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The economic opportunity of AI in the Netherlands

Capturing the next wave of benefits from *generative* AI

An Implement Consulting Group study commissioned by Google

March 2024

SUMMARY

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

The Netherlands needs a strong focus on innovation and an international outlook to propel its competitive edge into the generative AI era.

The economic opportunity

Generative AI alone could boost the Netherlands' GDP by

€80-85 billion

→

+9% GDP

over ten years if the Netherlands 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 to other value-creating activities.

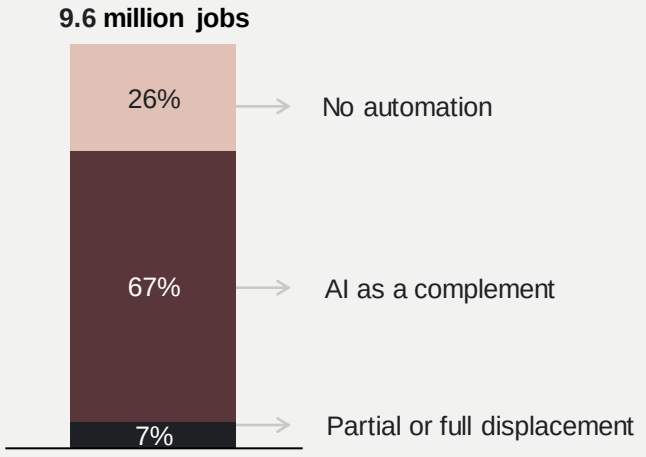
The job implications

67% of jobs in the Netherlands are estimated to work **together with** generative AI.

38% of Dutch workers believe that generative AI will positively impact their job.

Share of jobs exposed to automation by generative AI

% of total employment in the Netherlands



The Netherlands is well placed to manage the job changes from generative AI.

New jobs in the AI-powered economy are expected to replace those lost to automation, resulting in unchanged employment levels. The highly exposed jobs represent only 5-10% of the historical level of job changes in the Netherlands.

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

SUMMARY

The Netherlands has historically been good at commercialising new technologies and needs a strong focus on innovation and talent to capture the AI opportunity

AI readiness of the Netherlands

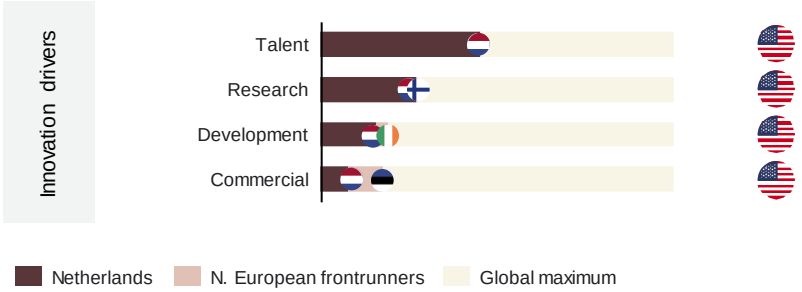
The Netherlands is doing well on the basics, like other small, digitally advanced European economies …

The Netherlands' AI capacity according to the Tortoise Global AI Index

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

On track
The Netherlands scores high on operating environment for AI (e.g. trust, data governance), government strategy and infrastructure.

… but lags behind on innovation drivers compared to global leaders



Lags behind
The Netherlands leads Northern European frontrunners on AI talent, but it lags behind in R&D and AI-related commercial ventures on a global level. The government's vision for generative AI from 2024 addresses these issues.

Conclusions and policy implications

The Netherlands' future economic growth could exceed current long-term GDP forecasts. Leading banks are lifting growth forecasts from as early as 2028.

The 9% boost to GDP over ten years assumes that the Netherlands captures the full value of AI without delay.

A five-year delay in the adoption and development of generative AI could reduce potential GDP gains in the Netherlands from 9% to 2%, reducing the potential over ten years from €80-85 billion to €15-20 billion for the Netherlands.

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

Accelerate commercial uptake

Grow R&D by local innovators

Retrain and upskill workforce

Note: The Tortoise Global AI Index is underpinned by 111 indicators collected from 28 different public and private data sources and 62 governments. Northern European frontrunners refers to nine European countries comparable to the Netherlands in terms of size and level of digitalisation.

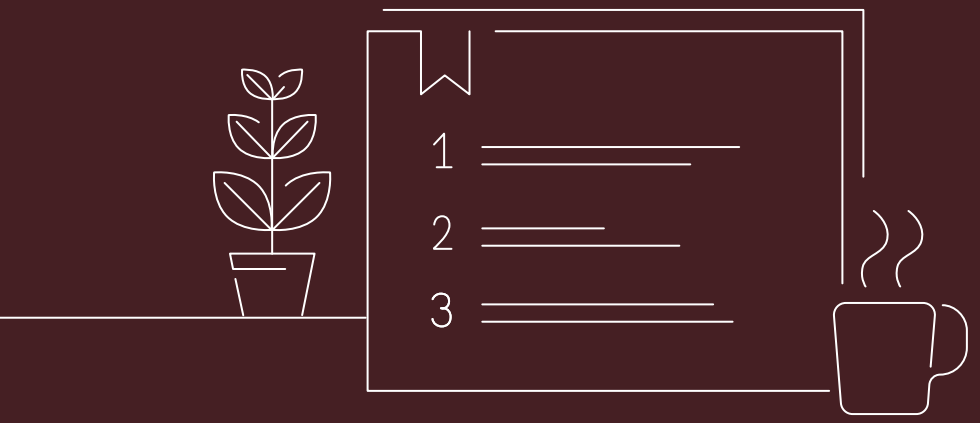
Foreword

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

AI and the next wave of generative AI has 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

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

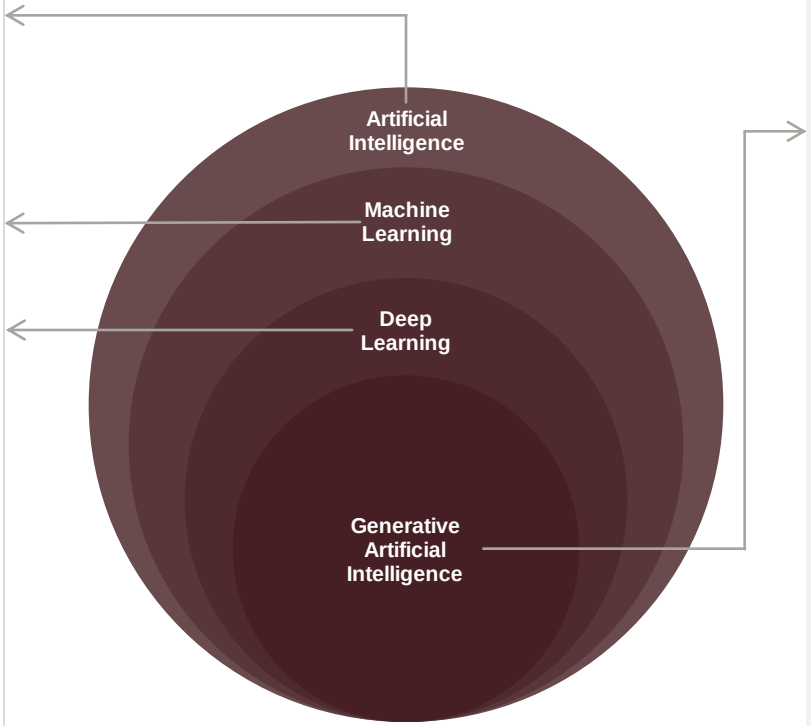
In addition to weather forecasting, similar predictive models are employed in managing warehouse inventories.

Categorisation and recognition

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

Optimisation

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



Generative AI

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

New capabilities include:

Create new unique images

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

Interact with voice and sound

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

Analyse and revise text and code

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

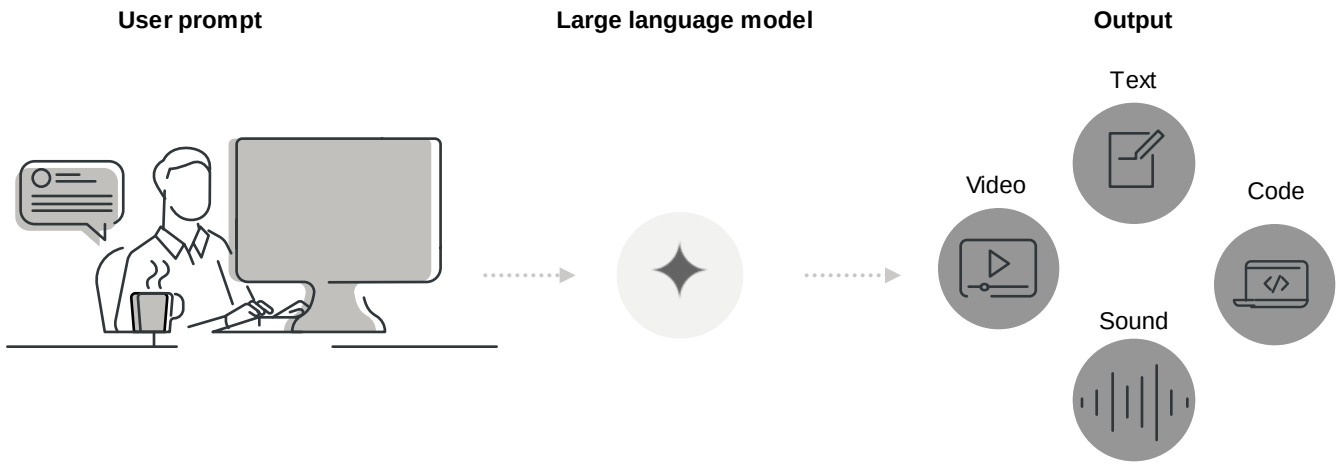
Do research and analyse data

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

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

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

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



No or low data requirements

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

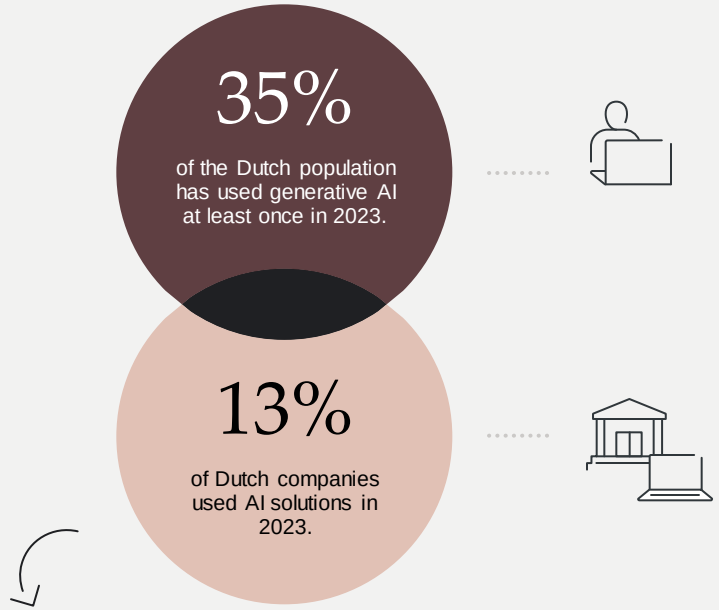
Easy to use in plain language

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

Many models are online and free of charge

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

… and many users have already adopted the technology



Solutions adopted at a company level are driven by non-generative solutions today.

Generative AI is still at an early stage and is yet to be widely adopted at a company or institution level.

Source: Implement Economics based on Eurostat and Ipsos survey.

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	Adaptions of pre-trained models through 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. Mistral*
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.

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 the Netherlands arises from humans working together with generative AI.

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

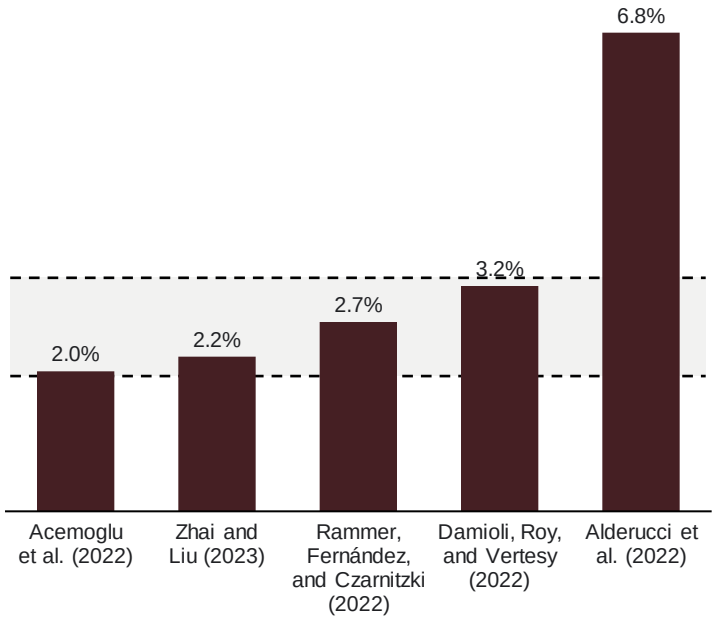
How to think about generative AI:

"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.

