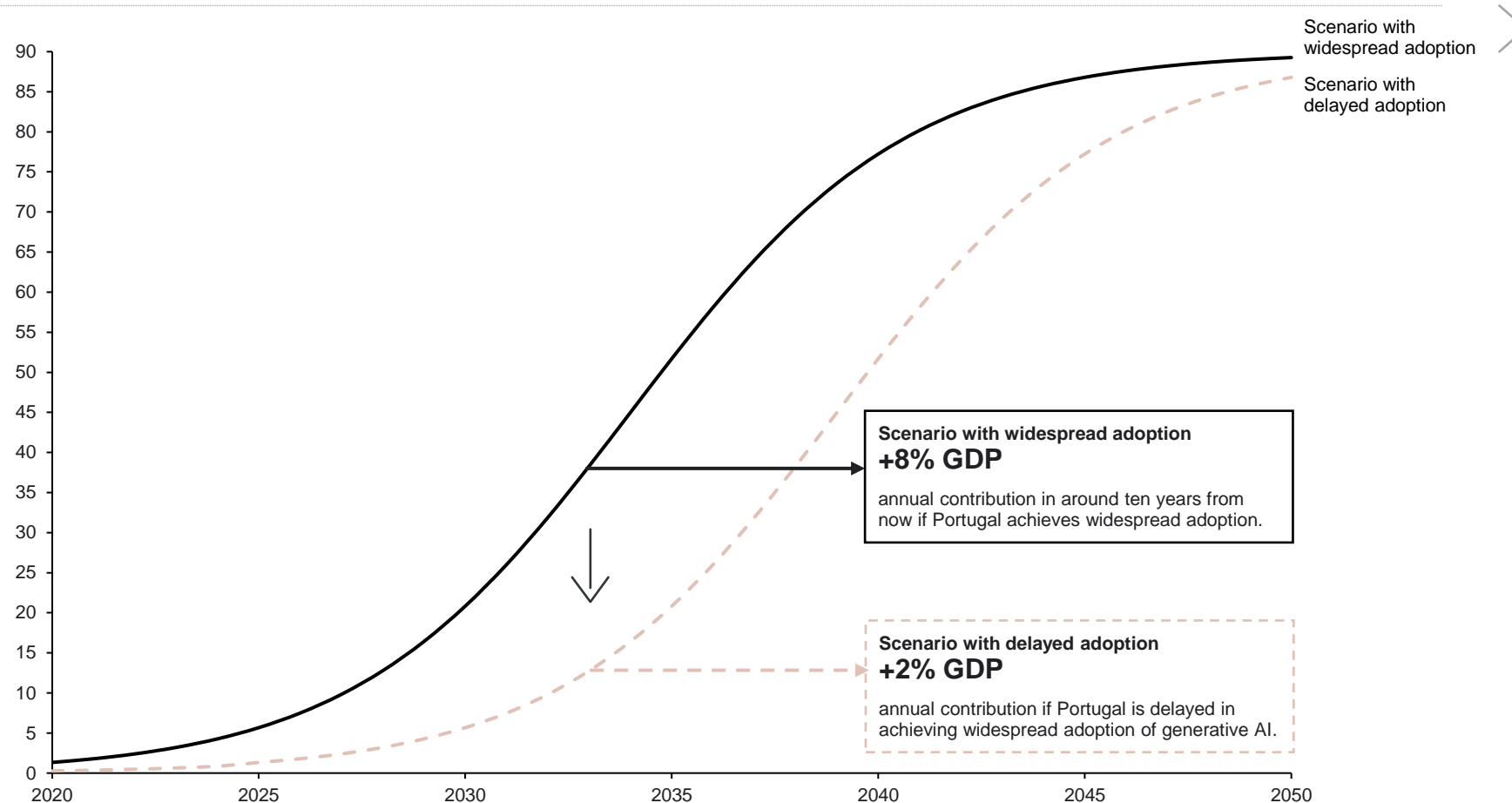
- If Portugal achieves widespread adoption of generative AI, we estimate an annual GDP potential of €18-22 billion, corresponding to 8% of GDP, in the peak year, which could be as early as ten years from now.
- This potential comprises the increased value creation by generative AI in all industries as well as the corresponding increase in net taxes.
- The dominant impact of generative AI is a productivity boost to the majority of workers (60%) by augmenting their capabilities, quality and efficiency which is estimated at €15-17 billion for Portugal.
- The estimate includes impacts of re-employment of a small share of workers (6%), where generative AI is freeing up a significant share of work for other tasks. This is estimated at €4-5 billion in Portugal.
- The estimate accounts for the possible productivity loss associated with re-employment to other occupations. This reduces the estimate for Portugal by around €1 billion.
- Generative AI is so powerful that Portugal'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 can potentially 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 around ten years from now when the impact is assumed to peak in the widespread adoption scenario (see next page). 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. We estimate an increase in GDP of 8%, or €18-22 billion, based on a calculated increase in gross value added of 8% and the proportional increase in net taxes included in the definition of GDP. Source: Implement Economics based on Eurostat, O\*Net, Briggs and Kodnani (2023a), BNP Paribas (2023), and Dell'Acqua et al. (2023).

# A five-year delay in the adoption of generative AI could reduce Portugal's potential GDP gains from 8% to 2%

## Adoption of generative AI

%

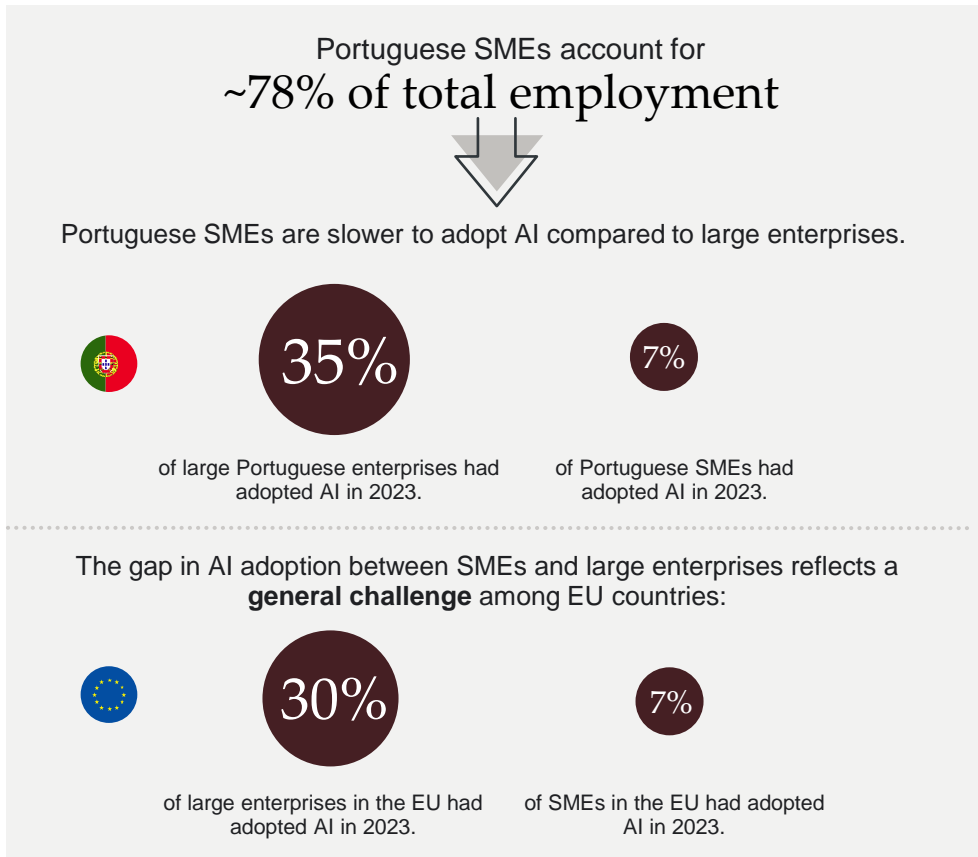


- Generative AI is a new general-purpose technology and will take time to adopt.
- Our estimate of Portugal's GDP potential from generative AI is reliant on the widespread adoption and development of the new AI technology within the next ten years.
- This adoption trajectory for Portugal is ambitious, considering Portugal's relatively modest levels of digitalisation (see section 6 on AI readiness). However, this report assumes that Portugal can achieve adoption in line with other similar EU countries if the correct measures are put in place.
- A five-year delay in capturing the benefits of generative AI is estimated to reduce the annual potential at peak from 8% (€18-22 billion) to only 2% (€3-5 billion) of GDP.
- Portugal can increase the welfare and GDP contribution from generative AI by ensuring that policies are in place to capture the benefits as assumed in the widespread adoption scenario.

Note: GDP figures are expressed in 2022 levels. The figure shows generative AI adoption as a share of economy-wide companies exposed to AI automation. The estimate is made for a ten-year adoption period to align with the time horizon for widespread adoption by the most advanced countries apart from the US. The "widespread adoption" scenario assumes adoption in line with "other developed markets" in Briggs and Kodnani (2023b). Source: Implement Economics based on Eurostat, O\*Net and Briggs and Kodnani (2023a&b).

# 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



## 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.

# Portugal's AI start-up scene is growing with support from governmental efforts

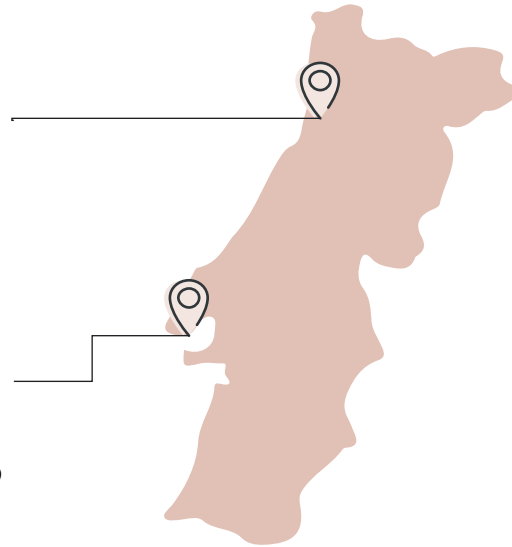
The AI start-up ecosystem is characterised by two major hubs supported by an establish network of digital innovation hubs (DIHs)

## Porto

- Porto is rapidly becoming a hub for AI development supported by strong academic institutions.
- The [ATTRACT DIH](#) located in Porto provides essential support to both startups and SMEs, focusing on fostering the use of AI and HPC to enhance organisational performance and innovation.

## Lisbon

- Lisbon stands out as a central hub in Portugal's AI ecosystem, greatly bolstered by its hosting of pivotal events like the [Web Summit](#), which attracts global tech attention and investment.
- The city also hosts [AI4PA Portugal](#), a DIH dedicated to integrating AI into public administration.



