The economic opportunity of AI in Türkiye

Capturing the next wave of benefits from *generative* AI

An Implement Consulting Group study commissioned by Google

May 2024

Preface

Dear readers,

In the rapidly evolving world of technology, we are witnessing the impressive pace of advancements in artificial intelligence, reminiscent of the early days of the internet. The dawn of the internet and global network technology (the world wide web) was also met with a similar mixture of curiosity, doubt, and concern, eventually leading to profound changes in society. Today, rapid digitization and the advancement of generative AI technologies are ushering in a new era with significant social, economic, and socio-cultural changes.

The 2017 research paper by eight scientists at Google titled "Attention is All You Need" has been recognized as one of the foundational documents of modern AI and led the development of a transformer deep learning model. This academic work not only laid the groundwork for advancements in generative AI but also became a cornerstone of AI technologies that deeply influence all business models. It is unknown whether the authors anticipated that their work—inspired by a Beatles song title—would become so influential; in any case, generative AI solutions and services are transforming business processes, presenting unique opportunities in both professional and personal lives.

As societies and countries undergo transformations, distinct approaches are required for the public sector, academia, and the business world. To understand these transformations correctly, it is necessary first to comprehend the factors influencing them. Readers will likely find this pioneering study focusing on the potential economic opportunities of generative AI transformation in Türkiye to be quite exciting.

I would like to highlight some findings from the report "The Economic Opportunity of AI in Türkiye: Capturing the Next Wave of Benefits from Generative AI." The rapid spread of generative AI technologies among individuals and institutions, particularly through the adoption of large language model (LLM) based services in businesses, is notable. A significant portion of the workers in Türkiye believes that this technology will positively impact their jobs, and the proportion of jobs working with this technology is increasing. If Türkiye achieves widespread adoption of generative AI, it is projected to contribute significantly, 5% to the country's annual GDP. This is particularly notable in the digitization of production and the digital transformation process, where early-stage generative AI technologies adopted in SMEs show the potential to reach remarkable new levels.

When examining Türkiye's position in the field of AI, it appears to be capable of aligning with global leaders. However, the fact that we are lagging behind in terms of AI strategy and infrastructure must be well-defined, and the creation of a favorable operational environment and the development of skills must be well-understood as a policy priority. Generative AI applications specifically structured for Turkish (such as fine tuning and foundational models) require the realization of full productivity gains suitable for development and commercial adoption, necessitating a comprehensive and competitive innovation ecosystem.

In conclusion, it is vital to expand R&D activities and support technology-focused ventures in our country in order to promote AI-based business models. Broadening AI skills and providing skill-enhancing training programs to all segments of society are also critical factors for future success.

In light of this report, while assessing Türkiye's potential in the field of AI and the challenges it may face, a significant perspective focused on the future is detailed, ranging from the business world to public administration, and from ways of doing business to business transformations. Hoping to see the major contributions that generative AI technology will bring to Türkiye's economy and society, I wish this report to be beneficial to its readers.

Respectfully,

Prof. Dr. Altan Çakır

Istanbul Technical University
AITR Co-Chair, ITU AI

Generative AI has the potential to boost Türkiye's GDP

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> Generative AI has the potential to increase productivity and GDP in Türkiye, but capturing the benefits requires investments in skills and innovation.

The economic opportunity

Generative AI technology is developing rapidly. In the most advanced countries, the economic contribution could peak in as little as ten years.

The new technology could increase the economy's ability to produce goods and services, decreasing price pressures and provide real wage increases.

In about ten years from now, generative AI alone could contribute 5% to Türkiye's annual GDP, corresponding to TRY 1,200-1,400 (USD 50-60) billion.

Because of its user-friendly nature, some of the productivity gains could be achieved sooner.

+5% GDP
annual contribution if Türkiye achieves widespread adoption of generative AI.

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

55% of jobs in Türkiye are estimated to work **together with** generative AI.

47% of workers in Türkiye believe that generative AI will **positively impact** their job.

Share of jobs exposed to automation by generative AI
% of total employment in Türkiye 2023

31 million jobs

41% → No automation

55% → AI as a complement

4% → Partial or full displacement

The workforce in Türkiye can benefit from generative AI.

New jobs in the AI-powered economy are expected to replace those lost due to automation, resulting in unchanged employment levels. The highly exposed jobs only represent around 4% of current jobs in Türkiye.

The transition is expected to be gradual, allowing workers time to adapt to new tasks and develop new skills.

Note: The estimate is based on data for 2023. A 5% increase in Türkiye's 2023 GDP corresponds to TRY 1,200-1,400 billion in 2023 price levels or around USD 50-60 billion using the daily average official exchange rate in 2023 from Türkiye's Central Bank.
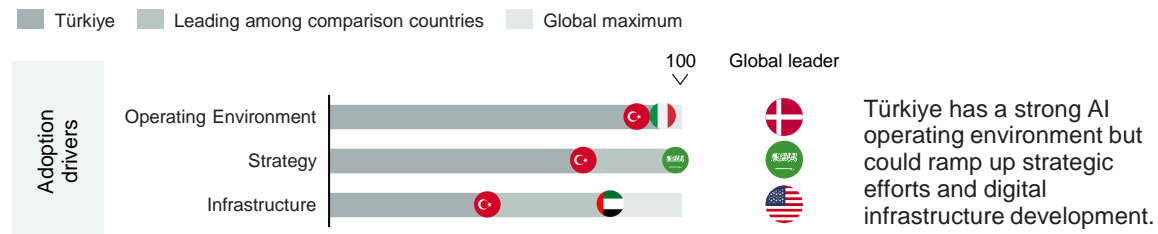
Türkiye has a strong AI operating environment which should be used for further strengthening of commercial uptake, AI-related skills and innovation

AI readiness in Türkiye

Türkiye performs relatively well on several basic AI adoption drivers, including operating environment …

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

Legend: Türkiye | Leading among comparison countries | Global maximum

Global leader
100

Adoption drivers:
- Operating Environment
- Strategy
- Infrastructure

Türkiye has a strong AI operating environment but could ramp up strategic efforts and digital infrastructure development.

… but lags far behind global leaders on innovation drivers

Innovation drivers:
- Talent
- Research
- Commercial
- Development

Türkiye lags behind regional and global leaders in R&D, commercialisation and AI-related skills.
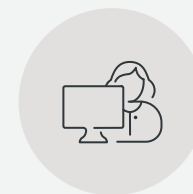
Conclusions and policy implications

The global impact of generative AI is expected to peak in around ten years from now. The potential in Türkiye in ten years from now is around 5% of GDP and around 7% in 12-13 years from now.

Leading banks are raising their long-term growth forecasts for Türkiye, and the impact of generative AI is forecasted to be stronger than the historical contributions of technology.

A five-year delay in the adoption of generative AI could reduce the annual GDP potential from generative AI in Türkiye from 5% (TRY 1,200-1,400 billion or USD 50-60 billion) to 1% (TRY 150-200 billion or USD 6-9 billion).

Capturing the full economic gains requires skills, innovation 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.
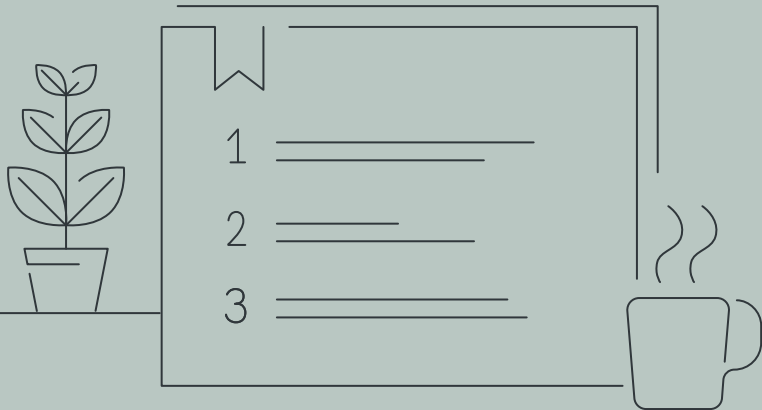
Foreword

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 in general and for Türkiye in particular while recognising the significant economic potential of other types of AI.
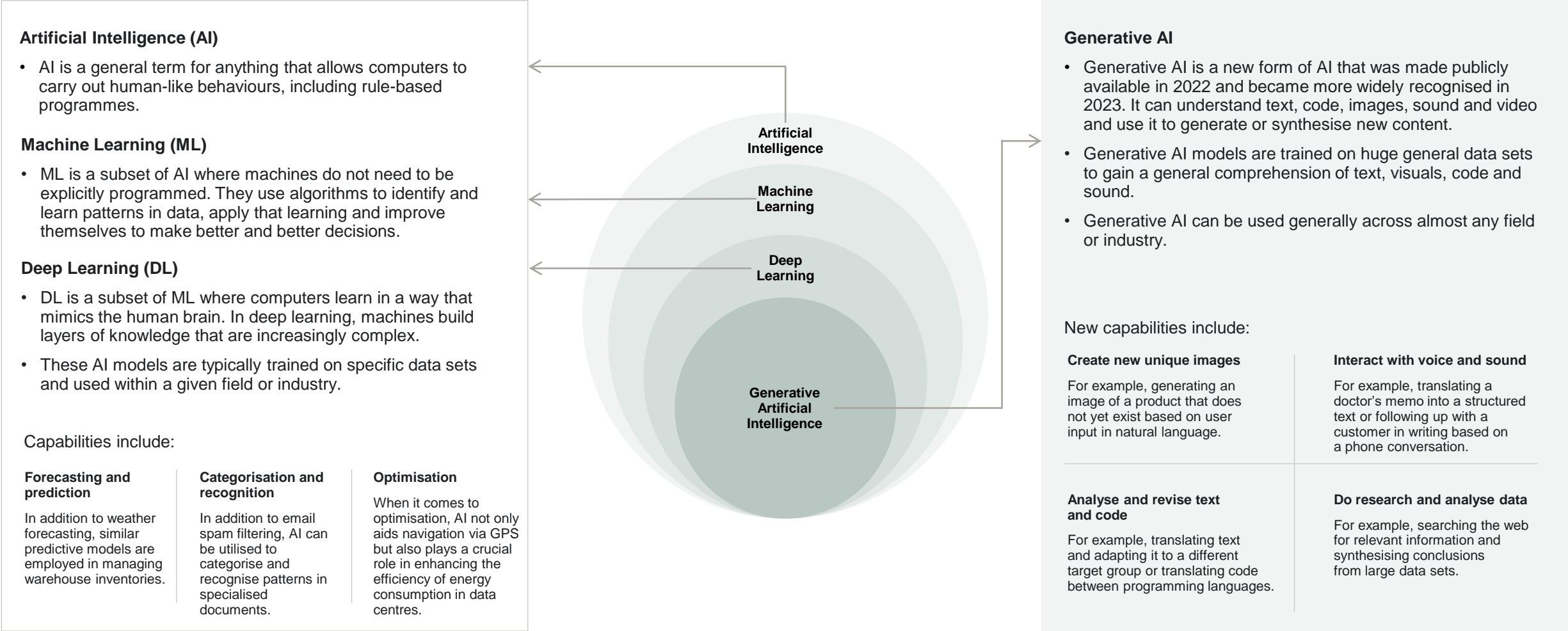
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01

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

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 specialised 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.

Artificial Intelligence

Machine Learning

Deep Learning

Generative Artificial Intelligence

Generative AI

- Generative AI is a new form of AI that was made publicly available in 2022 and became more widely recognised in 2023. 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.

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

Generative AI models have strong built-in capabilities and are easy to work with …
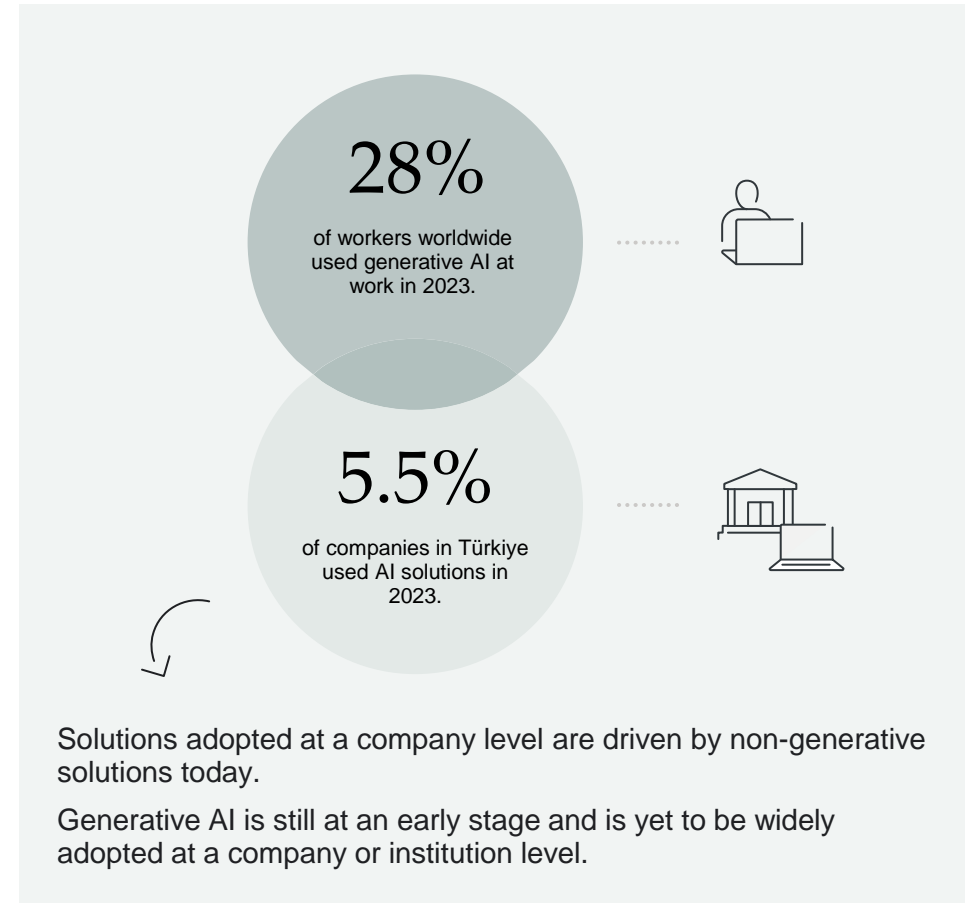
… and many users have already adopted the technology