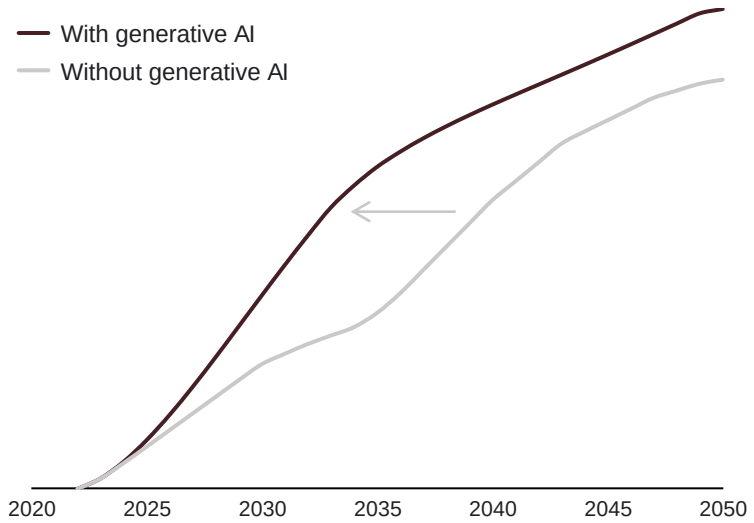
Growth in labour productivity from AI adoption
Percentage points



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



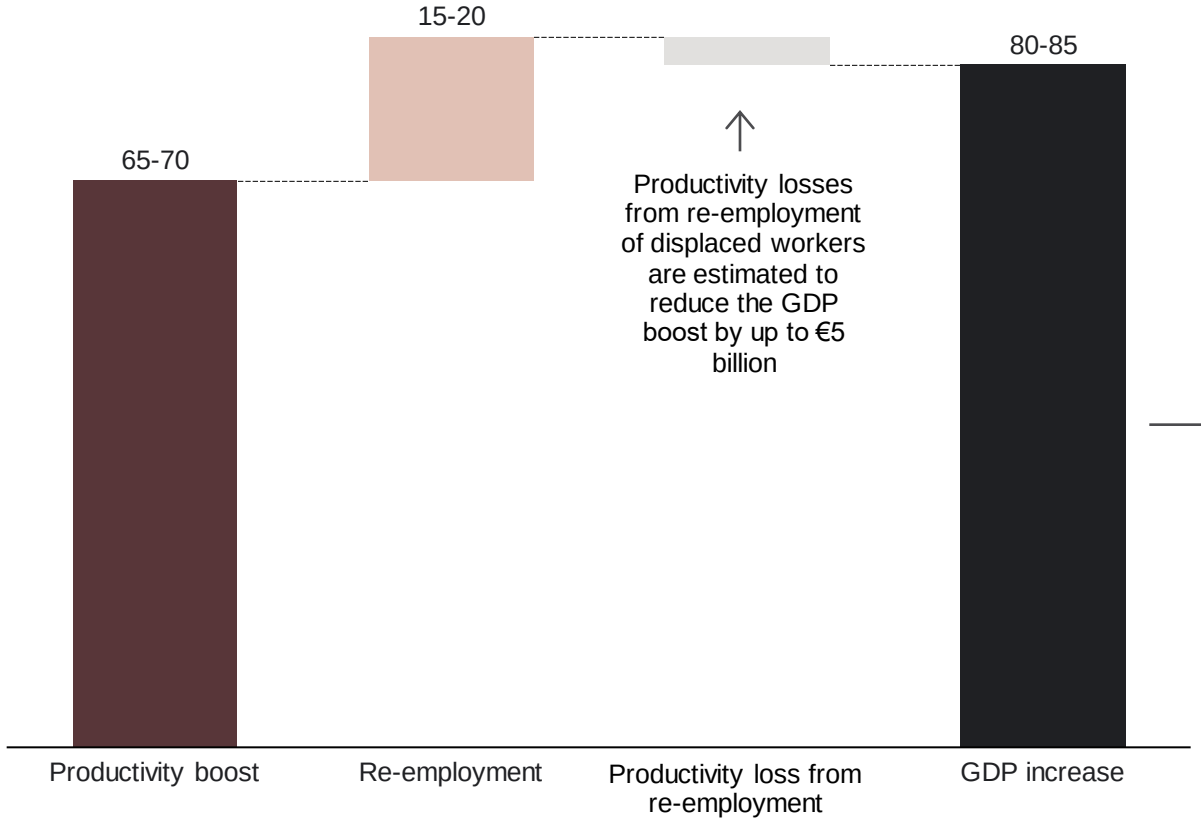
- AI has evolved rapidly with the recent breakthrough of generative AI. Due to its user-friendly nature, generative AI is expected to greatly accelerate the potential of AI to create economic impacts.
- Generative AI is only a part of AI's overall economic potential. Some studies estimate with some uncertainty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

Source: Implement Economics based on Brynjolfsson et al. (2019), 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).

Generative AI could increase the Netherlands' GDP by 9% in ten years

Potential impact of generative AI on GDP in the Netherlands

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



+9% GDP

if the Netherlands achieves widespread adoption within ten years.

- If the Netherlands widely adopts generative AI, we estimate a potential increase in GDP of €80-85 billion over the next ten years.
- The dominant impact of generative AI is a productivity boost to the majority of workers (67%) by augmenting their capabilities, quality and efficiency, which is estimated at €65-70 billion for the Netherlands.
- The estimate includes impacts of re-employment of a small share of workers (7%), where generative AI is freeing up a significant share of work for other tasks. This is estimated at €15-20 billion in the Netherlands.
- The estimate accounts for the possible productivity loss associated with re-employment to other occupations. This reduces the estimate for the Netherlands by up to €5 billion.
- At its peak, the productivity effect of generative AI in the Netherlands is estimated to be equivalent to 1.5% annually.
- Generative AI is so powerful that the Netherland's future economic growth could exceed current long-term GDP forecasts, and leading banks are lifting growth forecasts from as early as 2028.

Note: The estimate assumes widespread adoption of generative AI over a ten-year period. There is much uncertainty around the capability and adoption timeline of generative AI. The size of the productivity boost depends on the difficulty level of tasks that generative AI will be able to complete and the number of jobs it can automate. GDP is in 2022 levels. The average number of work activities that potentially can be performed by generative AI across all types of tasks for both complemented and highly exposed workers corresponds to 20-30%. Our estimate is the isolated potential of generative AI. The estimated boost from generative AI may not be fully additive to GDP trends, since 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 (2023), BNP Paribas (2023), Centraal Planbueau and Dell'Acqua et al. (2023).

The Dutch economy will benefit from increased global AI adoption because of its role as a digital hub and its strong semiconductor value chain

The Netherlands has an advanced digital infrastructure …

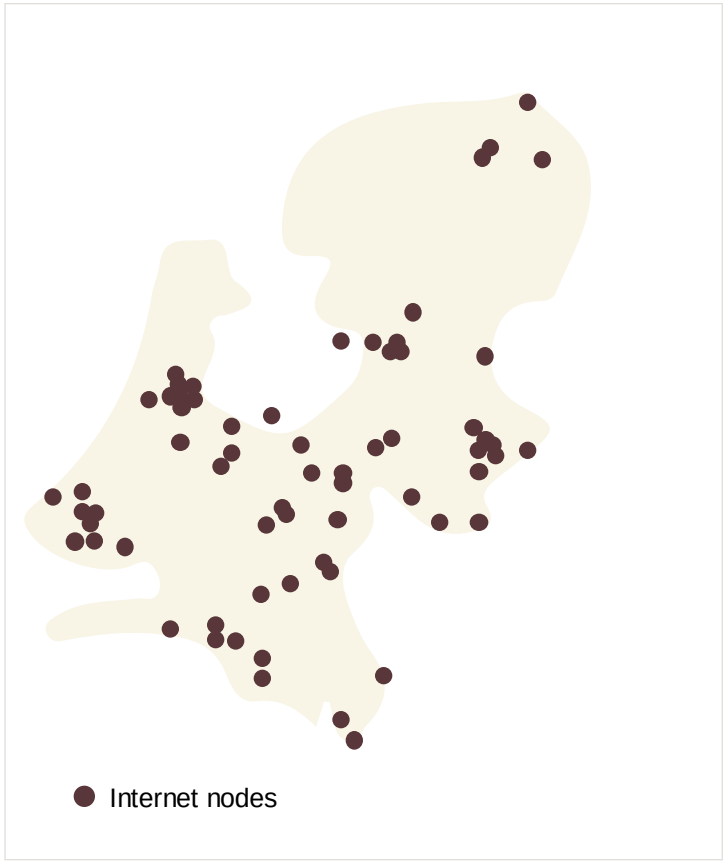
Data centres
The Netherlands has one of the largest data centre capacities in Europe, housing servers, networking devices and communication links.

Internet exchanges
The Netherlands has numerous internet nodes and one of the largest global internet exchanges, AMS-IX, making it one of the best-connected places in the world.

Subsea cables
The Netherlands is one of five hyperconnected places in Europe, partly due to widespread sea cable installation.

Telecom networks
The entire country is covered by 4G, and the 5G network coverage is expanding. Almost all households and companies have access to a fibre optic network.

Cloud access
The digital infrastructure gives Dutch companies access to cloud services, allowing them to easily store data and applications in the cloud.



… and a strong semiconductor ecosystem.

Strong semiconductor value chain

The Netherlands also plays a significant role in the global semiconductor industry, with many companies involved in design, production equipment, assembly and system integration. ASML, a Dutch company, is the world's sole supplier of extreme ultraviolet (EUV) lithography machines that are crucial for the manufacturing of advanced semiconductors.

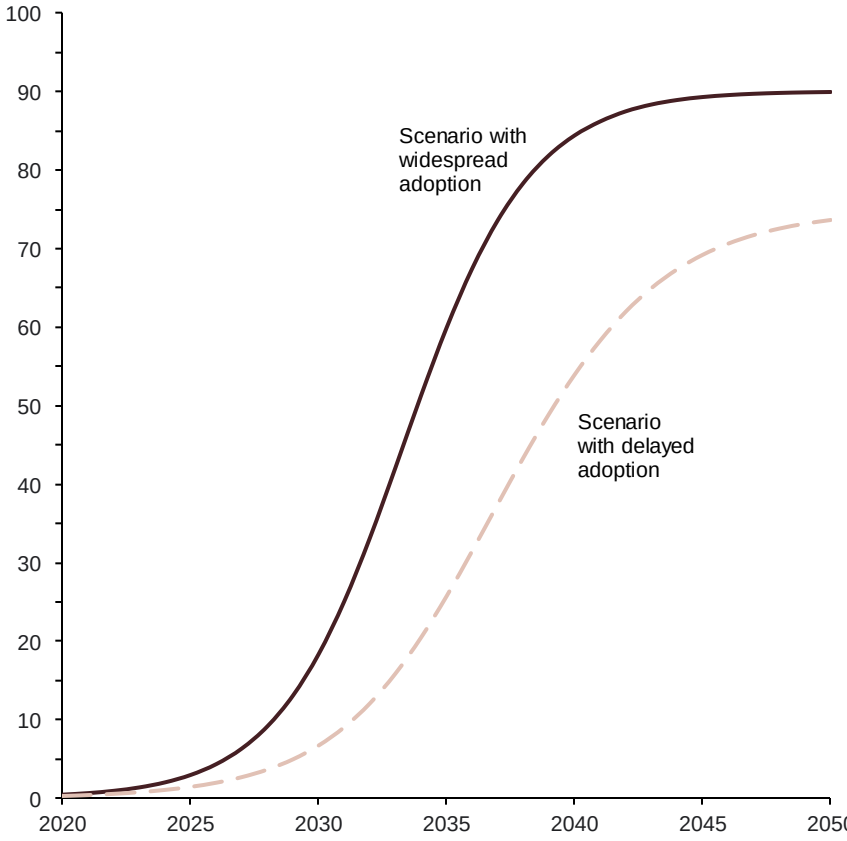
The Netherlands has historically been good at adopting and commercialising new technology.

Source: Implement Economics based on the ASML, Dutch Data Center Association, Ministerie van Economische Zaken en Klimaat.

