

Effects of GenAI on the German labor market

An opportunity to mitigate skilled labor shortages

November 2023



An opportunity to mitigate skilled labor shortages

1 Germany is experiencing skilled labor shortages

2 GenAI can unlock and boost productivity to mitigate these shortages

3 Germany has a promising landscape for GenAI adoption

- Share of businesses affected by **skilled labor shortages** have **increased 5-fold** since 2009. p.4
- **General open positions have increased 4-fold** since 2004 p.5
- GenAI has the **potential to greatly enhance Germany's competitiveness by boosting productivity growth by an estimated 18%**. GenAI can also help address skilled labor shortages through innovation. p.12
- This primarily concerns: **Professions in workforce training, STEM, and healthcare** that have both the greatest need (represented by the share of job vacancies per share of employment in an occupation group – of >0.9) and greatest GenAI potential (>17 pp) for labor shortage mitigation p.15
- Greatest profitable effects for **a) employees in highly professionalized careers** (e.g., legal and business, 36 pp) and **b) higher education** (e.g., tertiary education, 24 pp), as well as **c) high-earning employees** (e.g., top earners, 12 pp) p.14 p.13 p.16
- Germany boasts the **highest number of GenAI startups (>500) in the EU** private sector p.20
- Germany holds a **top-five global ranking in computing power, academic publications, and patents**, demonstrating its competitiveness in tech and research. p.22
- Germany **ranks second among OECD countries in AI skill penetration**, with 1.7 out of every 100 workers reporting AI skills, only slightly behind the United States. p.23

Agenda

The skilled labor shortage in Germany

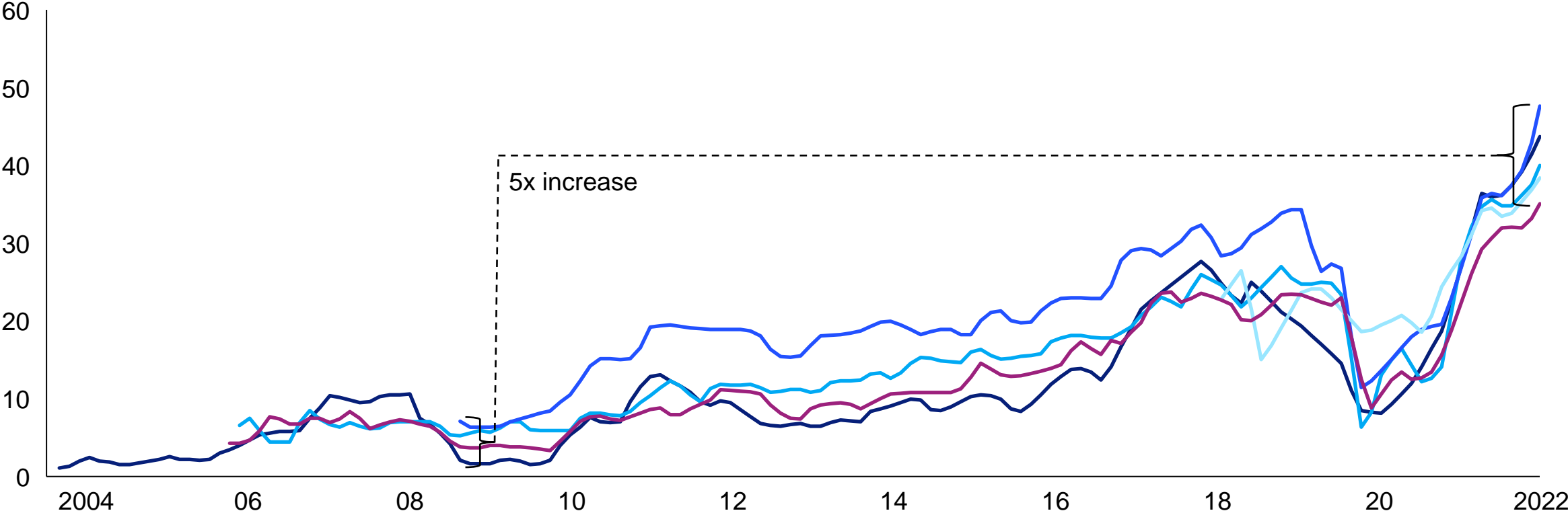
The potential of GenAI to increase productivity

The GenAI landscape in Germany

At the end of 2022, ~50% of businesses reported they had been affected by skilled labor shortages, marking a 5x increase since 2009

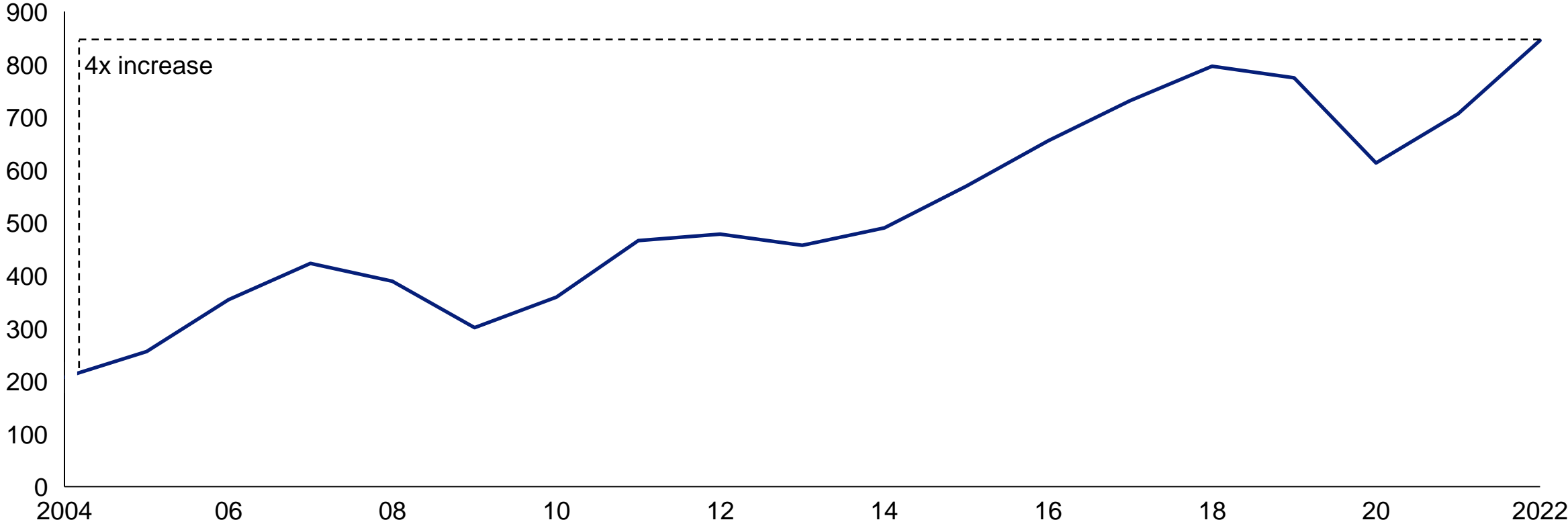
— Manufacturing industry — Retail — Services — Construction — Wholesale

Share of enterprises affected by skilled labor shortages according to sectors in Germany,
Reported to the ifo Institute, percent



Skilled labor shortage sentiment is corroborated by reported open positions quadrupling between 2004 and 2022

Absolute number of open positions in Germany,
Reported to the Federal Employment Agency in Germany, thousands



Source: Federal Employment Agency (Bundesagentur für Arbeit), labor market in numbers