User prompt

Large language model

Output

Text

Video

Code

Sound
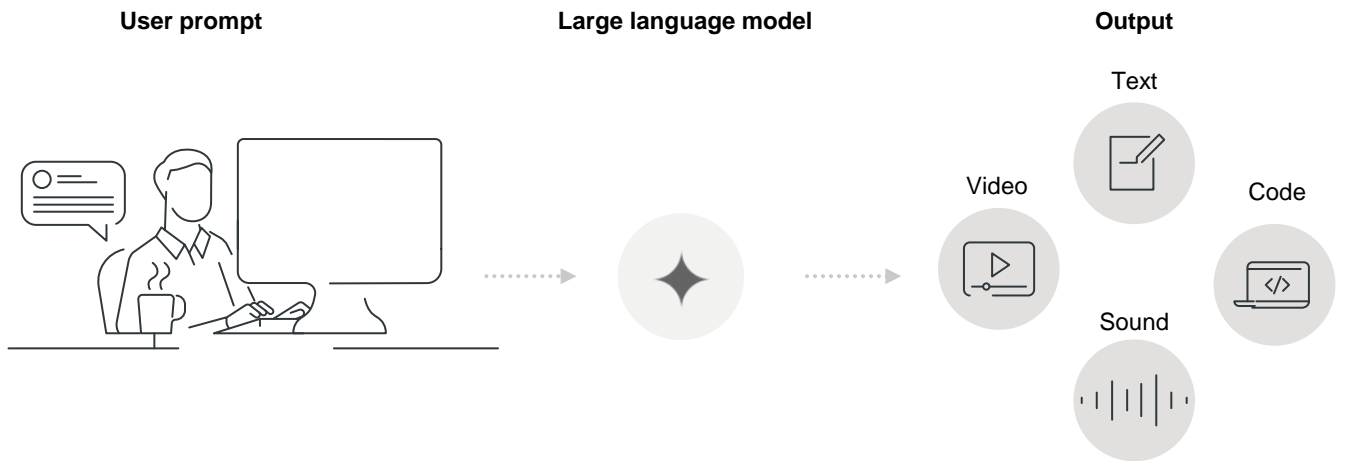
No or low data requirements

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.

28%

of workers worldwide used generative AI at work in 2023.

5.5%

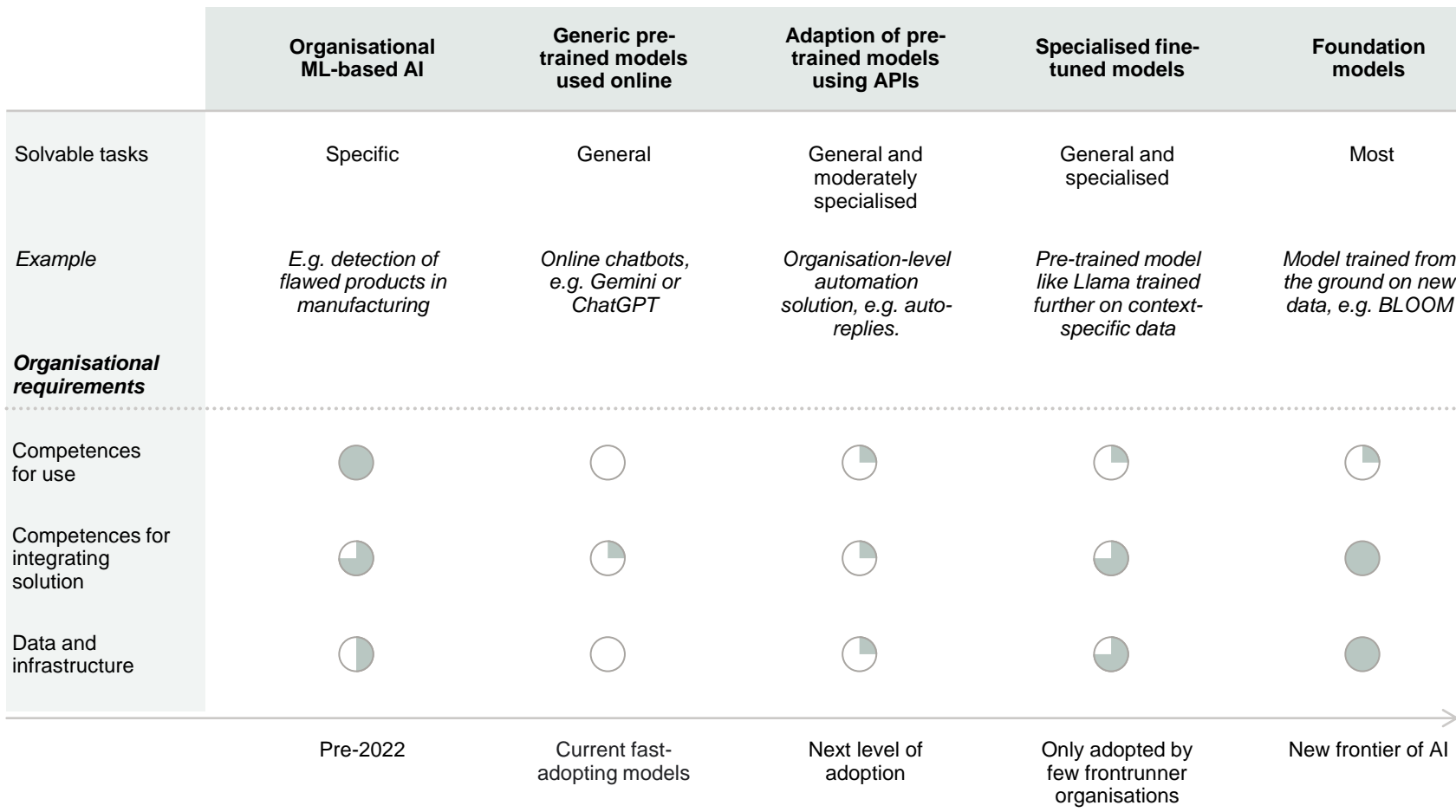of companies in Türkiye used AI solutions in 2023.

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 generative 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*
Organisational 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

- 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.
- These models do not require a high level of competence to use effectively. They are designed with accessible interfaces that understand and respond with natural language, images, audio and video and are accessible to users of all skill levels.

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.

02

Economic opportunities from AI

The main economic opportunity in Türkiye arises from humans working together with generative AI.
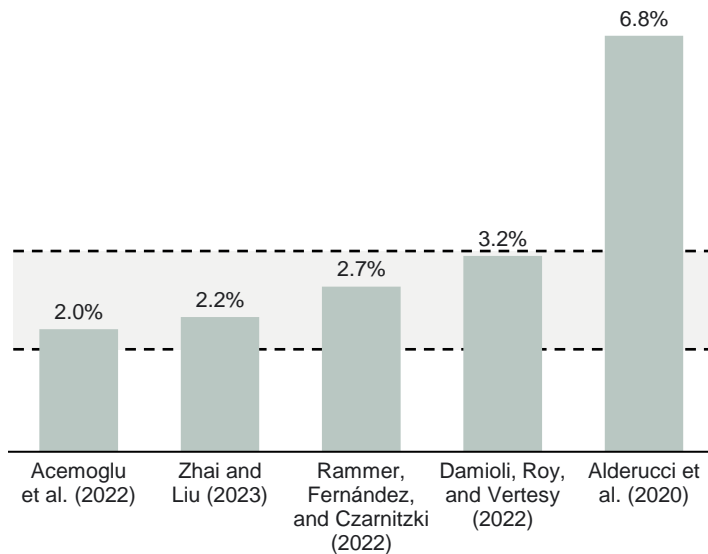
AI has great economic potential which can be further boosted by generative AI

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. Nevertheless, this evidence clearly suggests that generative AI can drive an economically significant increase in productivity.

Growth in labour productivity from AI adoption
Percentage points

Study	Value
Acemoglu et al. (2022)	2.0%
Zhai and Liu (2023)	2.2%
Rammer, Fernández, and Czarnitzki (2022)	2.7%
Damioli, Roy, and Vertesy (2022)	3.2%
Alderucci et al. (2020)	6.8%

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

— With generative AI
— Without generative AI
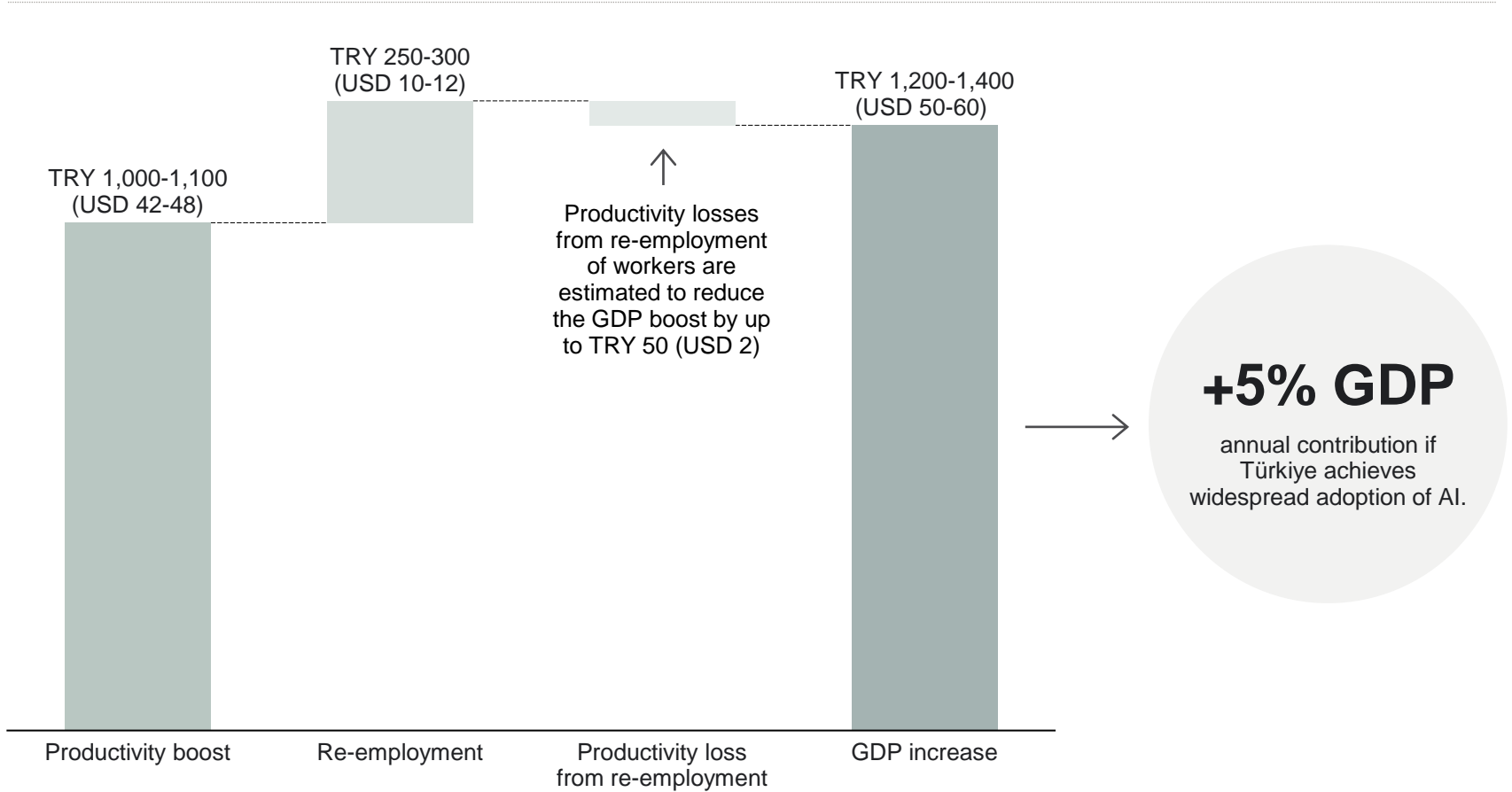
2020 2025 2030 2035 2040 2045 2050
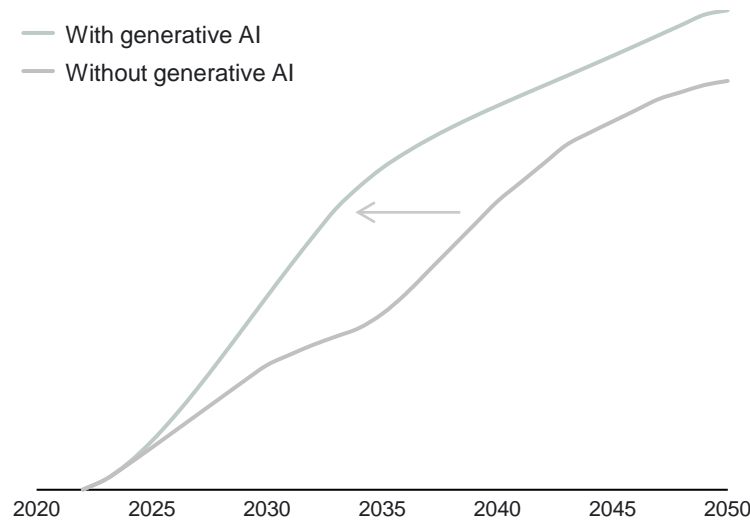
- AI has evolved rapidly with the recent break-through of generative AI. Due to its user-friendly nature, generative AI is expected to greatly accelerate the potential of AI to create economic impacts.

- 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.