A five-year delay in the adoption of generative AI could reduce the Netherlands' potential GDP gains from 9% to 2%

Adoption of generative AI

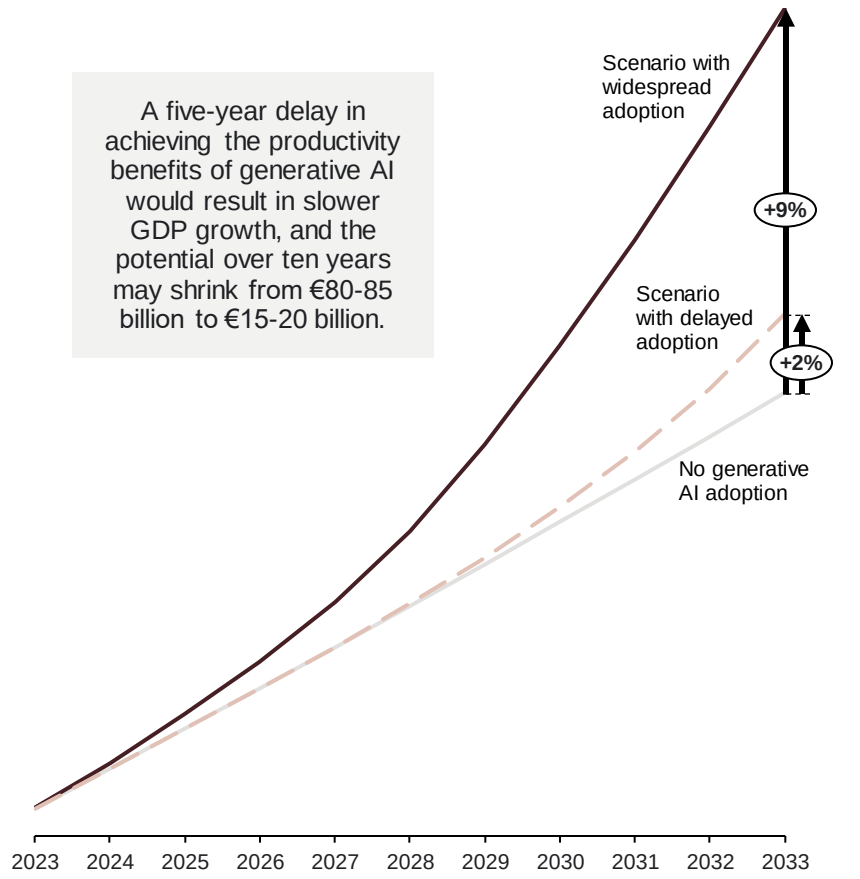
%



Potential impact of generative AI on GDP in the Netherlands

Index, 2023=100

A five-year delay in achieving the productivity benefits of generative AI would result in slower GDP growth, and the potential over ten years may shrink from €80-85 billion to €15-20 billion.



- Generative AI is a new general-purpose technology and will take time to adopt.
- Our estimate of the Netherlands' 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 GDP growth potential in ten years from 9% (€80-85 billion) to only 2% (€15-20 billion).
- The Netherlands 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 in € billion are expressed in 2022 levels. The leftmost figure shows generative AI adoption expressed as a percentage of work activities exposed to automation by generative AI.
Source: Implement Economics based on Eurostat, Briggs and Kodnani (2023) and O*Net.

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

Dutch SMEs account for
~61% of total employment

Like other European countries, Dutch SMEs are slower to adopt AI compared to large enterprises.

40%
of large Dutch enterprises adopted AI in 2023.

12%
of Dutch SMEs adopted AI in 2023.

The gap in AI adoption between SMEs and large enterprises reflects a general challenge in the EU, and overall, Dutch enterprises perform well on AI adoption:

- #6 The Netherlands ranks 6th in the EU on AI adoption by SMEs.
- #5 The Netherlands ranks 5th in the EU on AI adoption by all enterprises.

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.

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

03

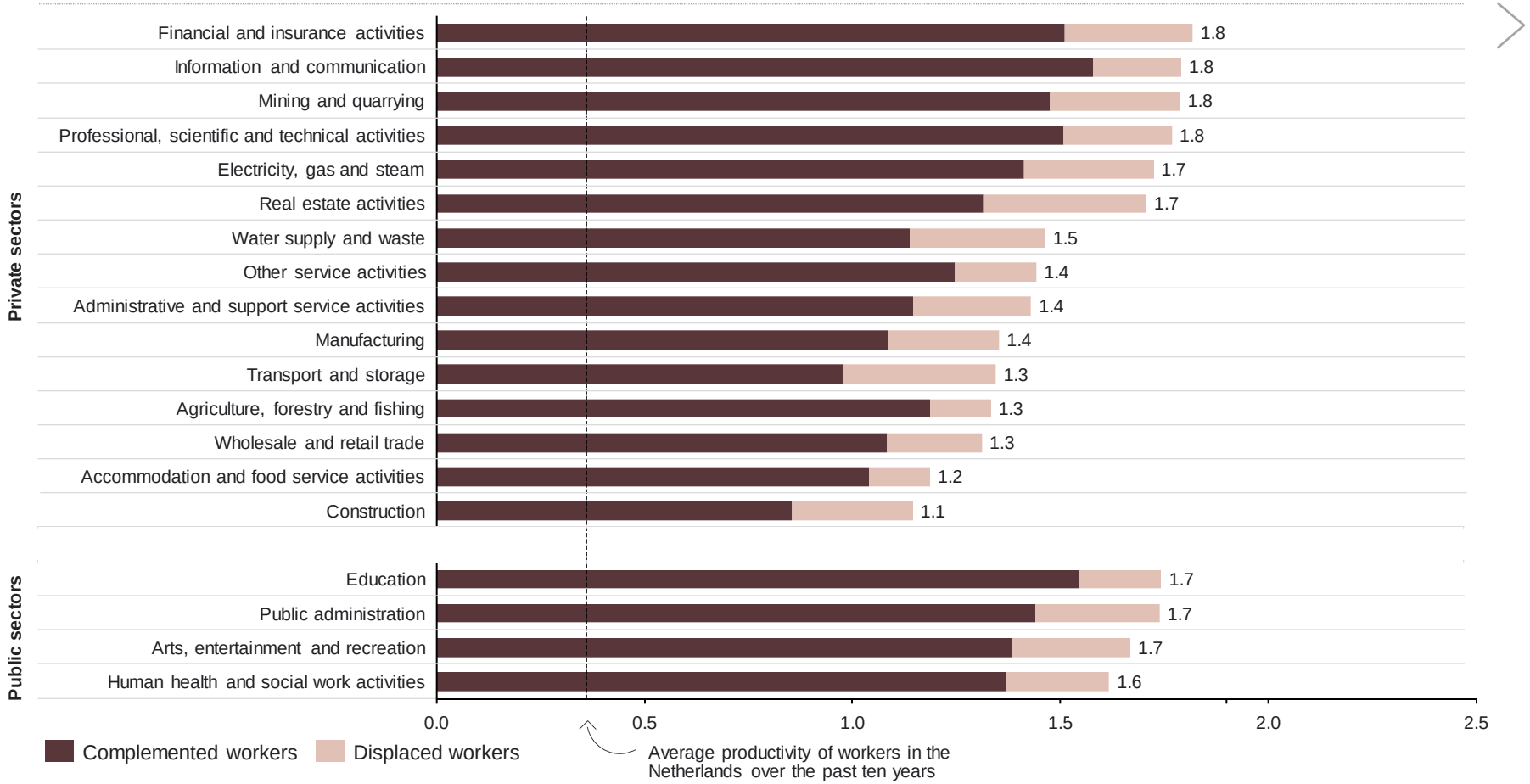
Key sectors benefitting from AI

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

AI can boost productivity across top sectors in the Netherlands

Productivity boost from generative AI

% productivity growth p.a. at peak



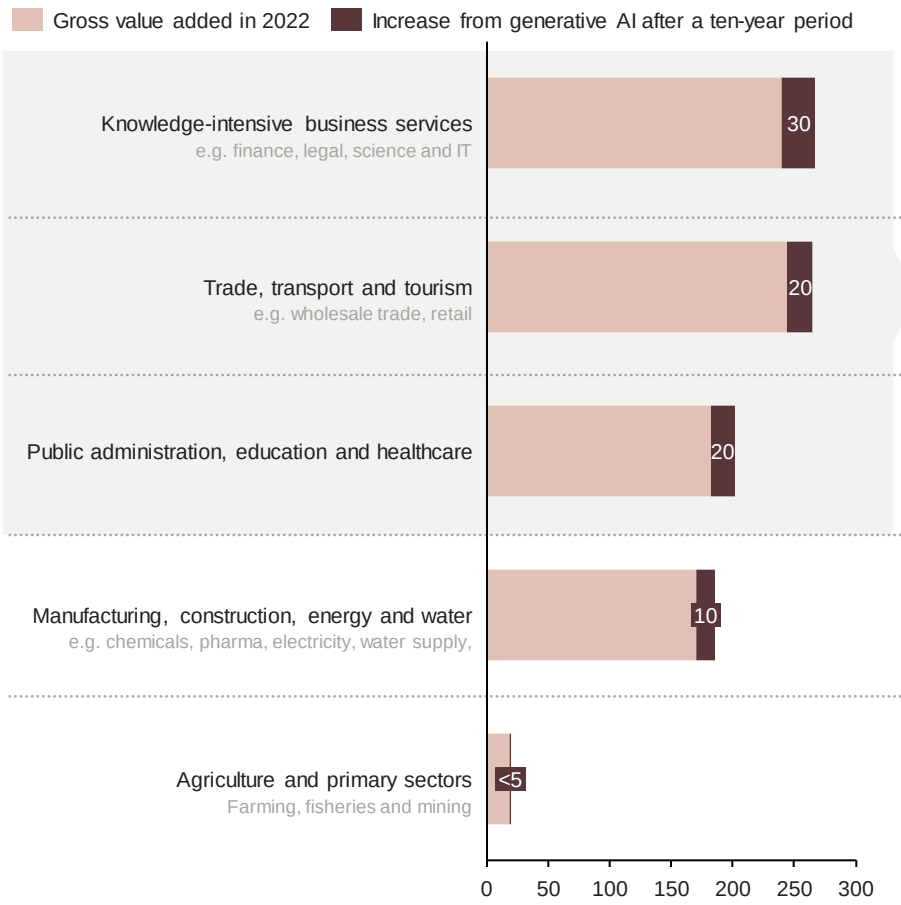
- The Dutch AI coalition and the Ministry of Economic Affairs are focused on so-called *top innovation sectors* such as agriculture and food, logistics and transport as well as the ICT sector.
- Generative AI is estimated to give a boost to productivity across these top sectors as well as many other industries in the Netherlands.
- Generative AI is also estimated to have large potential in the public sector, including both public administration, education and healthcare.
- The complementary role of generative AI prevails across these industries and sectors, 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 would provide a much-needed boost to productivity in the Netherlands, which has been significantly below OECD average in the past decade.
- Displacement mainly occurs where administrative and repetitive knowledge-based tasks make up a large part of the work activities.

Note: Sectors are according to NACE categorisation. Labour productivity gains are mapped one-to-one to GDP if total employment (as here) is assumed constant and the capital stock increases to match productivity improvements. The estimates take into account that the growth impact of generative AI may not be fully additive to the current GDP trend. First, AI-related gains may substitute for growth that would otherwise occur in a non-AI baseline. Second, underlying productivity growth has slowed over the past decades. The estimated boost from generative AI may be partially offset by an underlying growth slow down.
Source: Implement Economics based on Eurostat, O*Net and OECD Economic Surveys Netherlands (2023).

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

€ billion



80% of potential

Generative AI has the potential to boost value added in knowledge-intensive business services by around **€30 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.