Agenda

The skilled labor shortage in
Germany

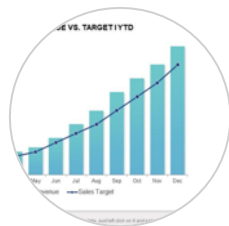
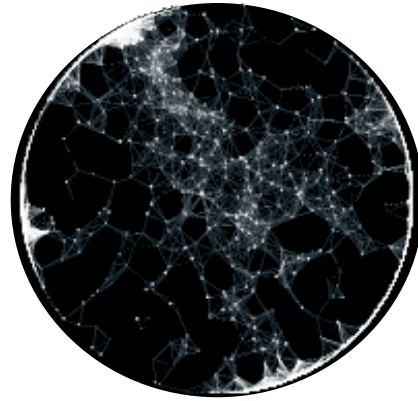
**The potential of GenAI to
increase productivity**

The GenAI landscape in Germany

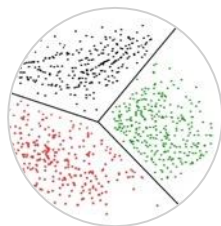
Background: GenAI is the natural evolution of analytical AI, addressing a novel set of challenges to realize large automation potential, thus unlocking meaningful productivity potential

Analytical AI

Analytical AI algorithms are used to solve analytical tasks faster and more efficiently than humans — e.g., being able to classify, predict, cluster or evaluate data



Forecasting sales



Segmenting customers



Conducting sentiment analyses



Generative AI

GenAI algorithms are used to either create new content on par with humans, or greatly enhance humans' abilities — e.g., generating audio, code, images, text, and videos



Designing concepts



Creating marketing or social media copy



Generating code

Example: By unlocking productivity potential, GenAI can address skilled labor shortages in manufacturing, resulting in fewer vacancies due to more internal task completion

Illustrative – computer engineer



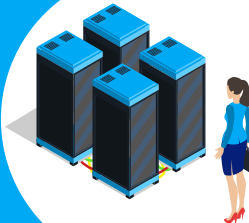
01 Sara's current job as a computer engineer

Sara is a computer engineer for a manufacturing company who shifts between 17 unique activities, including testing the performance of electrical equipment and collaborating with technical personnel. Her company is struggling to find skilled personnel.

Sara's company adopts new technologies

Sara's company invests in real-time data analytics and machine-learning software to help monitor the computer systems in the manufacturing plant. The company also purchases several robotics and automation systems to streamline production.

02



03 Sara's time rearrangement and productivity gains

With automation, the resulting free time creates increased productivity and innovation: Sara can now operate an adjacent workstation, which is underutilized, as her company has not been able to recruit a suitably skilled new colleague. Moreover, she invents a novel solution to a computer-design problem at the plant.

Fewer vacancies and more innovation in 2030

Various workflows have been optimized. Thus, numerous positions are now covered internally where the company had previously struggled to find suitably skilled colleagues. Moreover, Sara's company has implemented various computer-design improvements, which speeds up production.

04



Example: By unlocking productivity potentials, GenAI can meet skilled labor shortages in workforce training resulting in less vacancies and better apprentice performance and satisfaction

Illustrative – educator and workforce training

02 John's organization has adopted new technologies

John's organization invests in educational generative AI software which can analyze the needs, constraints, and preferences of each apprentice, and subsequently offers tailored content and learning styles. Moreover, the new software can create simulation-based and individualized trainings with much less input from John.

02



01 John's current job as a workforce trainer

John is a workforce trainer in a vocational school who shifts between 13 unique activities, including frontal teaching, preparing individual work samples, development conversations, and assessing the apprentices' individual outputs. His organization struggles to find skilled trainers.



04

04 Less vacancies and better apprentice performance and satisfaction in 2030

Various individualized courses and modules have been implemented across the organization's workforce training portfolio. Hence, now significantly less trainer input is required. Therefore, the average performance of apprentices has increased, and the personal satisfaction of apprentices has improved as they now receive tailored training while having more space for deeper exchange with trainers on a more personal level..

03

03 John's time rearrangement and productivity gains

With automation, the resulting free time creates increased productivity and innovation: John can now increase the number of apprentices under his supervision from 20 to 30 which is great for the organization, as it has been struggling to recruit another workforce trainer. Moreover, he implemented data-driven informed development conversations and additionally introduced a new innovative course offering individualized remote work simulation.

To assess GenAI productivity potentials, we analyzed around 2,100 distinct work activities and ~850 professions

ILLUSTRATIVE



Capability requirements

Physical

- Fine motor skills/dexterity
- Gross motor skills
- Navigation
- Mobility

Sensory

- Sensory perception

Cognitive

- Retrieving information
- Recognizing known patterns/categories (supervised learning)
- Generating novel patterns/categories
- Logical reasoning/problem solving
- Optimizing and planning
- Creativity
- Articulating/display output
- Coordinating with multiple agents

Natural language processing (NLP)

- Understanding natural language
- Generating natural language

Social

- Social and emotional sensing
- Social and emotional reasoning
- Emotional and social output

In Germany, GenAI promises greater productivity potential in complex processes, such as decision making and collaboration...

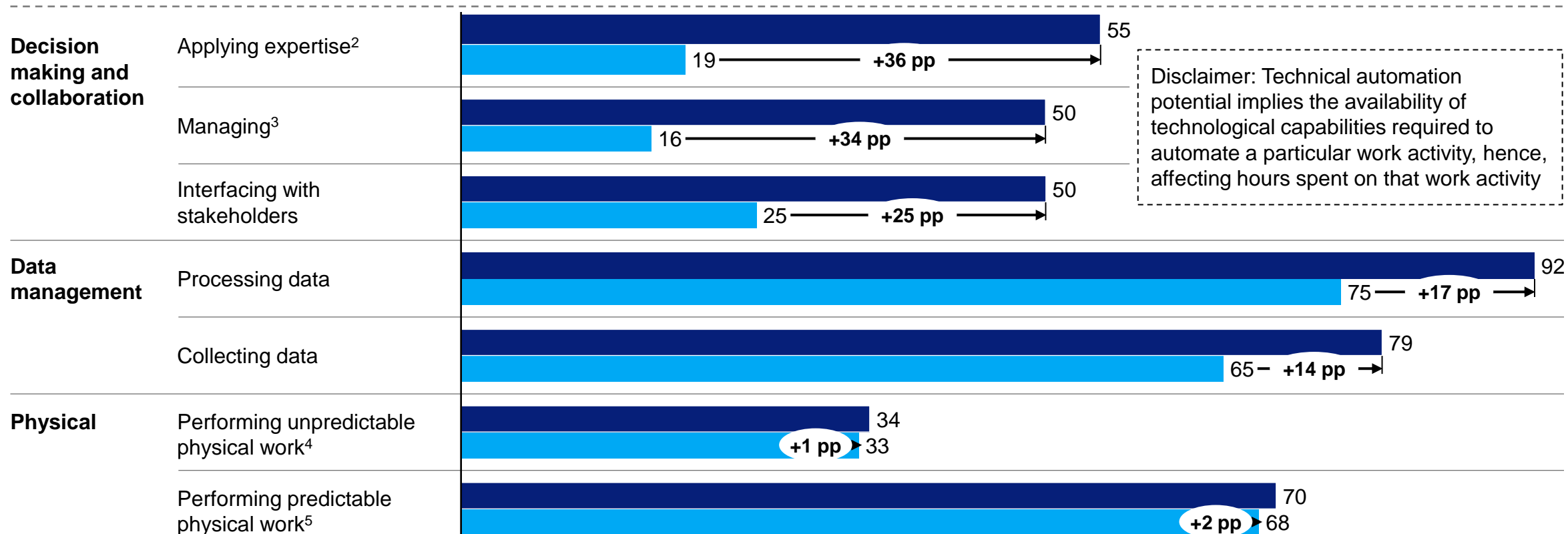
■ With GenAI

■ Without GenAI¹



Overall technical automation potential, comparison by midpoint scenarios, percent

