

# The economic opportunity of AI in Denmark

Capturing the next wave of benefits from *generative AI*

An Implement Consulting Group study commissioned by Google

April 2024

# The economic potential of AI can be boosted further by generative AI

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

## 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 Denmark's GDP by

DKK 200-250 billion

→

+8% GDP

annual contribution in the peak year if Denmark 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.

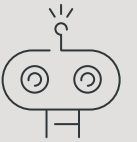


Re-prioritised and re-employed time for other value-creating activities.

## The job implications

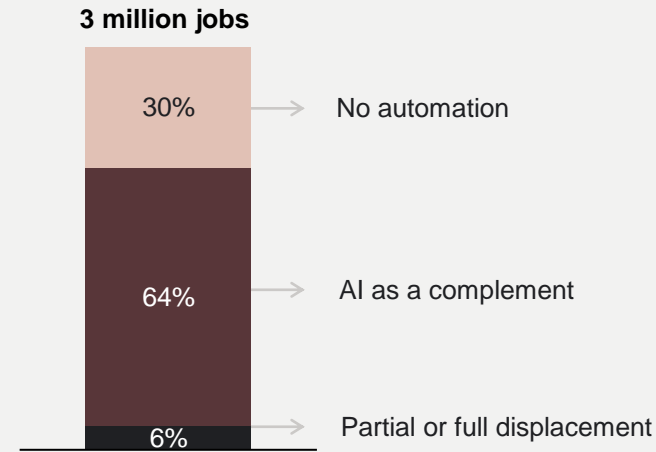
**64%** of jobs in Denmark are estimated to work **together with** generative AI.

**39%** of Danish workers think that generative AI will **positively impact** their job opportunities.



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

% of total employment in Denmark



**Denmark is well placed to manage the job changes 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 represent only 5-10% of the historical level of job changes in Denmark.

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

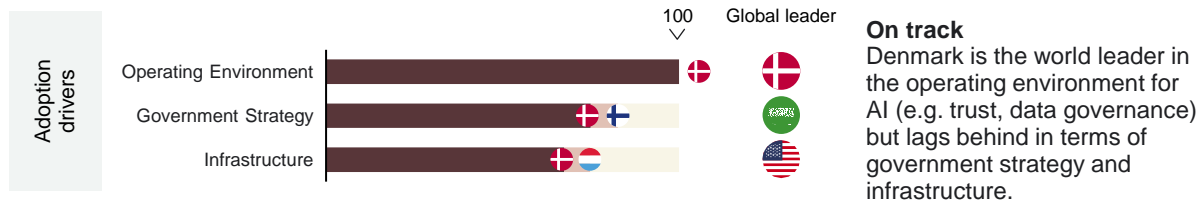
# Denmark is well-positioned to capture the benefits of AI – but can promote innovation and research even more

## AI readiness in Denmark

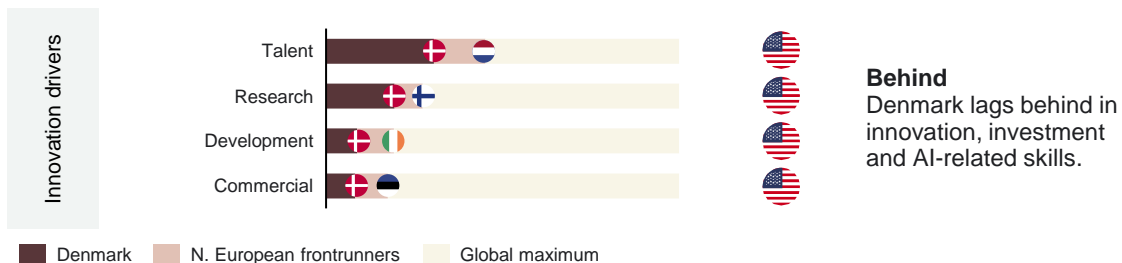
**Denmark performs well on the basics like other small, digitally advanced European economies ...**

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

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



**... but lags behind on innovation drivers compared to global leaders**



## Conclusions and policy implications

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

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

**A five-year delay in adoption will reduce the annual GDP potential of generative AI in Denmark from 8% to 2% of GDP, i.e. from DKK 200-250 billion to DKK 40-60 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**

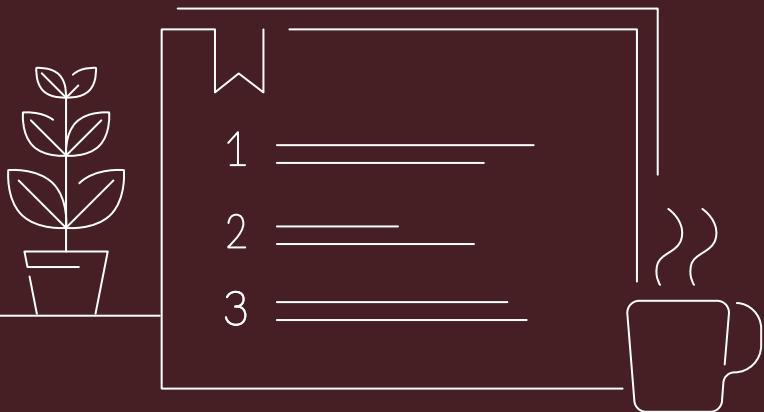
# Foreword

## **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.



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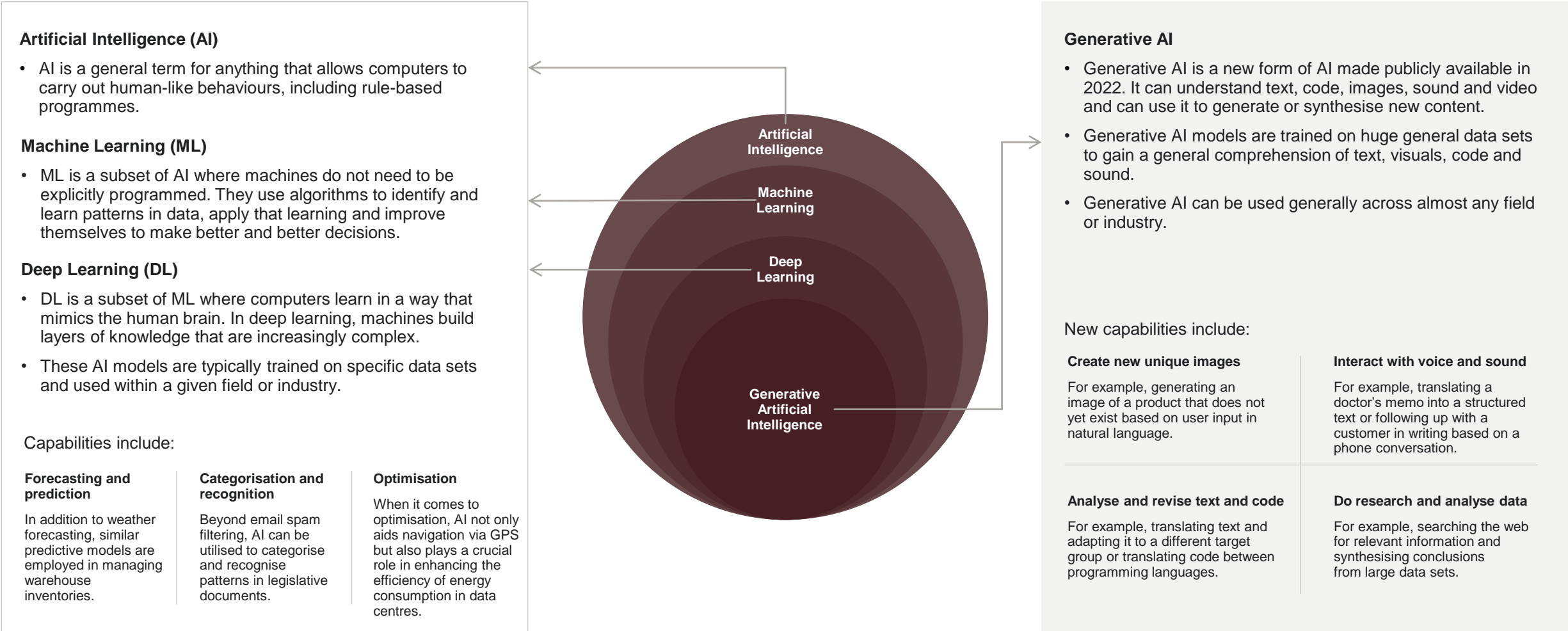
# 01

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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 and have accelerated uptake

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

... and many users have already adopted the technology

01

## 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.



02

## 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.



03

## 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.



34%

of the Danish population has used generative AI at least once in 2023.



15%

of Danish companies 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 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. Poro</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.



02

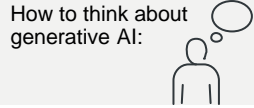
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# Economic opportunities from AI

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



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



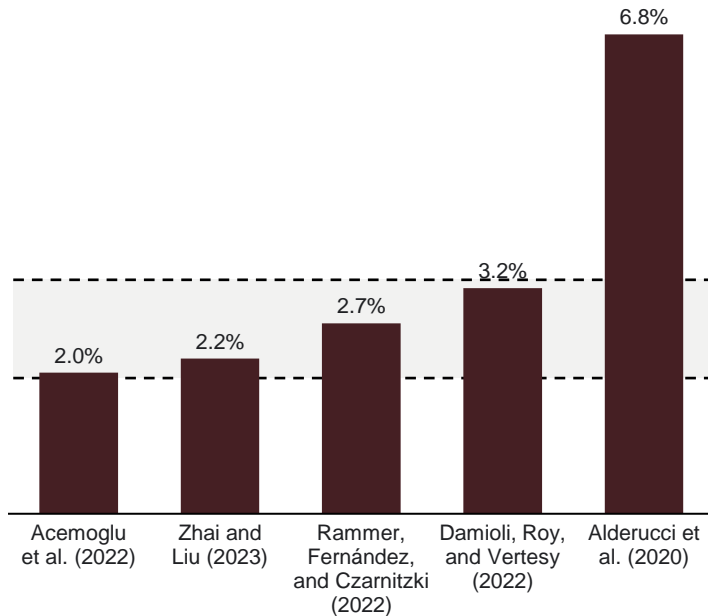
*“What would you do if you had 1,000 well-trained interns ready to work for you day and night?”*