In recent years, Portugal has evolved into a dynamic hub for start-up companies, spawning multiple notable unicorns, many of which have integrated AI into their core business strategies.

Notable unicorns include *Farfetch*, *OutSystems*, *Talkdesk*, *Feedzai*, *Unbabel*, *SISCOG* and *Vision-Box*.

### Several initiatives are aiming to strengthen the AI start-up scene, including:

- [Startup Portugal](#): This entity aims to act as a one-stop shop for information and advice on establishing a business in Portugal as a part of the broader National Strategy of Entrepreneurship.
- [AI Portugal 2030](#): This 2019 strategy aims, among other initiatives, to enhance Portugal's attractiveness for young AI companies and increase innovation levels for, for example, startups and SMEs through business networking and academia collaboration platforms.
- [Startup Lisboa](#): This initiative collaborates with Google to enhance support for its incubated startups through advisory services, exclusive ecosystem benefits and joint events such as entrepreneurship awards.

### Portuguese AI startups are experiencing some common challenges, including:

- **Funding**: While there is a growing interest from venture capitalists, Portuguese startups often struggle with accessing capital compared to their European counterparts. The sector could benefit from strategic initiatives to attract international funding.
- **Talent shortage**: While Portugal produces excellent engineers and researchers, the sector could benefit from initiatives aimed to increase access to seasoned professionals in AI and machine learning and to establish widespread know-how in the workforce.



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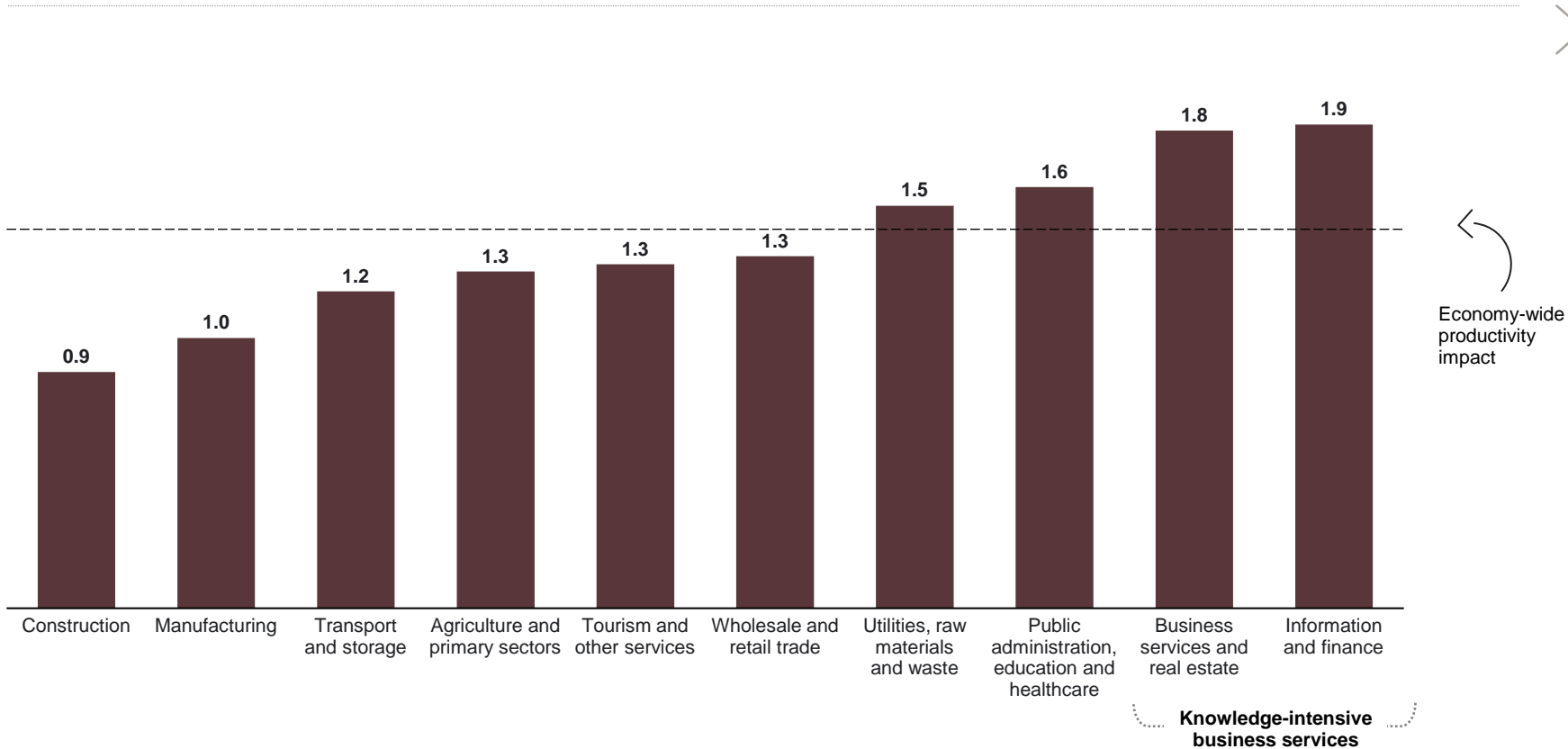
## Key sectors benefitting from AI

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

# AI can boost productivity across all sectors in Portugal

## Productivity boost from generative AI

Percentage point productivity growth p.a. at peak



- The complementary role of generative AI is prevalent in most industries, meaning that most occupations are estimated to work together with generative AI, hence utilising AI to augment and improve human capabilities, thereby boosting productivity.
- According to [Banco de Portugal](#), the Portuguese economy has a modest performance of competitiveness ranking 21<sup>st</sup> in the EU. However, Portugal records the greatest progress since 2007. Generative AI has the potential to support this positive trend.
- In contrast to past automation, such as robots, generative AI can boost productivity in services.
- In the service sector, productivity increases can be achieved when humans are assisted by generative AI. For example, lawyers can be assisted in reviewing and summarising long documents and drafting basic documents.
- The largest productivity boost occurs in information and finance, business services and the public sector. However, the overall potential also depends on the size of the sectors (see next page).
- Displacement mainly occurs where administrative and repetitive knowledge-based tasks make up a large part of the work activities.

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. Labour productivity gains 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, O\*Net and Briggs and Kodnani (2023a), Amador, J., Nogueira, G. and Fernandes, A. (2022)



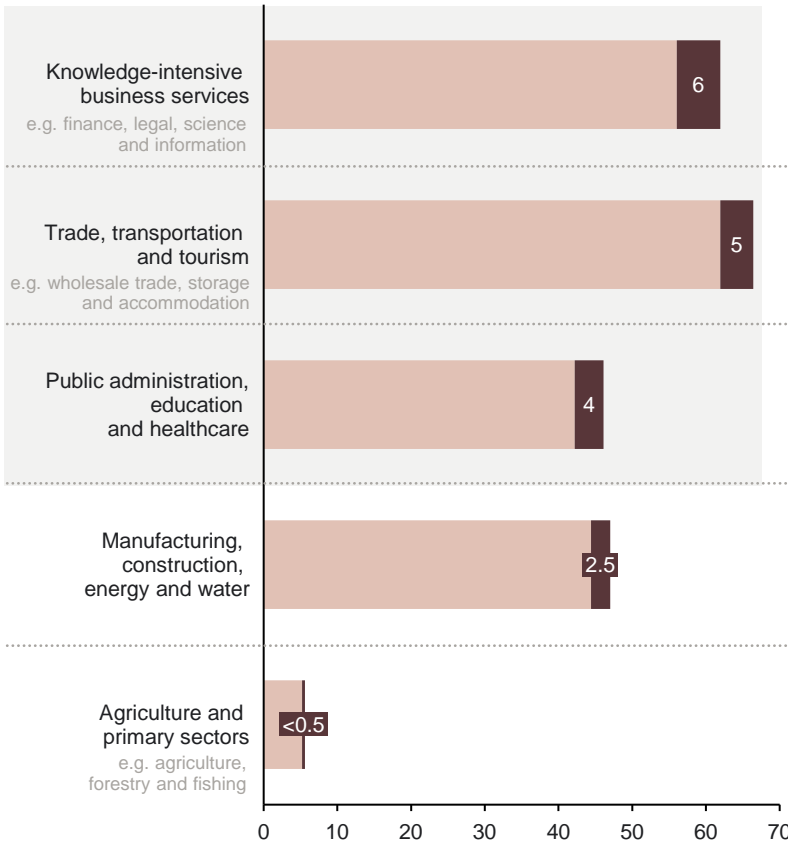
# Around 85% of generative AI's economic potential lies in service sectors, while manufacturing and other sectors can also benefit

## Gross value added (GVA) by sector in Portugal

€ billion

■ Gross value added in 2022 ■ GVA contribution from generative AI in ten years

**85% of potential**



Generative AI has the potential to boost value added in knowledge-intensive business services by around **€6 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 around **€5 billion** due to its large size. The sector can, for example, benefit from enhanced customer service through responsive chatbots and processing of legal documents or contracts.

Generative AI can benefit the public sector with an estimated **€4 billion**, e.g. through personalised tutoring in education, diagnostic support and patient interactions in healthcare and automatic document handling and preparatory decision-making in public administration. Other types of AI also have potential in the public sector.

Generative AI has the potential to increase productivity in manufacturing and construction by around **€2.5 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.

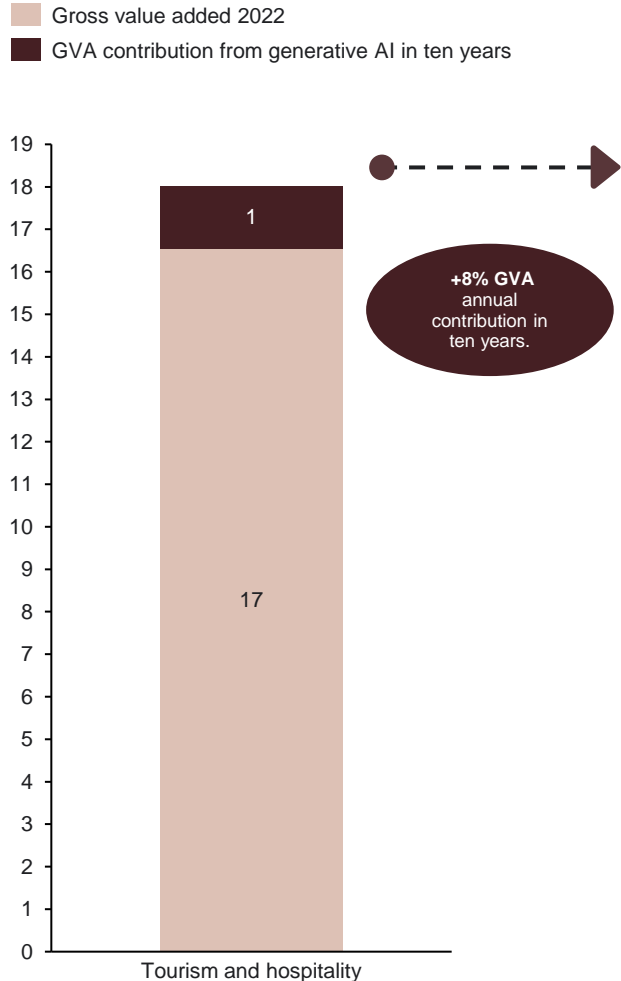
Generative AI can, for example, optimise crops through precision farming and optimise resource consumption, thereby supporting an estimated potential of up to **€0.5 billion**.