Activity groups



Disclaimer: Technical automation potential implies the availability of technological capabilities required to automate a particular work activity, hence, affecting hours spent on that work activity

1. Previous assessment of work automation before the rise of GenAI, including analytical AI, machine learning, and deep learning

2. Applying expertise to decision making, planning, and creative tasks

3. Managing and developing people

4. Performing physical activities and operating machinery in unpredictable environments.

5. Performing physical activities and operating machinery in predictable environments

Note: Figures may not sum, because of rounding

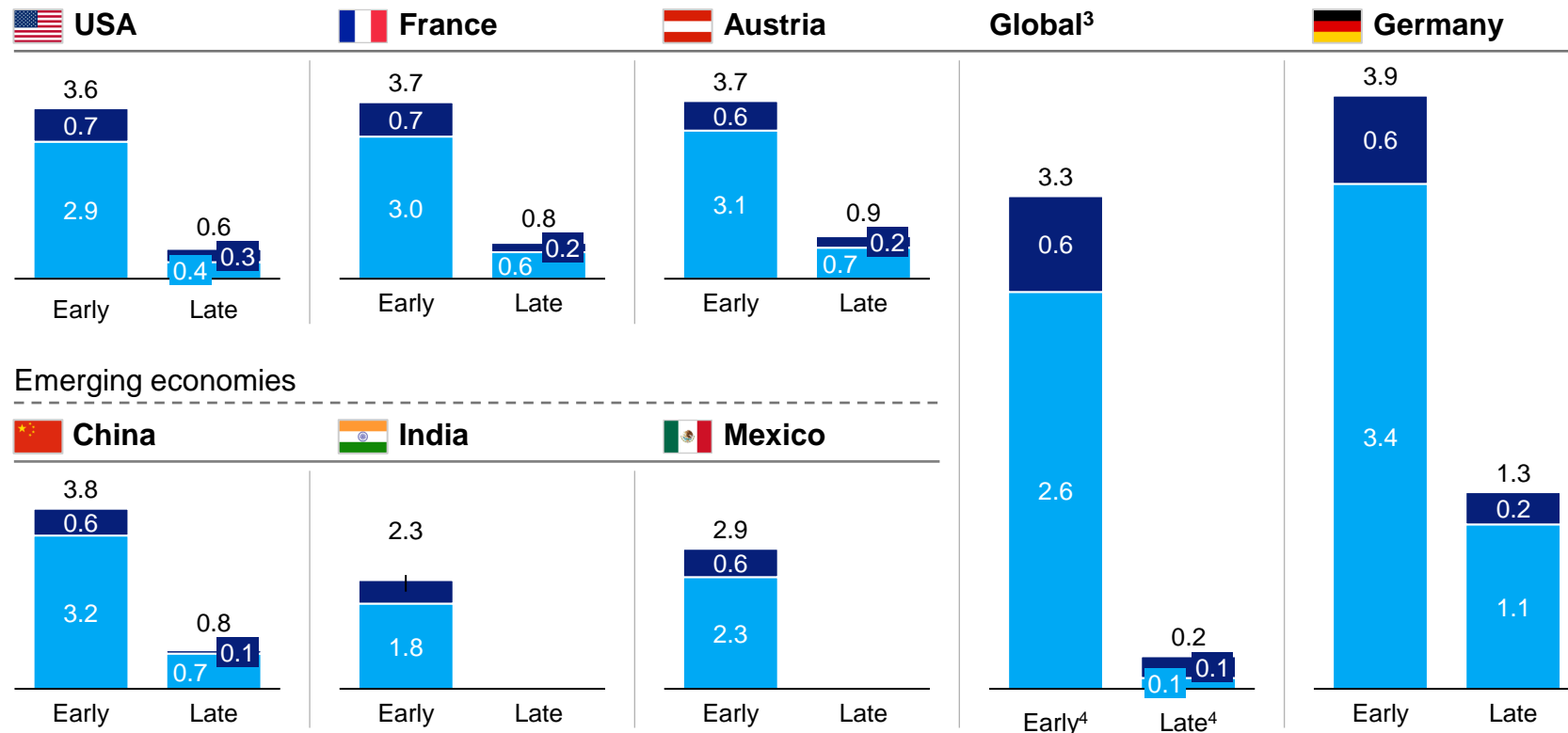
Source: McKinsey Global Institute analysis

...thus, GenAI makes it possible to contribute significantly to Germany's competitiveness

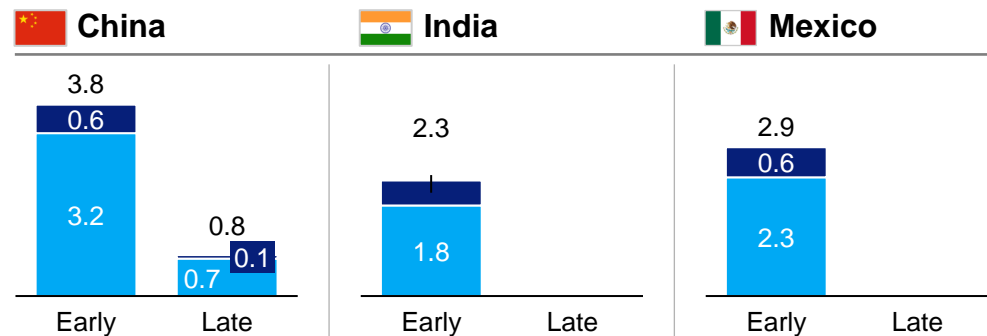
■ With GenAI ■ Without GenAI² 

Productivity impact from automation by scenario, 2022-40, CAGR,¹ percent

Developed economies



Emerging economies



Key implications for Germany

Early (vs. late) adoption of automation potential will lead to an **additional ~EUR 2,600bn in GDP by 2040**

Early additional adoption of GenAI alone can **increase Germany's GDP by ~EUR 585bn (13%) by 2040**

GenAI can increase **automation impact on productivity growth by ~18%**, significantly advancing Germany's competitive position

1. Based on the assumption that automated work hours are reintegrated into work at today's productivity level
 2. Previous assessment of work automation before the rise of GenAI
 3. Based on 47 countries, representing about 80% of global employment
 4. Automation scenarios (early: early adoption of GenAI technology capabilities; late: late adoption of GenAI technology capabilities, expert based)
 Note: Figures may not sum, because of rounding.