## 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

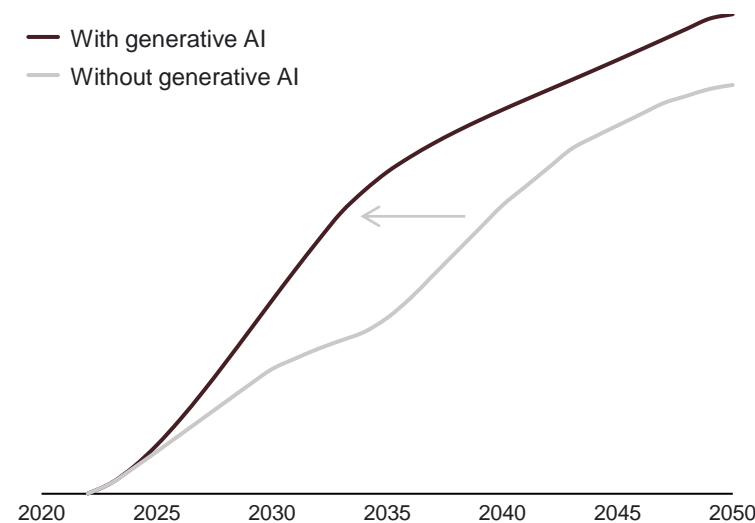


## Generative AI advances automation

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



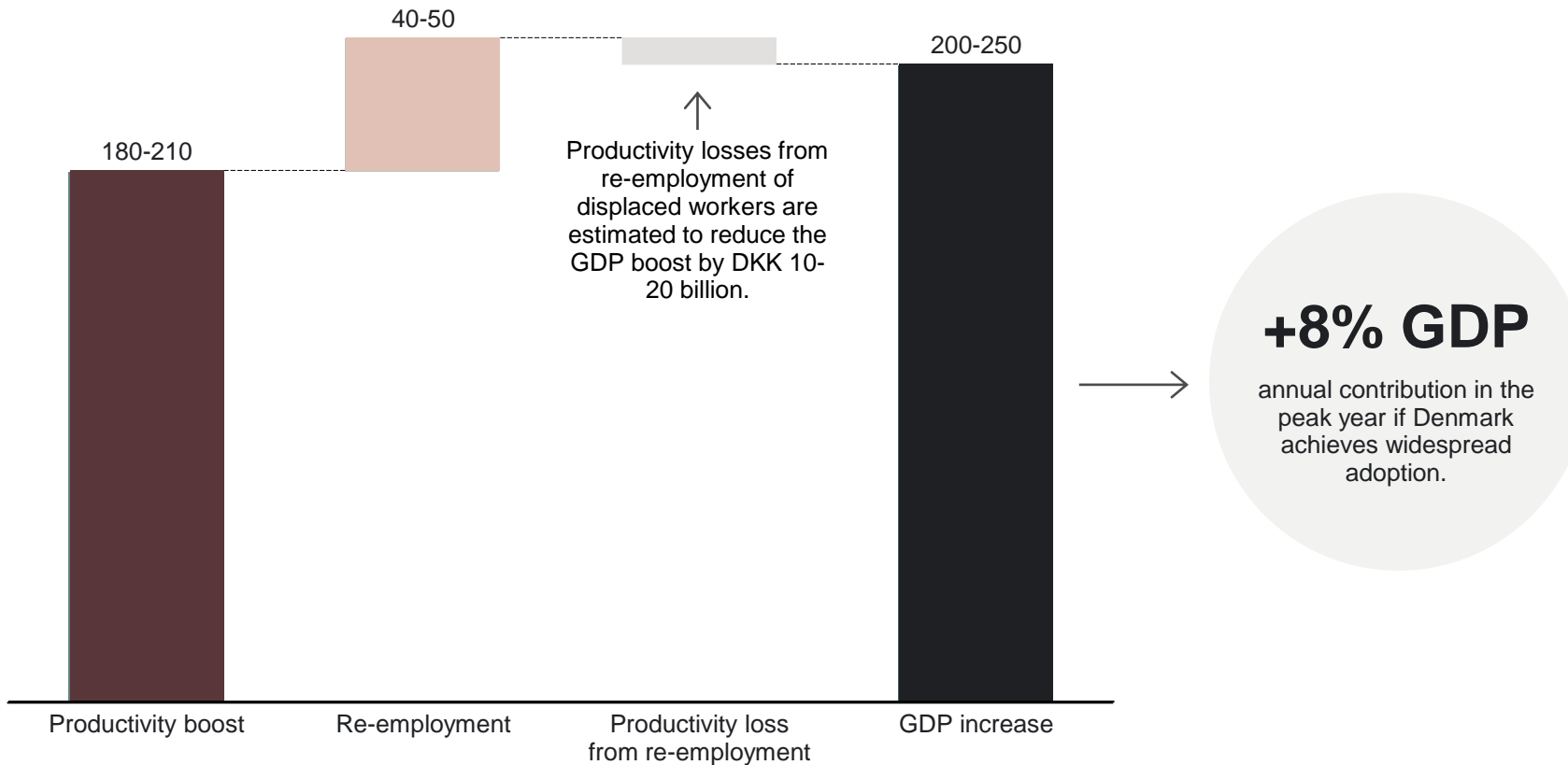
- AI has evolved rapidly with the recent breakthrough of generative AI. Due to its user-friendly nature, generative AI is expected to greatly accelerate the potential of AI to create economic impacts.
- Generative AI is only a part of AI's overall economic potential. Some studies estimate with some uncertainty 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 Denmark's GDP by 8% in ten years

## GDP potential of generative AI in Denmark

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



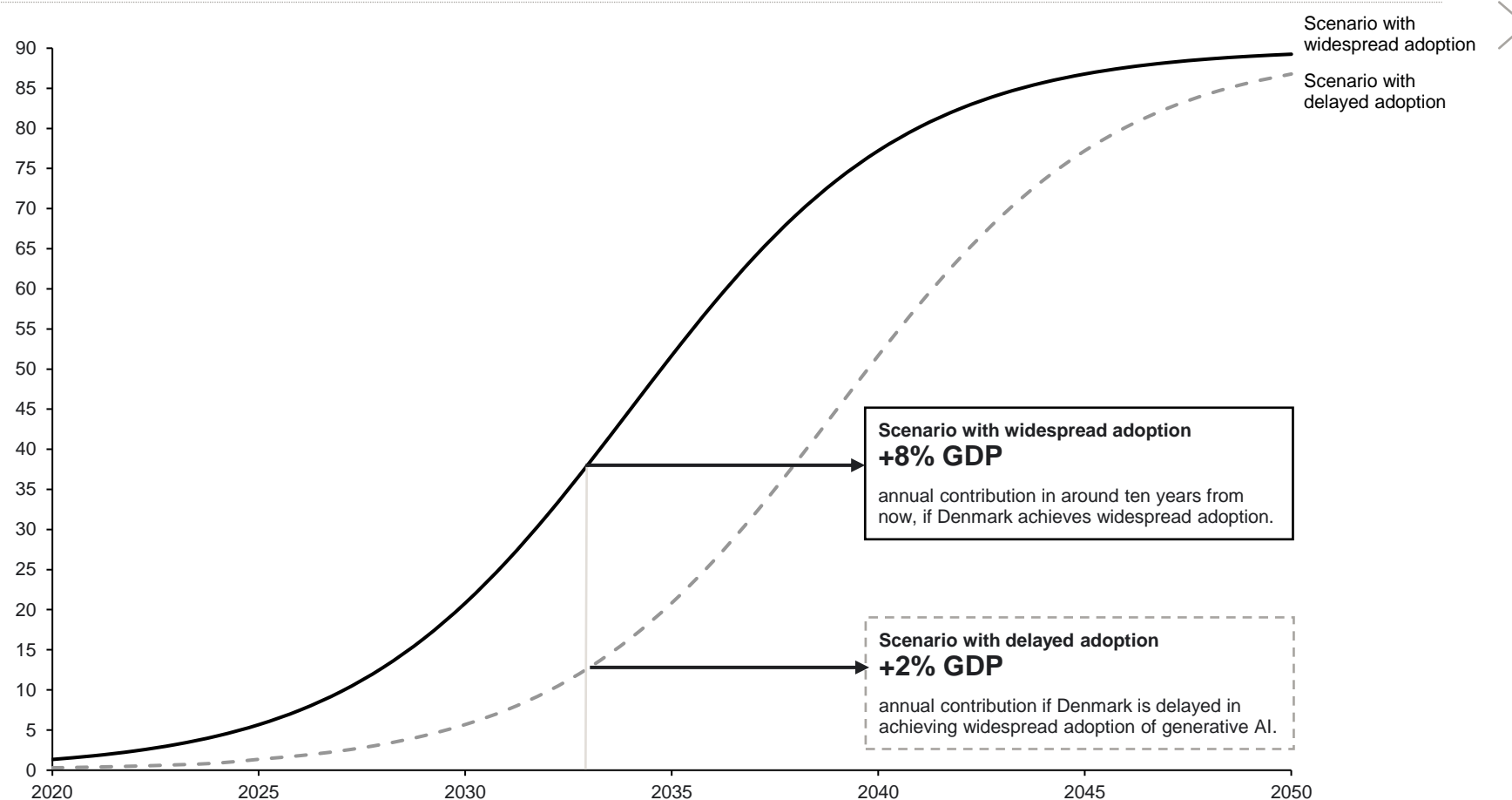
- If Denmark achieves widespread adoption of generative AI, we estimate an annual GDP potential of DKK 200-250 billion in the peak year, which could be as early as ten years from now.
- The dominant impact of generative AI is a productivity boost to the majority of workers (64%) by augmenting their capabilities, quality and efficiency, which is estimated at DKK 180-210 billion for Denmark.
- 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 DKK 40-50 billion in Denmark.
- The estimate accounts for the possible productivity loss associated with re-employment to other occupations. This reduces the estimate for Denmark by DKK 10-20 billion.
- At its peak, the productivity effect of generative AI in Denmark is estimated to be equivalent to 1.5% annually.
- Generative AI is so powerful that Denmark's future economic growth could exceed current long-term GDP forecasts, and leading banks are raising growth forecasts as early as 2028.