The trade, transport and tourism sector also represents a significant economic potential of an estimated **€20 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 **€20 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 **€10 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 **€5 billion.**

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

04

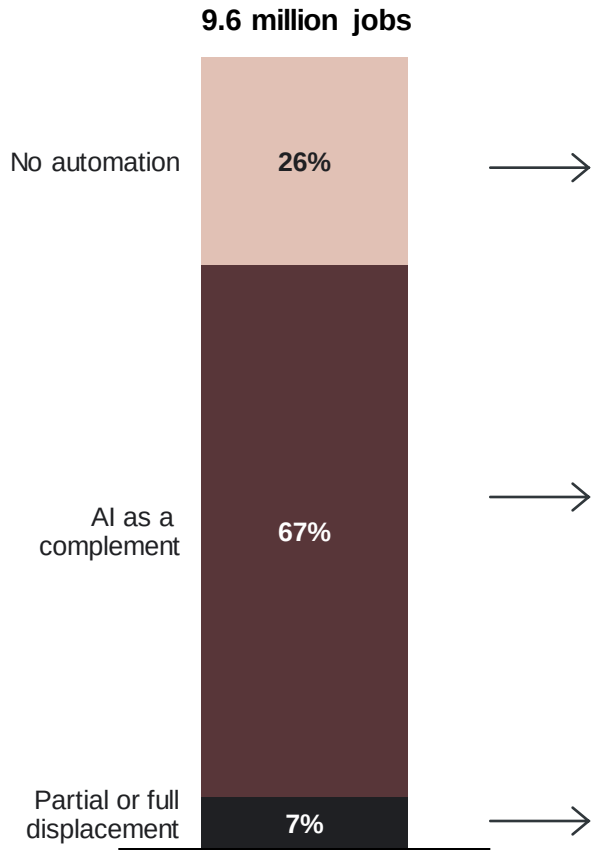
Job implications of AI

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

Generative AI augments most jobs

Share of jobs exposed to automation by generative AI

% of total employment in the Netherlands



~ 2.5 million jobs are unlikely to be exposed to automation

An estimated one-third of jobs in the Netherlands 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.

~ 6.5 million jobs are likely to be augmented by generative AI

Most jobs (67%) 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.

~ 0.6 million jobs are likely to be fully or partially displaced

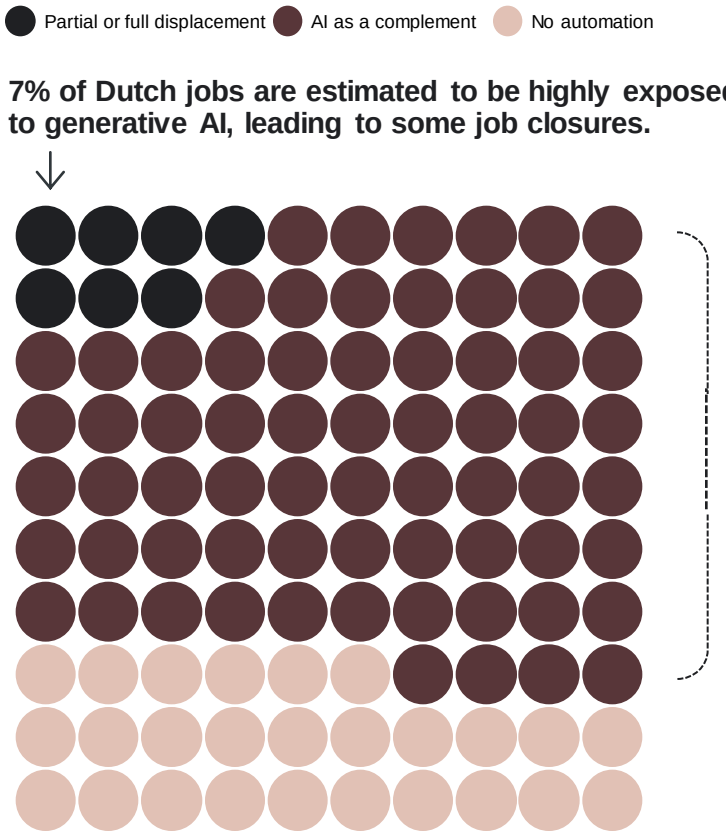
A small share of jobs (7%) are expected to have over half of their work activities exposed to automation by generative AI, e.g. in occupations such as clerical support workers, contact centre salespersons and translators. These workers are likely to see their jobs fundamentally change and may need to be re-employed in new occupations.

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

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 the Netherlands



7% of Dutch jobs are estimated to be highly exposed to generative AI, leading to some job closures.

At the same time, 67% 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

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.

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 demand for those occupations.

Even with accelerated and broad adoption of generative AI over a ten-year period, only around 35,000-60,000 persons in highly exposed job are estimated to need re-employment per year, which is low compared to historical averages (see page 23).

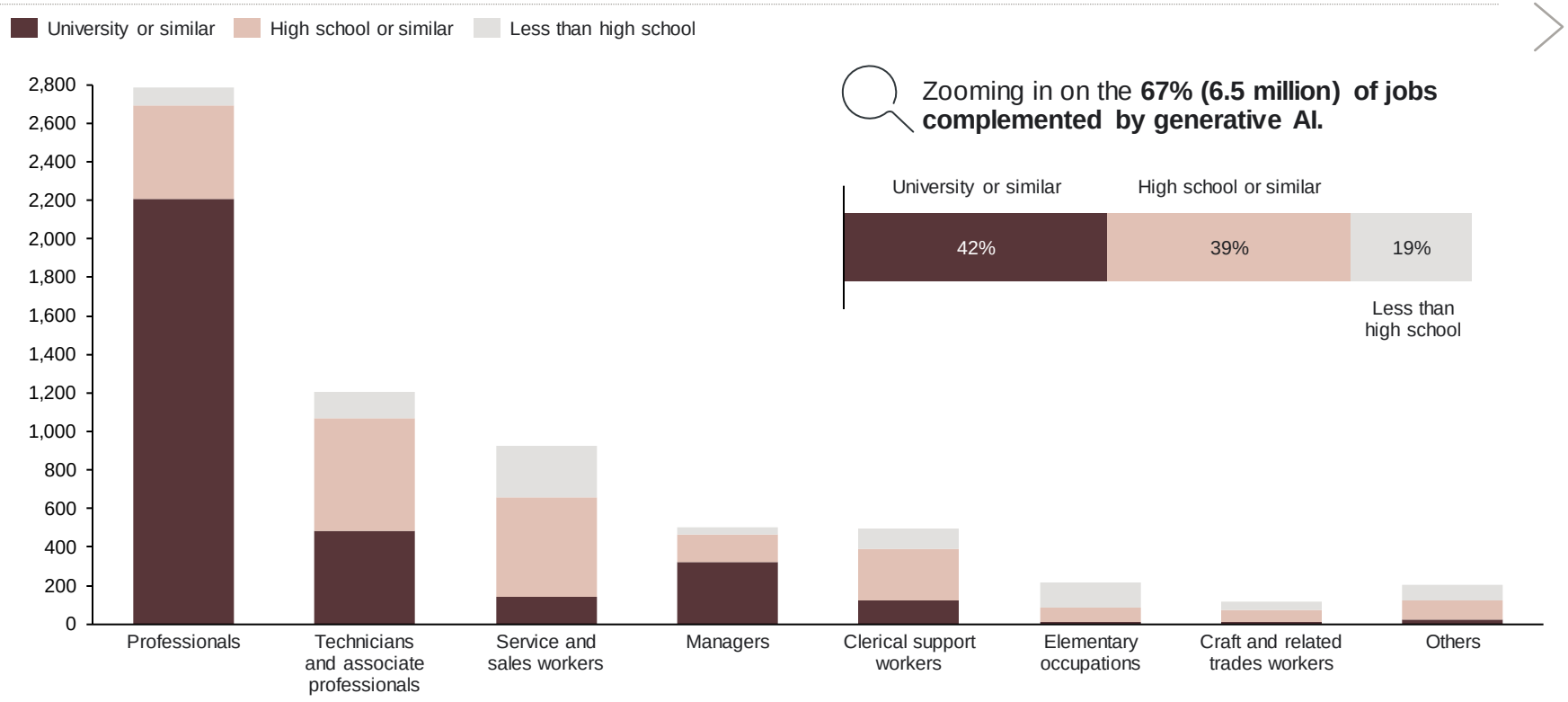
- The job development in the Netherlands over the next decades will depend on a range of factors.
- The isolated impact of generative AI depends on the speed of adoption and the size of the productivity boost relative to the size of the displacement effect for the jobs highly exposed to generative AI.
- 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 a 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 and O*Net.

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

Jobs complemented by generative AI

Thousand jobs



Examples of jobs include …	Research, analysis and advising services (including legal)	Engineering technicians, robot controllers and air traffic safety technicians	Caterers, housekeepers and travel agents	Secretaries, record keepers and information suppliers	Cleaners, washers and delivery	Executives and supply and general managers	Train drivers and machinery operators	Police services and farmers

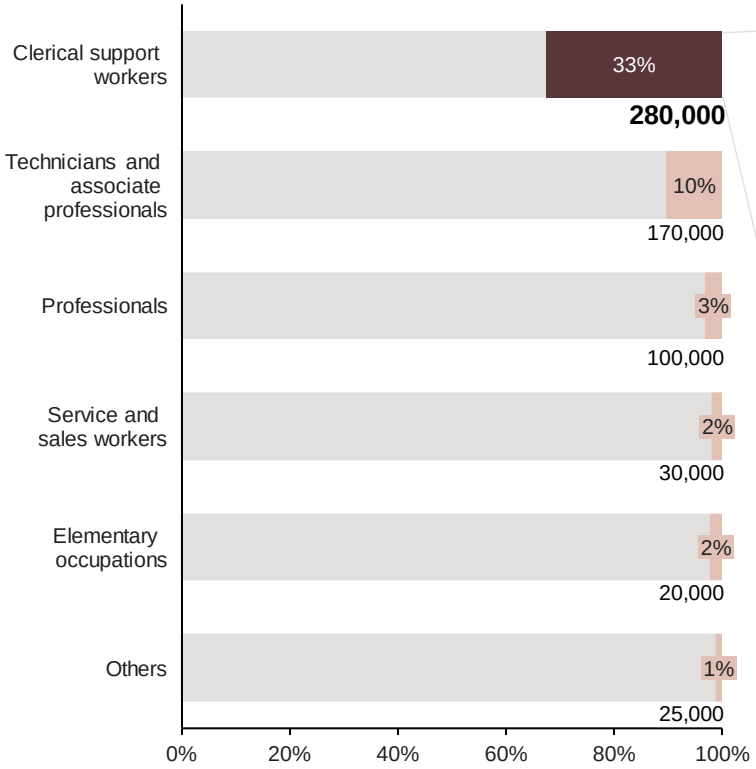
- Generative AI is estimated to augment the capabilities of around 6.5 million jobs in the Netherlands at full adoption and around half of these over a ten-year period.
- Of the complemented workers, 42% are estimated to hold higher educational attainment, such as lawyers, scientists and engineers.
- 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 and O*Net.

Around 0.6 million Dutch jobs are highly exposed to generative AI, but the AI-powered economy will help create new jobs

Jobs highly exposed to generative AI

Share of jobs in occupation exposed



Highly exposed jobs in total ~ 620,000

***Example*: Dutch clerical support workers and job transition**

Of the 280,000 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.

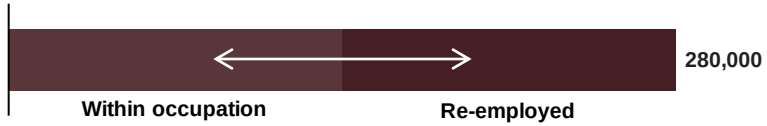
II **New tasks and jobs created**, arising from the introduction of generative AI.

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.



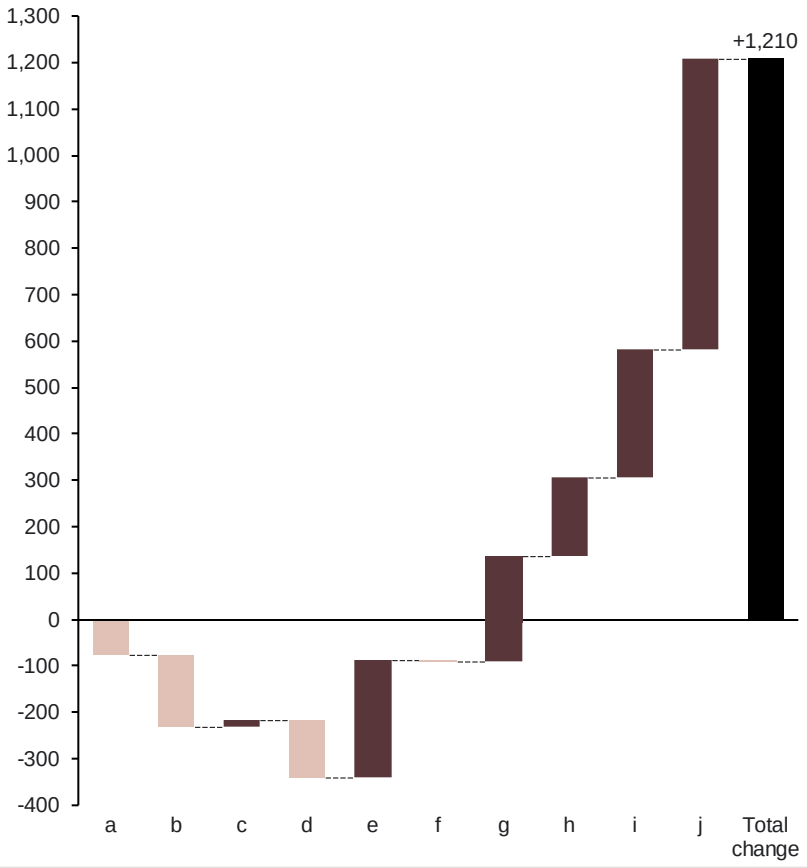
- Around 0.6 million jobs in the Netherlands are estimated to be highly exposed to generative AI at full adoption, and around half of these are expected to be affected over a ten-year period.
- This report assumes full re-employment of displaced workers. This means no net change in total employment or unemployment.
- The Dutch economy is thus assumed to be able to sustain at least the current level of employment in the coming 10-15 years as also predicted by EU forecasts from CEDEFOP.
- Clerical support workers, technicians and service and sales workers are highly exposed to generative AI and up to a third of these jobs are expected to see significant change.
- The transition is likely to be gradual, allowing workers time to adapt to new tasks and skills.
- Through three channels, the AI-powered economy will gradually lead to new jobs and support employment within the occupation or re-employment in other sectors.
- Historically, worker displacement from automation has been offset by the creation of new jobs, and the emergence of new occupations following technological innovations accounts for the vast majority of long-run employment growth.