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).

# The tourism sector can benefit from operational efficiencies and higher quality of services

## Value added in tourism and hospitality

€ billion



### How generative AI can help tourism ...

#### Optimisation and preservation

- Demand forecasting and crowd management
- Optimise energy and waste management

### ... and contribute to the economic impact

Better capacity use, higher volume of tourists, improved cost competitiveness and/or GVA contributions.

#### Personalisation and marketing

- Personalised recommendations
- Marketing and targeting

Higher quality services, repeat tourism and increased demand from niche and high-value visitors.

#### Accessibility and audience adaptation

- Chatbots and customer service
- Translation and audio explanations

Improved tourist experiences and increased demand from diverse audiences.

- The economic potential of generative AI in the tourism and hospitality sector is estimated to be €1 billion in ten years.
- This potential covers the sector's accommodation and food services, travel agencies, tour operators, reservation services and other administrative support services.
- With an estimated 1.3% productivity growth boost in the peak year, the sector is expected to benefit greatly from generative AI.
- By employing generative AI, the sector can enhance on-site operational efficiency, which contributes to improved preservation efforts and more strategic resource distribution.
- Furthermore, the application of generative AI can serve to engage new demographics and enrich the travel experiences of individuals by offering customised recommendations and readily available assistance.

Note: "Tourism and other hospitality" comprises accommodation and food services, travel agency, tour operator, reservation service and related activities and other administrative and support service activities. This sectoral definition does not include all the activities captured in the [Tourism Satellite Account](#) definition like direct demand for services, e.g. transport, and retail products as well as indirect effects, e.g. activity from tourism-driven income generation.  
Source: Implement Economics based on Eurostat, O\*Net and Briggs and Kodnani (2023a).

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## Job implications of AI

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

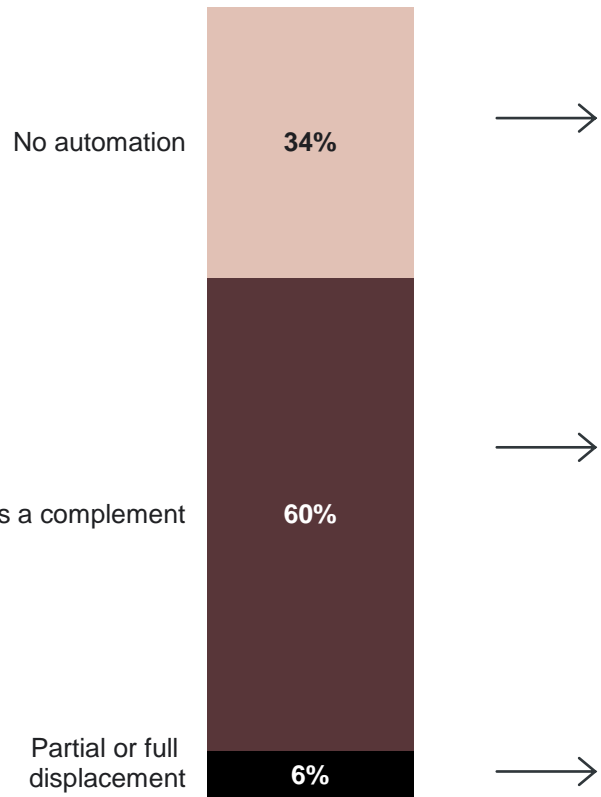


# Generative AI augments most jobs

## Share of jobs exposed to automation by generative AI

% of total employment in Portugal

5 million jobs



~ **1.7 million jobs** are unlikely to be exposed to automation

An estimated 34% of jobs in Portugal 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.

~ **3.0 million jobs** are likely to be augmented by generative AI

Most jobs (60%) 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. These jobs include professional services such as legal and consulting but also teachers and healthcare workers.

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

~ **0.3 million jobs** are likely to be fully or partially displaced

A small share of jobs (6%) 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 Q3 2023 employment data. In accordance with Briggs and Kodnani (2023), "No exposure" are occupations with less than 10% exposure, "Medium exposure" are occupations with 10-49% exposure and "High exposure" 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).

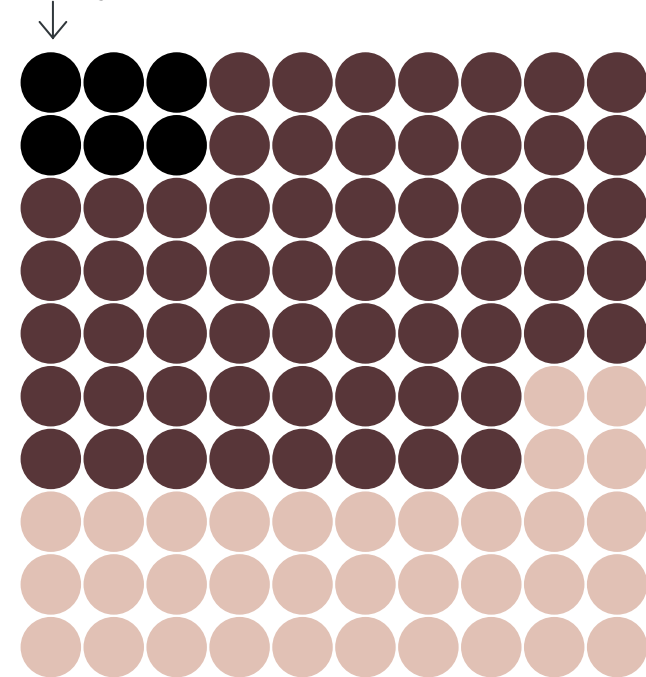
# The AI-powered economy is expected to create new jobs and ensure full re-employment of potentially displaced workers

## Share of jobs exposed to automation by generative AI

% of total employment in Portugal

● Partial or full displacement ● AI as a complement ● No automation

6% of Portuguese jobs are estimated to be highly exposed to generative AI, leading to some job closures.



Meanwhile, 60% of jobs will 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 content creators and data trainers – 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 cheaper, 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 15,000-30,000 people in highly exposed jobs are estimated to need re-employment per year, which is low compared to historical levels of job changes (see page 24).



- The job development in Portugal over the next decades will depend on a range of factors.
- The isolated impact of generative AI depends on the speed of adoption and the size of the productivity boost relative to the size of the displacement effect for those jobs that are highly exposed to generative AI.
- This report assumes full re-employment of displaced 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 labour supply and skill mix of the workforce.
- The short-term job impacts will depend, among other things, on the flexibility of the labour market as well as re-training and skilling opportunities for workers.

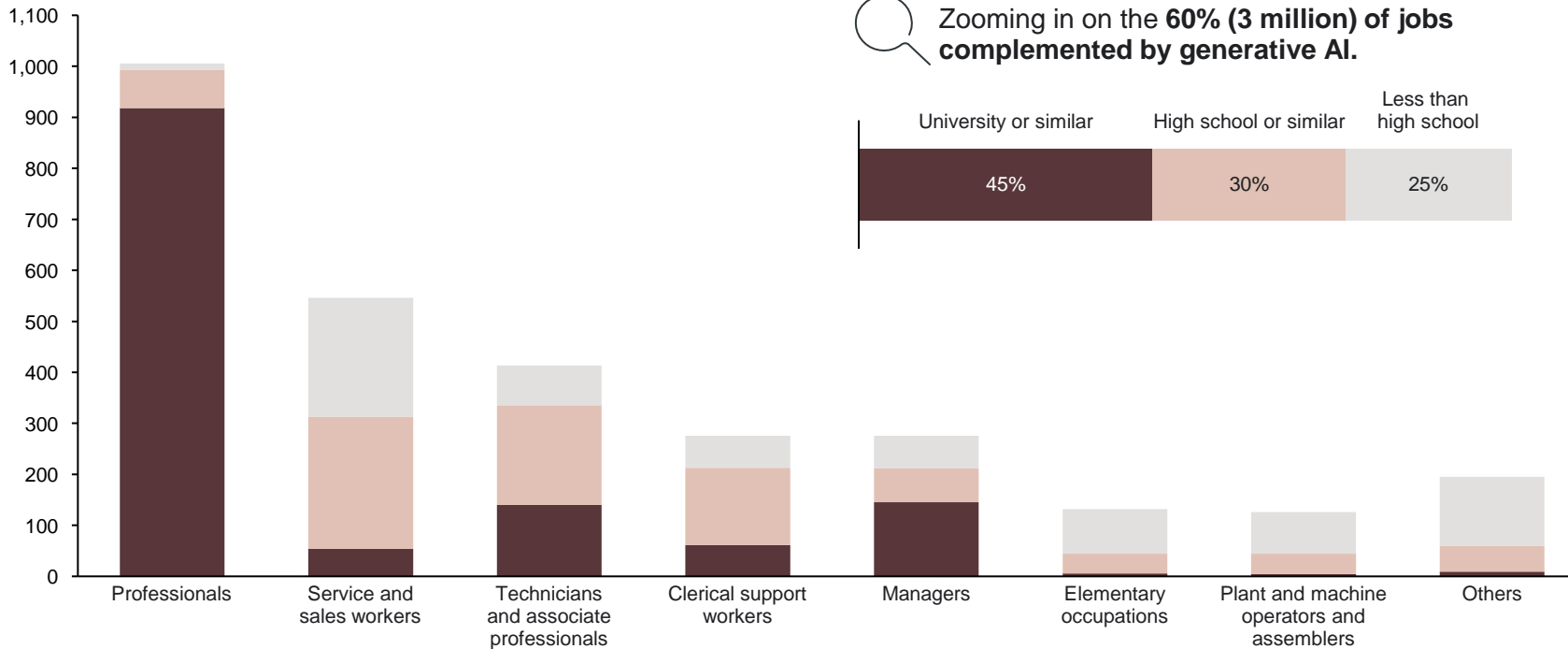
Note: The assumption that labour supply predetermines employment is widely applied by economists. See, for example, *Principles Of Economics* by N. Gregory Mankiw (2020). Source: Implement Economics based on Eurostat, O\*Net and Briggs and Kodnani (2023a).