Note: The estimate assumes widespread adoption of generative AI over a ten-year period. There is much uncertainty around the capability and adoption timeline of generative AI. The size of the productivity boost depends on the difficulty level of tasks that generative AI will be able to complete and the number of jobs it can automate. GDP is in 2022 levels. The average number of work activities that potentially can be performed by generative AI across all types of tasks for both complemented and highly exposed workers corresponds to 20-25%. Our estimate is the isolated potential of generative AI 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.  
Source: Implement Economics based on Eurostat and 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 Denmark's potential GDP gains from 8% to 2%

## Adoption of generative AI

%

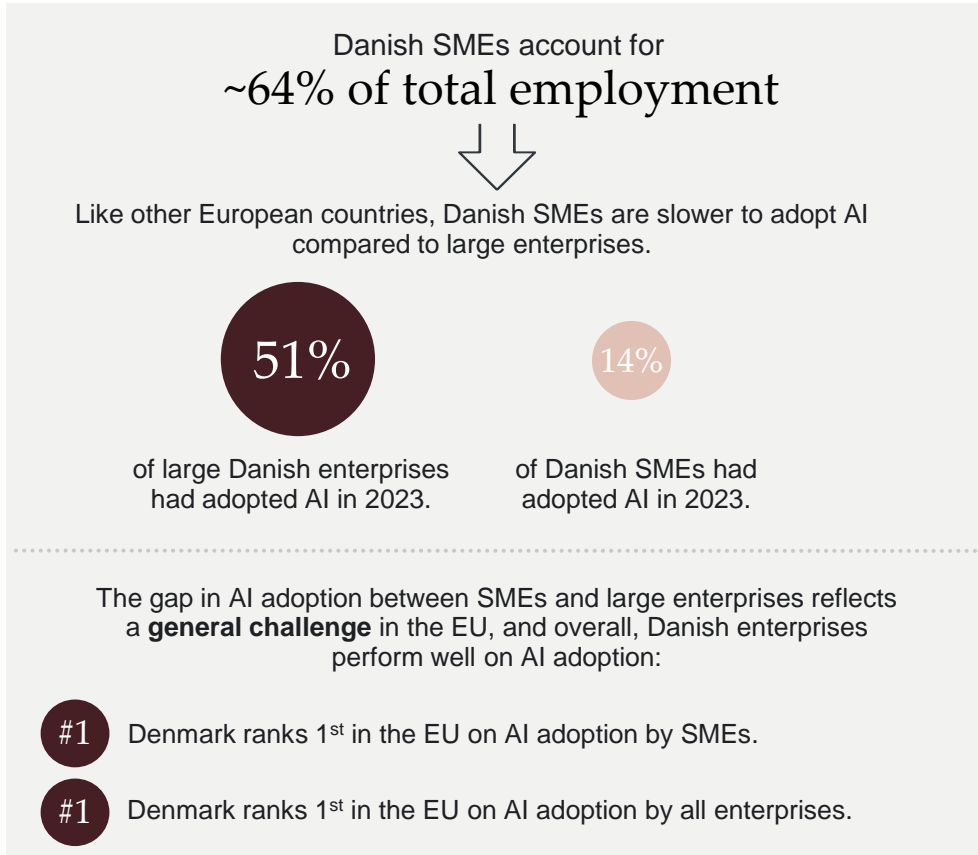


- Generative AI is a new general-purpose technology and will take time to adopt.
- Our estimate of Denmark's GDP potential from generative AI is reliant on the widespread adoption and development of the new AI technology within the next ten years.
- A five-year delay in capturing the benefits of generative AI is estimated to reduce the annual potential at peak from 8% (DKK 200-250 billion) to only 2% (DKK 40-60 billion) of GDP.
- Denmark can enhance 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 in DKK billion are expressed in 2022 levels. The figure shows generative AI adoption expressed as a share of economywide firms 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.





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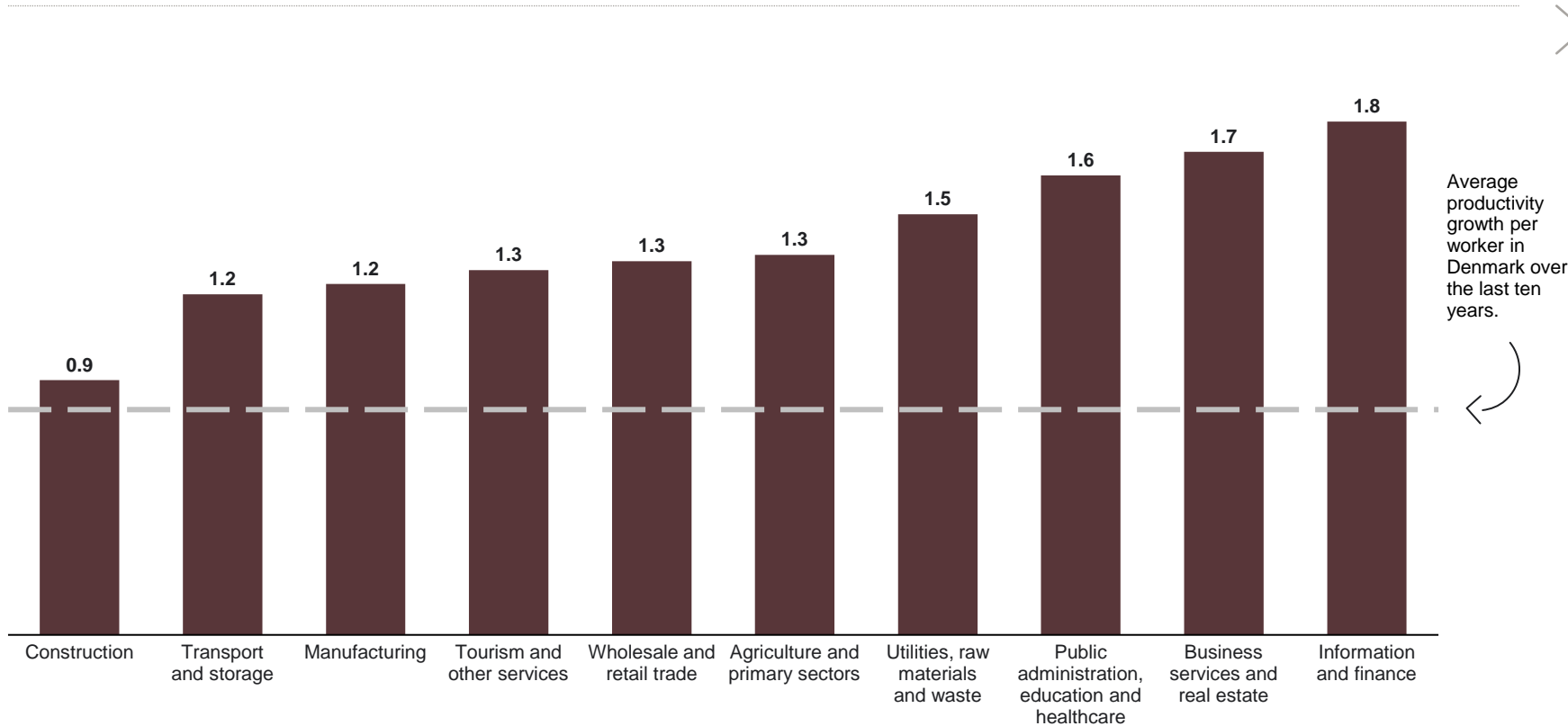
# Key sectors benefitting from AI

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 – exceeding historical levels

## Productivity boost from generative AI

% productivity growth p.a. at peak



- 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. Lawyers can be assisted in reviewing and summarising long documents and in drafting basic documents. Some journalists even use AI to suggest headlines or summarise information as exemplified by [Wired Magazine](#).
- 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 map 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. Data on companies is from Statistics Denmark.  
Source: Implement Economics based on Eurostat, O\*Net, Briggs and Kodhani (2023a) and Statistics Denmark.

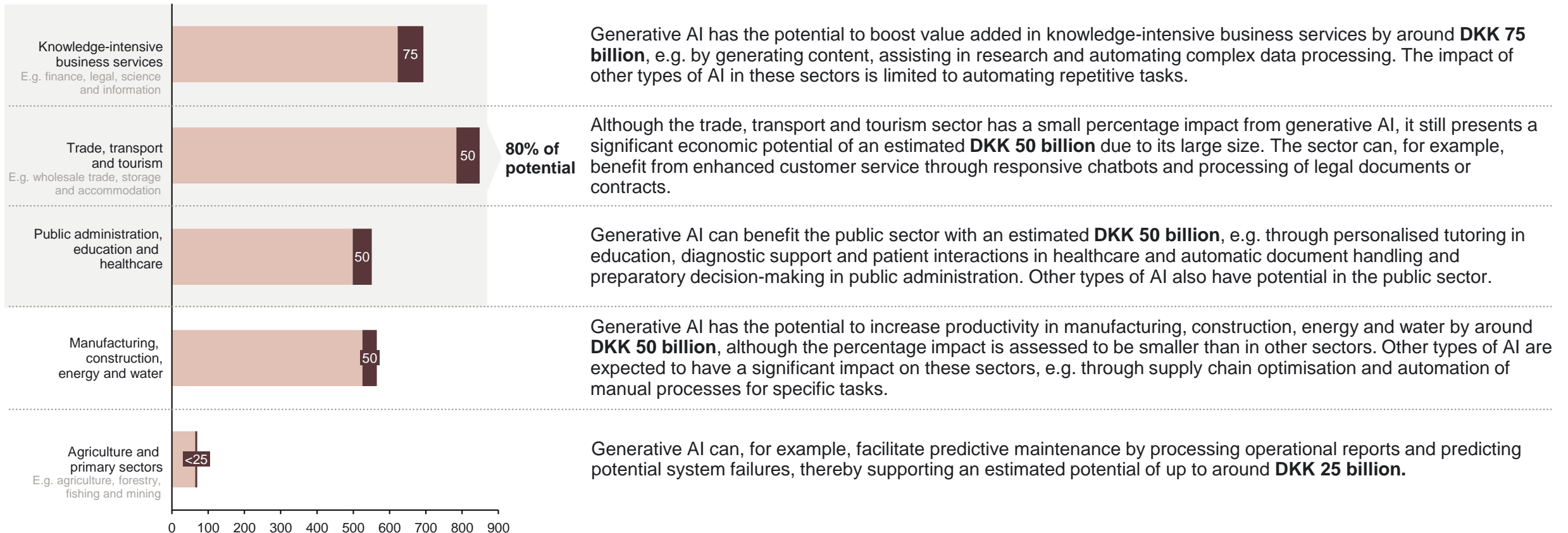


# 80% of generative AI's economic potential lies in service sectors, while manufacturing and other sectors can also benefit from other types of AI

## Gross value added by sector

DKK billion

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



Generative AI has the potential to boost value added in knowledge-intensive business services by around **DKK 75 billion**, e.g. by generating content, assisting in research and automating complex data processing. The impact of other types of AI in these sectors is limited to automating repetitive tasks.

Although the trade, transport and tourism sector has a small percentage impact from generative AI, it still presents a significant economic potential of an estimated **DKK 50 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 **DKK 50 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, construction, energy and water by around **DKK 50 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, facilitate predictive maintenance by processing operational reports and predicting potential system failures, thereby supporting an estimated potential of up to around **DKK 25 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, Briggs and Kodnani (2023a) and Statistics Denmark.

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# Job implications of AI

Generative AI will introduce job changes in Denmark – 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 Denmark



Note: Based on 2022 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 Eurostat, O\*Net and Briggs and Kodnani (2023a).