Note: Based on 2022 employment data. High exposure to AI does not automatically imply full displacement of all workers in that occupation. In the GDP estimates, we make a conservative assumption, assuming low automation to avoid overestimating GDP impacts. In the job exposure and potential displacement assessment, we show the full size of the potential displacement to avoid underestimating the job implications. The size of each re-employment channel is uncertain and depends on how the technology is adopted and the interplay between increased efficiency and how unmet demand translates into increased or decreased employment in various occupations.
Source: Implement Economics based on Eurostat, CEDEFOP and O*Net.

Job changes from generative AI are small compared to historical averages

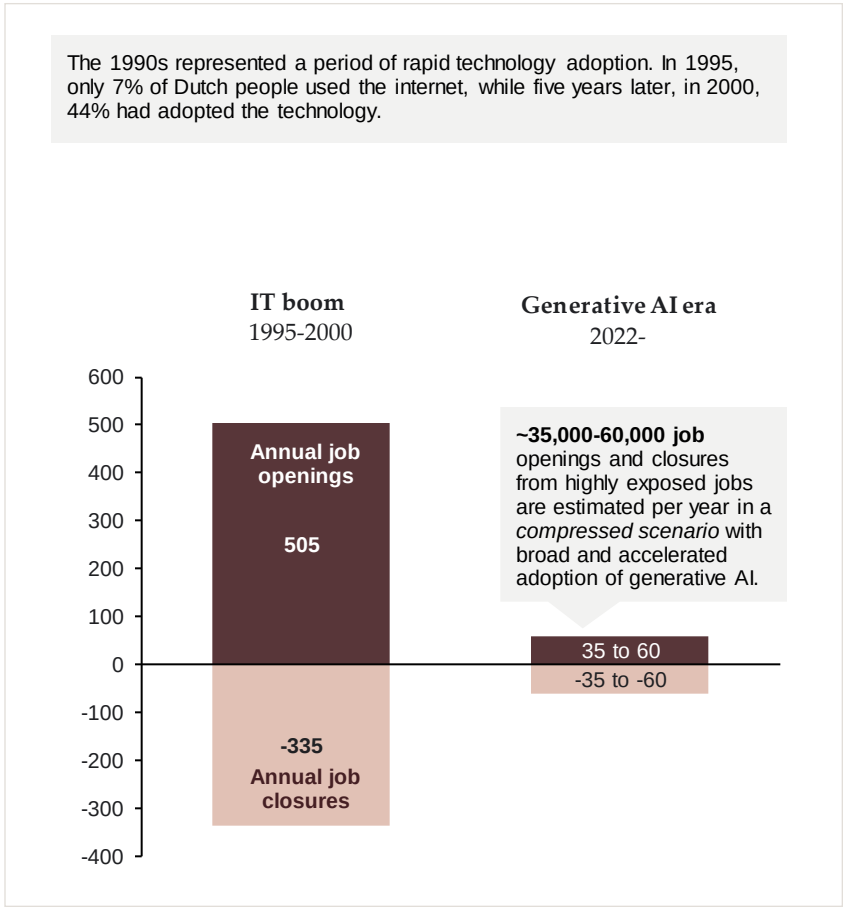
Change in employment across Dutch sectors, 2008-2022

Thousand jobs



Job development during the 1990s IT boom in the Netherlands

Thousand jobs

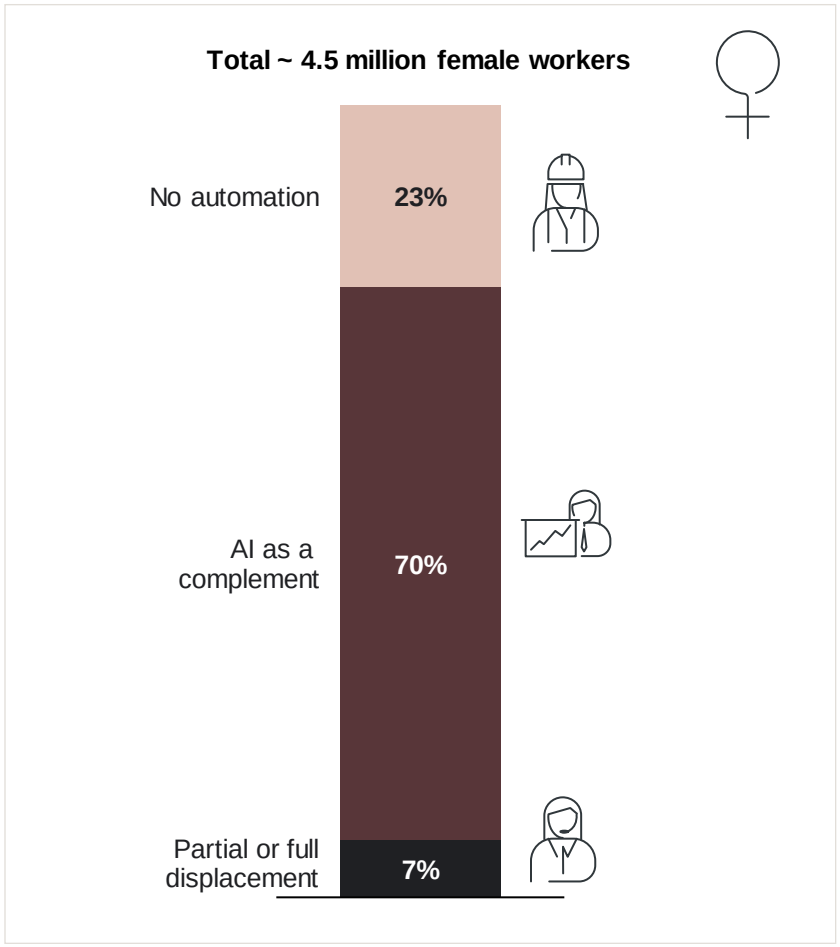


- The Dutch economy has added 1.2 million jobs over the last 15 years. A few sectors, including agriculture, manufacturing and construction, have contracted, while most other sectors, including retail, business services, and the public sector, have added significant amounts of new jobs.
- In addition, numerous new jobs are created and closed each year *within* each sector to adapt to changing needs and demands.
- During rapid IT adoption in the 1990s, the Dutch economy created around 505,000 new jobs and only closed 335,000 jobs annually during the same period.
- We estimate that the jobs highly exposed to generative AI can lead to 35,000-60,000 annual job openings and closures over ten years. This is approximately 5-10% of the historical average number of job openings in the Netherlands.
- The labour market effects stemming from generative AI's impact on highly exposed jobs are thus 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.

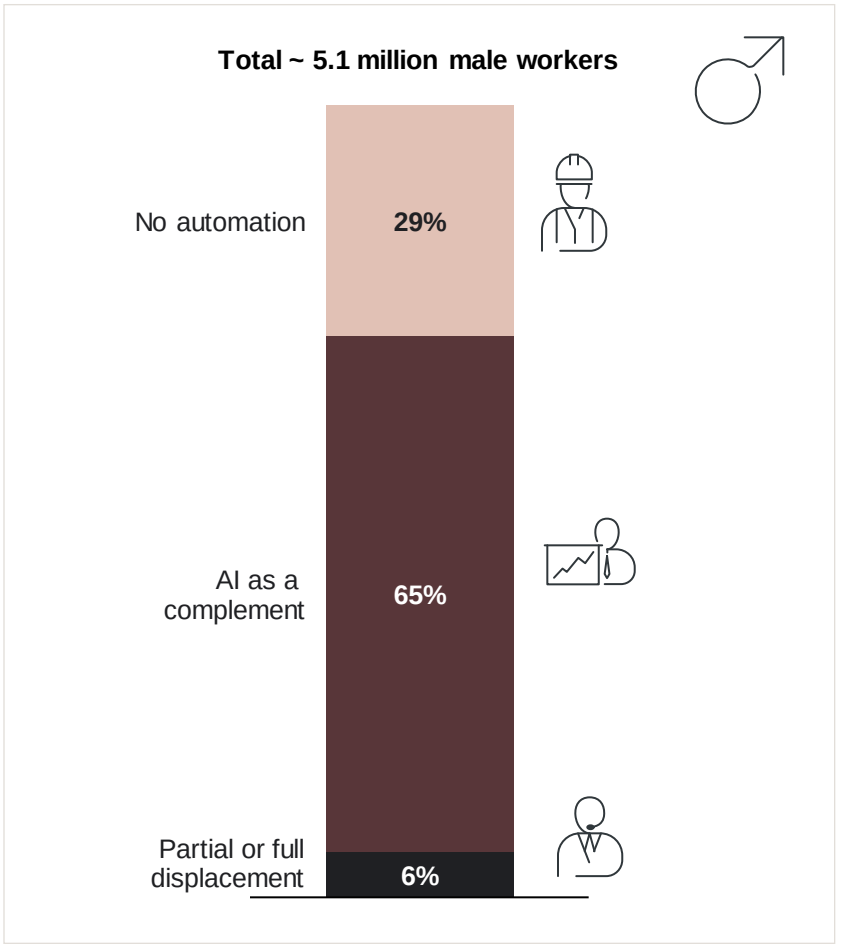
Note: a. Agriculture and primary sectors; b. Manufacturing; c. Utilities, raw materials and waste; d. Construction; e. Wholesale and retail trade; f. Transport and storage; g. Tourism and other services; h. Information and finance; i. Business services and real estate; j. Public administration, education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

A higher share of female workers are estimated to be affected by generative AI – both regarding 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

- 23% of female workers in the Netherlands and 29% of male workers are in jobs with limited exposure to generative AI. These are, for example, manual, outdoor and human-to-human jobs.

Complemented jobs

- 70% of female workers are expected to see generative AI complement their current job, whereas the share is only 65% 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 6% of male workers in the Netherlands 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.