Source: Implement Economics based on Brynjolfsson et al. (2019), Chui et al. (2023), Acemoglu et al. (2022), Andersen et al. (2023), Alderucci et al. (2022), Rammer, Fernández, and Czarnitzki (2022), Damiol, Roy, and Vertesy (2022) and Zhai and Liu (2023).

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Generative AI could increase Türkiye's GDP by 5% in ten years

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GDP potential of generative AI in Türkiye
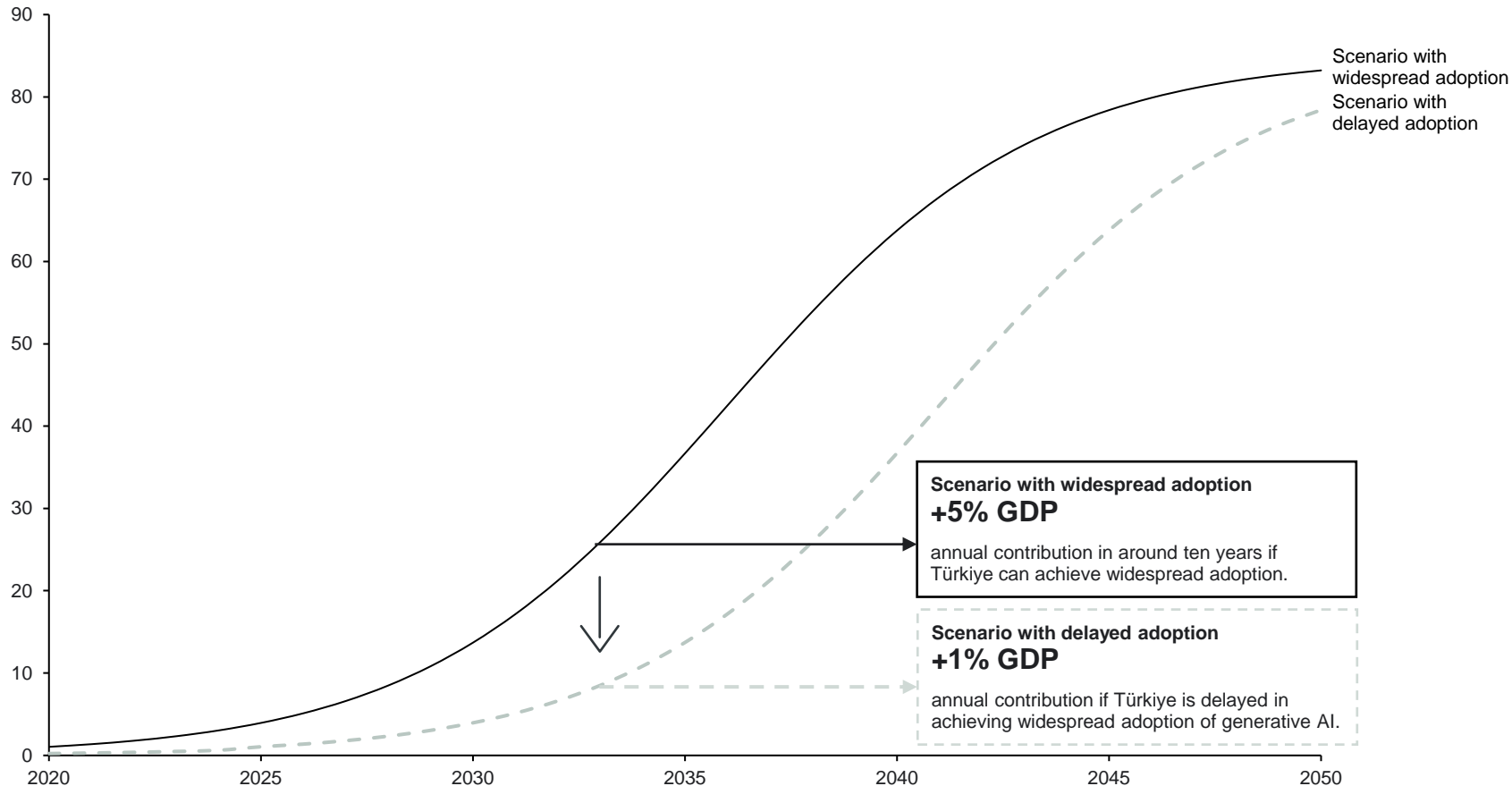Billion (2023 levels and exchange rates) increase from baseline GDP after a ten-year adoption period

TRY 250-300
(USD 10-12)

TRY 1,200-1,400
(USD 50-60)

TRY 1,000-1,100
(USD 42-48)

Productivity losses
from re-employment
of workers are
estimated to reduce
the GDP boost by up
to TRY 50 (USD 2)

+5% GDP

annual contribution if
Türkiye achieves
widespread adoption of AI.

| Productivity boost | Re-employment | Productivity loss from re-employment | GDP increase |

- If Türkiye widely adopts generative AI, we estimate a potential annual increase in GDP of 5% in about ten years. This is more than the combined GDP contribution from accommodation and food services in Türkiye today.

- The dominant impact of generative AI is a productivity boost to the majority of jobs (55%) by augmenting their capabilities, quality and efficiency, which is estimated at TRY 1,000-1,100 (USD 42-48) billion for Türkiye.

- The estimate includes impacts of re-employment of a small share of jobs (4%), where generative AI is freeing up a significant share of work for other tasks. This is estimated at TRY 250-300 (USD 10-12) billion in Türkiye.

- The estimate accounts for the possible productivity loss associated with re-employment to other occupations. This reduces the estimate for Türkiye by up to TRY 50 (USD 2) billion.

- At its peak, in around 12-13 years from now, the annual GDP contribution from generative AI is estimated at 7%, equivalent to TRY 1,700-2,000 (USD 75-85) billion.

- Leading banks, such as Goldman Sachs, are raising their ten-year growth forecasts for Türkiye, and the impact of generative AI is forecasted to be stronger than the historical contributions of technology.

Note: The estimate is based on 2023 data and 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. 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 around 20%. Our estimate is the isolated potential of generative AI around ten years from now, when the impact is assumed to peak in leading countries. 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. Moreover, the boost from generative AI may be partially offset by an underlying growth slowdown. USD estimates are calculated using the daily average official exchange rate in 2023 from Türkiye's Central Bank.
Source: Implement Economics based on Turkish Statistical Institute, Central Bank of the Republic of Türkiye, O*Net and Briggs and Kodnani (2023a&b), BNP Paribas (2023) and Dell'Acqua et al. (2023).

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A five-year delay in the adoption of generative AI could reduce Türkiye's potential GDP gains from 5% to 1%
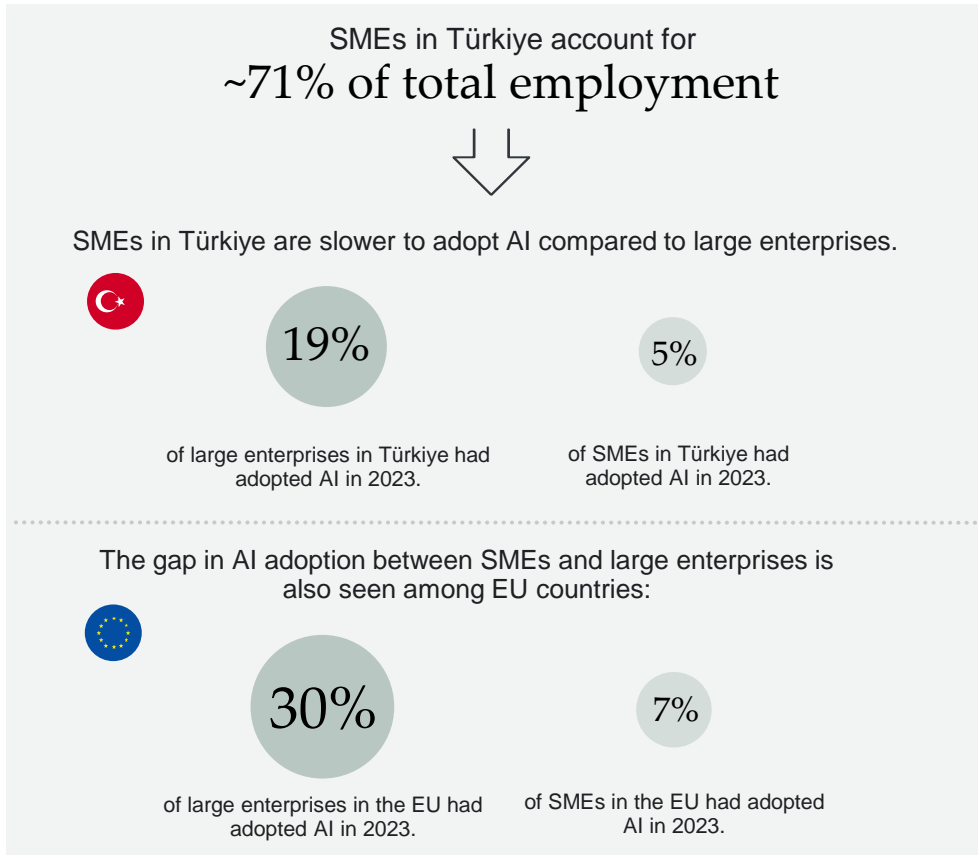
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Adoption of generative AI

%

Scenario with
widespread adoption

Scenario with
delayed adoption

Scenario with widespread adoption
+5% GDP

annual contribution in around ten years if
Türkiye can achieve widespread adoption.

Scenario with delayed adoption
+1% GDP

annual contribution if Türkiye is delayed in
achieving widespread adoption of generative AI.

- Generative AI is a new general-purpose technology and will take time to adopt.

- Our estimate of Türkiye's GDP potential from generative AI is reliant on the widespread adoption and development of the new AI technology within the next ten years.

- A five-year delay in capturing the benefits of generative AI is estimated to reduce the annual GDP contribution in ten years from 5% (TRY 1,200-1,400 billion or USD 50-60 billion) to only 1% (TRY 150-200 billion or USD 6-9 billion).

- Türkiye can enhance the welfare and GDP contribution from generative AI by ensuring that policies are in place to capture the benefits in line with leading countries (see section 6).

Note: GDP figures are expressed in 2023 levels. The figure shows generative AI adoption expressed as a share of economywide 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 emerging markets. Thus, the "widespread adoption" scenario assumes adoption in line with "advanced emerging economies" in Briggs and Kodnani (2023b). Note that the impact of generative AI may take longer than ten years before reaching its peak impact in less digitalised economies such as in Türkiye.
Source: Implement Economics based on Turkish Statistical Institute, Central Bank of the Republic of Türkiye, O*Net and Briggs and Kodnani (2023a&b).

13

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

SMEs lag behind larger corporations on AI adoption

SMEs in Türkiye account for
~71% of total employment

SMEs in Türkiye are slower to adopt AI compared to large enterprises.

19%

5%

of large enterprises in Türkiye had adopted AI in 2023.

of SMEs in Türkiye had adopted AI in 2023.

The gap in AI adoption between SMEs and large enterprises is also seen among EU countries:

30%

7%

of large enterprises in the EU had adopted AI in 2023.

of SMEs in the EU had adopted AI in 2023.

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 challenges around generative AI can increase implementation risks and compliance costs, notably for SMEs lacking in-house legal capabilities.

Note: Employment numbers are based on 2022 data provided by the Turkish Statistical Institute. SMEs are defined as enterprises with 1-249 employees.
Source: Implement Economics based on Turkish Statistical Institute, Eurostat and OECD (2024).

03

Key sectors benefitting from AI

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 in Türkiye

Productivity boost from generative AI
Percentage points productivity growth p.a. at peak

Chart values by sector:
- Construction: 0.7
- Manufacturing: 0.8
- Transport and storage: 0.9
- Utilities, raw materials and waste: 0.9
- Agriculture and primary sectors: 1.0
- Tourism and other services: 1.0
- Wholesale and retail trade: 1.0
- Business services and real estate: 1.3
- Public administration, education and healthcare: 1.3
- Information and finance: 1.5
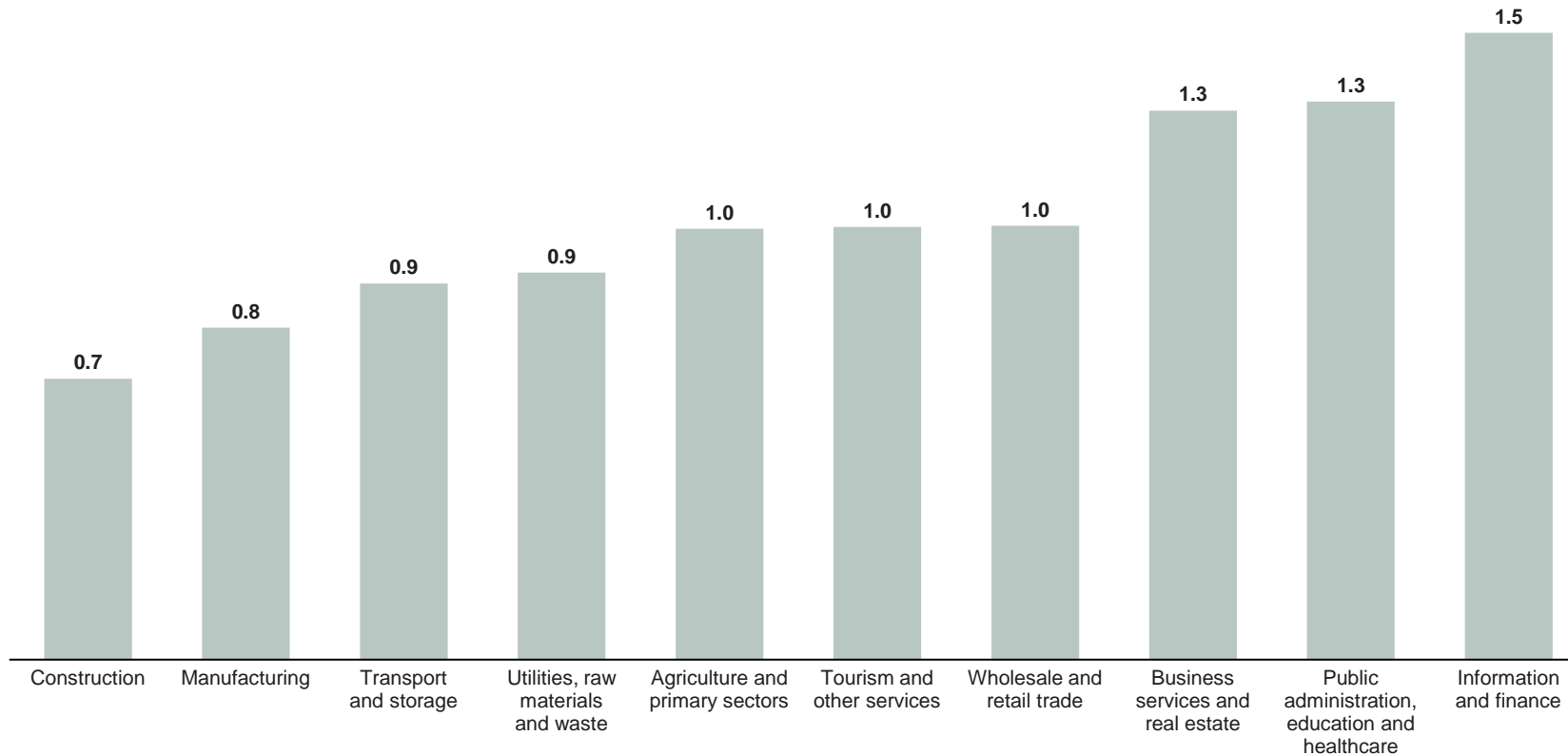
- The complementary role of generative AI prevails in most industries, meaning that most occupations are estimated to use AI to augment and improve human capabilities.