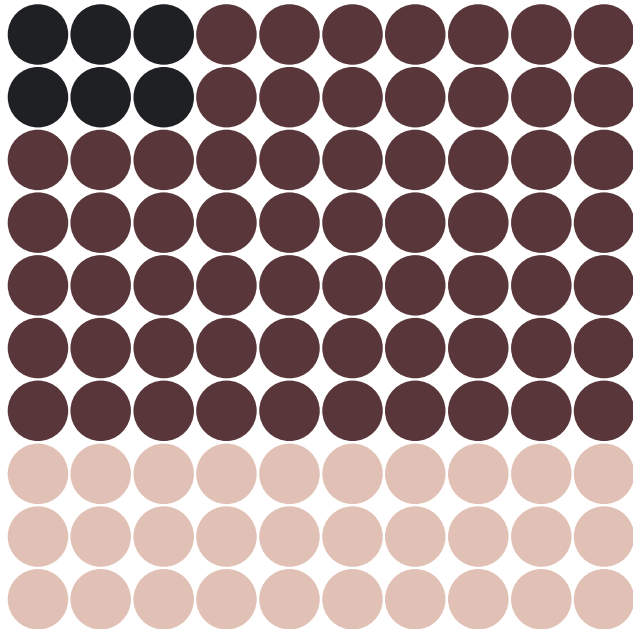
# The AI-powered economy is expected to create new jobs and ensure full re-employment of potentially displaced workers

## Share of jobs exposed to automation by generative AI

% of total employment in Denmark

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

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



**At the same time, 64% 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.

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- II New tasks and jobs created  
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.

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- 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 10,000-20,000 people in highly exposed jobs are estimated to need re-employment per year, which is low compared to historical averages (see page 22).**



- The job development in Denmark 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.

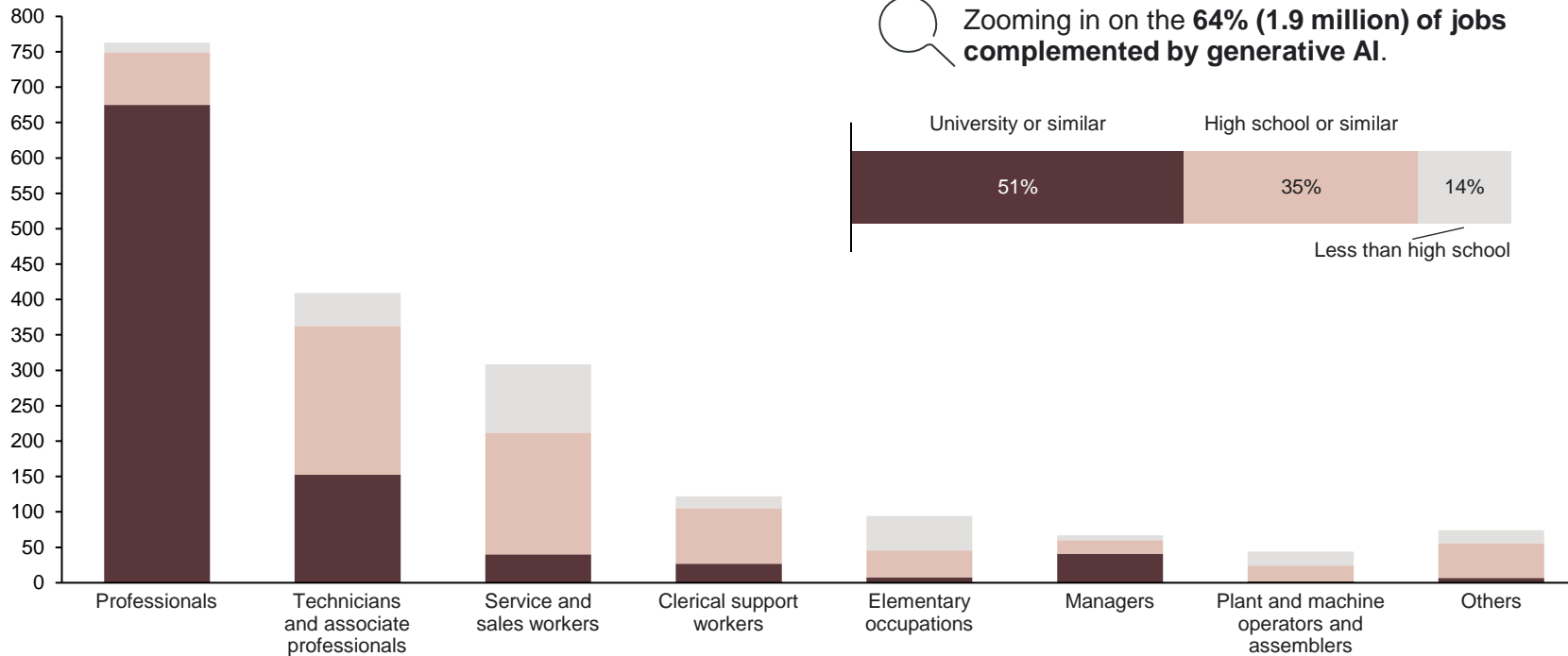
Note: The assumption that labour supply predetermines employment is widely applied by economists, see for example *Principles Of Economics* by N. Gregory Mankiw (2020).  
Source: Implement Economics based on based on Eurostat, Statistics Denmark, O\*Net and Briggs and Kodnani (2023a).

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

## Jobs complemented by generative AI

Thousand jobs

Less than high school High school or similar University or similar



Examples of jobs include:	Professionals	Technicians and associate professionals	Service and sales workers	Clerical support workers	Elementary occupations	Managers	Plant and machine operators and assemblers	Others
	Research, analysis and advising services (including legal)	Engineering technicians, robot controllers and air traffic safety technicians	Caterers, travel agents and personal care workers	Secretaries, record keepers and information suppliers	Transport and storage workers, food preparation assistants	Executives, senior officials and general managers	Train drivers and machinery operators	Police services and farmers

- Generative AI is estimated to augment the capabilities of around 1.9 million jobs in Denmark at full adoption and around half of these over a ten-year period.
- Of the complemented workers, 51% 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.

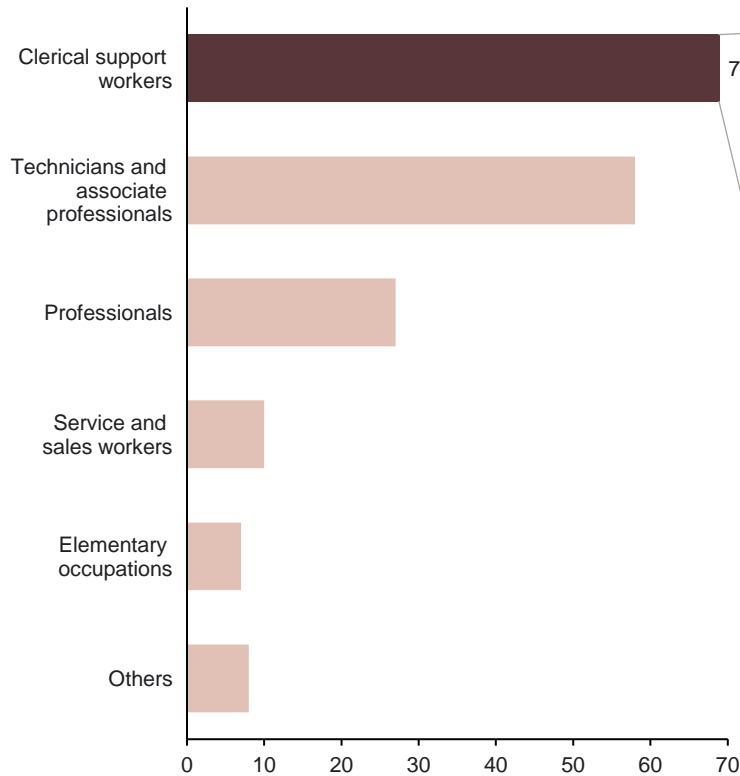
Note: Based on 2022 employment data. Source: Implement Economics based on Eurostat, O\*Net and Briggs and Kodnani (2023a).



# Around 0.2 million Danish 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



Highly exposed jobs in total ~ 180,000

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

Of the 70,000 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 tasks and jobs created**, arising from the introduction of generative AI.

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 proportions of employment within occupations and in new occupations are uncertain.



- Around 0.2 million jobs in Denmark 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.
- 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.
- The AI-powered economy will gradually lead to new jobs through three channels 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.

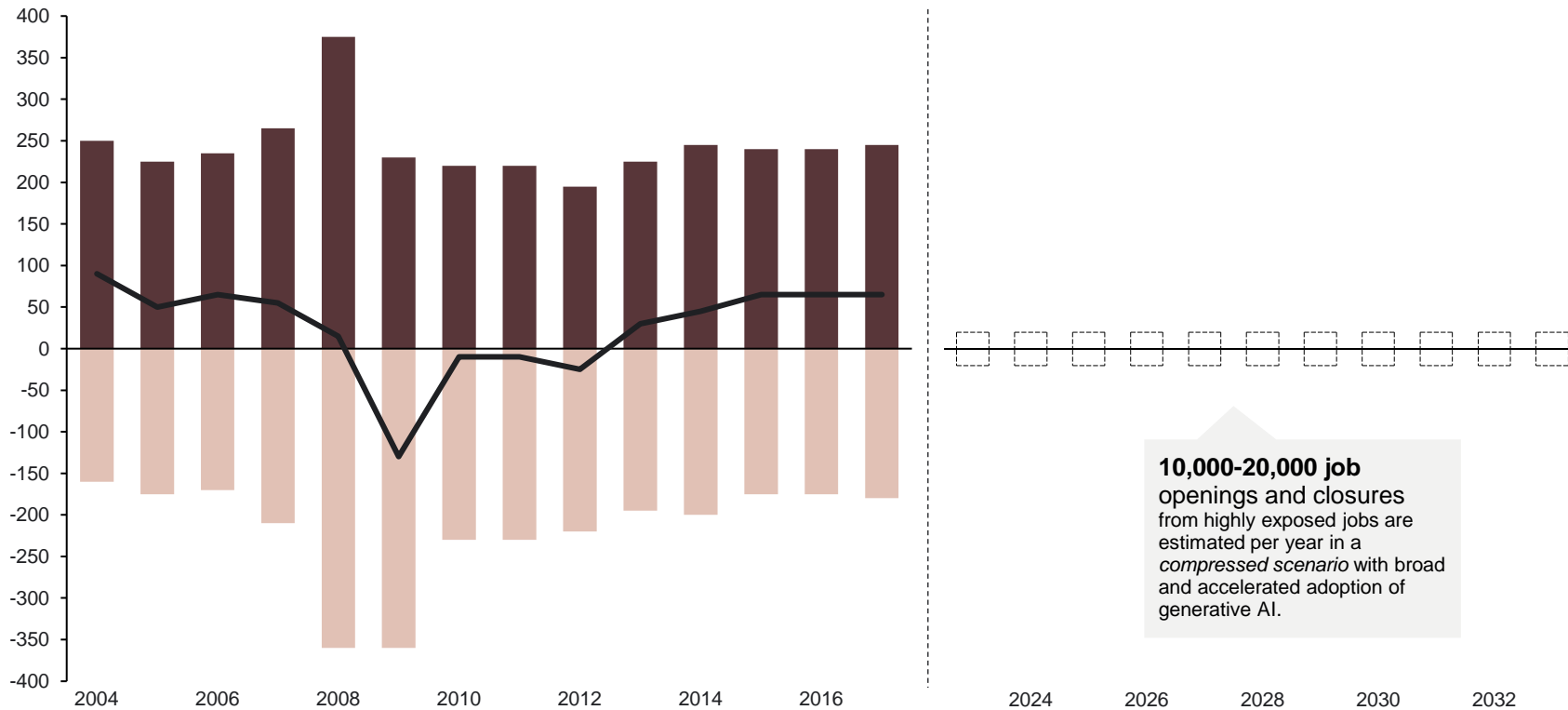
Note: Based on 2022 employment data. High exposure to AI does not automatically imply full displacement of all workers in that occupation. In the GDP estimates, we conservatively assume low automation potential to avoid overestimating GDP impacts. In the job exposure and potential displacement assessment, 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 Kodrani (2023a).