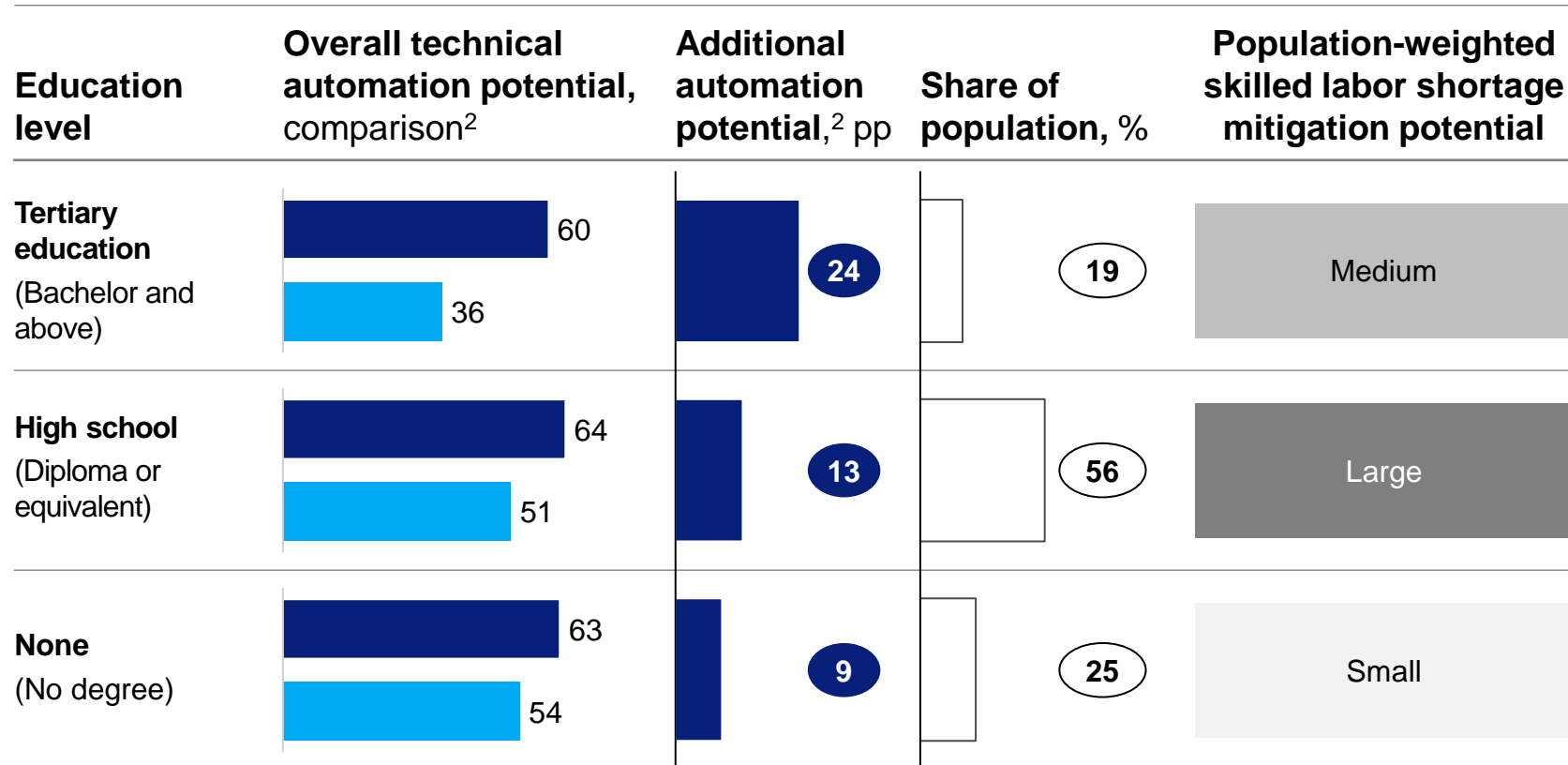
Education: Greatest labor shortage mitigation potential for tertiary education level while societally for high school education level

■ With GenAI

■ Without GenAI¹



Impact of GenAI on technical automation potential in midpoint scenario, 2023, percent



Key implications for Germany

Additional impact of GenAI is expected to be **highest for those with tertiary-level education (24 pp)**

Example: Computer engineers (STEM) like Sara or workforce trainers like John

The **population-weighted skilled labor shortage mitigation potential** is highest for high-school-degree holders (55.9% population share)

Example: Community health care worker or pharmacy technician

1. Previous assessment of work automation before the rise of GenAI

2. Based on US extrapolation

Professions: GenAI holds the greatest opportunities for workforce training, business and legal, and STEM

■ With GenAI

■ Without GenAI¹



Impact of GenAI on automation potential sorted by additional GenAI potential, percent

Professions	Overall technical automation potential, comparison by midpoint scenarios, 2023, %	Automation potential shift, pp	Share of German employment %	Employment-weighted skilled labor shortage mitigation potential	World automation potential shift, pp
Educator and workforce training	54 (With GenAI), 14 (Without GenAI)	40	3	Medium	39
Business/legal professionals	68 (With GenAI), 32 (Without GenAI)	36	6	High	30
Creatives and arts management	51 (With GenAI), 22 (Without GenAI)	29	1	Medium	25
STEM professionals	57 (With GenAI), 28 (Without GenAI)	29	7	High	29
Office support	85 (With GenAI), 63 (Without GenAI)	22	19	High	21
Community services	67 (With GenAI), 45 (Without GenAI)	22	6	High	26
Managers	49 (With GenAI), 29 (Without GenAI)	20	3	Medium	17
Health professionals	45 (With GenAI), 28 (Without GenAI)	17	2	Medium	14
Customer service and sales	70 (With GenAI), 60 (Without GenAI)	10	9	Medium	12
Production work	75 (With GenAI), 67 (Without GenAI)	8	13	Medium	9
Property maintenance	37 (With GenAI), 30 (Without GenAI)	7	4	Low	9
Transportation services	59 (With GenAI), 53 (Without GenAI)	6	3	Low	7
Health aides, technicians, and wellness	40 (With GenAI), 34 (Without GenAI)	6	9	Medium	9
Builders	55 (With GenAI), 50 (Without GenAI)	5	5	Low	4
Food services	66 (With GenAI), 61 (Without GenAI)	5	4	Low	8
Mechanical installation and repair	68 (With GenAI), 63 (Without GenAI)	5	4	Low	6
Agriculture	66 (With GenAI), 62 (Without GenAI)	4	1	Low	4
Total	65 (With GenAI), 49 (Without GenAI)	16	100		12

Key implications for Germany

Greatest skilled labor shortage mitigation potential in Germany in the areas of **workforce training (40 pp)**, **business and legal (36 pp)**, and **STEM (29 pp)**

Employment-weighted labor shortage mitigation potential in Germany is largest for **business and legal, STEM, office support, and community services**

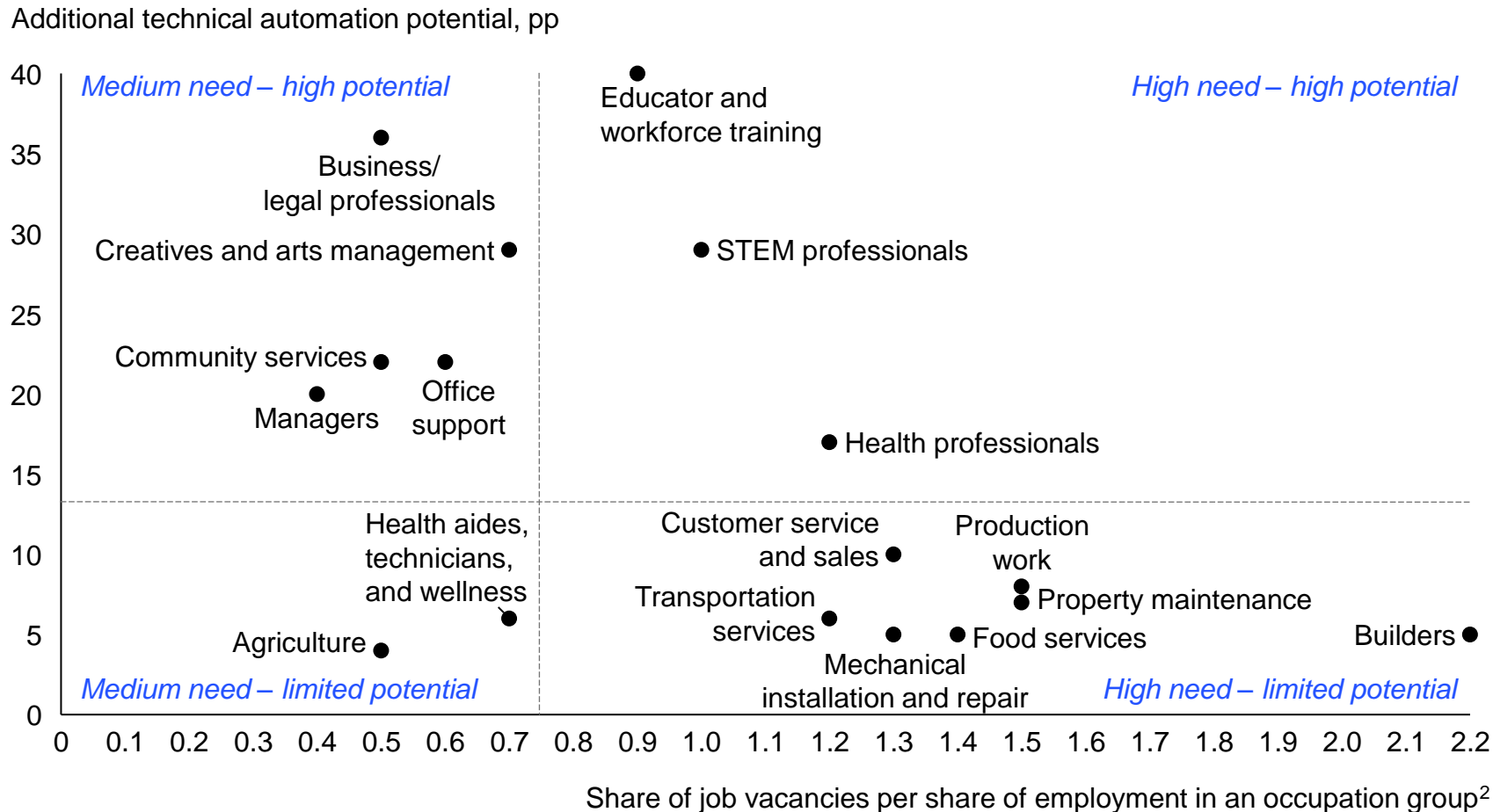
Based on relative employment in Germany and the world, **STEM and community services might profit more in Germany**, while workforce training and customer service might profit less than the global average