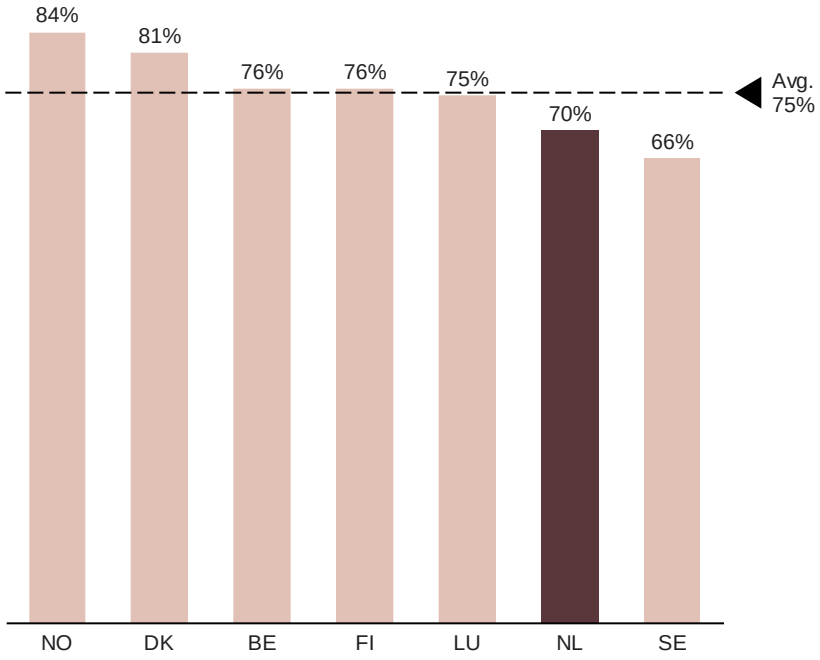
Note: Based on 2022 employment data. In accordance with Briggs and Kodnani (2023), "No automation" are occupations with less than 10% exposure, "AI as a complement" are occupations with 10-49% exposure, "Partial or full displacement" are occupations with exposure of or above 50%. Note that percentages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

Seven out of ten workers in the Netherlands see productivity-enhancing effects of generative AI, and nearly 40% expect AI to positively impact their job

Workers think that generative AI makes them more productive

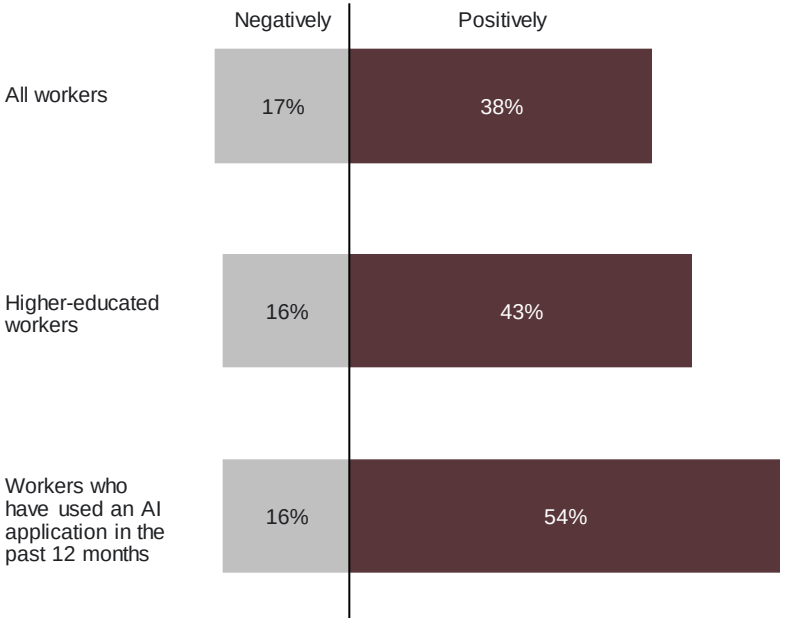
Generative AI will help improve my productivity at work

Workers who agree, %



Workers think that AI will positively impact their job

How will AI impact your job?



- Polling conducted by Public First shows that 70% of Dutch workers think that generative AI will help them be more productive. This is slightly less positive than in some other European countries.
- A recent Ipsos survey on attitudes towards AI reveals that 38% of workers in the Netherlands expect AI to have an overall positive impact on their job, while only 17% expect a negative impact.
- The positive expectations are more pronounced for higher-educated workers with 43% expecting a positive job impact.
- Workers who have used an AI application in the past 12 months have the most positive expectations with 54% expecting AI to positively impact their job in the future.

Note: Public First survey conducted in summer 2023. Nationally representative consumer and business polling. Respondents of the survey include the Netherlands (NL), Sweden (SE), Denmark (DK), Belgium (BE), Luxembourg (LU), Finland (FI) and Norway (NO).
Source: Implement Economics based on Public First country surveys and Ipsos survey.

Workers need more than just digital upskilling for effective use of generative AI and there is a widespread need for re-skilling

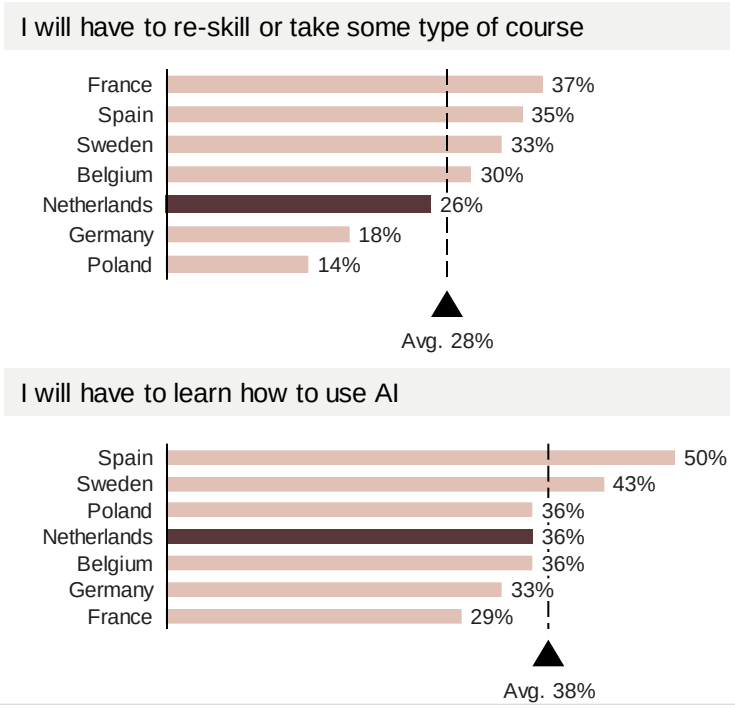
Multiple skills are needed to leverage generative AI …

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 European workers express a widespread need for re-skilling

What will you do in the next five years as a result of AI?
% of respondents who are employed and think that AI will slightly or completely transform the way they do their job.



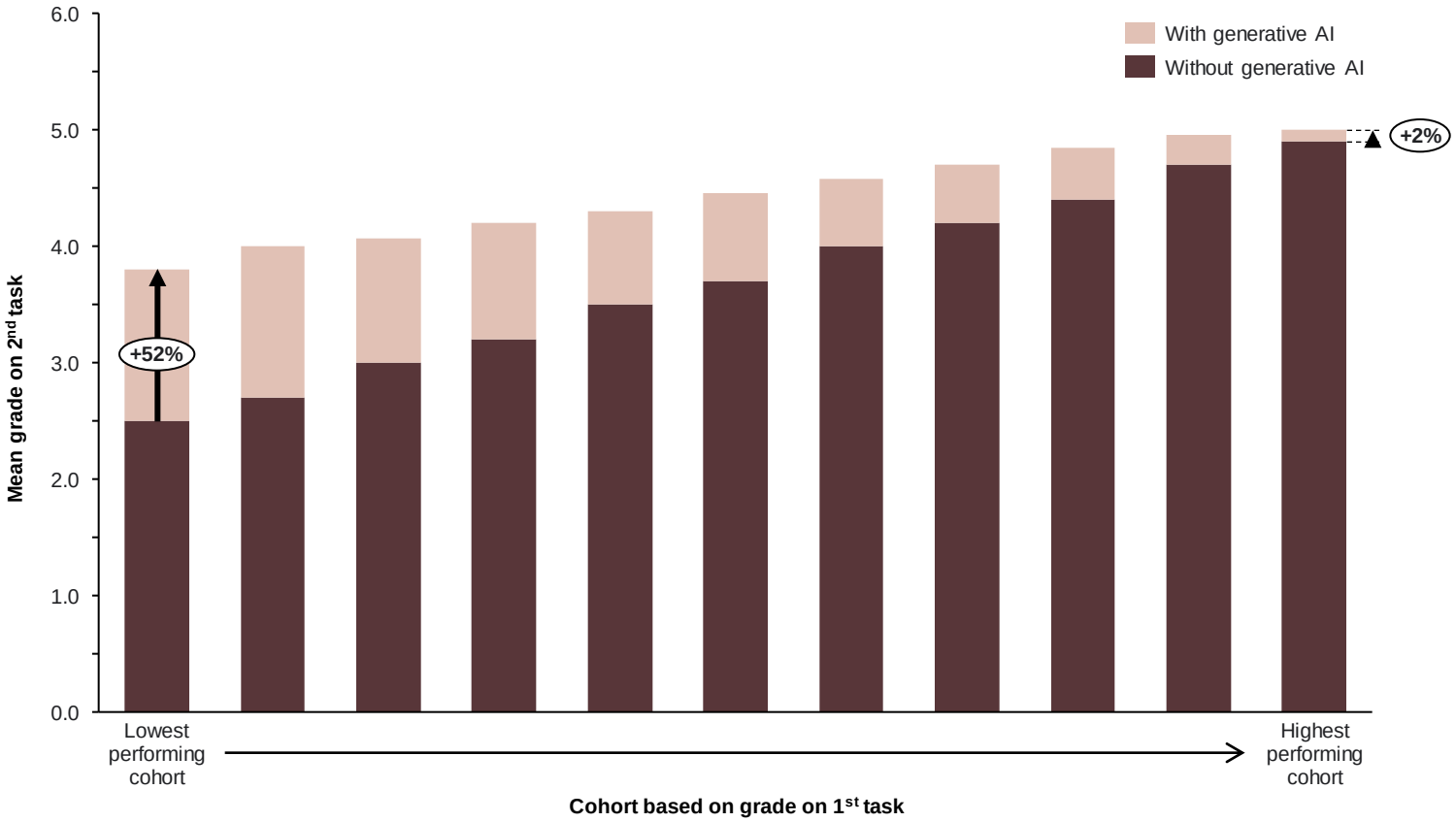
- Generative AI adoption and usage requires limited digital skills relative to earlier advancements in information and communication technology (ICT) due to its ability to understand and interact in language, sound and images on human terms.
- However, fully leveraging generative AI requires skills beyond basic digital skills, i.e. creative, managerial and analytical skills.
- Of the Dutch workers indicating that AI will completely or slightly change their job, an average of 26% expect to have to re-skill or take some type of course within the next five years as a result of AI.
- In 2023, 83% of the Dutch population aged 16-74 had basic digital skills, but it was required in 90% of professional roles.
- OECD studies based on companies in Estonia and the Netherlands 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.

Source: Implement Economics based on OECD, the European Commission, Ipsos survey, Eurostat, Mosiashvili and Pareliussen (2020), Borowiecki et al. (2021), Gal et al. (2019) and Andrews et al. (2016).

Early studies suggest that generative AI can help close the skills gap for those with the lowest skill levels

Grades with and without generative AI

Estimated mean grade on 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 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 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 and the Netherland’s new mission-driven innovation policy.

AI can play a key role in addressing climate change

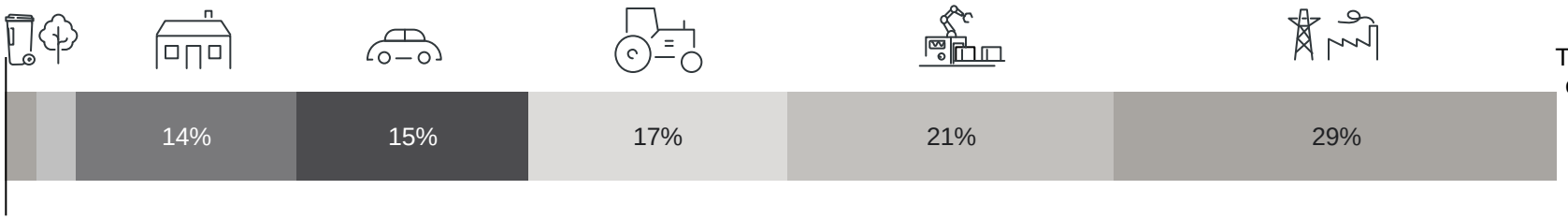
In 2023, the Dutch government focused its innovation and impact goals on mission-driven challenges such as the energy transition and the transformation of healthcare.

Public First poll

41% of Dutch people support AI tools being used to help them make more environmentally sustainable choices in their life.

56% of Dutch people support AI tools being used to reduce carbon emissions by managing energy use.

The Netherlands' net greenhouse gas emissions, 2021
$MtCO_2e$



Total GHG emissions **172** $MtCO_2e$

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

Buildings
- Smart buildings
- Transition to heat pumps
- Improved energy efficiency

Domestic transport
- 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)

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

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

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

Note: Data on net greenhouse gas emissions and removals sent by countries to UNFCCC and the EU Greenhouse Gas Monitoring Mechanism (EU Member States). This data set reflects the GHG inventory data for 2021 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 CO2).
Source: Implement Economics based on the European Environment Agency (EEA) and Public First survey.

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

The Netherlands faces growing challenges in its capacity to sustainably deliver high-quality care and address the evolving needs of its population.

The Dutch Health Plan 2024-2027 aims to increase the population's life expectancy in good health and diminish socioeconomic health disparities. Additionally, it seeks to promote the organisation and provision of care in individuals' living environments.