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

## Job openings and closures in Denmark

Thousand jobs

Job closures Job openings Net job openings



- Denmark has a dynamic labour market, and close to 1 million Danes changed jobs in 2022. That is almost one in three people in employment – and the highest share since 2009. If maintained, this implies that the average employee will change jobs three times over a ten-year period.
- Denmark has also increased overall employment. Since 2013, the Danish economy has created around 400,000 additional jobs. This is a result of a much larger number of job openings and closures during the period.
- Historically, there are around 200,000 new job openings every year due to economic growth, technological advancements and structural changes.
- We estimate that the jobs that are highly exposed to generative AI could lead to around 10,000-20,000 annual job openings and closures over the next ten years. This is 5-10% of the historical average number of job openings in Denmark.
- 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.

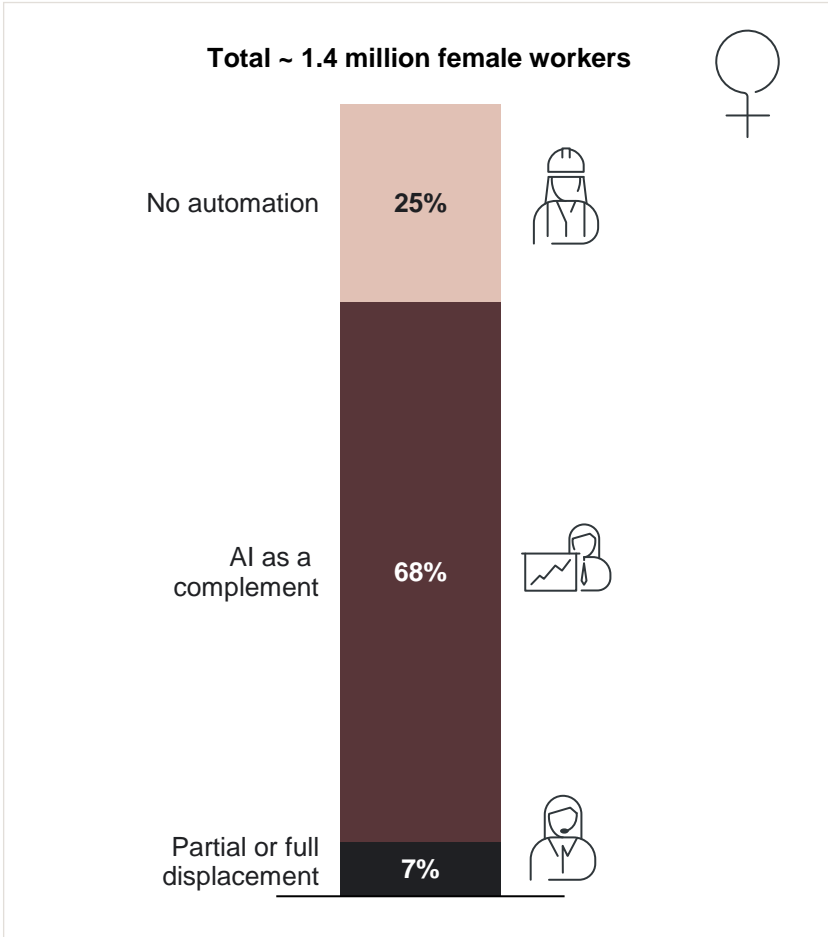
Note: Our GDP estimate makes conservative assumptions about the scope of tasks for generative AI and the speed of adoption as in the base scenario in Briggs-Kodnani (2023a). To avoid underestimating the possible job impacts of generative AI, these estimates are in a compressed scenario with broader and 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, Arbejderbevægelsens Erhvervsråd, Statistics Denmark and Danish Agency for Labour Market and Recruitment (STAR).



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

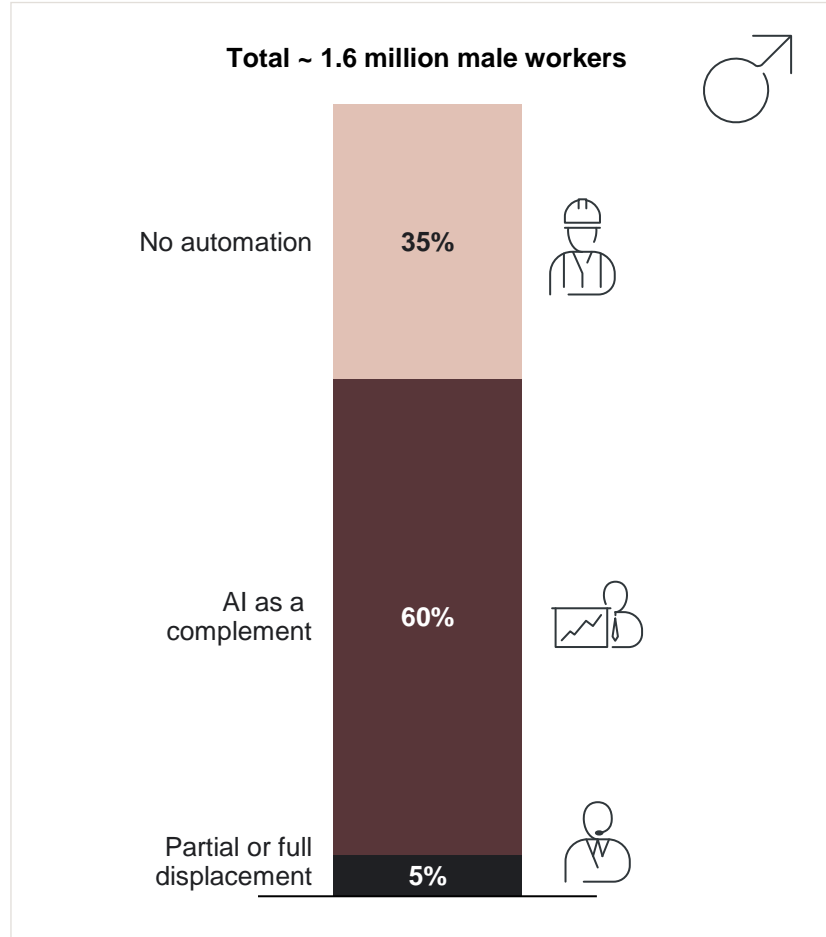
## Share of female jobs exposed to automation by generative AI

% of total employment among female workers



## Share of male jobs exposed to automation by generative AI

% of total employment among male workers



### No automation

- 25% of female workers and 35% of male Danish workers are in jobs with limited exposure to generative AI. These are, for example, manual, outdoor and human-to-human jobs.

### Complemented jobs

- 68% of female workers are expected to see generative AI complement their current job, whereas the share is only 60% 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 the human capabilities and make workers more productive.

### Potentially displaced jobs

- 7% of female workers and 5% of male workers in Denmark 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.

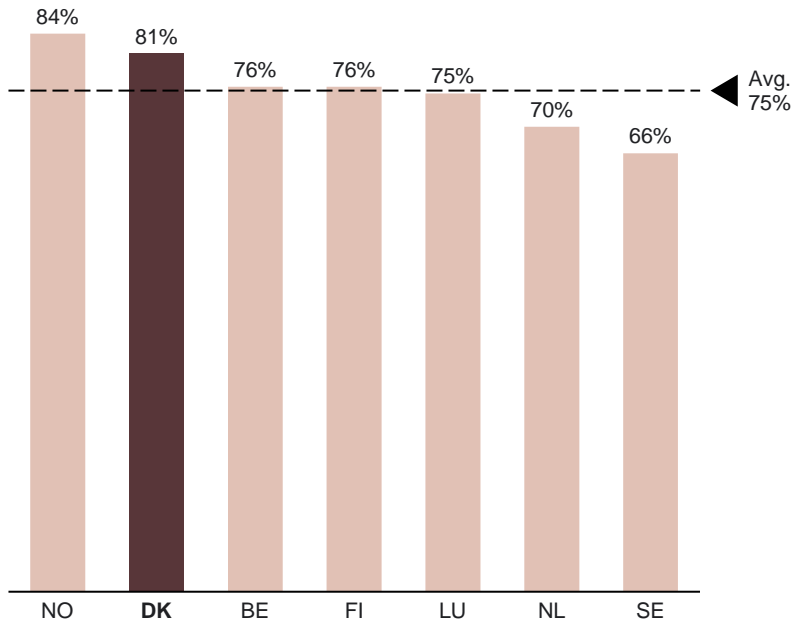
Note: Based on 2022 employment data. In accordance with Briggs and Kodnani (2023a), "No automation" are occupations with less than 10% exposure, "AI as a complement" are occupations with 10-49% exposure, "Partial or full displacement" are occupations with exposure of or above 50%. Note that percentages and absolute numbers are rounded. Source: Implement Economics based on Eurostat, O\*Net and Briggs and Kodnani (2023a).