- In contrast to past automation, such as robots, generative AI has the ability to boost productivity in the service sector.

- This is estimated to provide a much-needed boost to service sector productivity, which has historically been difficult to increase.

- In the service sector, productivity increases can be achieved when humans are assisted by generative AI. This can help create content and is estimated to free up time for other valuable tasks.

- As examples, customer service staff can enhance their efficiency with AI-powered chatbots handling initial enquiries. Marketing teams can swiftly create first drafts of their materials freeing up time for more creative development by humans.

- Labour 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. 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 Turkish Statistical Institute, Central Bank of the Republic of Türkiye, O*Net and Briggs and Kodnani (2023a).

70% of generative AI's economic potential lies in service sectors, but manufacturing can also benefit

Gross value added by sector in Türkiye
Size of the sector scaled to 2023 data (TRY billion)

| Value added in 2023 | Contribution from generative AI in ten years | **70% of potential** |

Trade, transport and tourism
e.g. wholesale trade, storage and accommodation
+5%
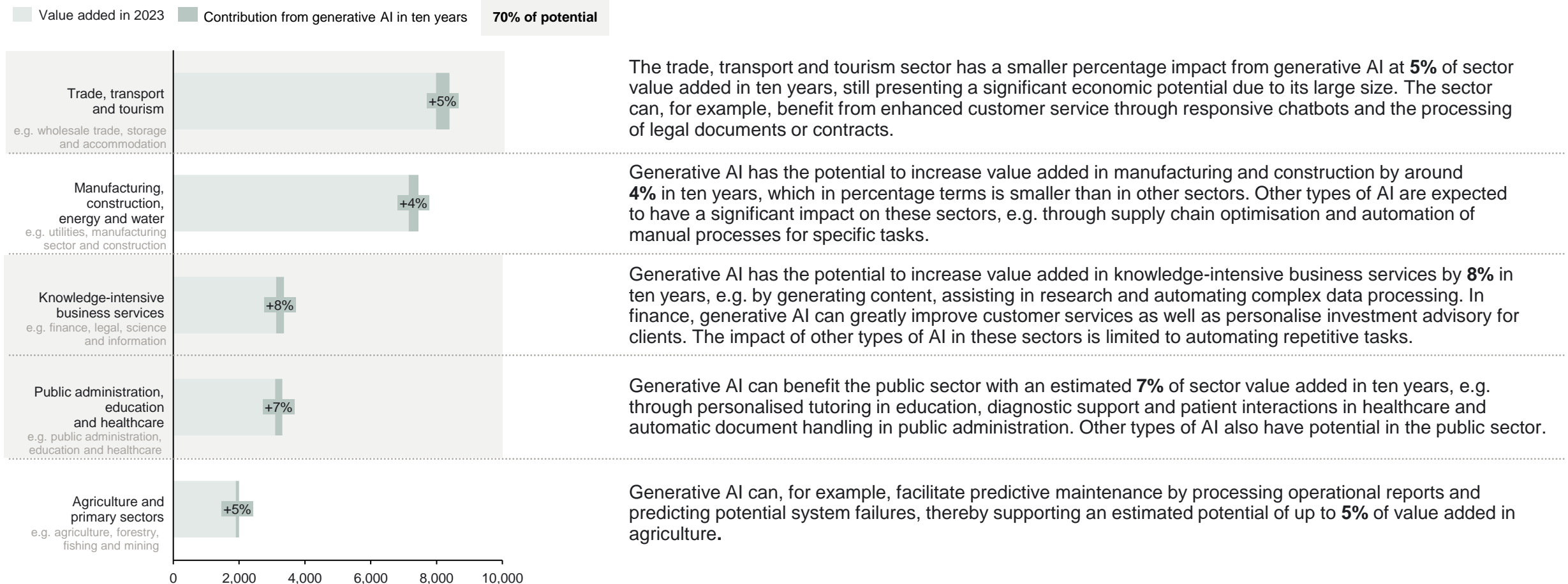
The trade, transport and tourism sector has a smaller percentage impact from generative AI at **5%** of sector value added in ten years, still presenting a significant economic potential due to its large size. The sector can, for example, benefit from enhanced customer service through responsive chatbots and the processing of legal documents or contracts.

Manufacturing, construction, energy and water
e.g. utilities, manufacturing sector and construction
+4%

Generative AI has the potential to increase value added in manufacturing and construction by around **4%** in ten years, which in percentage terms is 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.

Knowledge-intensive business services
e.g. finance, legal, science and information
+8%

Generative AI has the potential to increase value added in knowledge-intensive business services by **8%** in ten years, e.g. by generating content, assisting in research and automating complex data processing. In finance, generative AI can greatly improve customer services as well as personalise investment advisory for clients. The impact of other types of AI in these sectors is limited to automating repetitive tasks.

Public administration, education and healthcare
e.g. public administration, education and healthcare
+7%

Generative AI can benefit the public sector with an estimated **7%** of sector value added in ten years, e.g. through personalised tutoring in education, diagnostic support and patient interactions in healthcare and automatic document handling in public administration. Other types of AI also have potential in the public sector.

Agriculture and primary sectors
e.g. agriculture, forestry, fishing and mining
+5%

Generative AI can, for example, facilitate predictive maintenance by processing operational reports and predicting potential system failures, thereby supporting an estimated potential of up to **5%** of value added in agriculture**.**

x-axis: 0   2,000   4,000   6,000   8,000   10,000

Note: Sector size is scaled to 2023 data in billion Turkish Lira. 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. The contributions from generative AI shown are based on sectoral gross value added and are scaled to reflect the total GDP increase from generative AI.
Source: Implement Economics based on Turkish Statistical Institute, Central Bank of the Republic of Türkiye, O*Net and Briggs and Kodnani (2023a).
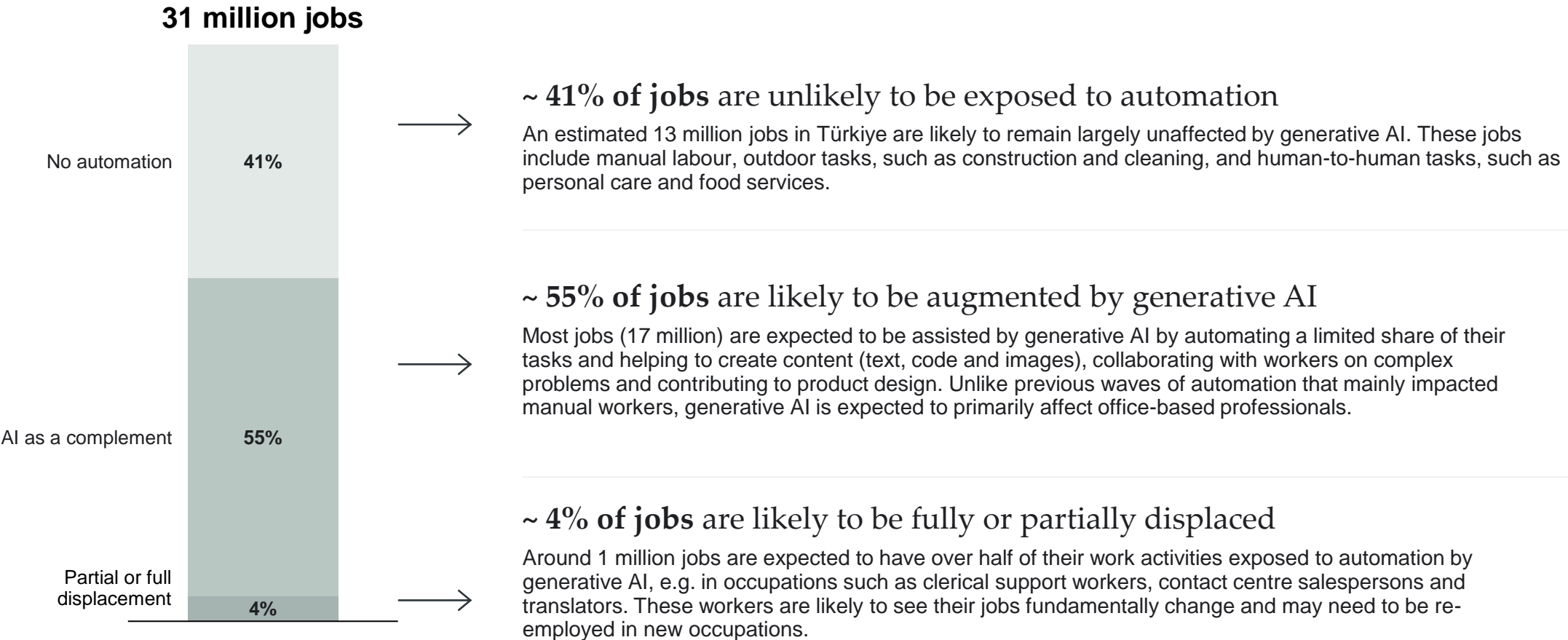
04

Job implications of AI

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

Generative AI augments most jobs

Going from exposure to full adoption is expected to take a long time
This graph provides estimates of the shares of current jobs in Türkiye with low, medium and high shares of tasks *exposed* to automation by generative AI. However, the process by which exposed tasks eventually become automated (the full adoption period) is long, around 20-25 years (see page 13).

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

31 million jobs

No automation — 41%

AI as a complement — 55%

Partial or full displacement — 4%

~ 41% of jobs are unlikely to be exposed to automation

An estimated 13 million jobs in Türkiye 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.

~ 55% of jobs are likely to be augmented by generative AI

Most jobs (17 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.

~ 4% of jobs are likely to be fully or partially displaced

Around 1 million jobs 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 (2023), "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 Turkish Statistical Institute, 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 in Türkiye

IM

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

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

4% of jobs in Türkiye are estimated to be highly exposed to generative AI, leading to some job closures.

↓
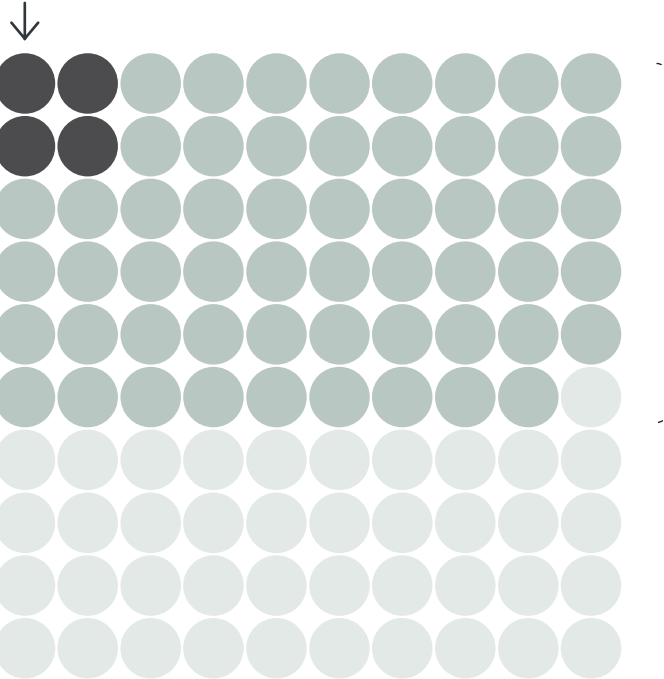
Meanwhile, 55% of jobs are expected to see a boost in productivity. This will create new jobs due to:

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 70,000-140,000 people in highly exposed jobs are estimated to need re-employment per year. This corresponds to less than 3% of the historical number of job changes in Türkiye (see page 23).

- The job development in Türkiye 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 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 the 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.