More hands are needed

- The Dutch healthcare system faces a scarcity of general practitioners, which is expected to worsen in the coming years as an estimated **one-third will be retiring within the next 4-5 years**.
- A scarcity of healthcare professionals leads to lower quality services, including 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.
- Rising living standards drive up societal expectations for healthcare services – especially related to preventative health measures.
- Chronic diseases are becoming more challenging and rare diseases more common.

Healthcare is a central focus area in the Dutch AI Strategy, identified because of AI's capacity to advance critical health objectives.

Among other things, the strategy acknowledges the significant potential of AI to empower citizens to manage their health more autonomously at home – in line with the priority of providing more local and online care outlined in the National Health Plan.

AI can help free up resources and alleviate bottlenecks

- Automation of tasks in healthcare administration, e.g. appointment scheduling.
- Faster screening and decisions by physicians.
- 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 as well as earlier and more accurate detection of diseases and injuries.
- Improved detection of complex and rare diseases with training data sets and smarter diagnostic tools.
- Predicting individual treatment response by analysing different patient data.
- Development of targeted therapies.
- Remote monitoring through wearable devices and sensors and faster identification of health issues and accidents.

Public First poll **41%** of Dutch people support AI tools being used to track their medical data.

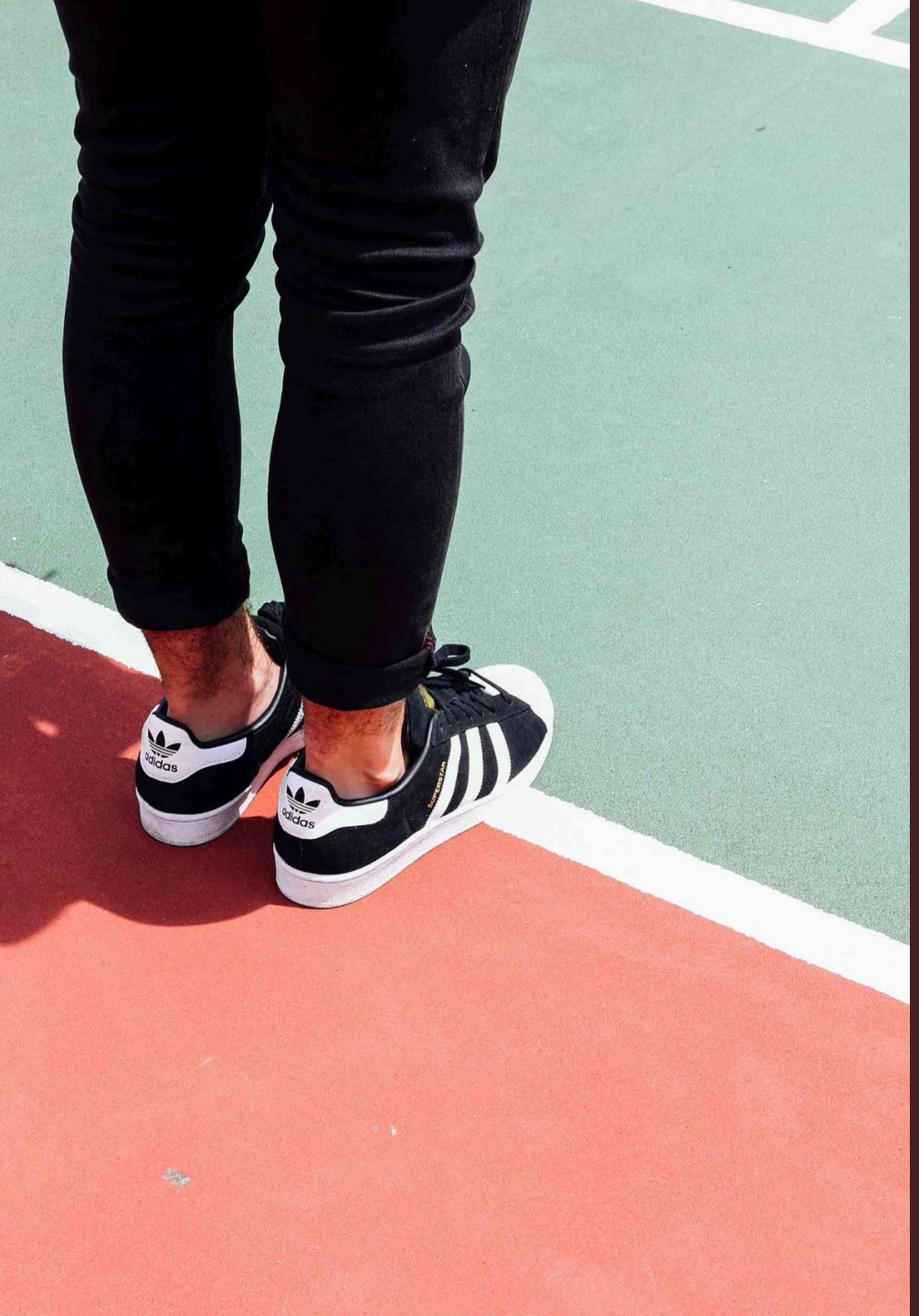
The Netherlands harnesses its success in private partnerships to advance AI use in healthcare.

Showcase initiative

The Dutch AI Coalition – Healthcare taskforce

- The healthcare taskforce of the Dutch AI Coalition brings together over **200 stakeholders** from hospitals and other care providers, academia, industry, investment funds and government.
- It aims to **accelerate the adoption of AI** in healthcare settings and **promote Dutch innovation** in health-focused AI applications.

Source: Implement Economics based on the Dutch Strategic Action Plan for Artificial Intelligence, the Knowledge and Innovation Agenda 2024-2027 for Health & Care, the Dutch AI Coalition, Public First survey and OECD/European Observatory on Health Systems and Policies.



06

AI readiness in the Netherlands

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

In assessing the Netherlands' AI readiness, we compare with other small digital frontrunner countries in Northern Europe

- In assessing the Netherlands' AI readiness, we can compare the Netherlands 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, the Netherlands cannot compete on scale on, for example, the absolute amount of AI-related R&D investment.
- The Netherlands will be dependent on EU-wide initiatives. Therefore, the Netherlands 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

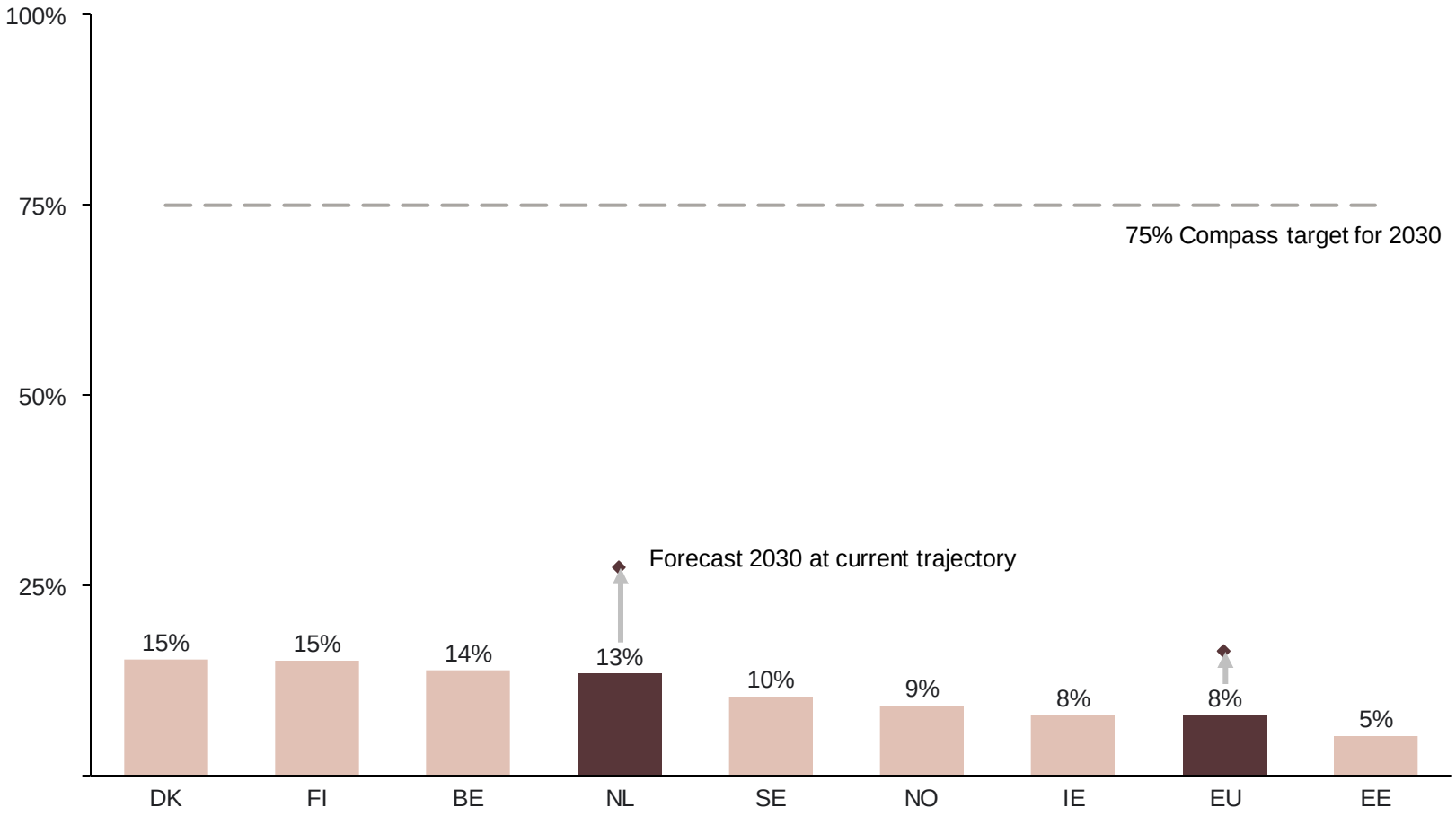
Belgium
#16 in DESI in 2022

Note: Ranking within the EU is shown. *) When we include Norway, it ranks #5 in DESI in the region.

The Netherlands is among the EU leaders on AI adoption but still far from the 2030 target

Adoption of AI 2023

% of enterprises using at least one type of AI technology



- The Netherlands is among the leaders in the EU in AI adoption by companies. 13% of Dutch 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 of 75% AI adoption in companies for 2030.
- If we assume the same pace of adoption as the EU average, there is a risk that the Netherlands 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.

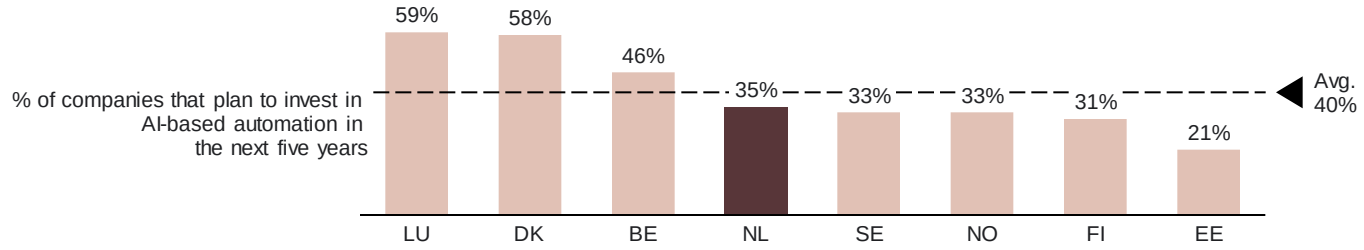
Note: Current adoption is from 2023 and includes enterprises with ten or more employees, excluding financial services. Forecast for 2030 is based on European Commission-forecasted AI adoption.
Source: Implement Economics based on Eurostat and the European Commission.