# Eight out of ten workers in Denmark see productivity-enhancing effects of generative AI, and almost 40% expect AI to positively impact their job opportunities

Workers think that generative AI makes them more productive

**Generative AI will help improve my productivity at work**

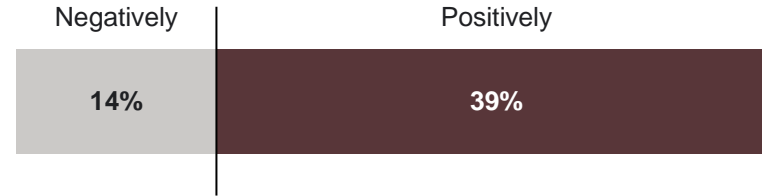
Workers who agree, %



Workers and students think that AI will positively impact their job opportunities

**How will AI impact your future job prospects?**

Students and workers, %





- Polling by Public First shows that 81% of Danish workers think that generative AI makes them more productive. Danish workers are generally quite positive about the productivity impacts of generative AI compared to other European countries.
- A recent survey by Megafon shows that most Danes have a positive attitude towards AI. 39% believe that AI will have a positive impact on their job opportunities, and only 14% stated that AI will have a negative impact on their job opportunities. 37% said it will have neither a positive nor negative impact on job opportunities.

Note: Public First survey conducted in summer 2023. Nationally representative consumer and business polling. Respondents of the survey include Denmark (DK), Sweden (SE), the Netherlands (NL), Belgium (BE), Luxembourg (LU), Finland (FI) and Norway (NO). The average across countries is computed as an arithmetic mean. The Megafon survey was published in December 2023 and includes people employed or enrolled in education. Source: Implement Economics based on Public First country surveys and Megafon survey.

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

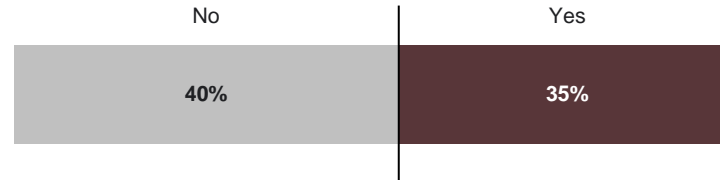
Multiple skills are needed to leverage generative AI ...

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

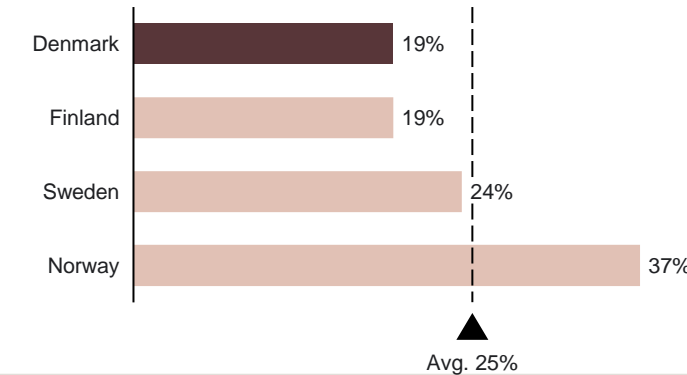
Skills ...	Type of skills	Examples
... for developing and maintaining AI systems. 	Specialised AI skills	Machine learning capabilities and knowledge
	Data science skills	Data analysis and visualisation, cloud computing and programming
	Other cognitive skills	Create problem-solving
	Transversal skills	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

... and recent surveys indicate a need for upskilling of workers in the Nordic countries

**Are there specific digital competencies that you are currently lacking among the employees in your organisation?**  
% of managers in the Nordic countries



**I have self-trained or received AI-related training from my employer**  
% of employees



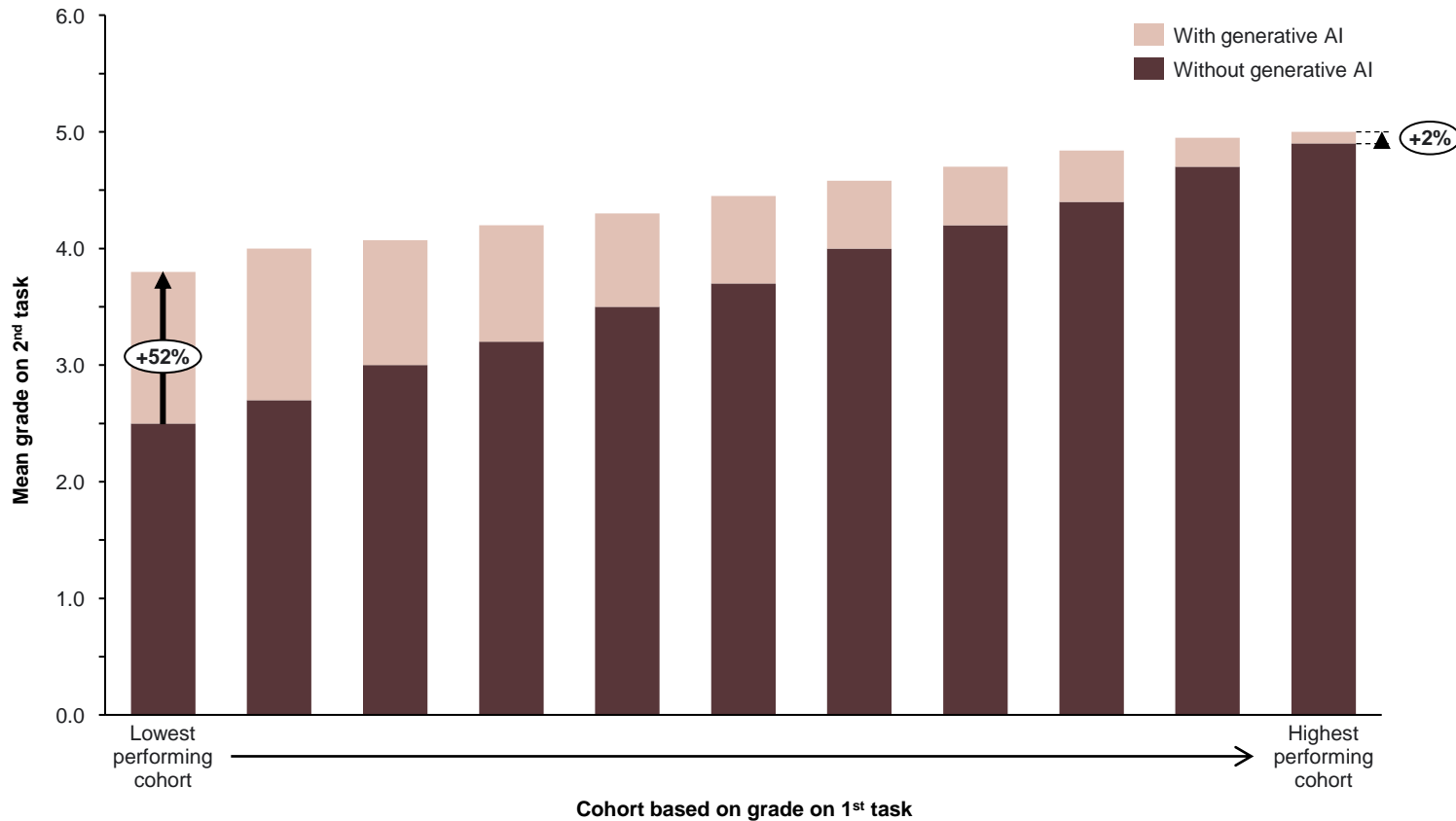
- Generative AI adoption and usage requires limited digital skills relative to earlier advancements in information and communication technology (ICT) due to its ease of use via normal language prompts.
- However, fully leveraging generative AI requires skills beyond basic digital skills, i.e. creative, managerial and analytical skills.
- A recent survey by [Tænketanken Mandag Morgen](#) assessing AI readiness in Nordic organisations reveals that 35% of managers believe that there are specific digital competencies that employees in their organisations are lacking.
- Another survey by YouGov showed that only 19% of Danish employees have self-trained or received AI-related training from their employer, which is low compared to other Nordic countries.
- 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, Norway and Finland.  
 Source: Implement Economics based on OECD, Tænketanken Mandag Morgen, YouGov, 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).

# 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 achieving Denmark's emission reduction goals



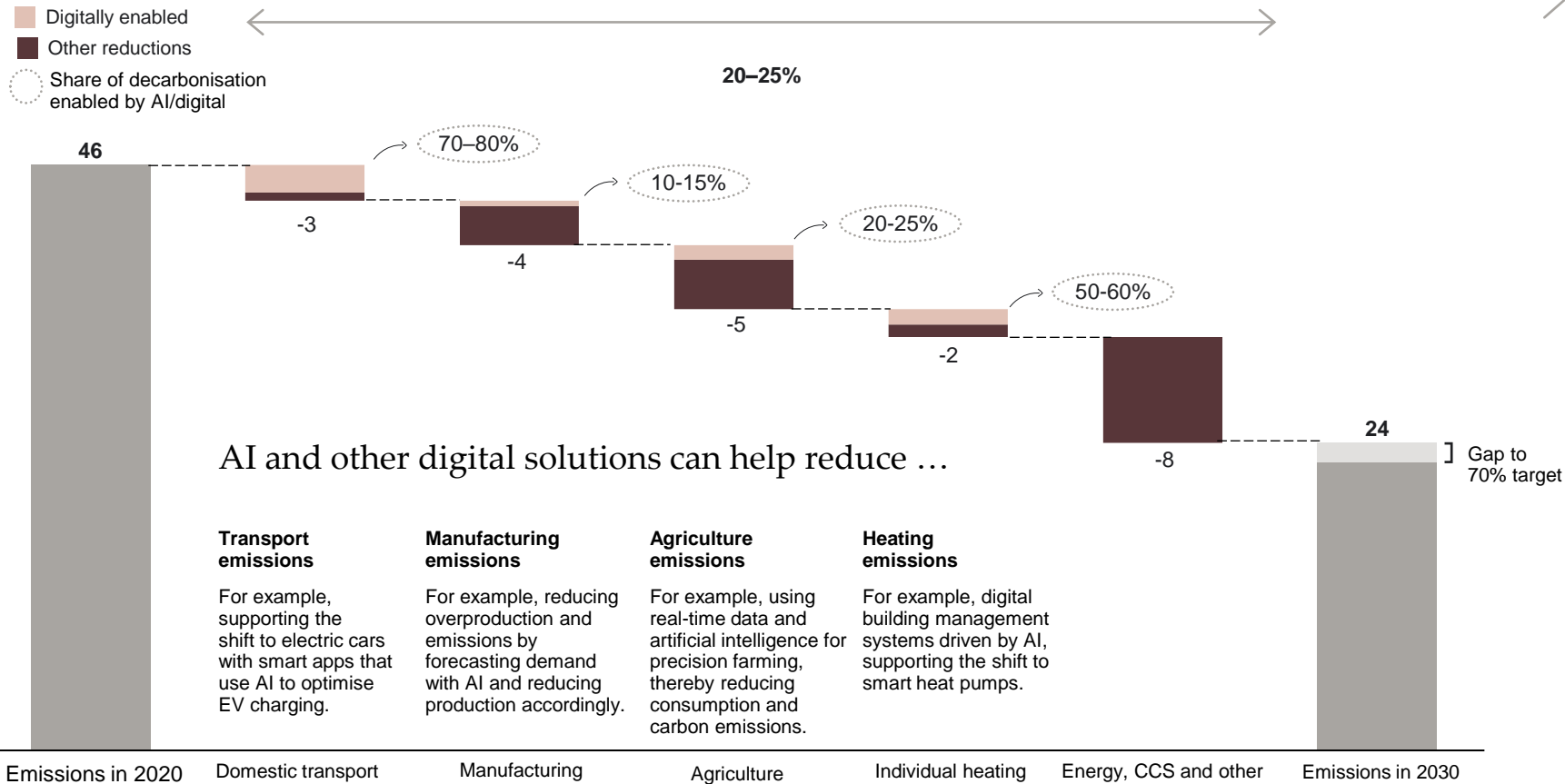
Public First poll

47% of Danes support AI tools being used to help them make more environmentally sustainable choices in their lives.