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

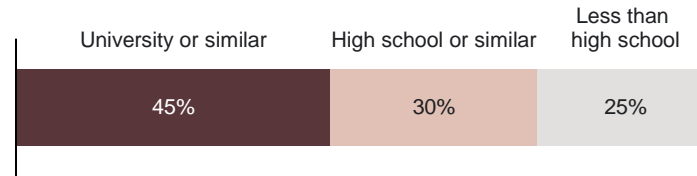
## Jobs complemented by generative AI

Thousand jobs

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



Zooming in on the **60% (3 million)** of jobs complemented by generative AI.



Examples of jobs include:	Professionals	Service and sales workers	Technicians and associate professionals	Clerical support workers	Managers	Elementary occupations	Plant and machine operators and assemblers	Others
	Research, analysis and advising services (including legal)	Caterers, housekeepers and travel agents	Engineering technicians, robot controllers and air traffic safety technicians	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

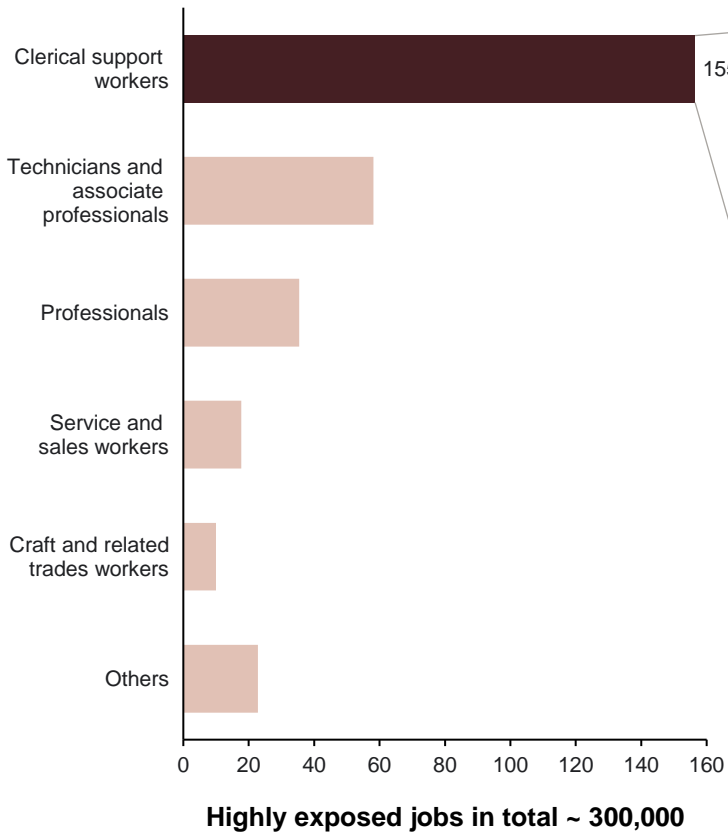
- Generative AI is estimated to augment the capabilities of around 3 million jobs in Portugal at full adoption and around half of these over a ten-year period.
- Of the complemented workers, 45% are estimated to hold higher educational attainment, such as lawyers, scientists and engineers.
- Generative 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 Q3 2023 employment data.  
Source: Implement Economics based on Eurostat, O\*Net and Briggs and Kodnani (2023).

# Around 300,000 Portuguese jobs are highly exposed to generative AI, but the AI-powered economy will help create new jobs

## Jobs highly exposed to generative AI

Thousand jobs



### Example: Portuguese clerical support workers and job transition

Of the 155,000 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.

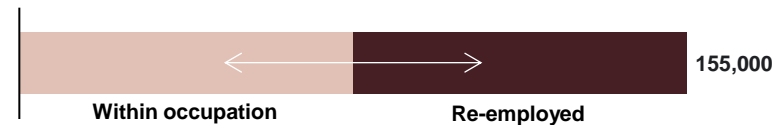
Most are expected to be re-employed in other occupations due to:

- 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.



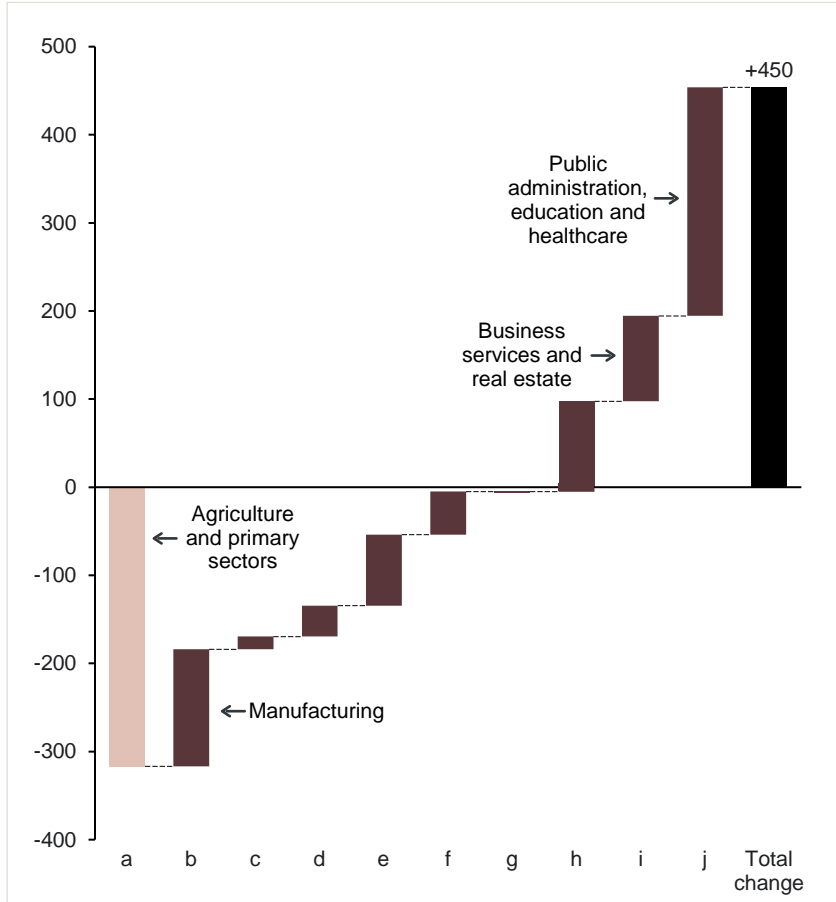
- Around 300,000 jobs in Portugal are estimated to be highly exposed to generative AI at full adoption and around half of these are expected to be affected over a ten-year period.
- This report assumes full re-employment of displaced workers. This means no net change in total employment or unemployment.
- The Portuguese economy is thus assumed to be able to sustain at least the current level of employment in the coming 10-15 years. In comparison, EU forecasts by CEDEFOP predict a slight contraction in the Portuguese labour market from 2022-2035.
- Clerical support workers, technicians and service and sales workers are highly exposed to generative AI and their 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, the AI-powered economy will gradually lead to new jobs and support employment within the occupation or re-employment in other sectors.
- 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.

Note: Based on Q3 2023 employment data. High exposure to AI does not automatically imply full displacement of all workers in that occupation. In the GDP estimates, we conservatively assume 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, CEDEFOP, O\*Net and Briggs and Kodnani (2023a).

# Job changes from generative AI are small compared to historical averages

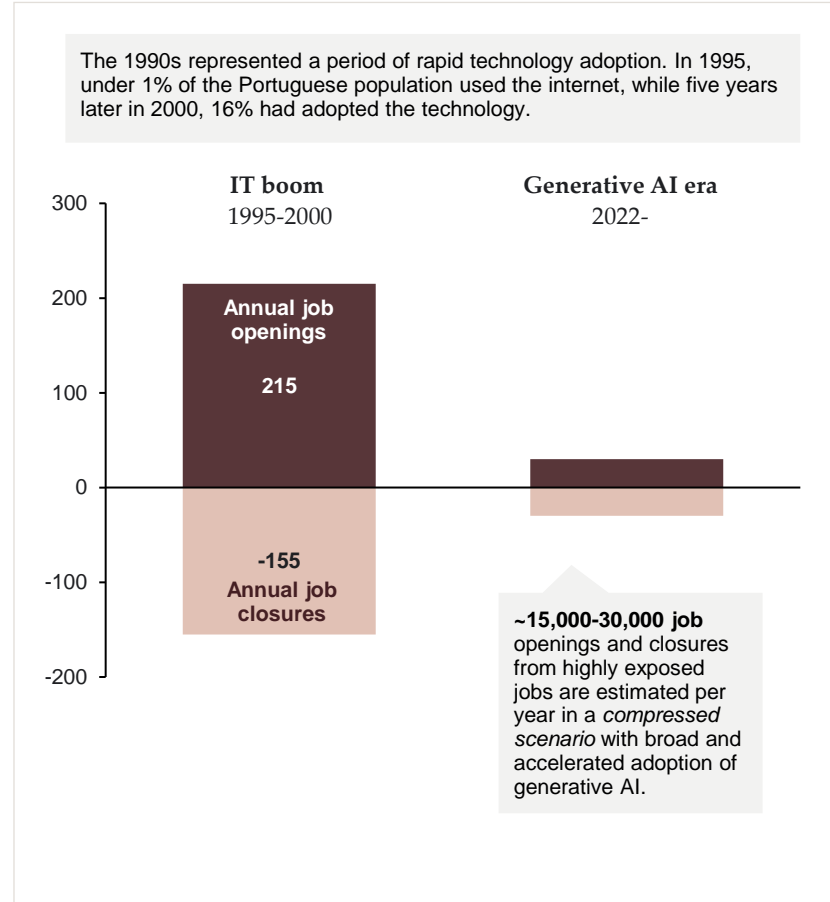
## Change in employment across Portuguese sectors, 2013-2022

Thousand jobs



## Job development during the 1990s IT boom in Portugal

Thousand jobs



The 1990s represented a period of rapid technology adoption. In 1995, under 1% of the Portuguese population used the internet, while five years later in 2000, 16% had adopted the technology.

- The Portuguese labour market was highly affected by the global financial crisis in 2008. The labour market saw a substantial contraction in the following years, and unemployment increased drastically – the aftermaths of which are still felt today, with the labour market worse off than it was in 2008.
- However, since 2013, the Portuguese economy has added around 450,000 jobs. Apart from agriculture, most sectors have added significant amounts of new jobs, e.g. manufacturing, business services and the public sector.
- In addition, numerous new jobs are being created and closed each year *within* each sector to adapt to changing needs and demands.
- During the rapid IT adoption in the 1990s, the Portuguese economy created around 215,000 new jobs every year and closed only 155,000 jobs annually during the same period.
- We estimate that the jobs that are highly exposed to generative AI can lead to 15,000-30,000 annual job openings and closures over the coming ten years. This is less than 15% of the historical average number of job openings in Portugal.
- The labour market effects stemming from generative AI's impact on highly exposed jobs are thus small compared to historical levels of job changes.