17 million jobs are expected to be complemented by generative AI – mainly service and sales workers and managers

Jobs complemented by generative AI
Thousand jobs

Legend: University or equivalent | High school or equivalent | Below high school level
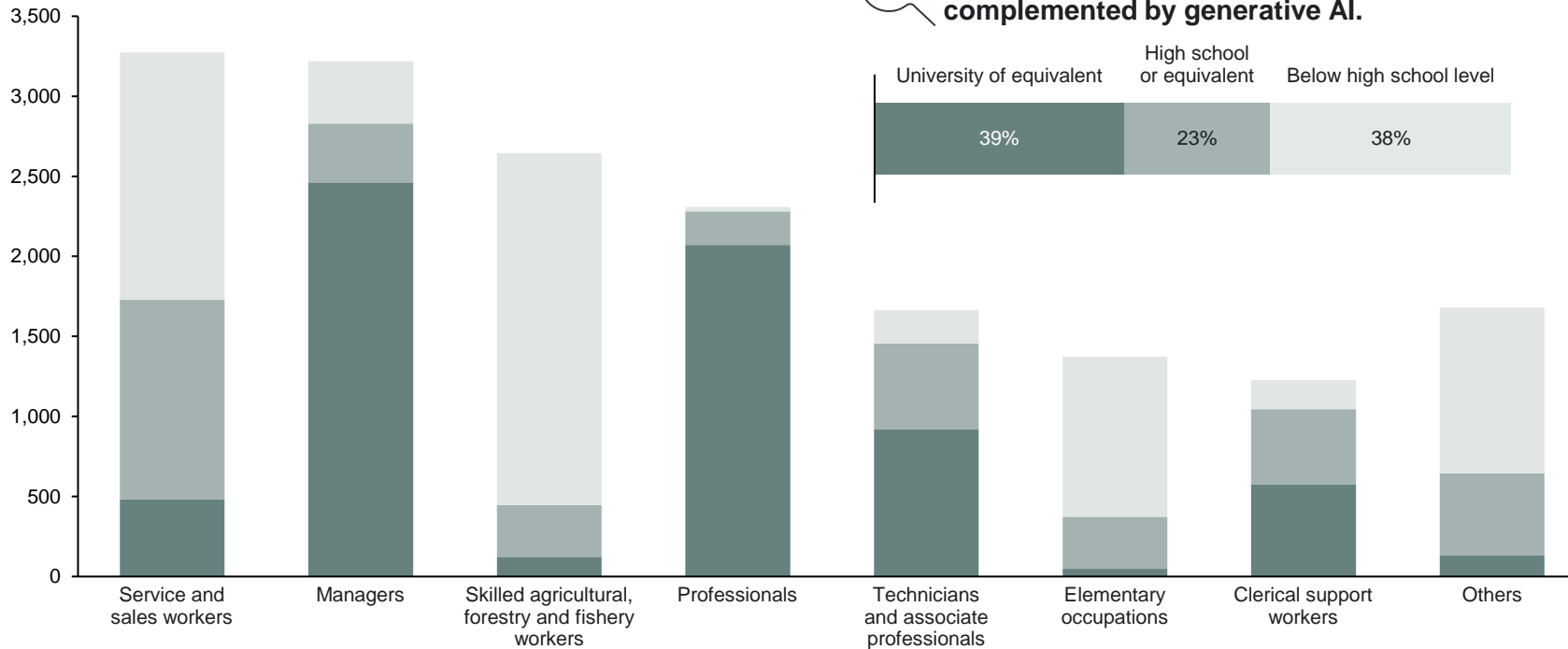
Zooming in on the 55% (~17 million) of jobs complemented by generative AI.

University of equivalent	High school or equivalent	Below high school level
39%	23%	38%

Chart categories (x-axis):
- Service and sales workers
- Managers
- Skilled agricultural, forestry and fishery workers
- Professionals
- Technicians and associate professionals
- Elementary occupations
- Clerical support workers
- Others
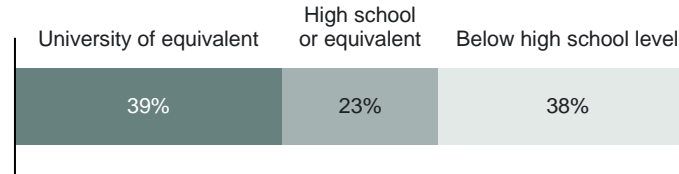
Examples of jobs include:

Service and sales workers	Managers	Skilled agricultural, forestry and fishery workers	Professionals	Technicians and associate professionals	Elementary occupations	Clerical support workers	Others
Caterers, travel agents and personal care workers	Executives, senior officials and general managers	Livestock and farm workers, fishery and forestry workers	Research, analysis and advising services (including legal)	Engineering technicians, robot controllers and air traffic safety technicians	Transport and storage workers, food preparation assistants	Secretaries, record keepers and information suppliers	Police services and machine operators

- Generative AI is estimated to augment the capabilities of around 17 million jobs in Türkiye at full adoption which is expected to take 20-25 years.

- An estimated 39% of complemented workers, including lawyers, scientists, and engineers, have higher educational attainment, substantially higher than the average for all workers at 28%.

- 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.

- Service and sales workers make up the largest group of complemented workers, with around half having less than a high school education. Generative AI can complement these workers e.g. by automating routine tasks, generating personalised content for customers, providing data analysis and streamlining customer service processes.

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

21

More than 1 million jobs in Türkiye are highly exposed to generative AI, but the AI-powered economy will help create new jobs

IM

Jobs highly exposed to generative AI
Thousand jobs

Clerical support workers — 685
Technicians and associate professionals
Professionals
Service and sales workers
Elementary occupations
Others

0 100 200 300 400 500 600 700
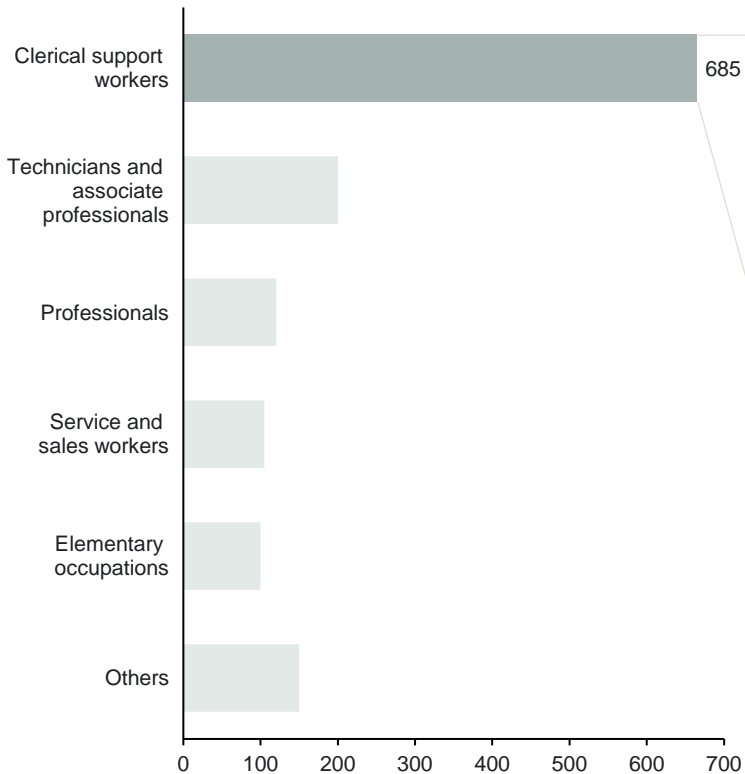
**Highly exposed jobs in total:
More than ~ 1 million**

Example: Clerical support workers and job transition in Türkiye

Of the 685,000 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.

685,000

Within occupation   **Re-employed**

- More than 1 million jobs in Türkiye 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.

- Türkiye 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, 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 (e.g. IT boom in the 1990s), and the emergence of new occupations following technological innovations accounts for the vast majority of long-run employment growth.

Türkiye has a highly dynamic job market, and job openings and closures due to generative AI are expected to be small compared to historical averages

Job openings and closures in Türkiye
Thousand jobs

Legend: Job openings, Job closures, Net job openings
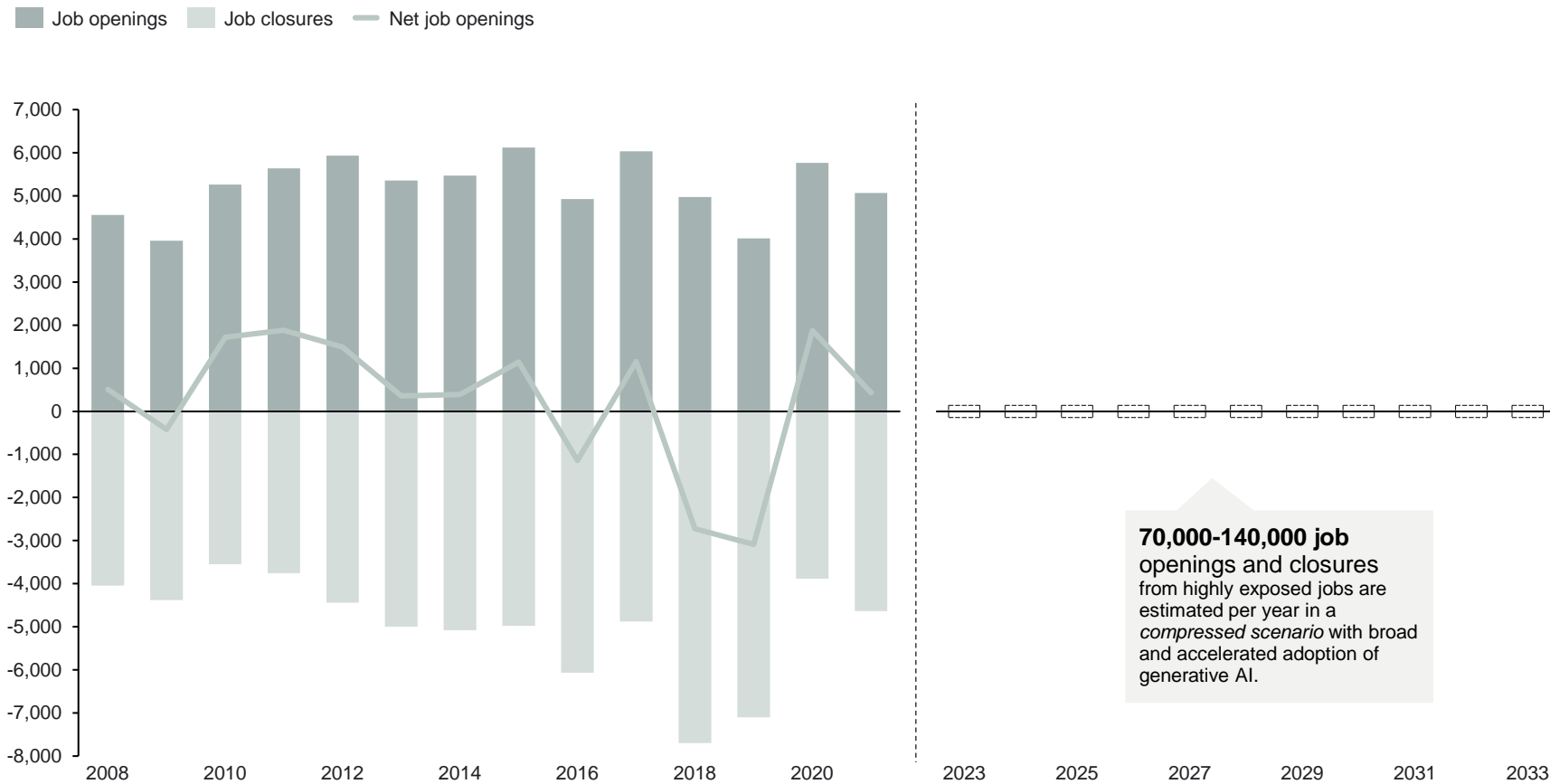
70,000-140,000 job openings and closures from highly exposed jobs are estimated per year in a *compressed scenario* with broad and accelerated adoption of generative AI.

- Türkiye's labour market is highly dynamic, which is reflected in significant job reallocation rates annually due to both substantial job openings and closures.

- Between 2008 and 2021, Türkiye created around 5.2 million new jobs and closed 5.0 million jobs on average each year.

- Most sectors have added significant amounts of new jobs in the period, especially in manufacturing, retail 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.

- We estimate that the jobs that are highly exposed to generative AI can lead to around 70,000-140,000 annual job openings and closures if all these job changes occur over the next ten years. This is less than 3% of the average number of job changes in Türkiye from 2008-2021.

- The labour market effects stemming from the impact of generative AI on highly exposed jobs are therefore small compared to historical levels of job changes.

- 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.

Note: 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 Turkish Statistical Institute, and Ayhan et al. (2023).