59% of Danes support AI tools being used to reduce carbon emissions by managing energy use.

## Denmark's net greenhouse gas emissions

MtCO<sub>2</sub>e



- Artificial intelligence and other digital solutions are expected to play a key enabling role in 20-25% of the necessary CO<sub>2</sub>e reductions needed for Denmark to reach its climate goals by 2030.
- The biggest gains come from facilitating the electrification of vehicles, where AI and other digital solutions are crucial to optimising the charging of EVs, providing a cleaner and cheaper solution for consumers.
- In manufacturing, AI and other digital solutions can help optimise energy efficiencies and 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.
- In heating, AI and other digital technologies can unlock energy efficiencies by making buildings smarter and improving their performance.

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>).  
 Source: Implement Economics based on Klimarådet, Public First polling, Malmödin and Bergmark (2015), the Danish Government, and Implement Consulting Group.

# AI can free up resources in the Danish health sector and improve patient treatment

Denmark faces growing challenges in terms of its ability to deliver quality care and meet evolving population needs.

In its 2030 plan, the government has allocated **DKK 21 billion** to boost the welfare system in line with demographic development and an added **DKK 5 billion** for additional investments in healthcare.



## More hands are needed

- Denmark's labour force growth is slowing. The healthcare sector is estimated to **lack 40,000 professionals by 2030** if tasks are to be completed as they are today.
- A scarcity of healthcare professionals leads to lower quality services, incl. longer waiting times, and overworked professionals.



## 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.



Healthcare has been named as one of the “**signature projects**” under the [Danish National AI Strategy](#) from 2019, as AI is believed to have great potential to achieve key health sector objectives in Denmark.

Denmark has one of the world's best health data infrastructures, which provides a strong foundation for leveraging the potential of AI in the Danish healthcare sector.



## AI can help free up resources and alleviate bottlenecks

- Automation of tasks in healthcare administration, e.g. appointment scheduling.
- Faster screening and decision-making by physicians – an estimated **30% of physicians' tasks** related to screening of medical images can be relieved by AI.
- Recording and synthesis of appointment notes, referral information and care plans.
- Enabling physicians to undertake remote consultations.



## AI can improve how we treat patients

- Analysis and enhancement of medical images, earlier and more accurate detection of diseases and injuries.
- Improved detection of complex and rare diseases with training data sets and smarter diagnostic tools.
- Prediction of individual treatment response by analysing different patient data.
- Development of targeted therapies.
- Remote monitoring through wearable devices and sensors, faster identification of health issues and accidents.

Public  
First poll



**48%** of Danes support AI tools being used to track their medical data.





# 06

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## AI readiness in Denmark

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

# In assessing Denmark's AI readiness, we compare with other small, digital frontrunner countries in Northern Europe

- In assessing Denmark's AI readiness, we can compare Denmark to a comparable group of small, digitally advanced and open European economies.
- 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).
- As a small country, Denmark cannot compete on scale on, for example, the absolute amount of AI-related R&D investment. Denmark will be dependent on EU-wide initiatives. Therefore, Denmark should work for initiatives at EU level, especially in the areas of R&D investment, regulation and digital infrastructure.



## The digital frontrunners of Northern Europe



**Finland**  
#1 in DESI in 2022



**Denmark**  
#2 in DESI in 2022



**The Netherlands**  
#3 in DESI in 2022



**Sweden**  
#4 in DESI in 2022



**Norway**  
#5\* in DESI in 2022



**Ireland**  
#5 in DESI in 2022



**Luxembourg**  
#8 in DESI in 2022



**Estonia**  
#9 in DESI in 2022



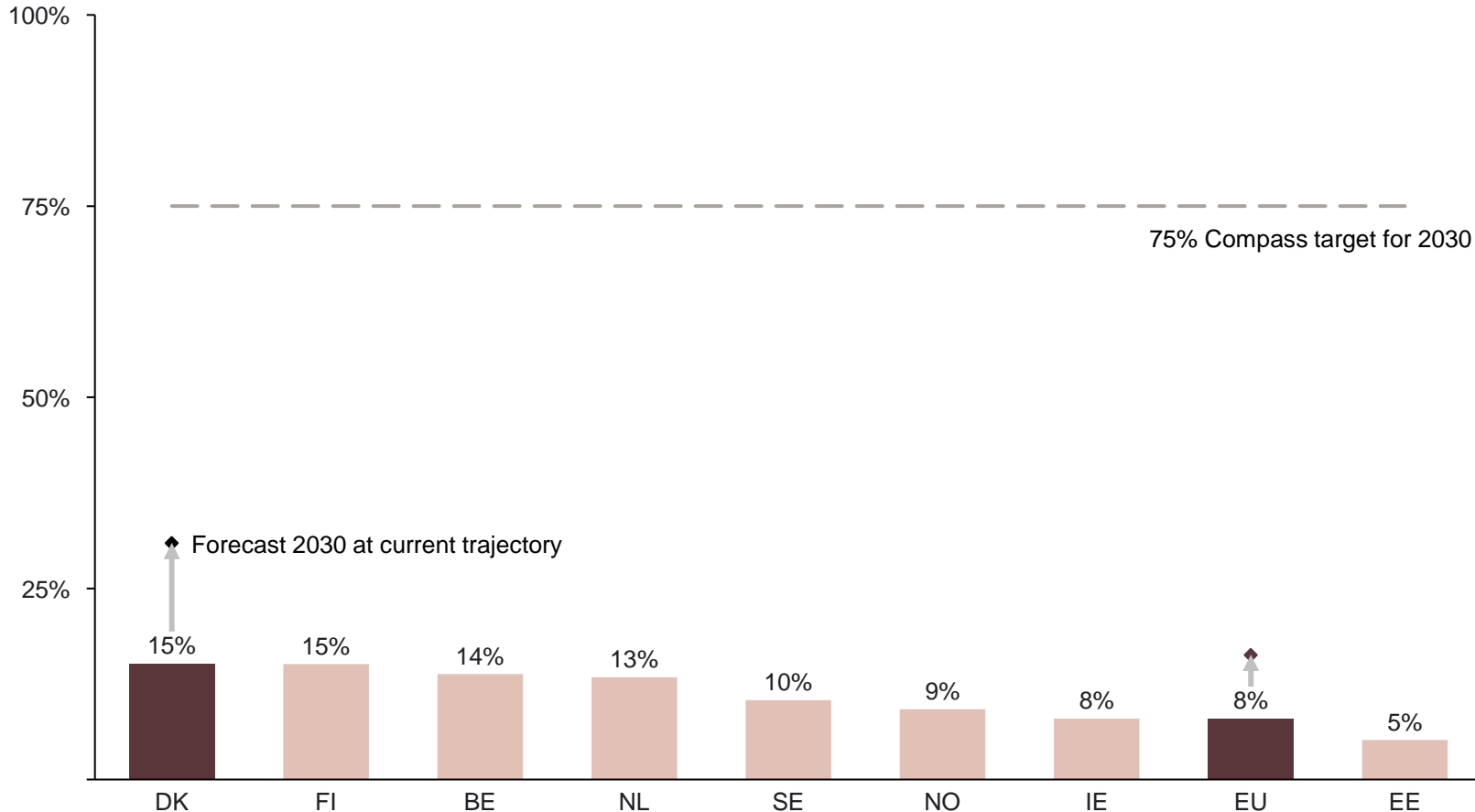
**Belgium**  
#16 in DESI in 2022



# Denmark leads the EU on AI adoption

## Adoption of AI 2023

% of enterprises using at least one type of AI technology



- Denmark leads the EU in AI adoption by companies. 15% of Danish 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 Denmark 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.

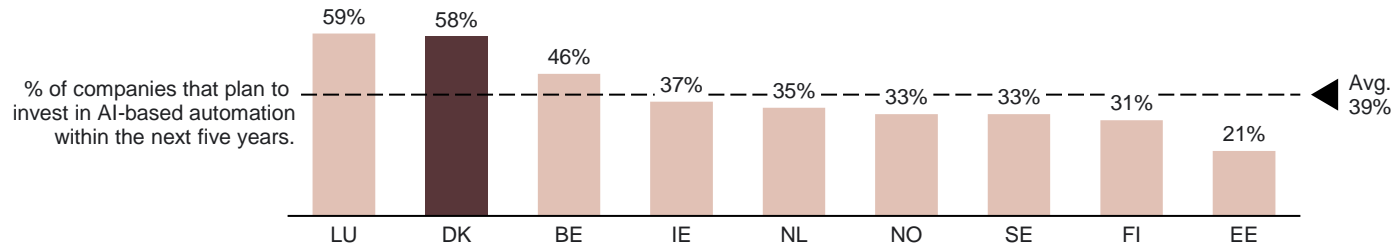
Note: Current adoption is from 2023 and includes enterprises with ten or more employees, excluding financial services. The AI adoption metric for Denmark is not comparable over time because the phrasing of AI-related questions in the questionnaire changed between 2021, 2022 and 2023. Forecast for 2030 is based on European Commission-forecasted AI adoption.  
Source: Implement Economics based on Eurostat and the European Commission.