1. Previous assessment of work automation before the rise of GenAI. | Note: Figures may not sum, because of rounding.

Profession: GenAI has greatest labor shortage mitigation potentials in high job vacancy concentration areas, such as educator training, STEM, and Health



Job-vacancy concentration² and corresponding automation shift in Germany



Key implications for Germany



- **Highest need (≥ 0.9) and potential** for GenAI for skilled labor shortage mitigation in **workforce training (40 pp)**, **STEM (29 pp)**, and **health professions (17 pp)**
- This applies to **workforce trainers** like John or computer engineers (STEM) like Sara
- **High potential (≥ 20 pp) but medium need** for business, creatives, or office support, and high needs but limited potential (≤ 10 pp) for builders

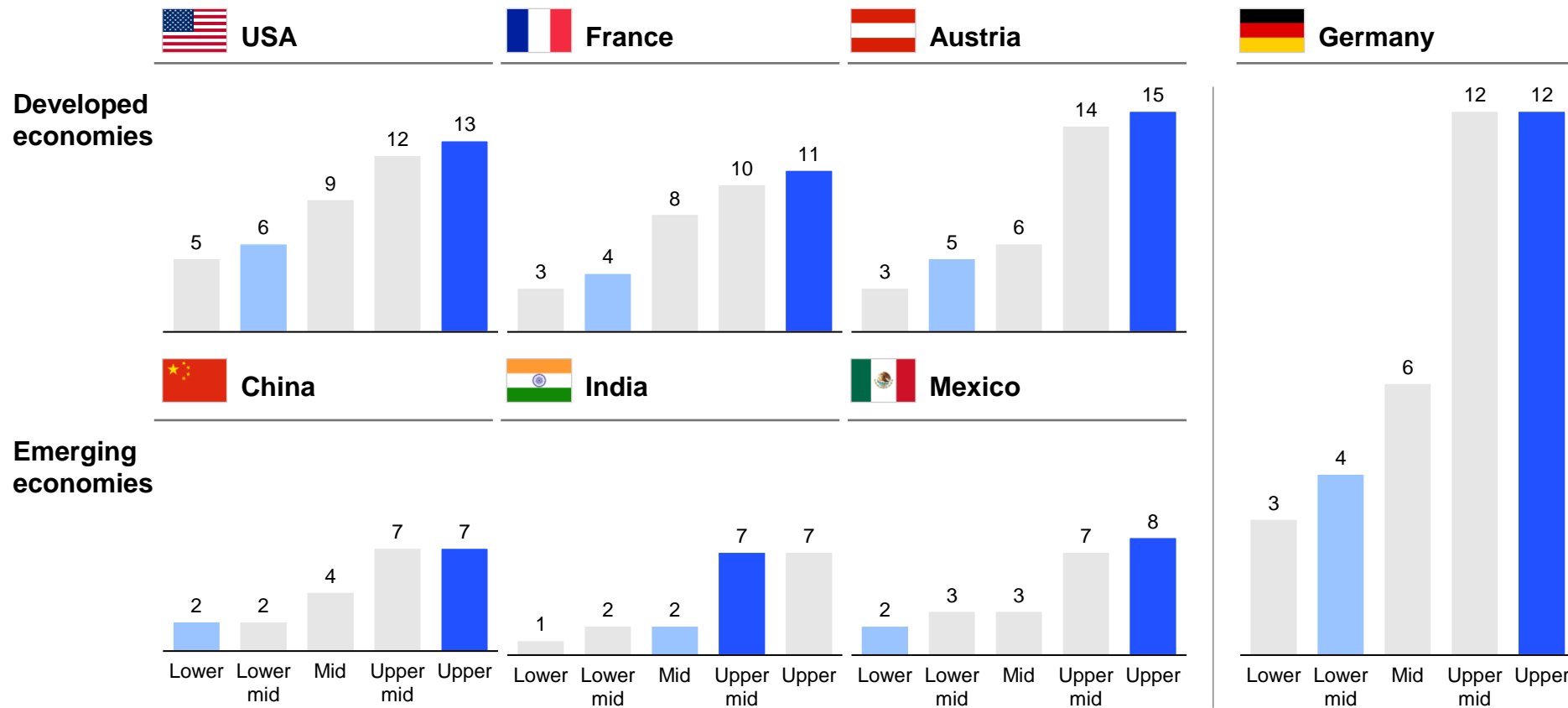
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1. Previous assessment of work automation before the rise of GenAI. | 2. Share of job vacancies divided by the share of employment within an occupation group indicating the concentration of open job positions per actual employment

Wages: GenAI is expected to have the biggest labor shortage mitigating impact in areas with high wages

- Largest increase in automation adoption from GenAI
- Largest automation adoption without GenAI¹

Additional GenAI automation adoption vs. without GenAI per wage group,² 2030, percentage points



Key implications for Germany

In Germany, the highest wage group (quintile) will experience the greatest additional automation potential (12 pp) and the corresponding labor shortage mitigation potential from GenAI

Largest automation adoption without GenAI is highest for 4th wage group (quintile), with 37% post-GenAI versus 33% pre-GenAI

1. Previous assessment of work automation before the rise of GenAI
 2. Difference between automation potential without GenAI and additional automation potential with GenAI

Upskilling and attracting the right tech talent is the core task of public and private organizations in mitigating labor shortages



Building on existing capabilities and competencies

- 1 Upskilling/ reskilling for AI roles**
 - **Developing requirements** for the building and leadership development of GenAI core competencies
 - **Determining the cohorts** with upskilling needs
 - **Establishing a boot camp approach** to GenAI training
- 2 Training and coaching**
 - **Implementing improvements** for the training program based on early findings
- 3 Establishing a 'learning culture'**
 - **Involving senior management** to ensure support is provided
 - **Defining the behavioral and mindset changes** required for a learning culture
 - **Designing of competency building initiatives** (e.g., on feedback, coaching)