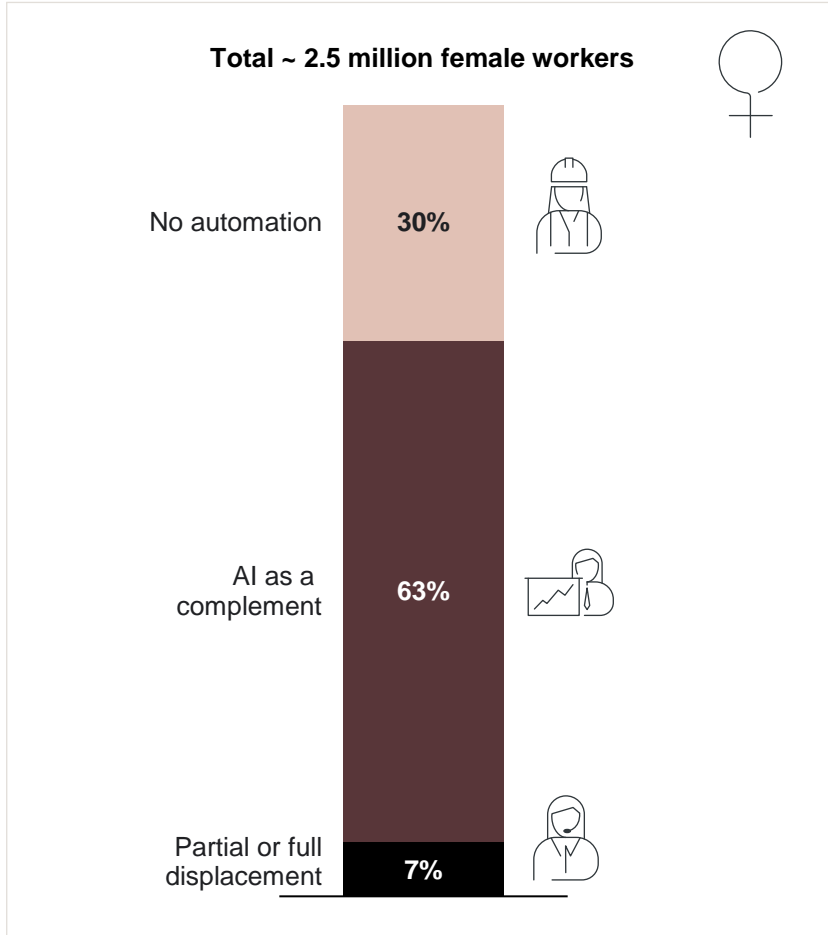
Note: a. Agriculture and primary sectors; b. Manufacturing; c. Utilities, raw materials and waste; d. Construction; e. Wholesale and retail trade; f. Transport and storage; g. Tourism and other services; h. Information and finance; i. Business services and real estate; j. Public administration, education 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). To avoid underestimating the possible job impacts of generative AI, these estimates are in a compressed scenario with broader and more accelerated adoption of generative AI than in our estimates of the GDP impacts. 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, World Bank and ECB.



# Women in Portugal hold jobs that are more exposed to augmentation and automation by generative AI than those held by men

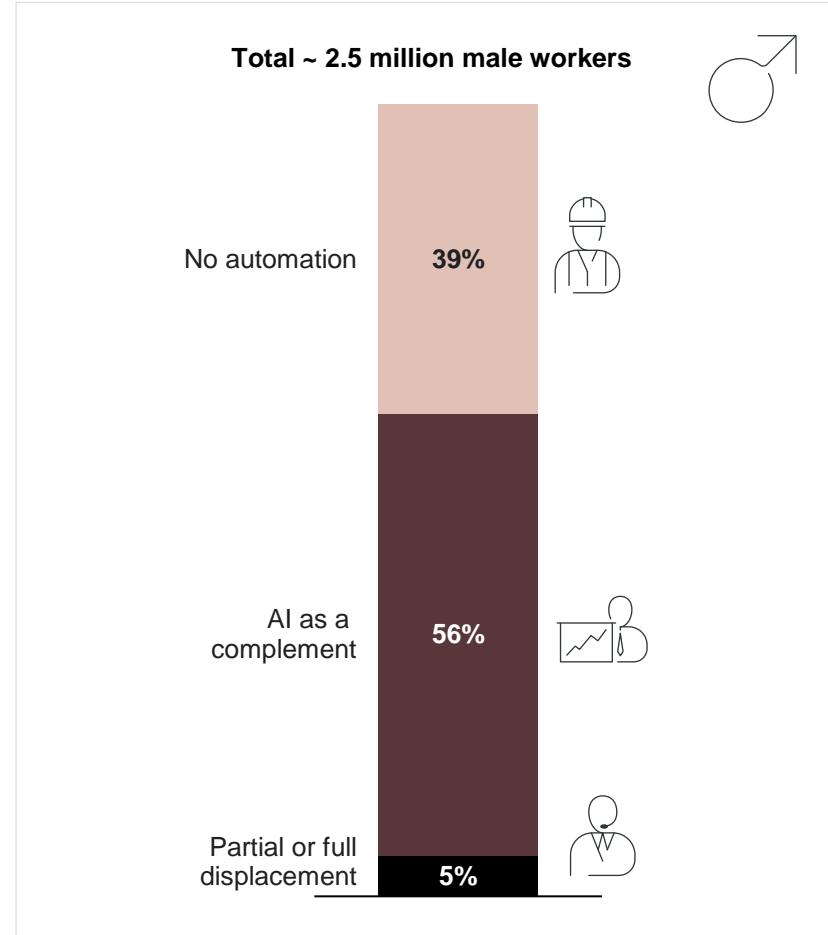
## Share of jobs held by women exposed to automation by generative AI

% of total employment among female workers



## Share of jobs held by men exposed to automation by generative AI

% of total employment among male workers





- No automation**  
 30% of female workers and 39% of male Portuguese workers are in jobs with limited exposure to generative AI. These are, for example, manual, outdoor and human-to-human jobs.
- Complemented jobs**  
 63% of female workers are expected to see generative AI complement their current job, whereas the share is only 56% 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 augment human capabilities and make workers more productive.
- Potentially displaced jobs**  
 7% of female workers and 5% of male workers in Portugal 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 by the new technology.

Note: Based on Q3 2023 employment data. In accordance with Briggs and Kodnani (2023), "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. Source: Implement Economics based on Eurostat, O\*Net and Briggs and Kodnani (2023a).

# Workers need a broad set of skills to effectively use generative AI

## Skill needs in the age of AI (incl. both generative and traditional), OECD

Skills ...	Type of skills	Examples
... for developing and maintaining AI systems. 	Specialised AI skills	Machine learning capabilities and knowledge
	Data science skills	Data analysis and visualisation, cloud computing and programming
	Other cognitive skills	Creative problem-solving
	Transversal skills	Social skills and management skills
... for adopting, using and interacting with AI applications. 	Elementary AI knowledge	Principles of machine learning
	Digital skills	Ability to use computer/smartphone
	Other cognitive skills	Analytical skills, critical thinking and problem-solving
	Transversal skills	Creativity, communication, teamwork and multitasking



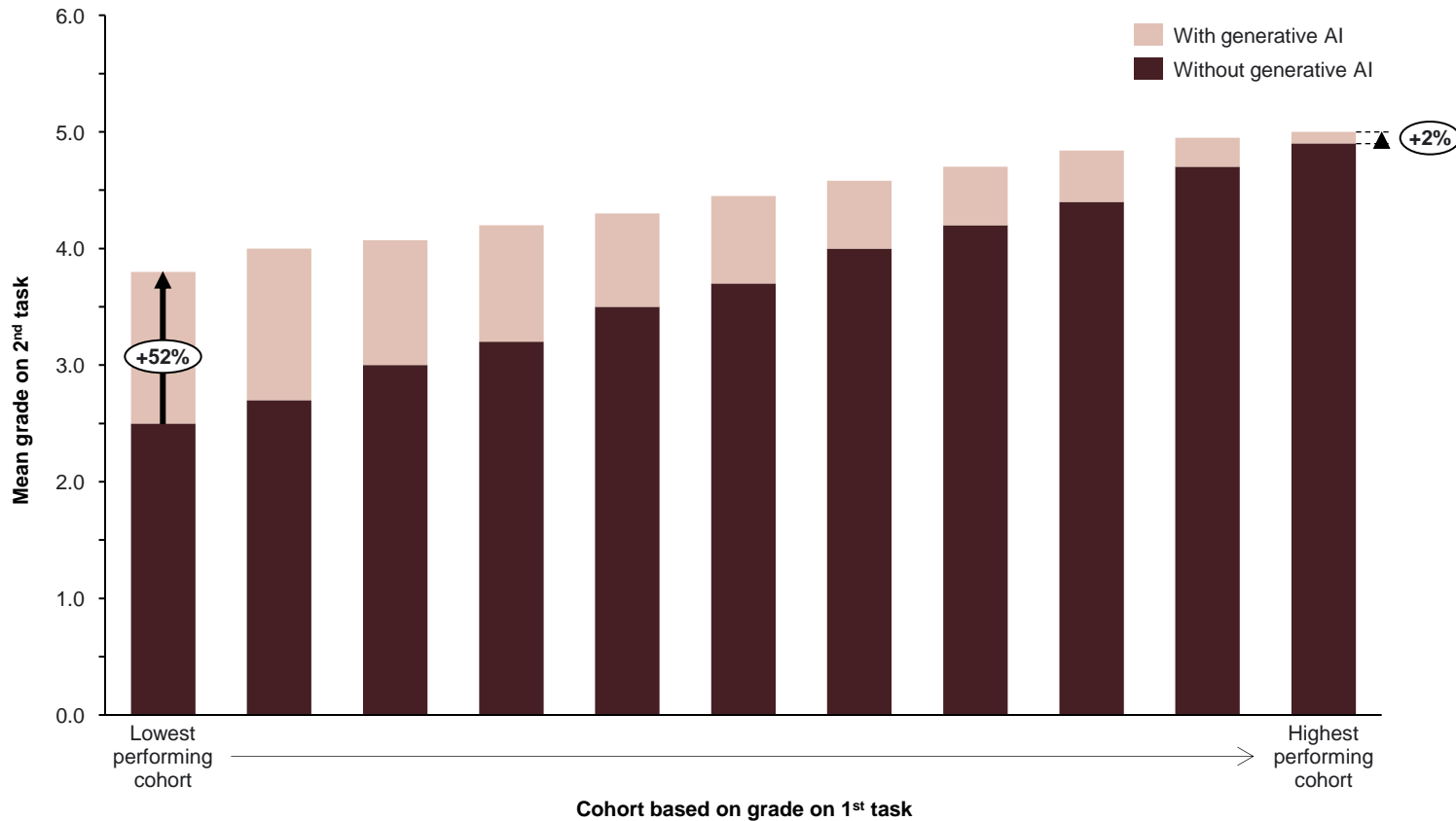
- Generative AI adoption and usage requires limited digital skills relative to earlier advancements in information and communication technology (ICT) due to its ease of use via normal language prompts.
- However, fully leveraging generative AI requires skills beyond basic digital skills, i.e. creative, managerial and analytical skills.
- In 2023, only 55% of Portuguese people aged 16-74 had basic digital skills, but it was required in 90% of professional roles.
- OECD studies suggest that companies that provide ICT training for their employees on average have 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.