A higher share of female workers are estimated to be affected by generative AI – both in terms of potentially positive and negative impacts

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Share of female jobs exposed to automation by generative AI
% of total employment among female workers

Total ~ 10 million female workers

Category	%
No automation	34%
AI as a complement	61%
Partial or full displacement	5%
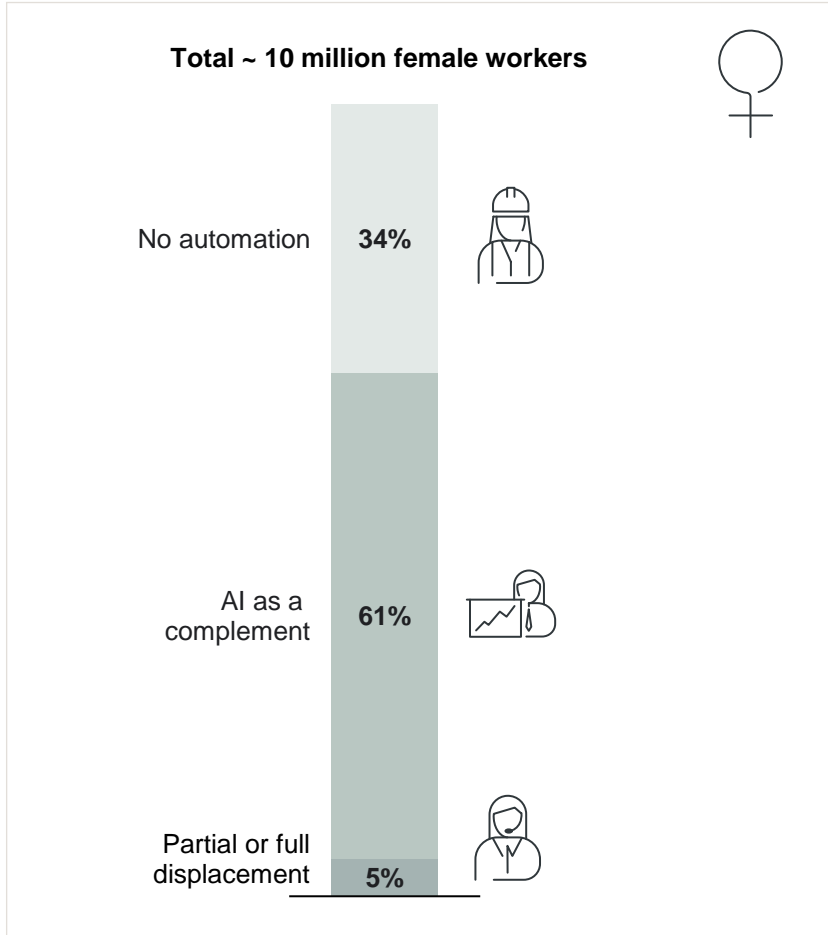
Share of male jobs exposed to automation by generative AI
% of total employment among male workers

Total ~ 21 million male workers

Category	%
No automation	43%
AI as a complement	53%
Partial or full displacement	4%
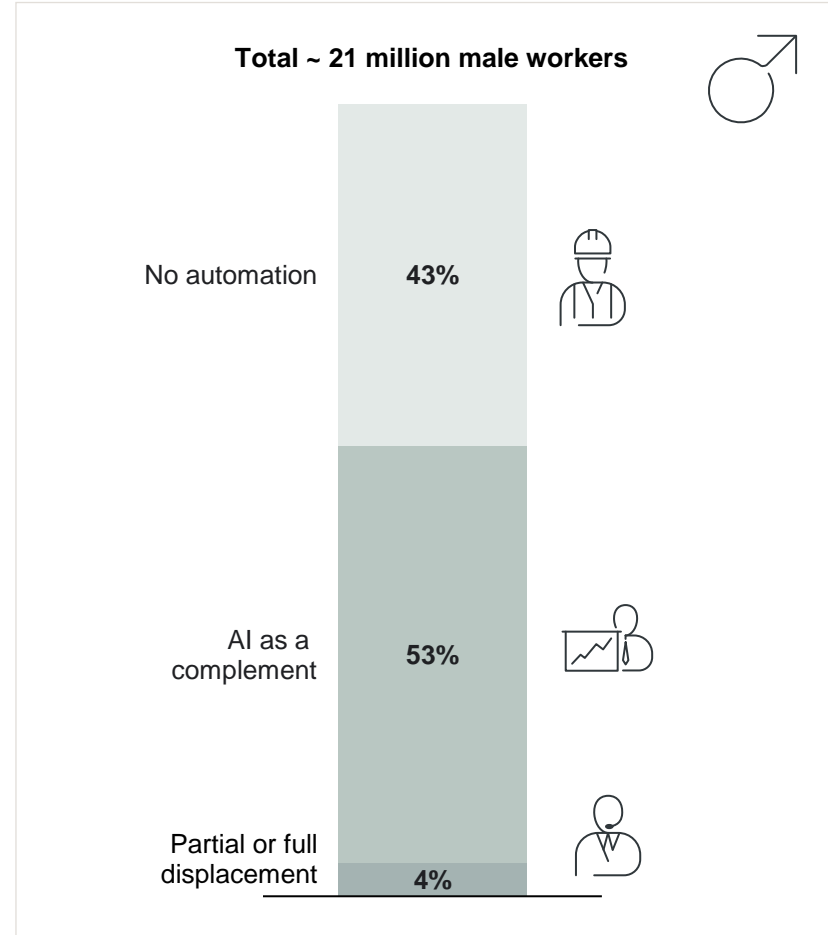
No automation

- 34% of female workers and 43% of male workers in Türkiye are in jobs with limited exposure to generative AI. These are, for example, manual, outdoor and human-to-human jobs.

Complemented jobs

- 61% of female workers are expected to see generative AI complement their current job, whereas the share is 53% 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

- 5% of female workers and 4% of male workers in Türkiye 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 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.
Source: Implement Economics based on Turkish Statistical Institute, O*Net and Briggs and Kodnani (2023).

Workers need a broad set of skills to reap the benefits of 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	Creating 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 require 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.

- 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.

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

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Grades with and without generative AI

Estimated mean grade on 2nd task
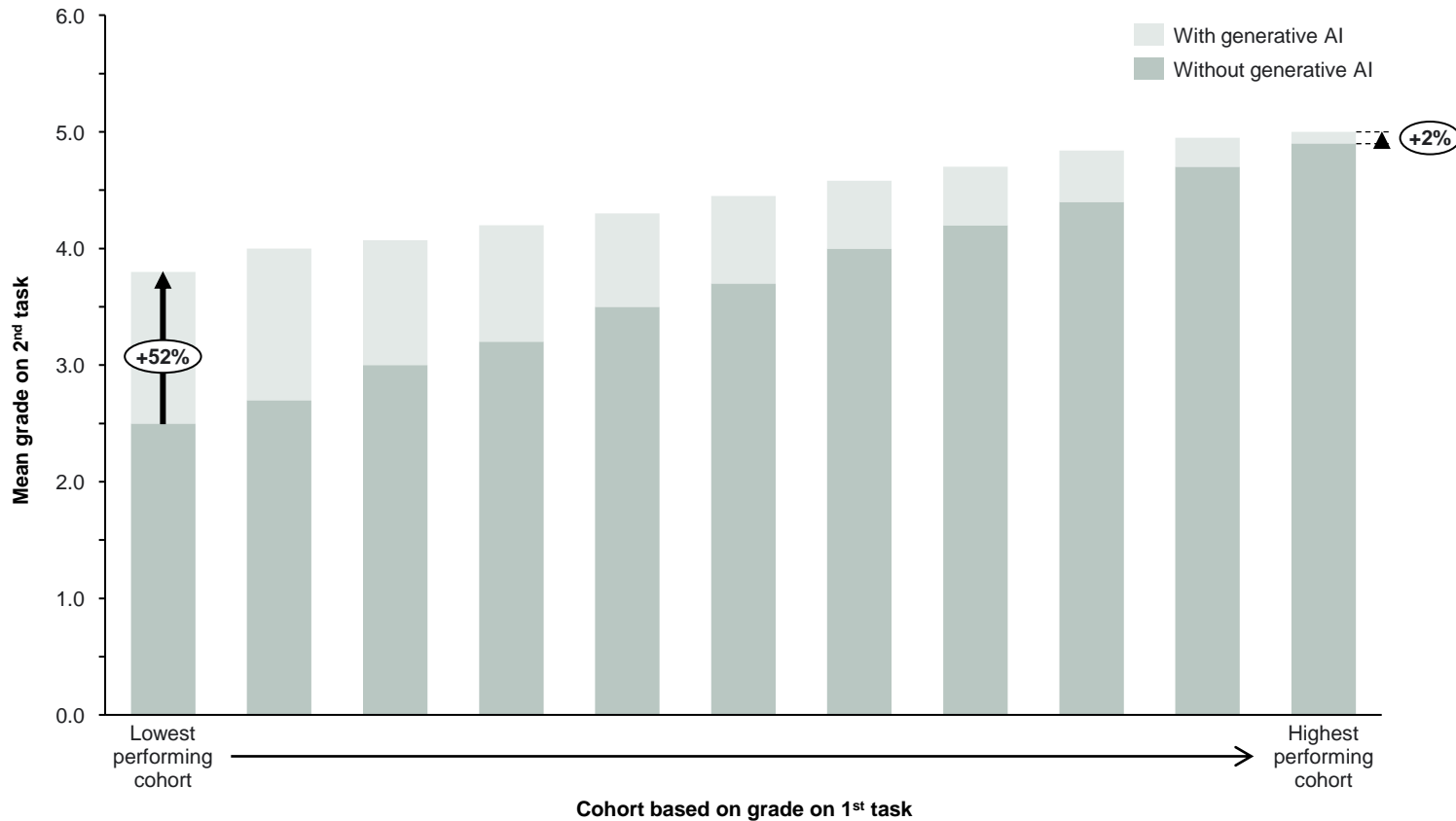
- AI requires a broad skill set to reap the benefits However, AI as a tool can itself augment the performance of human skills.

- 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 largest 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

AI's impact on societal challenges

AI can help with some of Türkiye's most pressing societal challenges.
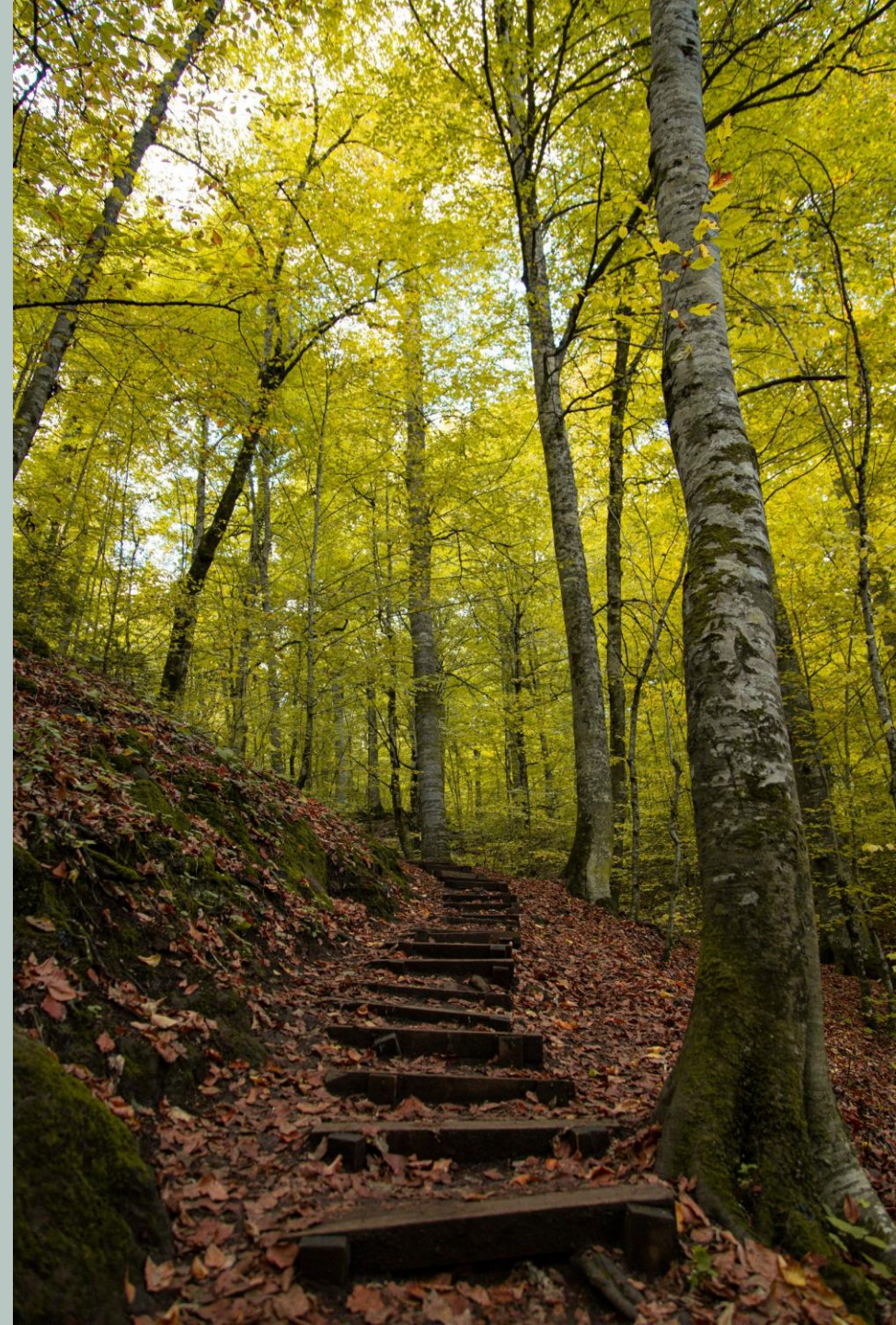
AI and generative AI can play a key role in addressing climate change

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Türkiye's gross greenhouse gas emissions, 2021
$MtCO_2e$

3%	11%	15%	16%	25%	30%
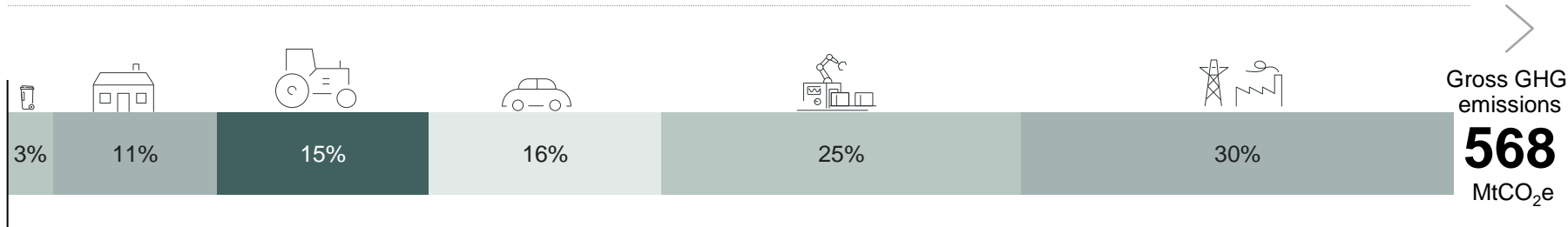
Gross GHG emissions
568
$MtCO_2e$

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

Agriculture	**Domestic transport**	**Manufacturing**	**Energy supply**
• Efficiency improvements from precision farming • Reduced food waste • Changes in land use	• Electric cars, vans, busses and small trucks • Efficient and eco-friendly driving • Reduced travel by use of digital tools (working from home and video conferences)	• Smart factory with AI systems • Efficiency improvements • Electrification of lighter processes	• Expansion of renewable energy • Electrification • Smart grid • Flexible electricity demand

- Artificial intelligence and other digital solutions are expected to play a key enabling role in reaching Türkiye's climate goals of net carbon neutrality by 2053.