Recruiting of new tech talent

- **Analyzing the skills and competence profiles** of current employees and existing open positions that cannot be recruited from the labor market
- **Establishing employer branding** and targeted recruiting to attract best-in-class talent
- **Identifying the remaining necessary qualifications**
- **Creating a short-term hiring target** for recruiting the required role profiles
- **Developing a mid-term road-map** for strategic recruiting

Agenda

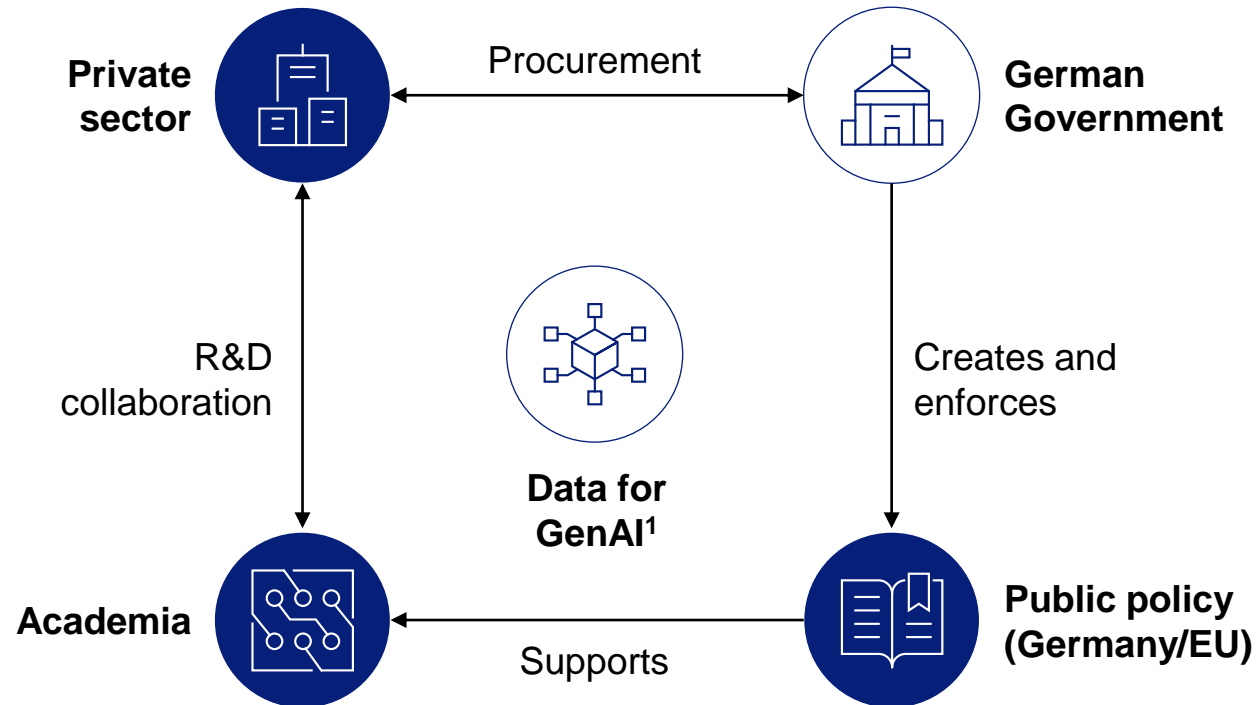
The skilled labor shortage in
Germany

The potential of GenAI to
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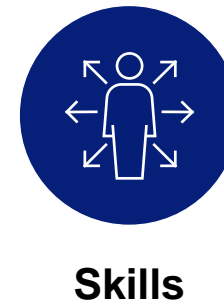
The GenAI landscape in Germany

Public and private actors must work toward a scenario with both the right operating environment and the availability of skills

Providing the right environment



Ensuring availability of skills



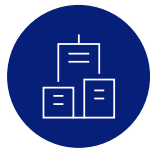
Key implications for Germany

The two key enablers for making use of GenAI in Germany are: The **right operating environment** and the **availability of relevant skills** in Germany

As they both have a **reinforcing effect** towards the respective counterpart they must be pursued simultaneously.

Quantitative deep dive on every stakeholder (group) on the following pages

1. We apply a GenAI focus to this framework because GenAI builds on the workforce, skillsets, and capabilities, which grew the AI market



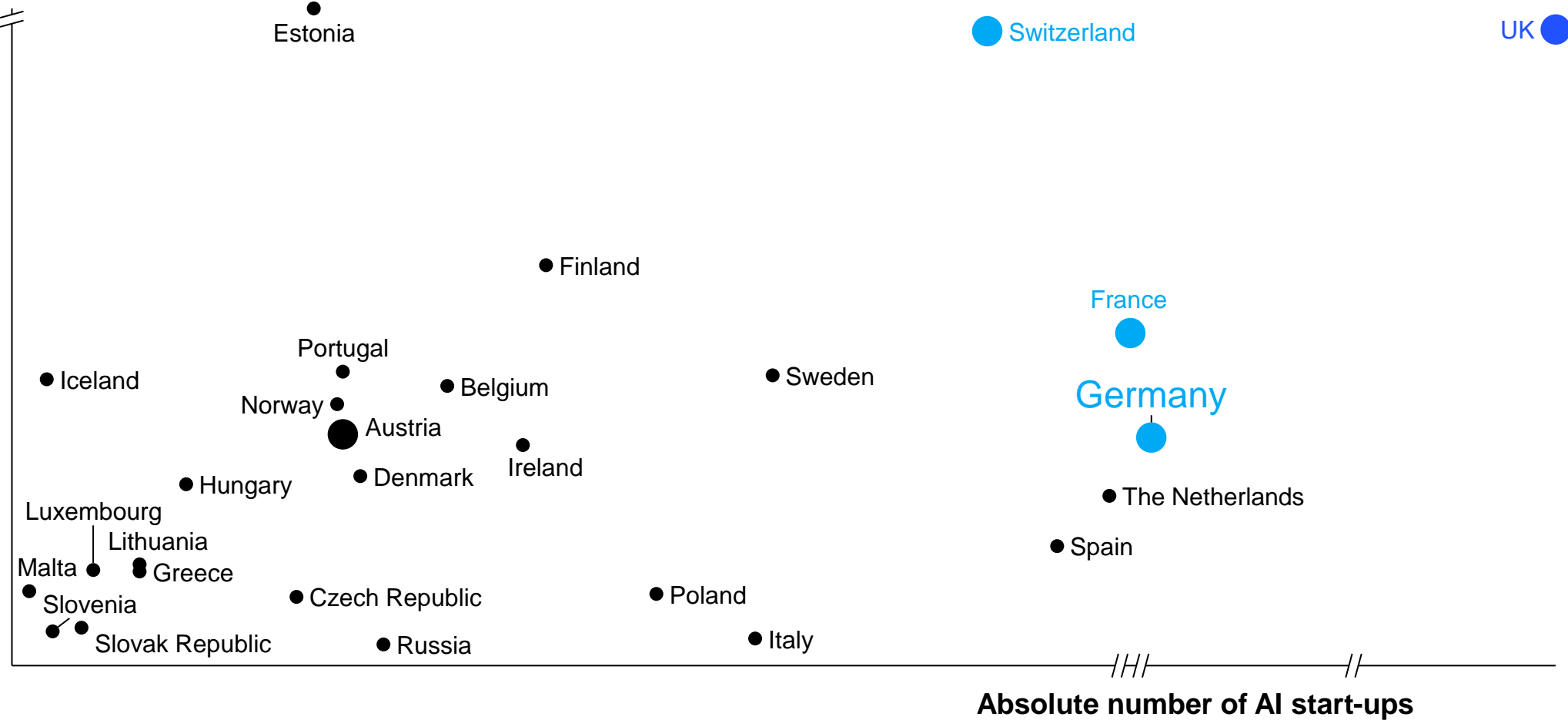
Germany is an entrepreneurial but underfunded country with great potential to becoming a European leader