# New survey data points to accelerated adoption but not enough to reach full potential

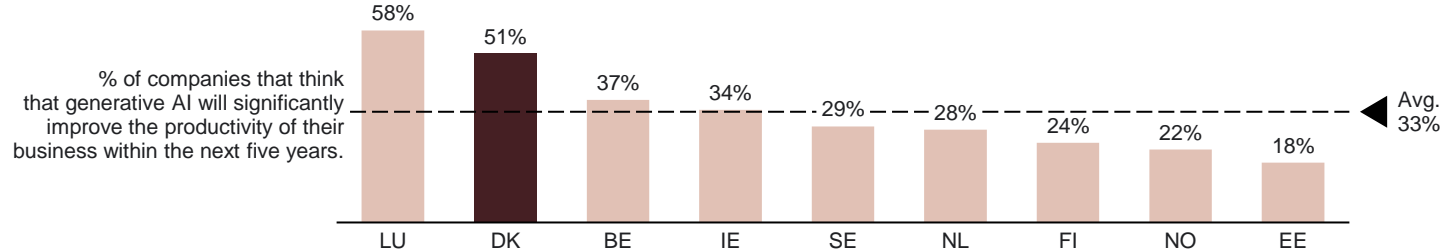
## Survey responses from companies on their five-year outlook on generative AI

% weighted average of enterprises, 2023

**Planned firm-level adoption of AI automation**



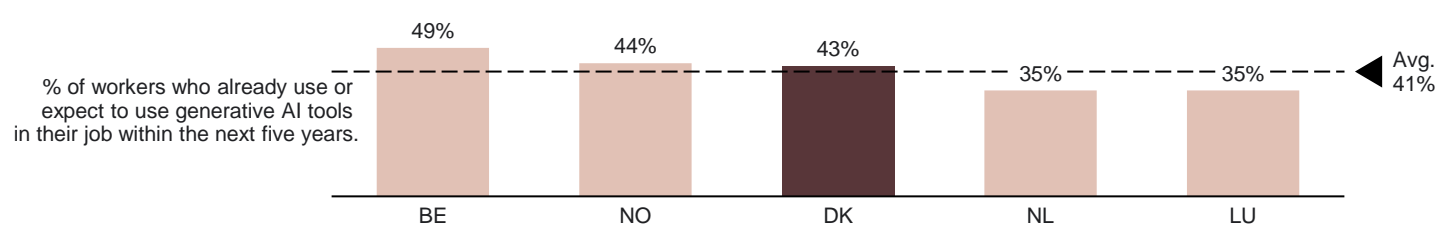
**Expected productivity boost from generative AI**



## Survey responses from workers on their five-year outlook on generative AI

% weighted average of employees, 2023

**Expected use of generative AI at work**



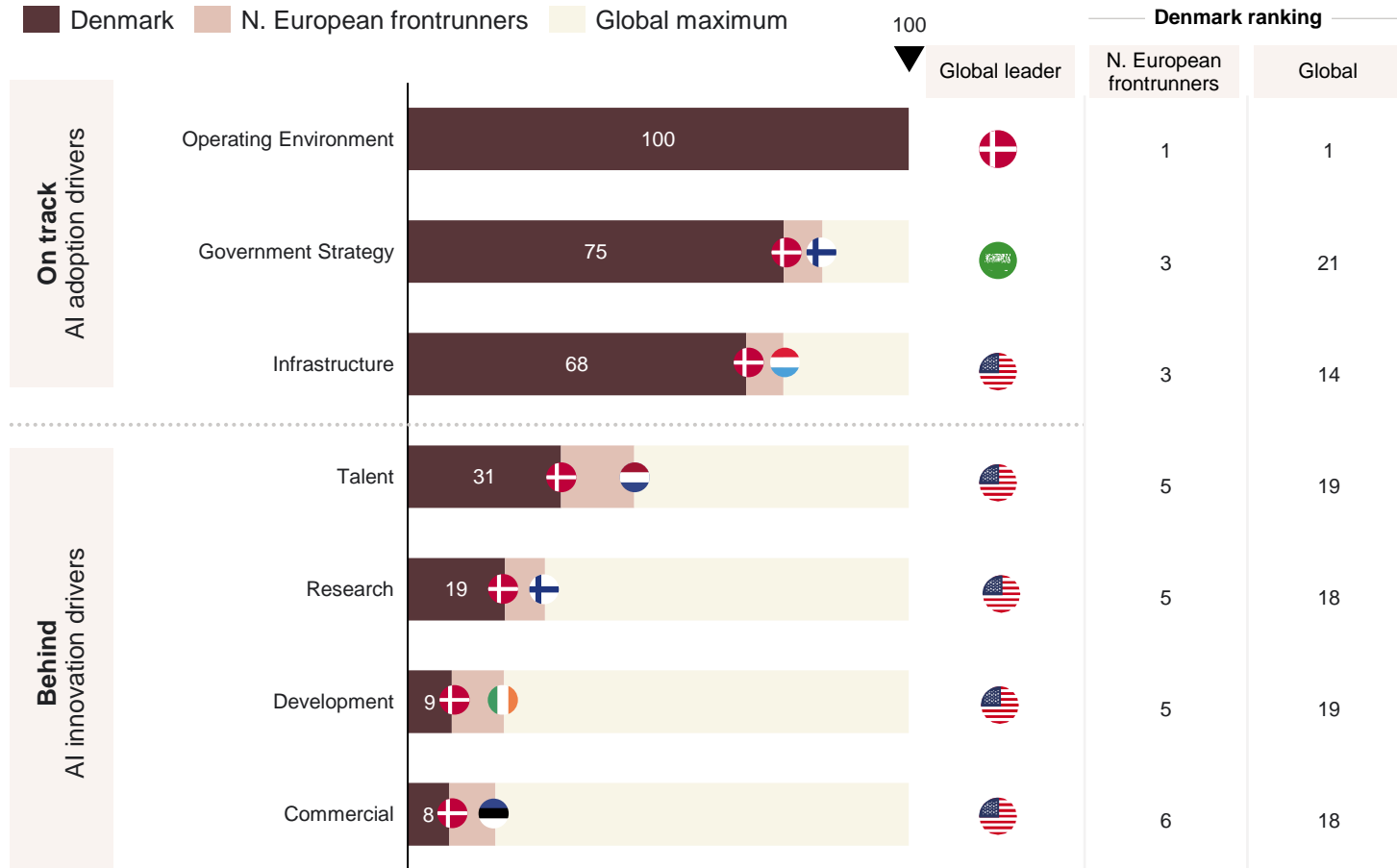
- 58% of companies in Denmark claim that they plan to invest in AI-based automation in the next five years. This is higher than the Northern European frontrunner average of 39%.
- 51% of Danish companies anticipate significant productivity impacts from generative AI on their business in the next five years, which again is above the Northern European frontrunner average of 33%.
- 43% of all surveyed Danish workers already use or expect to use generative AI tools in their jobs within the next five years. This is slightly higher than the Northern European frontrunner average of 41%. Another survey by [Algoritmer, Data & Demokrati](#) found that 34% of the Danish population has already used generative AI at least once in 2023.
- While this suggests a faster pace of adoption, AI adoption is still in an early phase, and more complementary innovations, investments and AI-related skills 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. Respondents of the survey include Denmark (DK), Sweden (SE), the Netherlands (NL), Belgium (BE), Luxembourg (LU), Finland (FI), Norway (NO), Estonia (EE) and Ireland (IE). Worker responses are not available for Finland, Sweden, Ireland and Estonia. Averages across countries are computed as arithmetic means.  
 Source: Implement Economics based on Public First country surveys and Algoritmer, Data & Demokrati.

# Drivers of AI adoption suggest that Denmark is likely to step into a superuser role rather than emerge as a lead innovator

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

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



*DK is well placed for generalised AI use and early phases of adoption.*

*DK is challenged in terms of being an innovator of more specialised AI applications.*

- Denmark is best positioned on the early foundational drivers of AI adoption that ensure a safe and reliable AI-ready environment: operating environment (e.g. trust, data governance), government strategy and infrastructure.
- However, 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.
- Similar to the other Northern European frontrunners, Denmark lags behind on innovation drivers (talent, research, development and commercialisation). Here, the United States is far ahead globally, mainly due to scale in AI capacity.
- Current gaps suggest that Denmark is at risk of losing its frontrunner position and needs to focus on strengthening its strategic efforts in AI and the AI-related 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

Denmark 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

Benefits from 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 <b>innovation</b> and invest in AI research and development	Create a conducive and aligned AI regulation	Promote widespread adoption and universal accessibility	Build <b>human capital</b> and an AI-empowered workforce	Invest in AI <b>infrastructure</b> 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 at national and EU level.</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, e.g. by leveraging the new <a href="#">EU AI innovation package</a>.</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 <i>improve the marginal productivity of workers</i> rather than replace them.</li> <li>In those selected types of jobs where AI risks displacing workers, efforts should be devoted to re-skilling 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>Enable trusted cross-border data flows in trade agreements and ensure regulatory interoperability and non-discrimination in the EU.</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](#), [EU's ethic guidelines for trustworthy AI](#), [EU's AI innovation package](#), [Google's AI principles](#) and paper on "[An Opportunity Agenda for AI](#)". For more details on carbon free energy and digital decarbonisation, see [European perspective](#) and [global perspective](#).

# Denmark can draw on policy choices of other frontrunners

## Denmark leads on transparency and ethical use ...

Indicator	 <p><b>Operating environment</b></p>
Northern European leaders	
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>

## ... and can draw on best practice initiatives from other Northern European frontrunners

Infrastructure		Talent		Research		Development		Commercial	
									
<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 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.</p> <p><b>Example:</b> <a href="#">Poro 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 capabilities with low-resource languages, Poro will be built to handle all 24 languages of 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>Ireland attracts global tech companies for its <b>competitive, pro-business environment and strong industry-academic research credentials</b>, ensuring that innovative researchers, companies and entrepreneurs that are 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>	<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>					

# Denmark 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 Danish context

and

Driving the application of leading global AI technology



- **Large language models** are trained on large amounts of data in different languages. While our estimates do not presume large Danish language models, Denmark could aim to **make Danish language data easily available** for those who want to fine-tune models for a Danish context.
- Drawing from **Finland's** success in AI development, Denmark may also focus on establishing industry-academic collaborations to foster innovation. Partnerships could, for example, be focused on leveraging the upcoming [Gefion supercomputer for AI development](#).



## 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



- Denmark has **the EU's highest adoption** of AI by companies. On average, only 15% of Danish companies have adopted AI, but more than half of large companies have adopted at least one AI application (>250 employees).
- Denmark could look to **the Netherlands'** recent **actions on generative AI** which seek to establish a public national AI test facility, launch InnovatieLabs as public-private partnerships and accelerate responsible generative AI applications in specific government services.



## 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



- Anticipated **workforce displacement** resulting from the adoption of generative AI is expected to be small compared to normal levels of job changes, thus not calling for any specific policy action.
- Denmark could focus on advancing general AI education for its citizens in line with the **Netherlands'** approach. An initiative could be to launch a nationwide AI course aimed at equipping the population broadly with skills relevant to the changing job market.

Dilemma

Recommendation

# 08

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## Annex

Modelling the impacts of generative AI in Denmark.

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# Modelling the economic opportunity for Denmark

## 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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