Note: "Nordic countries" refers to Denmark, Sweden, Portugal and Finland.  
 Source: Implement Economics based on OECD, Eurostat, Mosiashvili and Pareliussen (2020), Borowiecki et al. (2021), Gal et al. (2019), Andrews et al. (2016), Jiang et al. (2020) and Ouyang et al. (2022).

# Early studies suggest that 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 2<sup>nd</sup> 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 candidates' writing skills with and without access to generative AI.
- The results showed that, on average, all candidates were able to boost their grades on a written task 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).

05

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# AI's impact on societal challenges

AI can help with some of Europe's most pressing societal challenges.



# AI can play a key role in addressing climate change

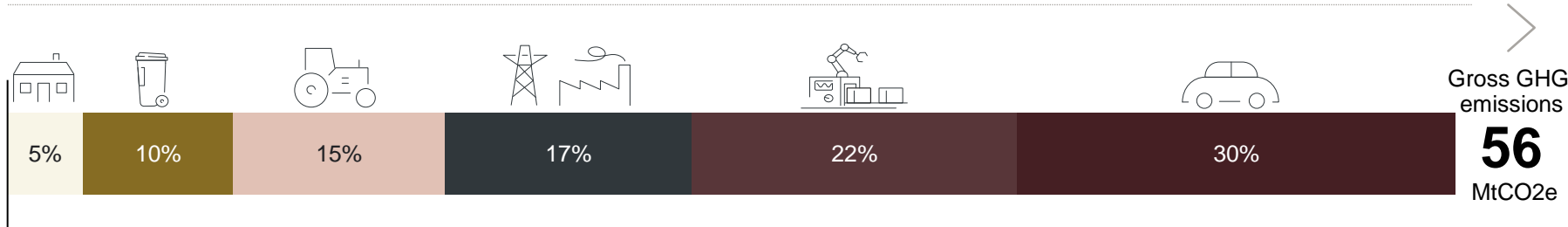


**80%** of Portuguese people support AI tools being used to reduce carbon emissions by managing energy use.

**66%** of Portuguese people support AI tools being used to help them make more environmentally sustainable choices in their lives.

## Portugal's gross greenhouse gas emissions, 2022

MtCO<sub>2</sub>e



Gross GHG emissions  
**56**  
MtCO<sub>2</sub>e

## Decarbonisation initiatives enabled by AI and other digital technologies (non-exhaustive)

### Waste

- Efficient conversion of waste into energy
- Automated waste sorting
- Optimising landfill management

### Agriculture

- Efficiency improvements from precision farming
- Reduced food waste
- Changes in land use

### Energy supply

- Expansion of renewable energy
- Electrification
- Smart grid
- Flexible electricity demand

### Manufacturing

- Smart factory with AI systems
- Efficiency improvements
- Electrification of lighter processes

### Domestic transport

- Electric cars, vans, buses and small trucks
- Efficient and eco-friendly driving
- Reduced travel by use of digital tools (working from home and video conferences)

- Artificial intelligence and other digital solutions are expected to play a key enabling role in reaching Portugal's climate goals of net carbon neutrality by 2050.
- AI and other digital technologies can play a significant role in decarbonising the energy sector by supporting the transition to flexible energy utilisation and smart grids.
- Large gains also arise from facilitating the electrification of vehicles, where AI and other digital solutions are crucial to optimising the charging of electric vehicles, providing a cleaner and cheaper solution for consumers.
- In manufacturing, AI and other digital solutions can help optimise energy efficiencies as well as reduce overproduction by more accurately forecasting demand.
- Agricultural emissions can also be reduced by AI and other digital solutions, where machine learning algorithms allow precision farming practices that are more eco-friendly and reduce consumption of, for example, fertilisers.

Note: Data on net greenhouse gas emissions and removals sent by countries to UNFCCC and the EU Greenhouse Gas Monitoring Mechanism (EU Member States). This data set reflects the GHG inventory data for 2022 as reported under the United Nations Framework Convention for Climate Change. CRF inventory categories: Energy supply: CRF 1A1 (energy industries) + 1B (fugitives); Industry and manufacturing: CRF 1A2 (manufacturing industries and construction) + CRF 2 (industrial processes and product use); Domestic transport: CRF 1.A.3; Residential and commercial: CRF 1A4a (commercial) + CRF 1A4b (residential); Agriculture: CRF 1A4c (agriculture, forestry and fishing) + CRF 3 (agriculture); Waste: CRF 5 (waste); LULUCF: CRF 4 (LULUCF); Other combustion (CRF1A5a + CRF1A5b + CRF indirect CO<sub>2</sub>). "Buildings" include both commercial and residential buildings. Increased digitalisation via smart thermostats in individual homes and advanced AI-powered building management systems play an active role in saving energy and providing demand flexibility.

Source: Implement Economics based on EEA.

# AI can help transform Portuguese healthcare into a more proactive system with better optimisation of resources and patient outcomes

Over 40% of healthcare expenditure in Portugal is allocated to primary care, marking the highest proportion in the EU. This emphasis on primary care places significant pressure on general practitioners and nurses, exacerbating the existing scarcity of these professionals. In addition to staff shortages, Portugal grapples with a growing elderly population and healthcare demand.

Modernisation of Portugal's public administration, including healthcare, is one of the seven action pillars of the National Strategy [AI Portugal 2030](#). This action pillar aims to change public service provision from a more reactive paradigm to a proactive paradigm, with better decision-making and public policies.

Portugal's [recovery and resilience plan](#), updated in 2023, also committed EUR 300 million to modernising the country's digital health infrastructure, where AI is likely to play a part.



## More hands are needed while ensuring efficiency

- Portugal has approximately the same amount of practicing doctors as the EU average but significantly less nurses than the EU average.
- Shortage of staff, and particularly nurses, means that doctors may need to take up even more responsibilities, potentially putting even more pressure on the country's primary care setting. This pressure may be reflected in lower quality services, incl. longer waiting times.



## AI can make spending more efficient and alleviate bottlenecks

- Automating tasks in healthcare administration, e.g. appointment scheduling.
- Recording and synthesising appointment notes, referral information and care plans.
- Enabling faster and more accurate screening and decision-making by physicians and nurses.
- Enabling physicians to undertake remote consultations.



## Better and more preventative treatment and care is needed

- An ageing population requires more healthcare services and specialised care.
- Growing living standards drive up societal expectations for healthcare services.
- Chronic diseases are becoming more challenging and rare diseases more common.



## AI can improve how we treat patients

- Analysing and enhancing medical images as well as earlier and more accurate detection of diseases and injuries.
- Improving detection of complex and rare diseases with training data sets and smarter diagnostic tools.
- Predicting individual treatment responses by analysing different patient data.
- Enabling the development of targeted therapies.
- Tracking health issues and accidents through wearable devices and sensors.

Portuguese doctors are already positive about AI's potential in healthcare.

**54%** of doctors agree that AI will revolutionise medicine in general.

**70%** of doctors agree that AI-powered data extraction and processing can improve healthcare delivery in general.

**52%** of doctors think that the use of AI can lead to a decrease in medical errors.

**52%** of doctors think that the use of AI can help facilitate medical care in isolated populations.

Public  
First poll



**64%** of Portuguese people support AI tools being used to track their medical data.



06

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# AI readiness in Portugal

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

# In assessing Portugal's AI readiness, we compare with European digital leaders

- In assessing Portugal's AI readiness, we can compare Portugal to the D9+ group – an informal group of digital leaders in Europe. The D9+ group accounts for 37% of GDP and of the population in the EU.
- Big economies, such as the United States, have an advantage when it comes to scale, i.e. absolute AI capacity, including the amount of commercial activity, availability of funding and volume of R&D.
- Common indicators, such as the Tortoise Global AI Index, compound both **scale** and **intensity** (AI capacity relative to population or GDP).
- Small countries like Portugal cannot compete on scale with global giants on, for example, the absolute amount of AI-related R&D investment. Strengthening partnerships within the EU is essential to gain scale and build a competitive tech ecosystem.
- Therefore, Portugal should work for initiatives at EU level, especially in the areas of R&D investment, regulation and digital infrastructure.