- 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.

AI can help alleviate healthcare resource shortages while enabling more advanced and personalised treatment options

AI for healthcare

Türkiye's National AI Strategy recognises AI as a solution to address major collective challenges, including the optimisation of healthcare delivery and resource use, drug development and the prevention of diseases.

Moreover, the Turkish Health Data Research and Artificial Intelligence Applications institute (TUYZE) was created in 2019 with the vision of elevating the efficiency of health services and improving public health through upgrades to digital infrastructure and integration of artificial intelligence.

More hands are needed

- Like its regional counterparts, Türkiye faces a shortage of practising doctors, with considerable regional differences in accessibility to healthcare services.
- A shortage of doctors and other healthcare workers may impact the quality of healthcare services and increase waiting times.

AI can help free up and optimise critical resources by…

- Automating tasks in healthcare administration, e.g. appointment scheduling.
- Recording and summarising appointment notes, referral information and care plans.
- Faster and more accurate screening and decisions by physicians.
- Enabling physicians to undertake remote consultations.

Better treatment and care is demanded

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

AI can help improve how we treat patients by…

- Analysing and enhancing medical images, enabling faster 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.

Türkiye is already experimenting with AI solutions across the health system.

The Turkish Brain Project

- Launched by the Gazi University Hospital and the Turkish Digital Transformation Office, the Turkish Brain Project (TBP) looks to facilitate early-stage disease detection and decision support for health workers.
- Within the scope of the project, different AI models are developed to enable earlier and more accurate detection of diverse anomalies, including strokes and tumours, in medical images.
- The AI-supported system is planned to be expanded to hospitals throughout the country.

Source: Implement Economics based on Türkiye's National Artificial Intelligence Strategy 2021-2025 and Eurostat.

06

AI readiness in Türkiye

Türkiye's capacity to leverage the potential of AI can be evaluated based on international comparisons.

In assessing Türkiye's AI readiness, we compare internationally

- In assessing Türkiye's AI readiness, we can compare it to other countries in the region. Additionally, Singapore is included due to their strong performance on digital infrastructure, talent and research parameters as measured by the Tortoise Global AI Index (see page 31).

- Several of these countries have ambitious AI strategies and invest heavily in the field.

- 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.

- Indices, such as the Tortoise Global AI Index (see page 32), compound both **scale** and **intensity** (i.e. in relation to population or GDP).

- Türkiye has a scale that allows for ambitions to align with global leaders on AI-related investment and effort.

- Türkiye could also collaborate on AI initiatives at the regional (Europe/MENA) level, especially in the areas of R&D investment, regulation and digital infrastructure.

International comparison group

SPAIN
ITALY
ARMENIA
TÜRKIYE
MALTA
GREECE
ISRAEL
BAHRAIN
QATAR
SAUDI ARABIA
UAE
PAKISTAN

MOROCCO
TUNISIA
SINGAPORE

31

Türkiye has a strong operating environment for widespread AI use but lags behind in AI strategy, infrastructure and key innovation drivers

Türkiye's AI capacity according to the Tortoise Global AI Index

Global AI Index, ranking

		Türkiye ranking	
	Global leader	Comparative countries (n=15)	Global
Operating Environment	Denmark	2	7
Strategy	Saudi Arabia	7	27
Infrastructure	USA	13	52
Talent	USA	6	29
Research	USA	9	41
Commercial	USA	11	49
Development	USA	11	52
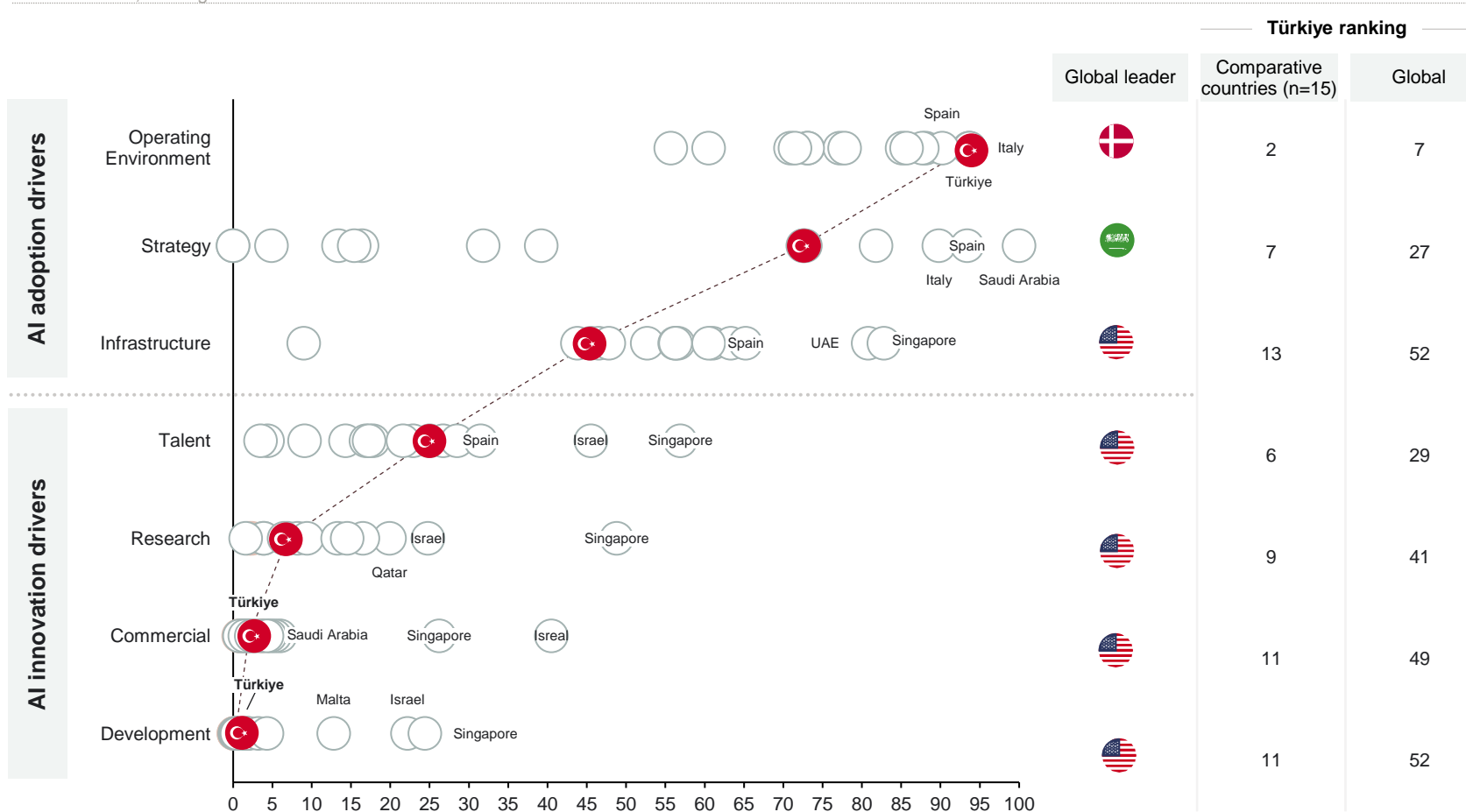
- Türkiye ranks second highest on operating environment for AI among the comparison group and 7th globally. The assessment of operating environment focuses on survey data indicating trust in AI, diversity of practitioners and data governance.

- Türkiye lags behind in the other foundational AI adoption drivers, namely AI strategy and infrastructure.

- More specialised AI applications (e.g. foundational and fine-tuned models) and the realisation of full productivity gains will require a cohesive and competitive innovation ecosystem that is conducive to development and commercial uptake.

- Türkiye lags behind global players in complementary innovations, investments and AI-related skills. Here, the United States is far ahead globally, which is largely due to scale in AI capacity.

- Current gaps suggest that Türkiye faces the risk of falling further behind comparable peers as well as globally in terms of AI innovation drivers and needs to ramp up talent development, R&D activities and commercialisation to catch up.

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

The strong operating environment has not yet resulted in high levels of AI adoption in Türkiye's enterprises, although they are ahead of Italy and Greece

Adoption of AI in 2023
% of enterprises using at least one type of AI technology
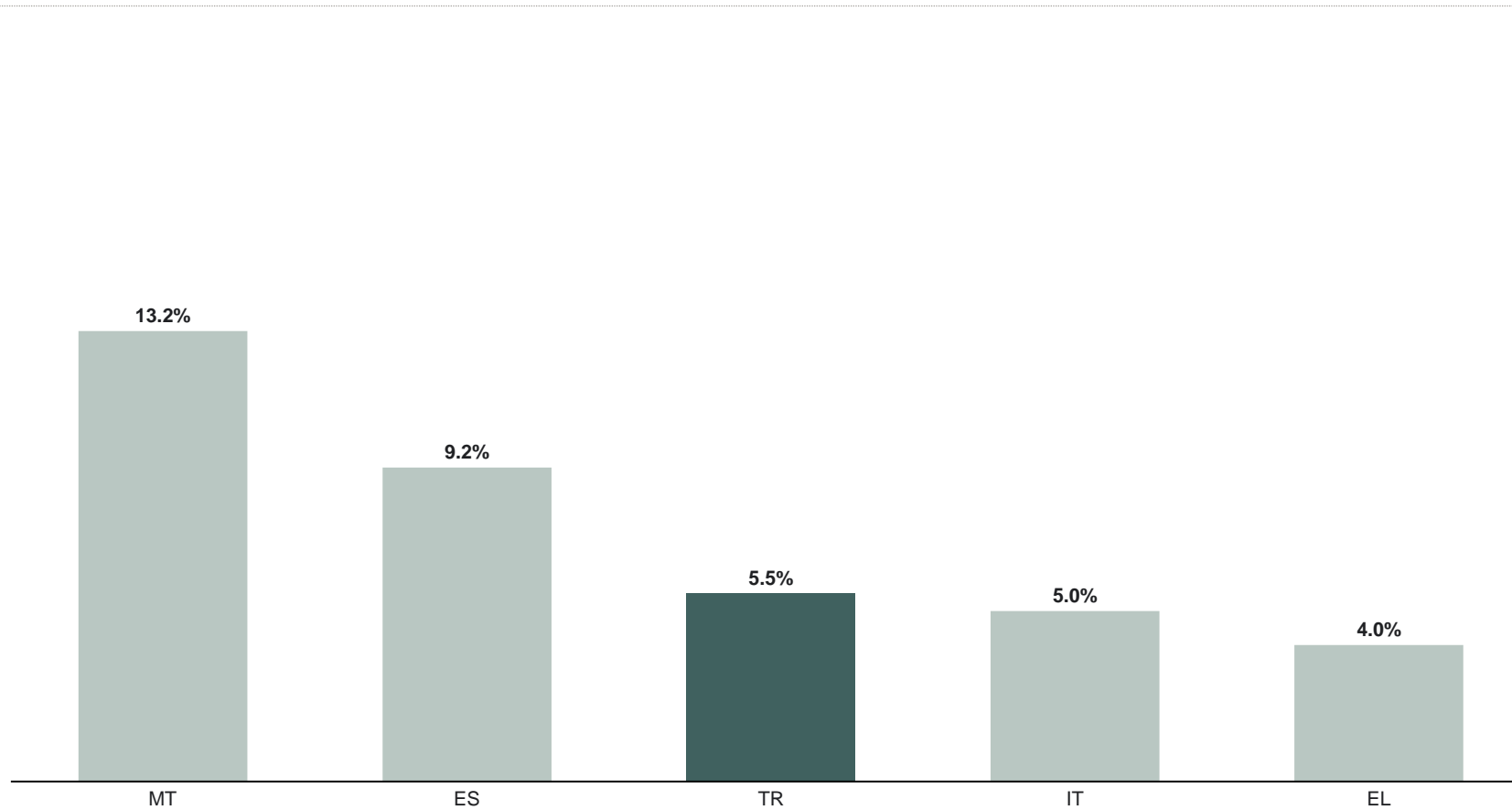
- The adoption of new AI technologies by businesses and organisations is key to realising the economic potential of the technology.

- Dispersion of the AI-related innovations will be needed to achieve the benefits of the new globally available technology.

- In 2023, 5.5% of companies in Türkiye had adopted at least one form of AI technology, as reported by the Turkish Statistical Institute. This rate of adoption, which is consistent with figures reported by Eurostat, positions Türkiye ahead of Italy and Greece.

- Türkiye ranks behind countries such as Malta and Spain in AI adoption among enterprises.

Chart data:
- MT: 13.2%
- ES: 9.2%
- TR: 5.5%
- IT: 5.0%
- EL: 4.0%

Note: Current adoption is from 2023 and includes enterprises with ten or more employees, excluding financial services.
Source: Implement Economics based on the Turkish Statistical Institute and Eurostat.

