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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

- 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

2 GenAI can unlock and boost productivity to mitigate these shortages

- 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

3 Germany has a promising landscape for GenAI adoption

- 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

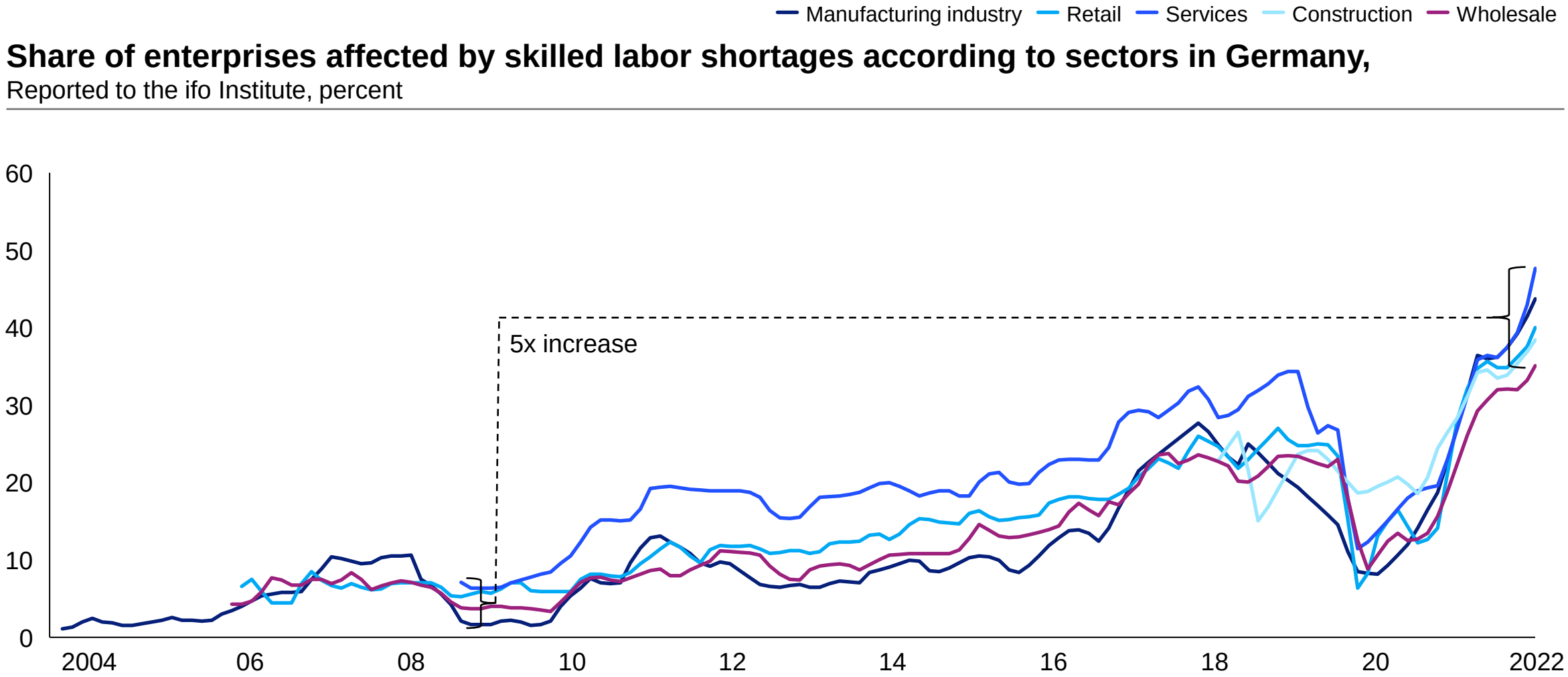
Agenda

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



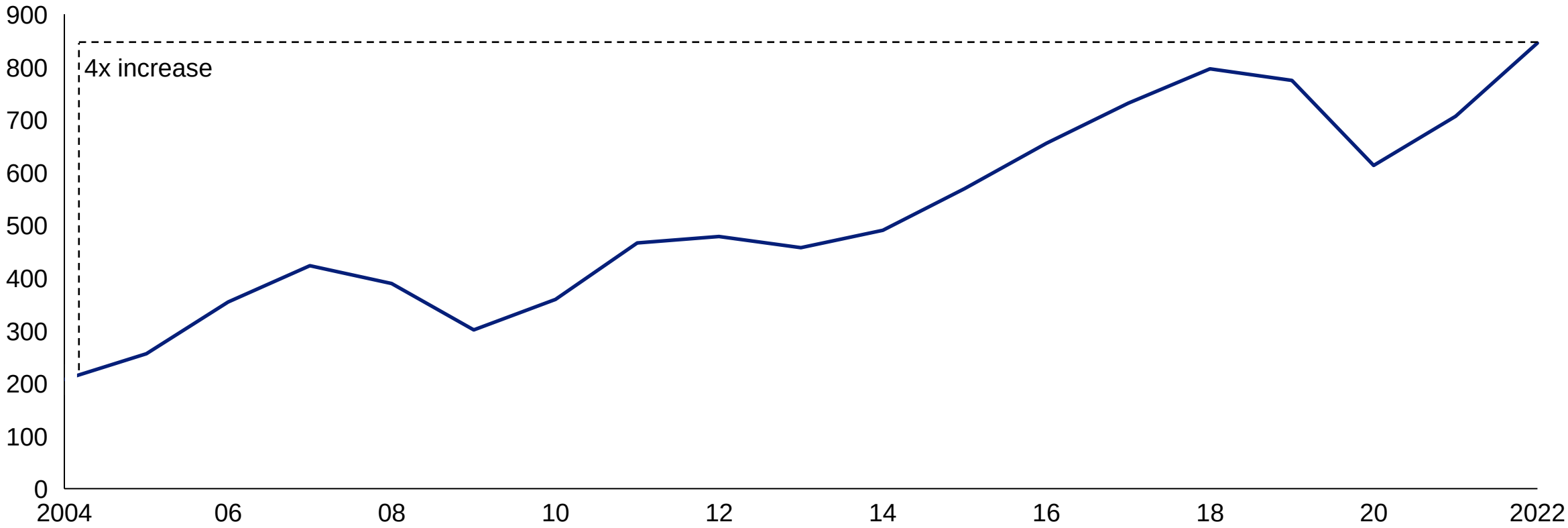
Share of enterprises affected by skilled labor shortages according to sectors in Germany,
Reported to the ifo Institute, percent

Source: ifo Institute, ifo Konjunkturumfragen

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

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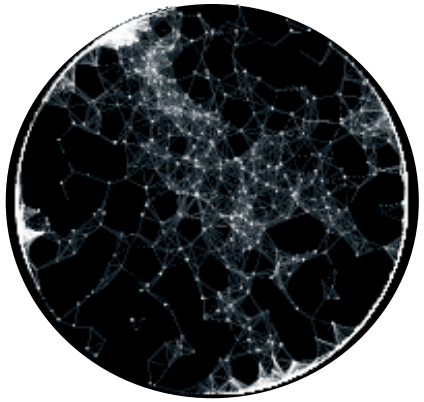
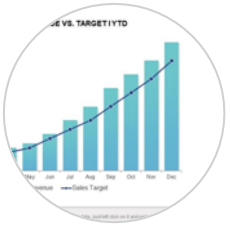
The GenAI landscape in Germany

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

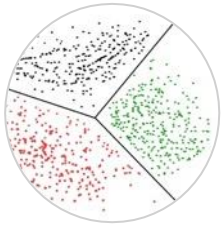
Analytical AI

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

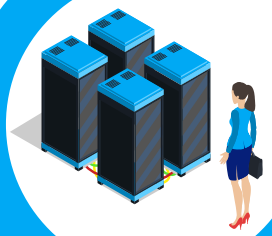
Sara’s current job as a computer engineer

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.

02

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.



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.

04

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.

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

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..

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.

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.

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.