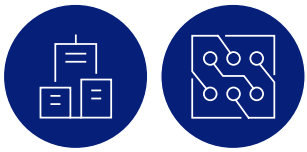
Private sector

European perspective

● Leader ● Emerging

Total funding of AI companies proportional to GDP

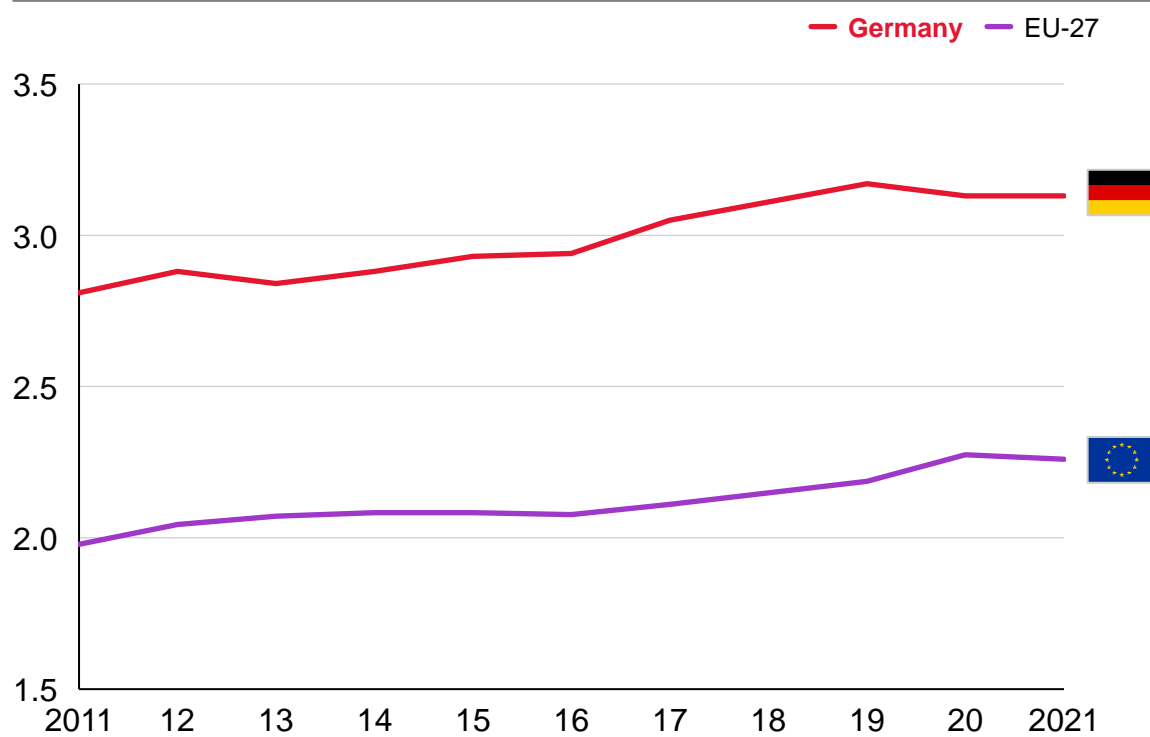




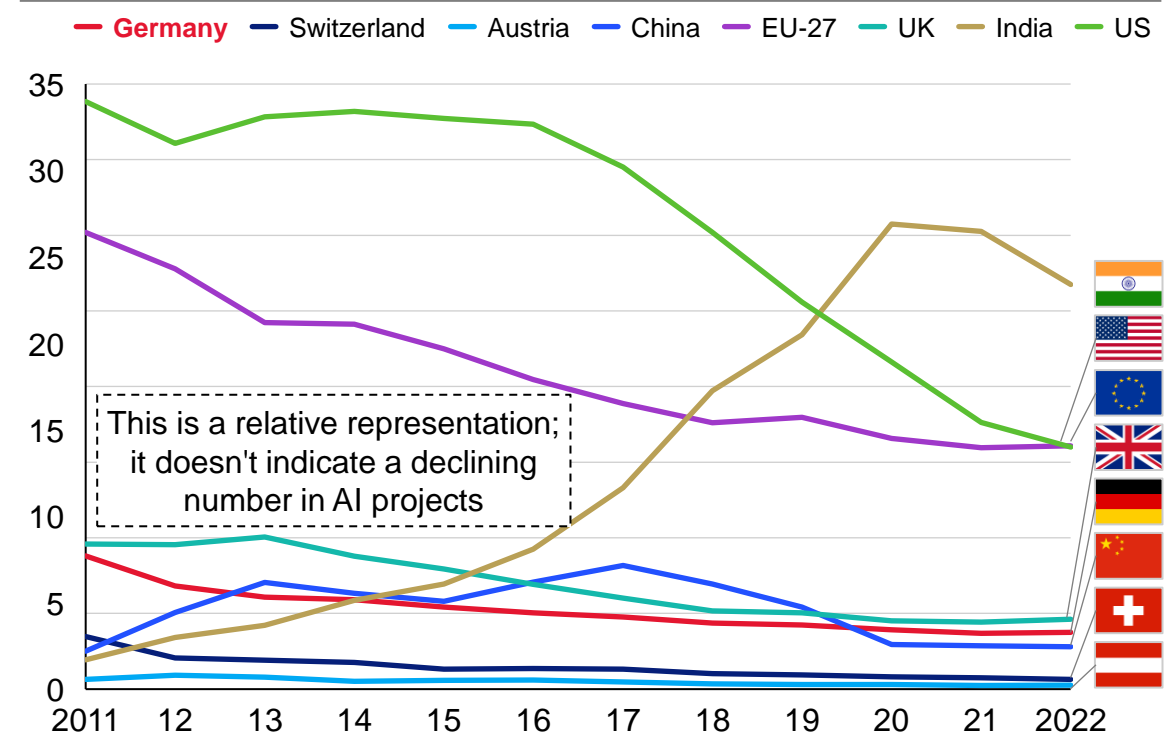
Private sector Academia

Germany's expenditure on R&D is increasing, whereas its contribution to AI projects has stagnated for years

Gross domestic expenditure on R&D, % of GDP



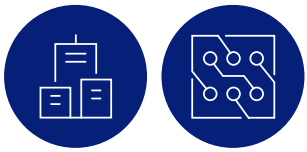
Number of AI projects by global comparison, % total AI projects¹



This is a relative representation; it doesn't indicate a declining number in AI projects

Number of AI projects (i.e., AI-related GitHub "repositories") as a fractional count based on the share of contributions (i.e., "commits") by country and over time