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

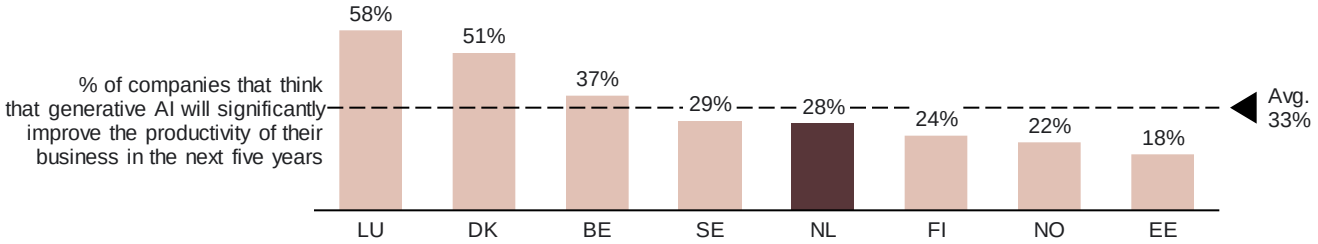
Survey responses from companies on their five-year outlook on generative AI

% weighted average of enterprises, 2023

Planned firm-level adoption of AI automation



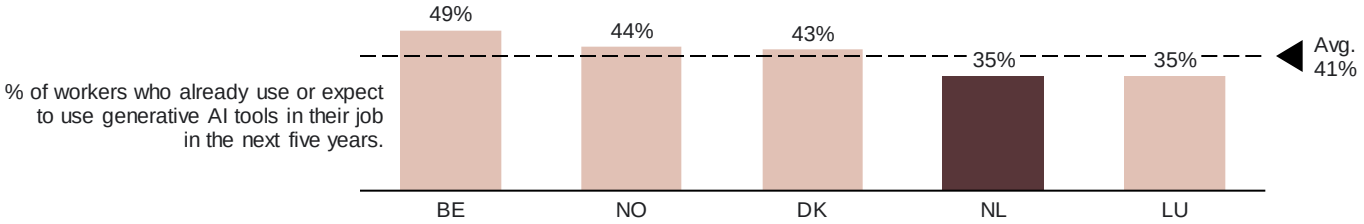
Expected productivity boost from generative AI



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

% weighted average of employees, 2023

Expected use of generative AI at work



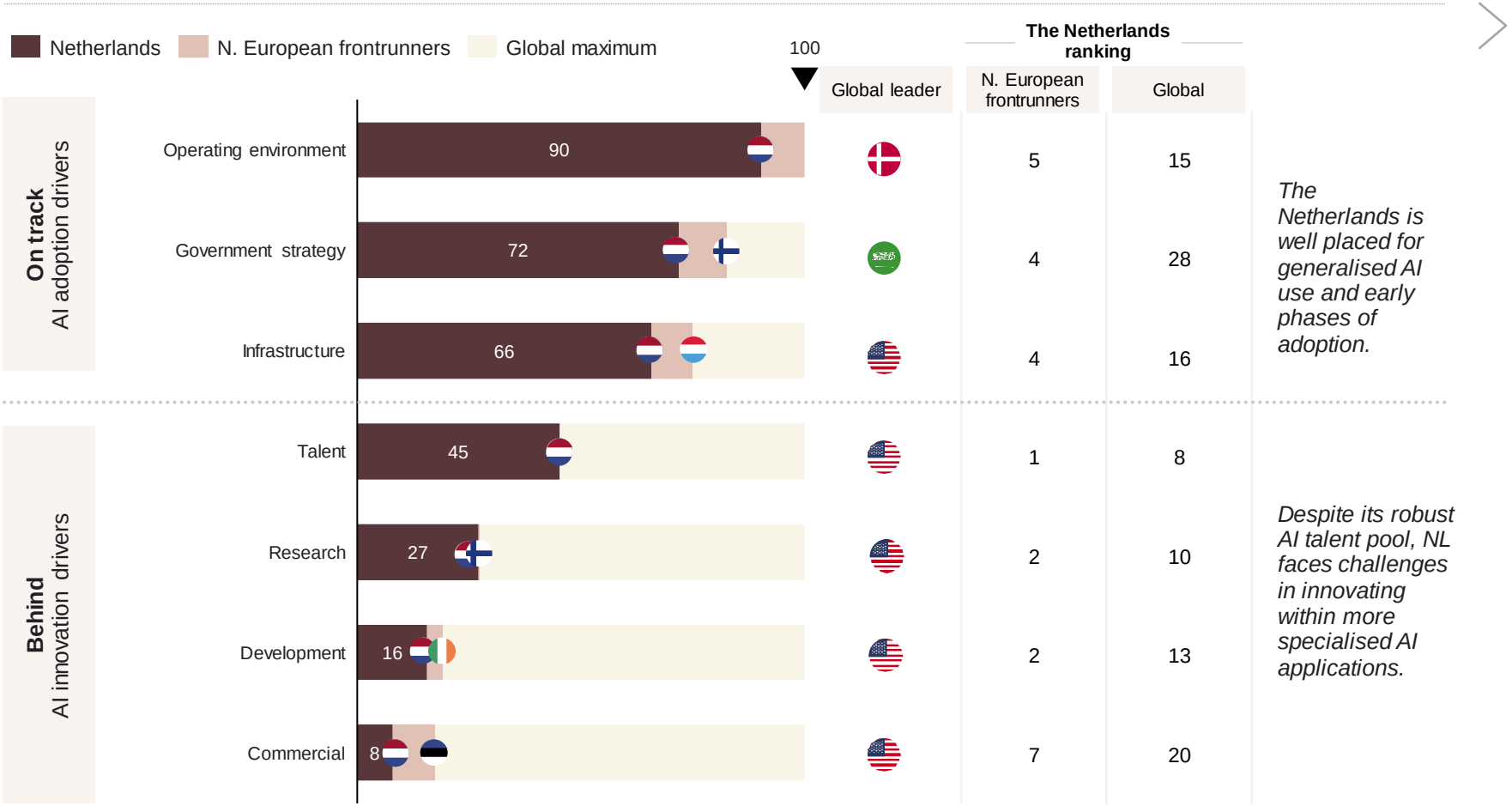
- According to polling by Public First, 35% of companies in the Netherlands claim that they plan to invest in AI-based automation in the next five years. This is lower than the Northern European frontrunner average of 40%.
- 28% of Dutch companies expect generative AI to have significant productivity impacts on their business in the next five years. This is lower than the Northern European frontrunner average of 33%.
- 35% of all surveyed Dutch workers already use or expect to use generative AI tools in their jobs within the next five years, again lower than the Northern European frontrunner average of 41%. Another survey by Ipsos also found that 35% of the Dutch population has already used generative AI at least once in 2023.
- While this generally suggests a fast pace of adoption, AI adoption is still in an early phase, and more complementary innovations, investments and commercial ventures around AI are needed to capture the full economic potential.

Note: Public First survey conducted in summer 2023 and Q1 2024 for Estonia. Nationally representative consumer and business polling. Respondents of the survey include the Netherlands (NL), Sweden (SE), Denmark (DK), Belgium (BE), Luxembourg (LU), Finland (FI), Norway (NO) and Estonia (EE). Worker responses are not available for Finland, Sweden and Estonia.
Source: Implement Economics based on Public First country surveys and Ipsos survey.

Drivers of AI adoption suggest that the Netherlands has yet to transform their lead in AI talent to commercial ventures and start-up activity

The Netherlands' AI capacity according to the Tortoise Global AI Index

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



- The Netherlands leads Northern European frontrunners when it comes to availability of AI-related talent and ranks 8th globally – though this is still significantly below the level of the United States.
- The Netherlands is otherwise best positioned on the early foundational drivers of AI adoption that ensure a safe and reliable AI-ready environment: operating environment, 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, the Netherlands lags behind globally on AI innovation drivers (talent, research, development and commercialisation). Here, the United States is far ahead globally, which is largely due to scale in AI capacity.
- Current gaps suggest that the Netherlands is at risk of losing its frontrunner position and needs to focus on strengthening its strategic efforts in AI and AI-related innovation drivers.

Note: The Global AI index looks at seven sub-pillars for AI capacity: talent (availability of skilled practitioners in AI solutions, including IT and STEM graduates, data scientists, AI professionals etc.), infrastructure (download speed, supercomputing capabilities etc.), operating environment (regulation, trust, 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 startup activity, investments, adoption of AI technologies by companies etc.)
Source: Implement Economics based on Tortoise Media.

07

The way forward to capture the benefits of AI

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

Potentials, pitfalls and paradoxes

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

- AI enables us to do things better and work more efficiently. It also enables us to do better things. With AI, we can focus on the best parts of our jobs and leave the rest to AI. Yet, AI is still in its infancy and how it is applied is highly uncertain.
- The benefits cannot be taken for granted as multiple pitfalls can stand in the way of the potential.

- AI policy is filled with paradoxes and 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 technology with a predetermined future that unfolds quickly or slowly. AI is new, **uncertain** and malleable. AI will develop in different directions and will involve **multiple paradoxes** that policymakers will need to navigate.

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 failing 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?

Note: For more background AI policies and principles, see: **OECD**, **IMF** and **Google**.

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

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

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

To navigate these choices, this report offers five perspectives:

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

- Invest in long-term public AI research and encourage private investment in basic and applied research at national and EU level.
- Foster industry, government and university innovation partnerships to undertake pre-commercial AI research projects.
- Support innovation on top of already developed foundational models and findings, e.g. by leveraging the new EU AI innovation package.
- Make 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.

Create a conducive and aligned AI **regulation**

- Avoid siloed approaches to AI regulation to minimise the risk of misalignment and fragmentation by increased international co-operation.
- Ensure copyright rules that support innovation and creativity and preserve the incentive to generate new content.
- Adopt a risk-based approach to AI regulation to provide clarity to developers, adopters and users about which uses are disallowed.
- Encourage privacy and security principles so that individuals' personal data is safeguarded.

Promote widespread **adoption** and universal accessibility

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

- 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 reskilling workers for other jobs.
- Ensure a flexible labour market and continuous lifelong training enabling new opportunities in the labour market.

Invest in AI **infrastructure** and compute power

- Ensure the right incentive and regulation for public and private entities to invest in AI infra-structure and compute capacity such as graphics processing and supercomputers needed to drive the powerful AI models.
- Enable trusted cross-border data flows in trade agreements and ensure regulatory interoperability and non-discrimination in the EU.
- Support the building of cross-border AI infrastructure and subsea cables through initiatives such as the G7 partnership for global infrastructure and investment.
- Reduce electricity emissions from data centres by promoting ambitious decarbonisation strategies such as 24/7 Carbon-Free Energy.

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

The Netherlands can draw on policy choices of other frontrunners

The Netherlands leads on AI talent … **… and can draw on best-practice initiatives from other Northern European frontrunners**

Indicator	Talent	Operating environment	Infrastructure	Research	Development	Commercial
Northern European leaders						
Best practice	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.	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.	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 being an **implementation leader** 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&D. **Example:** AI & Robotics Estonia (AIRE) • Supports Estonian industrial companies in adopting smart digital solutions in the field of AI and robotics. • Provides funding and expertise through training and consulting as well as by connecting companies with service providers.

Note: Luxembourg scores highest among Northern European frontrunners for infrastructure, largely due to high per capita supercomputing capacity, but we find it more appropriate to refer to Finland (ranking second among its peers in infrastructure) for best practice.

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

Grow R&D by local innovators

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

Dilemma

Ensuring performance of AI technology in a Dutch context

and

Driving application of leading global AI technology

Recommendation

- The Netherlands invests heavily in a large language model (GPT-NL). While not essential to achieving the economic potentials, it would be important to leverage the investment to create private sector AI innovation and investment.
- As one of the first countries, the Netherlands launched a *generative AI vision* in early 2024. When putting the vision into action, focus should be on growing local innovation and development of market-ready commercial ventures. Inspiration could be drawn from e.g. Finland's partnerships.

Accelerate commercial uptake

Promote widespread **adoption** and universal accessibility

Dilemma

Encouraging AI-based business models in tech-focused startups

and

Facilitating AI adoption in traditional, established companies

Recommendation

- The Netherlands could strengthen initiatives like the "AI for Netherlands" programme by enhancing focus on AI start-ups and scale-ups and generally strengthen commercial ventures in AI, seeking inspiration from e.g. Estonia.
- The Netherlands would also benefit from increased industrial adoption of AI which will need more AI-driven innovation within traditional industries and scale-ups. The Netherlands could boost existing industry-university partnerships (ICAI Labs) to pave the way for further AI adoption.

Retrain and upskill workforce

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

Dilemma

General AI upskilling across population

and

Targeted re-skilling of groups affected by AI

Recommendation

- The **Netherlands** is considered a leader in Europe with AI talent development; yet the country still faces a significant talent gap in AI expertise. To bridge this gap, the country could enhance its efforts to cultivate the pool of specialised AI expertise by offering AI-focused scholarships and opportunities for mid-career reskilling and bolstering initiatives like Kickstart AI.
- The Dutch government can expand initiatives such as the "AI for Everyone" programme, enhancing the population's overall AI skills.

Note: For more details on policies, see Generative AI Vision 2024, OECD AI Observatory and Google's policy paper on "AI Opportunity".

08

Annex

Modelling the impacts of generative AI in the Netherlands.

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Modelling the economic opportunity for the Netherlands

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 for 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 a O*NET defined scale of difficulty 1-7, no automation potential is assumed).

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

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

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

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

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

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