## D9+, a group of digital leaders



### FINLAND

- **Ranked no. 1** in DESI 2022
- 14<sup>th</sup> largest GDP in the EU27



### DENMARK

- **Ranked no. 2** in DESI 2022
- 11<sup>th</sup> largest GDP in the EU27



### THE NETHERLANDS

- **Ranked no. 3** in DESI 2022
- 5<sup>th</sup> largest GDP in the EU27



### SWEDEN

- **Ranked no. 4** in DESI 2022
- 7<sup>th</sup> largest GDP in the EU27



### IRELAND

- **Ranked no. 6** in DESI 2022
- 9<sup>th</sup> largest GDP in the EU27



### SPAIN

- **Ranked no. 8** in DESI 2022
- 4<sup>th</sup> largest GDP in the EU27



### LUXEMBOURG

- **Ranked no. 9** in DESI 2022
- 20<sup>th</sup> largest GDP in the EU27



### ESTONIA

- **Ranked no. 10** in DESI 2022
- 25<sup>th</sup> largest GDP in the EU27



### PORTUGAL

- **Ranked no. 17** in DESI 2022
- 15<sup>th</sup> largest GDP in the EU27



### BELGIUM

- **Ranked no. 18** in DESI 2022
- 8<sup>th</sup> largest GDP in the EU27



### THE CZECH REPUBLIC

- **Ranked no. 21** in DESI 2022
- 13<sup>th</sup> largest GDP in the EU27



### POLAND

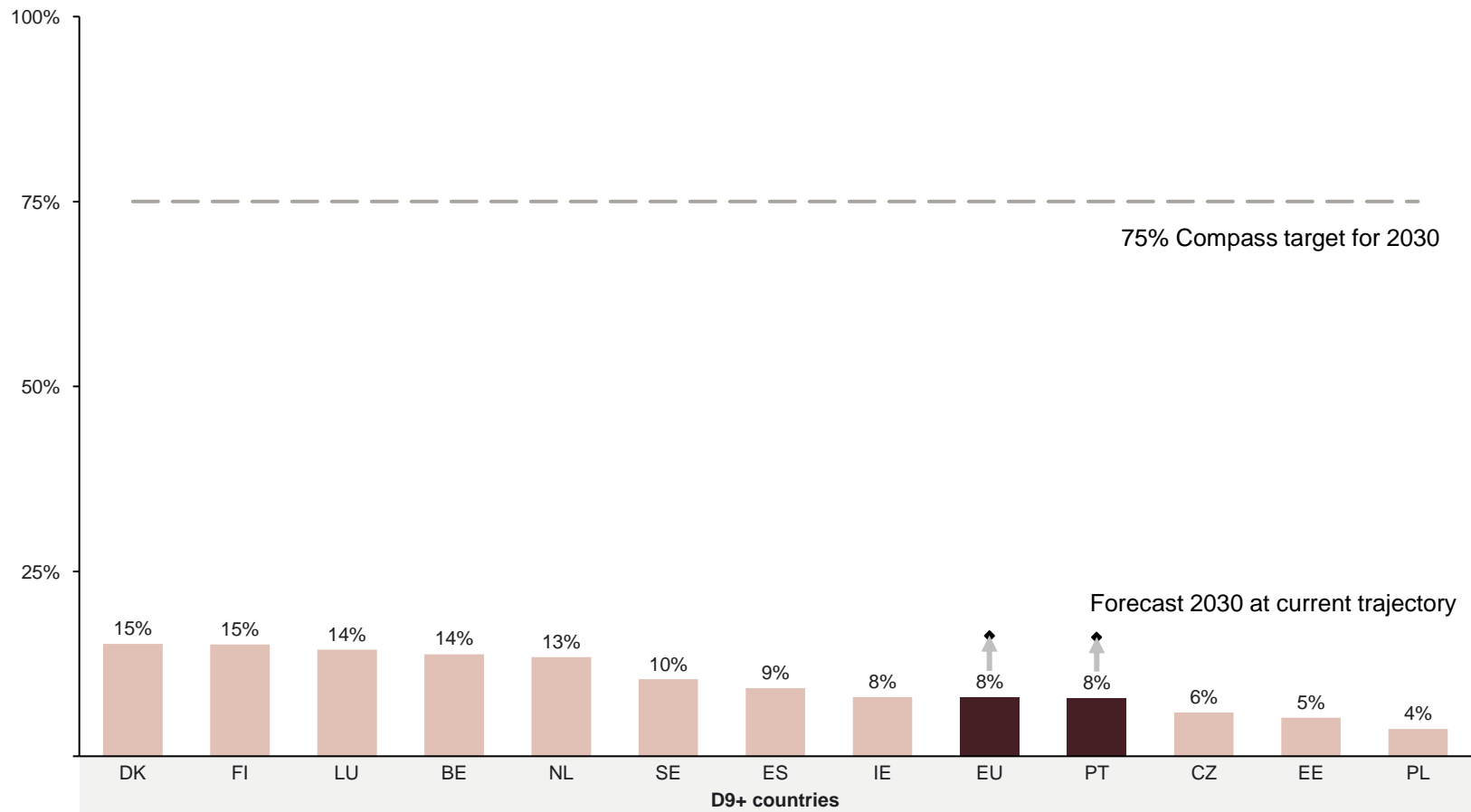
- **Ranked no. 26** in DESI 2022
- 6<sup>th</sup> largest GDP in the EU27



# Portugal is losing ground to EU leaders in AI adoption and needs to accelerate its efforts to meet the 2030 target

## Adoption of AI, 2023

% of enterprises using at least one type of AI technology

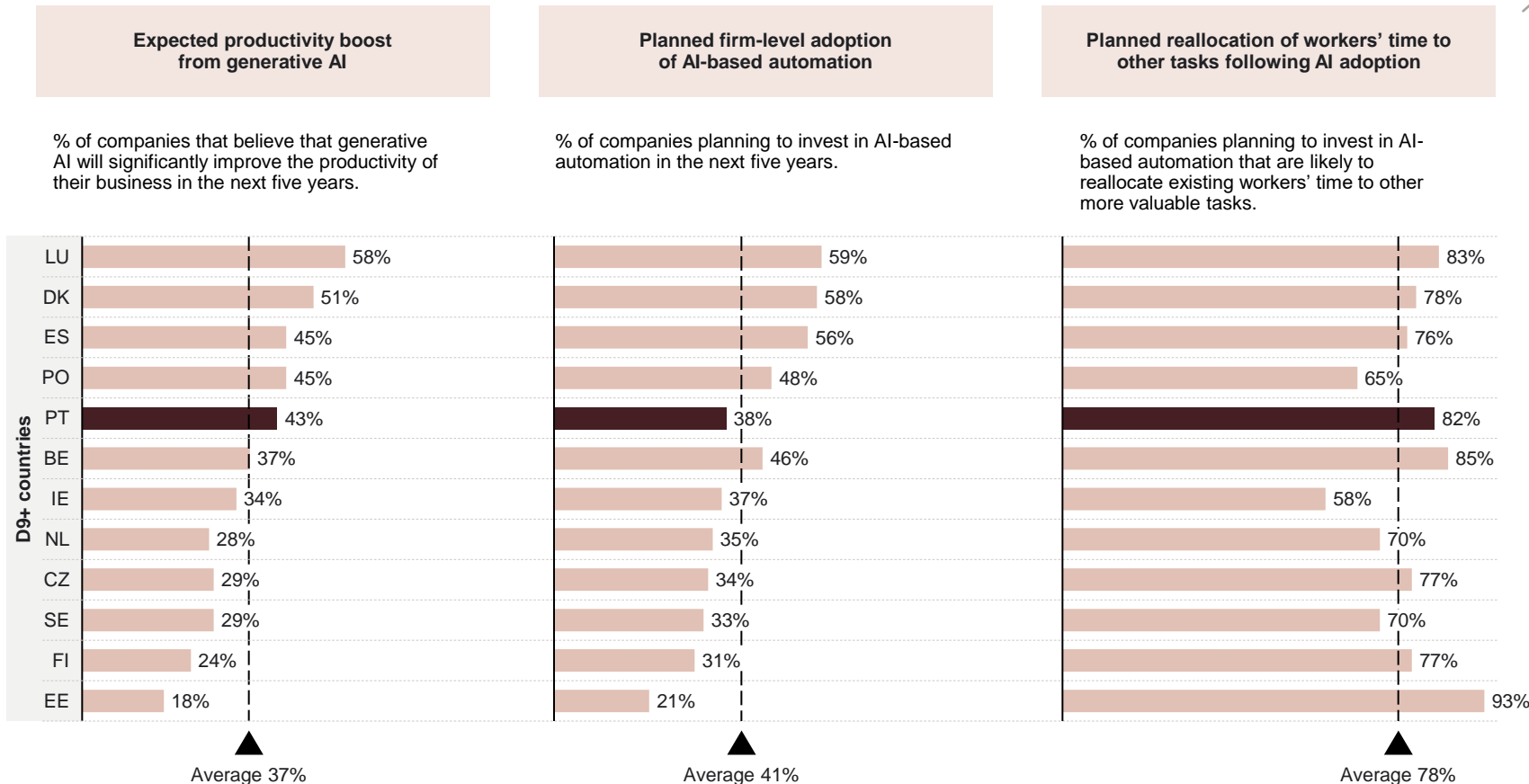


- Portugal is on par with the EU average in AI adoption by companies but below most of the European digital frontrunners. 8% of Portuguese companies had adopted at least one type of AI technology in 2023.
- In its most recent assessment, the European Commission concludes that the EU is set to fall significantly short of its target on AI adoption for 2030.
- If we assume the same pace of adoption as the EU average, there is a risk that Portugal will fall short of the 2030 target.
- Firm-level adoption data underestimates actual use in business settings (see page 7) as many instances of individual-level AI use are not captured.

# 43% of Portuguese companies expect a significant productivity boost from AI and 38% plan to invest in AI

## Survey responses from companies in D9+ countries on their five-year outlook on generative AI

% weighted average of enterprises, 2023



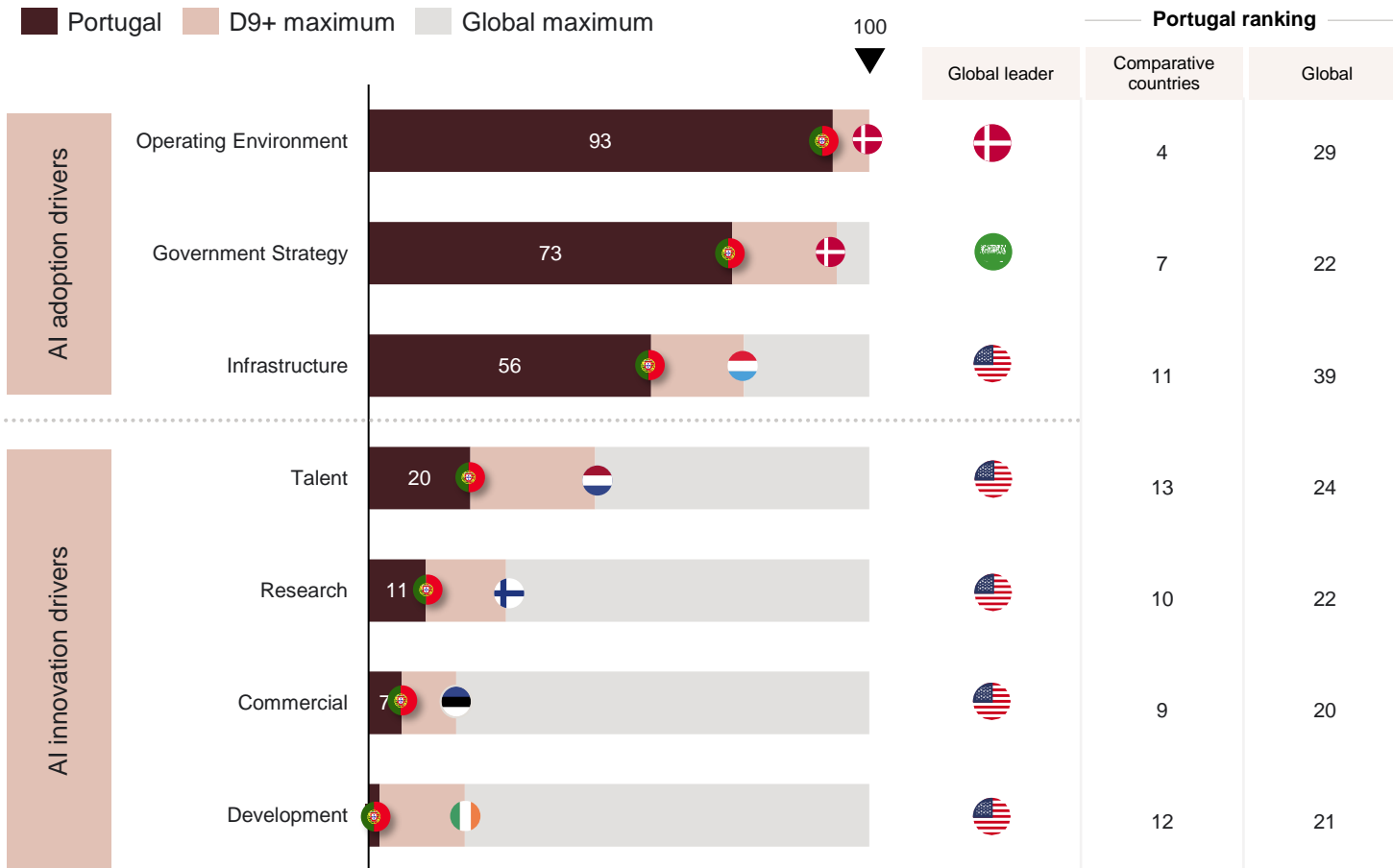
- According to polling by Public First, 43% of Portuguese companies anticipate significant productivity impacts from generative AI on their business in the next five years, slightly higher than the D9+ average.
- 38% of companies in Portugal claim that they plan to invest in AI-based automation in the next five years, slightly less than the D9+ average.
- Of the Portuguese companies planning to invest in AI-based automation, 82% are likely to reallocate workers' time to other more valuable tasks.
- While these metrics generally suggest 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 survey conducted in summer 2023 and Q1 2024 for Estonia and Ireland. Nationally representative consumer and business polling. The average across other surveyed countries is computed as an arithmetic mean. Respondents of the survey include Denmark, Sweden, Finland, Belgium, the Netherlands, Luxembourg, Ireland, Portugal, Spain, Poland, Czechia and Estonia.  
 Source: Implement Economics based on Public First country surveys.