1. fractional count based on contributions

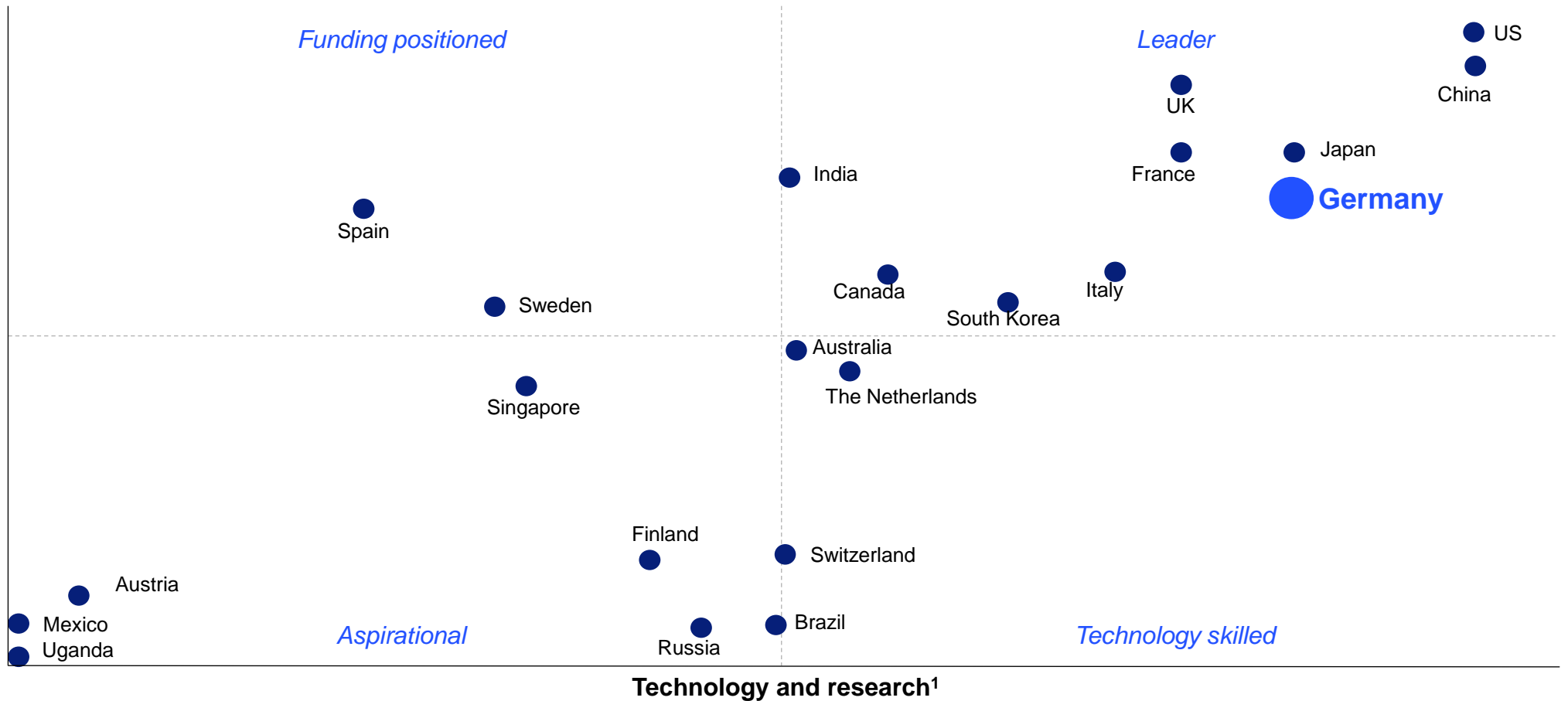


Private sector Academia

Germany is a leader in technology, but only keeping up with equally large countries in investments

Global perspective – relating to both AI and GenAI in 2022

Absolute private and public investments in AI companies



1. Technology and research contains country ranks by theoretical peak computer performance, number of processing cores, number of supercomputers, and maximal LINPACK performance achieved; the country ranks for the number of conference papers and journal papers; and the country rank for the number of patents

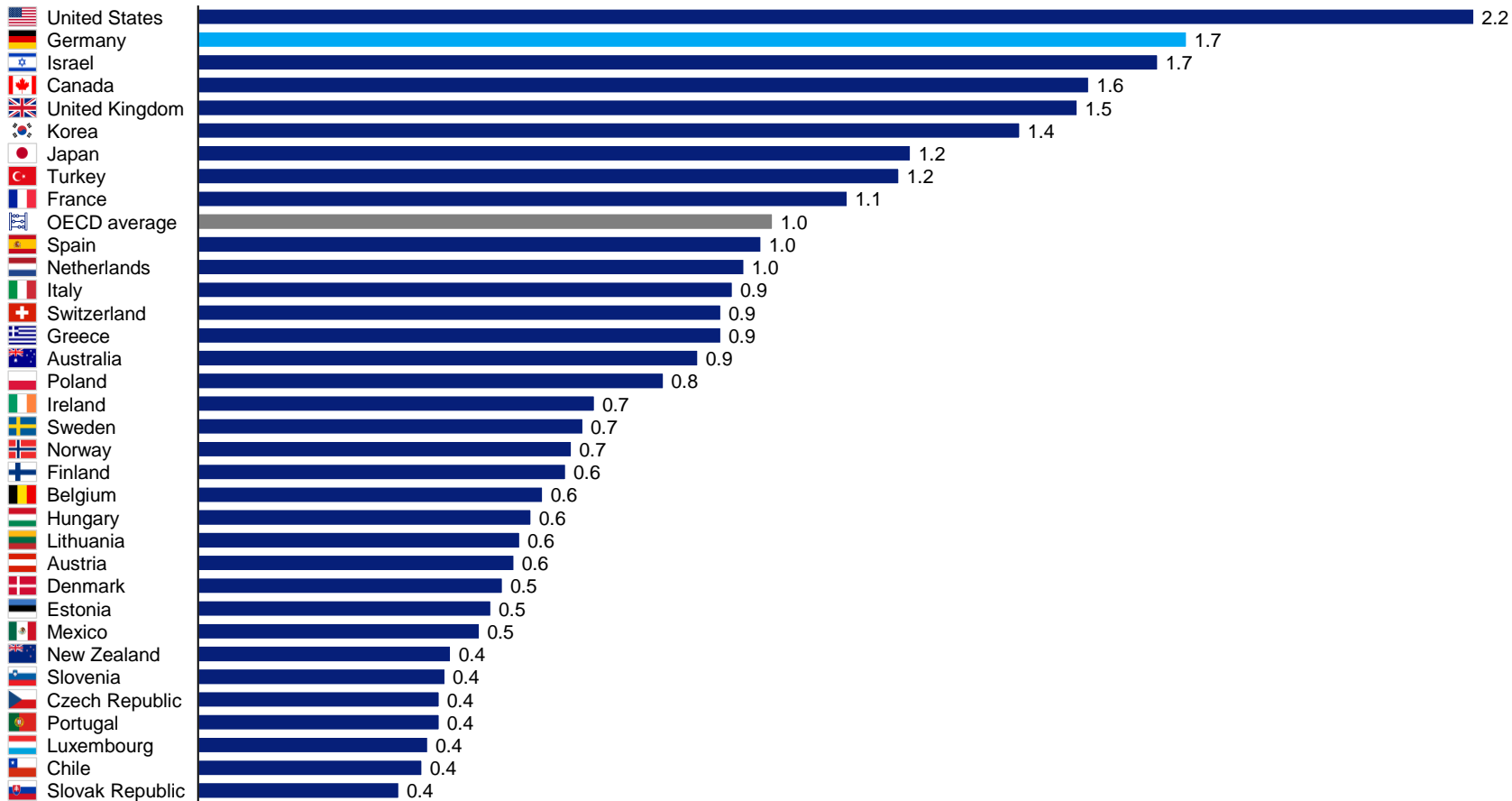


Skills

Germany has a high proportion of self-reported AI capabilities compared to the OECD average, trailing only the US

AI skill penetration of workforce

Prevalence of workers with AI skills as self-reported by LinkedIn members from 2015-2022 by country¹



1. A Country's AI skills penetration of 1.5 means that workers in that country are 1.5X more likely to report AI skills than workers in the benchmark

Source: Data from LinkedIn 2015-2022 accessed on Sep 20, 2023; self-reported; OECD.AI (2023)

Key implications for Germany

Germany has the **2nd highest AI skill penetration (1.5) in its workforce**, which is only surpassed by the US with a penetration factor of 2.2

German workers are 1.7x likely to report AI skills than workers in the OECD benchmark

Germany is thus in the group of leading AI nations, like the US, Israel, Canada, and the UK

McKinsey
& Company