07

The way forward to capture the benefits of AI

Türkiye can consider several options to capture the benefits and navigate the dilemmas of AI.
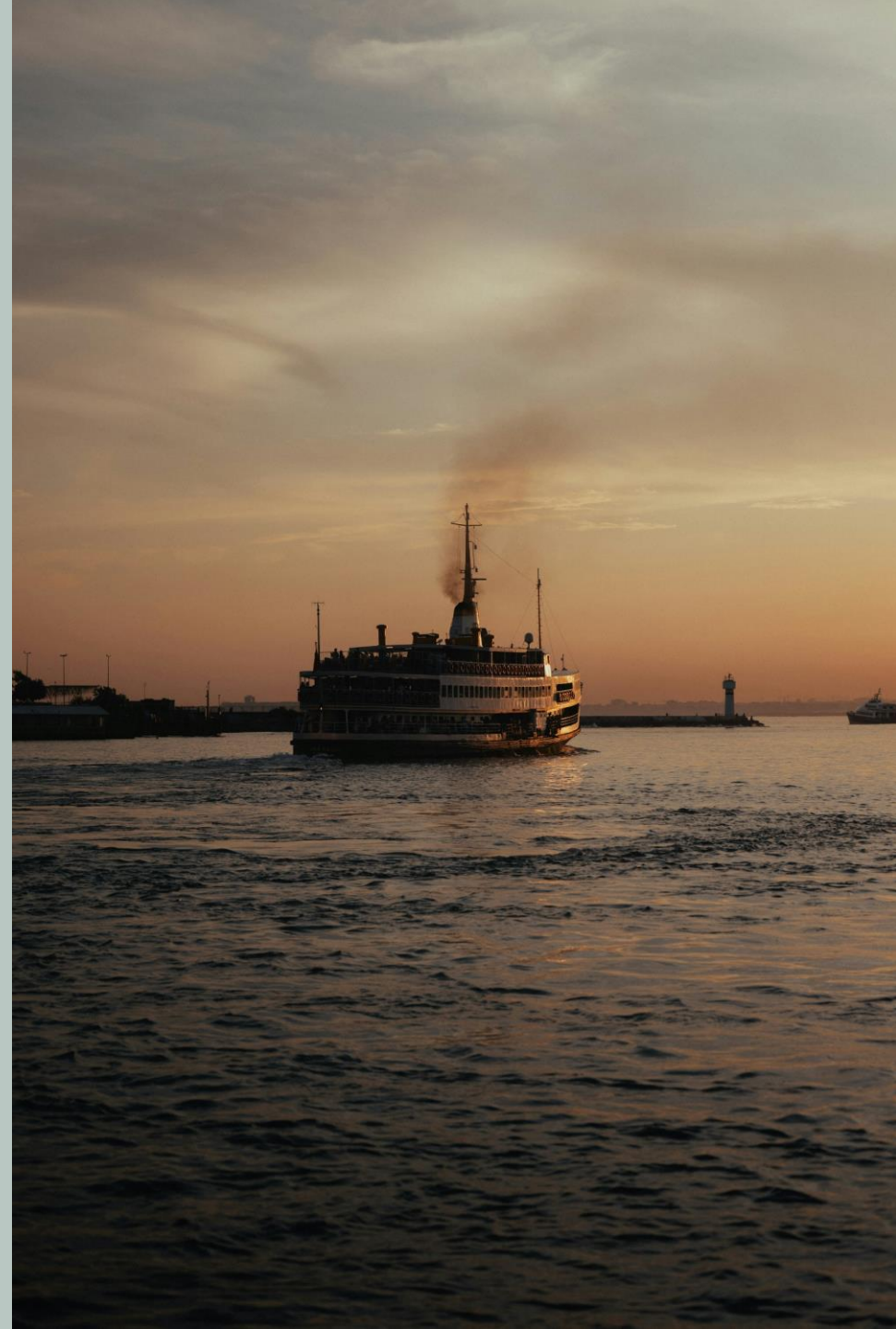
Potentials, pitfalls and paradoxes

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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
• The estimated economic potential assumes **widespread adoption** of generative AI within ten years.	• Displaced workers might end up in **less productive jobs** (than already assumed).	• How can policies encourage the types of AI that complement human labour and best prepare those at risk of losing a job to AI?
• The estimate includes both narrow **labour-saving** impacts and broader **value-creating** impacts that enable workers to do something novel or powerful.	• AI may end up being **less promising** or less ready to bring to market than initially hoped.	• What choices will encourage the development of AI that companies of all sizes can access instead of just the largest ones?
• It assumes that AI lives up to its promise of being the most radical **technological breakthrough** in decades.	• Time to market may be **challenged by a legal regime** not designed for AI.	• 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?
• Moreover, we estimate that AI will **complement the majority of workers** and free up time to spend on non-routine, creative and inventive tasks.	• Companies may **miss out on the benefits** of AI due to a lack of competences or failure to change organisations and habits.	• What kind of high-performance computer infrastructure is needed to power the new technology, and how is that best provided?
• The result is an economy not simply at a higher level of productivity, but at a **permanently higher growth rate**.	• National regulators, driven by any number of concerns, may **impose strict regulations** that slow the speed of AI development.	
	• **Regulatory challenges** and lack of clarity on future rules may delay the uptake.	

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

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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. 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
• Invest in long-term public AI research and encourage private investment in basic and applied research. • 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. • Make AI tools available to entrepreneurs and scientists so they can use AI in support of other discoveries and innovations. • Support international research collaboration, technology transfer and international movement of researchers.	• Avoid siloed approaches to AI regulation to minimise the risk of misalignment and fragmentation by increased international co-operation. • 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.	• 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. • Create a national strategy to spur AI adoption across all industries and all sizes of businesses. • Give small businesses an "AI jumpstart" through technical assistance, training and guidance to help them understand and leverage AI for their businesses.	• 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 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. • In those selected types of jobs where AI risks displacing workers, efforts should be devoted to re-skilling workers for other jobs. • Ensure a flexible labour market and continuous lifelong training, enabling new opportunities in the labour market.	• 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. • Support the building of cross-border AI infrastructure and subsea cables. • 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 the 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.

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Türkiye can draw on policy choices of regional frontrunners

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Indicator	Operating environment	Infrastructure	Talent	Research	Development	Commercial
Regional leaders	🇮🇹	🇦🇪	🇸🇬	🇸🇬	🇸🇬	🇮🇱

Best practice

Operating environment

Italy is proactively shaping its AI landscape by implementing regulatory standards focused on data protection, algorithm transparency and ethical principles, involving a wide range of stakeholders to ensure responsible AI development.

Example: National Strategy on Artificial Intelligence

- The strategy focuses on integrating ethical principles into AI development and usage.
- It encourages ethical AI development through public funding, support for AI solutions in public administration and international cooperation.

Infrastructure

The UAE is advancing its AI sector through strategic initiatives, enhancing infrastructure, promoting data access and fostering innovation, aligning with its vision to become a global AI leader.

Example: Digital Dubai's AI Lab

- Spearheads the integration of AI into government services and public life, enhancing efficiency and happiness.
- Provides critical digital infrastructure services like Dubai Pulse and DubaiNow, facilitating the development and application of AI technologies.

Talent

Through a comprehensive suite of programmes targeting students, professionals and the workforce at large, Singapore aims to accelerate the development of AI skills across various levels of expertise.

Example: AI Accelerated Masters Programme (AMP)

- This innovative programme targets Singaporean students, providing them an opportunity to start their AI-focused master's programme during their final undergraduate year.
- It aims to streamline talent development in STEM and AI, aligning education closely with industry needs and future technological challenges.

Research

Singapore is advancing its position as a global AI hub through significant investments in research and development, particularly in the creation of culturally nuanced large language models (LLMs).

Example: SEA-LION

- Singapore has allocated SGD70 million towards developing Southeast Asia's first large language model ecosystem, emphasising multimodal and localised LLMs for regional linguistic and cultural diversity.
- This endeavour aims not only to advance technological capabilities but also to cultivate a vibrant AI industry and foster skilled AI talent in the region.

Development

Singapore's dedication to AI innovation and commercial development is embodied in various initiatives that drive both public and private sectors towards creating a vibrant AI ecosystem.

Example: AI Singapore

- AI Singapore plays a pivotal role in establishing the nation as a hub for AI excellence. It explores and funds AI research, promoting the development of AI technologies to tackle national challenges.
- This initiative seeks to broaden AI's adoption across various sectors and stimulate innovation.

Commercial

The influx of capital and attention from global tech giants highlight Israel's status as a significant player in the global tech landscape driven by its innovative startups and attractive investment opportunities.

Example: Singapore–Israel Industrial R&D Programme

- A collaboration between EnterpriseSG and the Israel Innovation Authority (IIA) to support joint R&D projects between Singapore and Israeli companies across industries.
- The programme offers funding and support for projects with strong market potential.

In addition to regional peers, Türkiye can draw on best practice from Northern European frontrunners

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Indicator	Operating environment	Infrastructure	Talent	Research	Development	Commercial
Northern European frontrunners	🇩🇰	🇫🇮	🇳🇱	🇫🇮	🇮🇪	🇪🇪

Best practice						
	Denmark is a **pioneer in enforcing transparency and ethical use of AI** and has introduced principles and tools to ensure responsible AI deployment. The tools are aimed at building trust in AI technologies. **Example**: Guide for responsible use of generative AI • Formal ethics and safety guidelines for using and implementing AI publicly and privately. • *Datavejviseren:* A platform that provides access to all public data sources. • *Sprogteknologi:* Supports the development of AI solutions in Danish.	Finland is home to one of the **fastest supercomputers** in the world called LUMI. Up to 20% of the LUMI supercomputer's capacity has been 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. **Example:** Poro LLMs • A family of open LLMs built and trained on the LUMI supercomputer. • With its advanced capabilities with low-resource languages, Poro will be built to handle all 24 languages of the EU.	The Netherlands is nurturing and growing AI **talent through targeted and joint undertakings by industry and research institutions.** **Example:** Kickstart AI • Host AI superchallenges to solve societal issues and promote talent globally. • Create joint industry-academia appointments, adding 25 new positions to enhance education and training. • Promote a national AI course, aiming to reach 170,000 people.	Finland's long track record in AI research is a testament to its **world-renowned universities** offering a variety of AI courses/programmes, active industry-academic collaboration and innovative startups with roots in universities and research. **Example:** AI for Business programme (2018-2021) • Funding targeted for all-sized companies and research institutions for AI R&D projects. • Aimed to increase AI expertise and build global ecosystems and research collaborations.	Ireland attracts global tech companies for its **competitive, pro-business environment and strong industry-academic research credentials**, ensuring that innovative researchers, companies and entrepreneurs that are developing and using AI are connected to each other. **Example**: Lero, The SFI Research Centre for Software • Brings together 200 researchers in Ireland, covering a wide range of software development related to AI.	Estonia recognises itself as an **implementation leader** for startups and AI applications. The national AI strategy (2019) outlines 12 initiatives to accelerate AI uptake in companies, including different funding measures and 9 initiatives to increase R&D. **Example:** AI & Robotics Estonia (AIRE) • Supports Estonian industrial companies in adopting smart digital solutions in the field of AI and robotics.

Enhancing the competitive edge in technology and digitalisation requires a balanced set of choices

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Grow R&D by local innovators

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

Dilemma

Ensuring performance of AI technology in a Turkish context

and

Driving application of leading global AI technology

Recommendation

- Building on the existing comprehensive National Artificial Intelligence Strategy aiming to strengthen AI research and development, there could be benefits from initiatives that specifically support SMEs and local innovators. Türkiye could build on initiatives such as valuable NGOs (AI TR), ecosystem initiatives (TRAI) as well as research institutions (METU, ITU, and GAZI) to involve local SMEs, global AI leaders and academic institutions.

- In recognition of cloud infrastructure's pivotal role in the advancement of AI, Türkiye could adopt cloud first policies (i.e. Qatar's Cloud First framework) and enable incentives to foster innovation, research and development in AI.

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

- To harness the new era of AI, Türkiye could build on initiatives such as TÜBİTAK, replicating the country's gaming start-up success of multiple unicorn companies with high value impact.

- Türkiye could encourage partnerships that offer AI solutions tailored to the needs of each sector. Sector-specific support programmes could help facilitate AI adoption across traditional businesses, leveraging collaborations with tech-focused startups and established industry players, inspired by i.e. the approach of The Israel Innovation Authority (IIA).

Retrain and upskill workforce

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

General AI upskilling across population

and

Targeted reskilling of groups affected by AI

- Türkiye's AI talent pool lags behind peer countries and has been declining due to the internationalisation of AI talent. Reversing this trend and raising the AI competency level will be key.

- Türkiye could roll out comprehensive upskilling programmes, bolstering AI literacy more widely in the population- Inspiration could be taken from the Dutch Kickstart AI initiative. In addition, Türkiye could bolster programmes focusing on deepening expertise in specialised STEM areas to more strategic AI adoption and innovation. Türkiye could build on the Turkish STEM Alliance, an independent network promoting the enhancement of quality and participation in STEM education programmes.

Note: For more details on policies, see OECD AI Observatory and Google's policy paper on "AI Opportunity".

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Annex

Modelling the impacts of generative AI in Türkiye.

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Glossary of commonly used terms and list of abbreviations

IM

Gross value added (GVA): The value of output/production (excluding taxes and subsidies) minus the value of the intermediate inputs used to produce the output. It is a measure of the contribution to GDP made by an individual producer, industry or sector. The sum of GVA in all sectors plus taxes on products minus subsidies on products gives gross domestic product.	
GDP (Gross Domestic Product): Gross domestic product represents the total value of the final goods and services produced in a country during a specified time period, such as one year.	
GDP contribution from technology: The portion of GDP growth attributed to the adoption and integration of technological innovations.	
Productivity: Output (e.g. GDP) per unit of labour input (e.g. hours worked).	
Productivity boost: An increase in productivity, meaning that fewer hours of labour are needed to produce the same output or more output can be produced with the same hours of labour.	
NACE categorisation: A standard classification system for economic activities in Europe.	
Gross greenhouse gas emissions: The total emissions of greenhouse gases.	
AI adoption trajectory: The path and rate at which AI technologies are integrated into businesses and society.	
S-curve adoption trajectory: A pattern of technology adoption characterised by a slow start, rapid growth and then a plateau.	

AI	Artificial intelligence
CEDEFOP	Centre Européen pour le Développement de la Formation Professionnelle (European Centre for the Development of Vocational Training)
EEA	European Environment Agency
EL	Greece
ES	Spain
EU	European Union
GHG	Greenhouse gas emissions
IMF	International Monetary Fund
IT	Italy
MENA	Middle East and North Africa
MT	Malta
OECD	Organisation for Economic Co-operation and Development
R&D	Research and development
SGD	Singapore dollar
SMEs	Small and medium-sized enterprises
STEM	Science, technology, engineering and mathematics
TR	Türkiye
TRY	Turkish lira
UAE	United Arab Emirates
USD	U.S. dollar

Modelling the economic opportunity for Türkiye

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".

Disclaimer

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