# The drivers of AI adoption suggest that Portugal is at risk of losing ground to European and global leaders – action is needed across the board

## Portugal's AI capacity according to the Tortoise Global AI Index

Global AI Index, score out of 100 (global leader)



Portugal is generally well placed for generalised AI use but could strengthen its government strategy and AI infrastructure.

Portugal is challenged in terms of being an innovator of more specialised AI applications and falls significantly behind peers in terms of talent.

- Overall, Portugal is relatively well positioned in terms of the early foundational drivers of AI adoption that ensure a safe and reliable AI-ready environment. Portugal performs particularly well in terms of operating environment but could improve its government strategy and infrastructure to catch up to the digital frontrunners.
- Additionally, more specialised AI applications and the realisation of full productivity gains will require a cohesive and competitive innovation ecosystem that is conducive to development and commercial uptake.
- Like its peers, Portugal is behind on AI innovation drivers globally, where the United States claims the lead. When it comes to talent, Portugal falls significantly behind leaders in the D9+ group.
- Portugal needs to focus on strengthening its efforts across both basic adoption drivers and innovation drivers.

Note: The Global AI Index looks at seven sub-pillars of 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.

# 07

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## The way forward to capture the benefits of AI

Portugal can consider several choices to capture the benefits and navigate the dilemmas of AI.



# Potentials, pitfalls and paradoxes

## Artificial intelligence (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

- 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**.

### Pitfalls

- 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.

### Paradoxes

- 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 of AI that companies of all sizes can access instead of just the largest ones?
- 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?

# 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	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"> <li>Invest in long-term public AI research and encourage private investment in basic and applied research.</li> <li>Foster industry, government and university innovation partnerships to undertake pre-commercial AI research projects.</li> <li>Support innovation on top of already developed foundational models and findings.</li> <li>Make AI tools available to entrepreneurs and scientists so they can use AI in support of other discoveries and innovations.</li> <li>Support international research collaboration, technology transfer and international movement of researchers.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid siloed approaches to AI regulation to minimise the risk of misalignment and fragmentation by increased international co-operation.</li> <li>Ensure copyright rules that support innovation and creativity and preserve the incentive to generate new content.</li> <li>Adopt a risk-based approach to AI regulation to provide clarity to developers, adopters and users about which uses are disallowed.</li> <li>Encourage privacy and security principles so that individuals' personal data is safeguarded.</li> </ul>	<ul style="list-style-type: none"> <li>Promote widespread adoption and universal accessibility by helping governments, small businesses and all sectors of the economy adopt and use AI.</li> <li>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.</li> <li>Create a national strategy to spur AI adoption across all industries and all sizes of businesses.</li> <li>Give small businesses an "AI jumpstart" through technical assistance, training and guidance to help them understand and leverage AI for their businesses.</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> <li>Focus training and upskilling on areas where AI enhances and augments the capabilities of workers so that workers are trained to work together with the new technology. The aim should be to improve the marginal productivity of workers rather than replace them.</li> <li>In those selected types of jobs where AI risks displacing workers, efforts should be devoted to reskilling workers for other jobs.</li> <li>Ensure a flexible labour market and continuous lifelong training enabling new opportunities in the labour market.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure the right incentive and regulation for public and private entities to invest in AI infrastructure and compute capacity such as graphics processing and supercomputers needed to drive the powerful AI models.</li> <li>Support the building of cross-border AI infrastructure and subsea cables through initiatives such as the <a href="#">G7 partnership for global infrastructure and investment</a>.</li> <li>Reduce electricity emissions from data centres by promoting ambitious decarbonisation strategies such as <a href="#">24/7 Carbon-Free Energy</a>.</li> </ul>

Note: For more details on policies, see [OECD AI principles](#), [OECD AI Observatory](#), [Google's AI principles](#) and the paper on "[An Opportunity Agenda for AI](#)". For more details on carbon-free energy and digital decarbonisation, see the [European perspective](#) and [global perspective](#).

# Portugal can draw on policy choices of leaders in the D9+ group

## Best practice initiatives from leaders in the D9+ group

Indicator	Operating environment 	Infrastructure 	Talent 	Research 	Commercial 	Development 
D9+ group lead						
Best practice	<p>Denmark is a <b>pioneer in enforcing transparency and ethical use of AI</b> and has introduced principles and tools to ensure responsible AI deployment. The tools are aimed at building trust in AI technologies.</p> <p><b>Example:</b> <a href="#">Guide for responsible use of generative AI</a></p> <ul style="list-style-type: none"> <li>Formal ethics and safety guidelines for using and implementing AI publicly and privately.</li> <li><i>Datavejviseren</i>: A platform that provides access to all public data sources.</li> <li><i>Sprogteknologi</i>: Supports the development of AI solutions in Danish.</li> </ul>	<p>Finland is home to one of the <b>fastest supercomputers</b> in the world called <a href="#">LUMI</a>. Up to 20% of the LUMI supercomputer's capacity is reserved for European industry and SMEs, including access to the LUMI user support team, enabling companies to take advantage of high-performance computing for innovation and development activities.</p> <p><b>Example:</b> <a href="#">Poru LLMs</a></p> <ul style="list-style-type: none"> <li>A family of open LLMs built and trained on the LUMI supercomputer.</li> <li>With its advanced low-resource language capabilities, Poru will be built to handle all 24 languages in the EU.</li> </ul>	<p>The Netherlands is nurturing and growing AI <b>talent through targeted and joint undertakings by industry and research institutions</b>.</p> <p><b>Example:</b> <a href="#">Kickstart AI</a></p> <ul style="list-style-type: none"> <li>Host AI superchallenges to solve societal issues and promote talent globally.</li> <li>Create joint industry-academia appointments, adding 25 new positions to enhance education and training.</li> <li>Promote a national AI course, aiming to reach 170,000 people.</li> </ul>	<p>Finland's long track record in AI research is a testament to its <b>world-renowned universities</b> offering a variety of AI courses/programmes, active industry-academic collaboration and innovative startups with roots in universities and research.</p> <p><b>Example:</b> <a href="#">AI for Business program (2018-2021)</a></p> <ul style="list-style-type: none"> <li>Funding targeted for all-sized companies and research institutions for AI R&amp;D projects.</li> <li>Aimed to increase AI expertise and build global ecosystems and research collaborations.</li> </ul>	<p>Estonia recognises itself as being an <b>implementation leader</b> for startups and AI applications. The national AI strategy (2019) outlines 12 initiatives to accelerate AI uptake in companies, incl. different funding measures and 9 initiatives to increase R&amp;D.</p> <p><b>Example:</b> <a href="#">AI &amp; Robotics Estonia (AIRE)</a></p> <ul style="list-style-type: none"> <li>Supports Estonian industrial companies in adopting smart digital solutions in the field of AI and robotics.</li> <li>Provides funding and expertise through training and consulting as well as by connecting companies with service providers.</li> </ul>	<p>Ireland attracts global tech companies due to its <b>competitive, pro-business environment and strong industry-academic research credentials</b>, ensuring that innovative researchers, companies and entrepreneurs developing and using AI are connected to each other.</p> <p><b>Example:</b> <a href="#">Lero. The SFI Research Centre for Software</a></p> <ul style="list-style-type: none"> <li>Brings together 200 researchers in Ireland, covering a wide range of software development related to AI.</li> </ul>

# Portugal can capture the AI potential with a balanced set of choices



## Grow R&D by local innovators

Enable **innovation** and invest in **AI research and development**

Ensuring performance of AI technology in a Portuguese context  
*and*  
Driving the application of leading global AI technology

Dilemma



- Portugal has taken proactive steps to strengthen its AI research and development, but the country lags behind its European peers in this area. R&D will be critical for providing applicable solutions required to leverage the potentials of AI.
- To address this, Portugal could expand on the initiatives set forth in [AI Portugal 2030](#) by fostering targeted collaborations between academia, industry and SMEs in larger industries. Building on initiatives by the [FCT](#), like [AI in the cloud](#), and established AI hubs, like [ATTRACT DIH](#), inspiration could be drawn from Dutch [ICAI Labs](#).

Recommendation



## Accelerate commercial uptake

Promote widespread **adoption** and universal accessibility

Encouraging AI-based business models in tech-focused startups  
*and*  
Facilitating AI adoption in traditional, established companies



- Despite Portugal's significant progress in leveraging its digital innovation hubs (DIH) network to foster AI uptake, many SMEs across the country still struggle with the know-how needed to implement and utilise AI effectively in their operations.
- Building on the foundation set by initiatives, like [ATTRACT DIH](#), Portugal could expand targeted support for SMEs by providing dedicated information sessions and practical guidance on leveraging accessible generative AI tools to drive more widespread AI adoption.



## Retrain and upskill workforce

Build **human capital** and an AI-empowered workforce

General AI upskilling across the population  
*and*  
Targeted reskilling of groups affected by AI



- Portugal faces a dual talent challenge. The country needs to cultivate STEM talent to address the current talent gap while ensuring widespread AI competencies across the population to prepare for the AI-driven transition.
- To address these challenges, it is necessary to improve programmes like [Upskill](#), expanding education and continuous learning opportunities in digital skills across all sectors. Portugal could seek to develop a national programme similar to the Netherlands' [KickStart AI](#) that addresses both challenges.





08

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# Annex

Modelling the impacts of generative AI in Portugal.

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# Modelling the economic opportunity for Portugal

## 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".

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