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

ILLUSTRATIVE

Professions	Answers about products and services
1 Employees in retail and sales	Greet customers
2 Employees in food and beverage service	Clean and maintain work areas
3 Teachers	Demonstrate product features
4 Health practitioners	Process sales and transactions
• ... • … • …	• ... • … • …

~850 professions

~2,100 activities assessed across all professions

Source: National Labor Offices, Occupation Information Network; McKinsey Global Institute analysis

Capability requirements

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

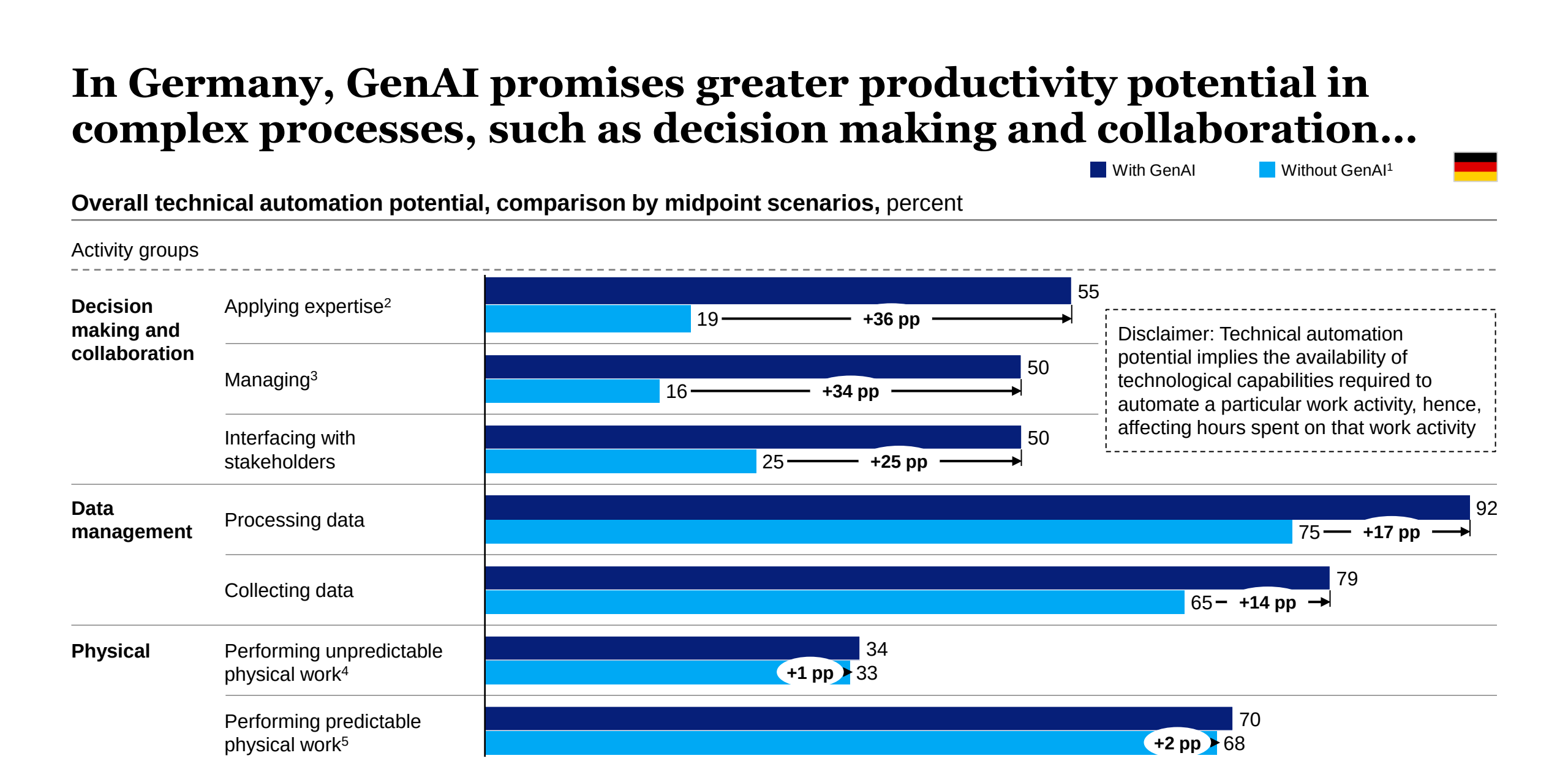
Sensory
- Sensory perception

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...



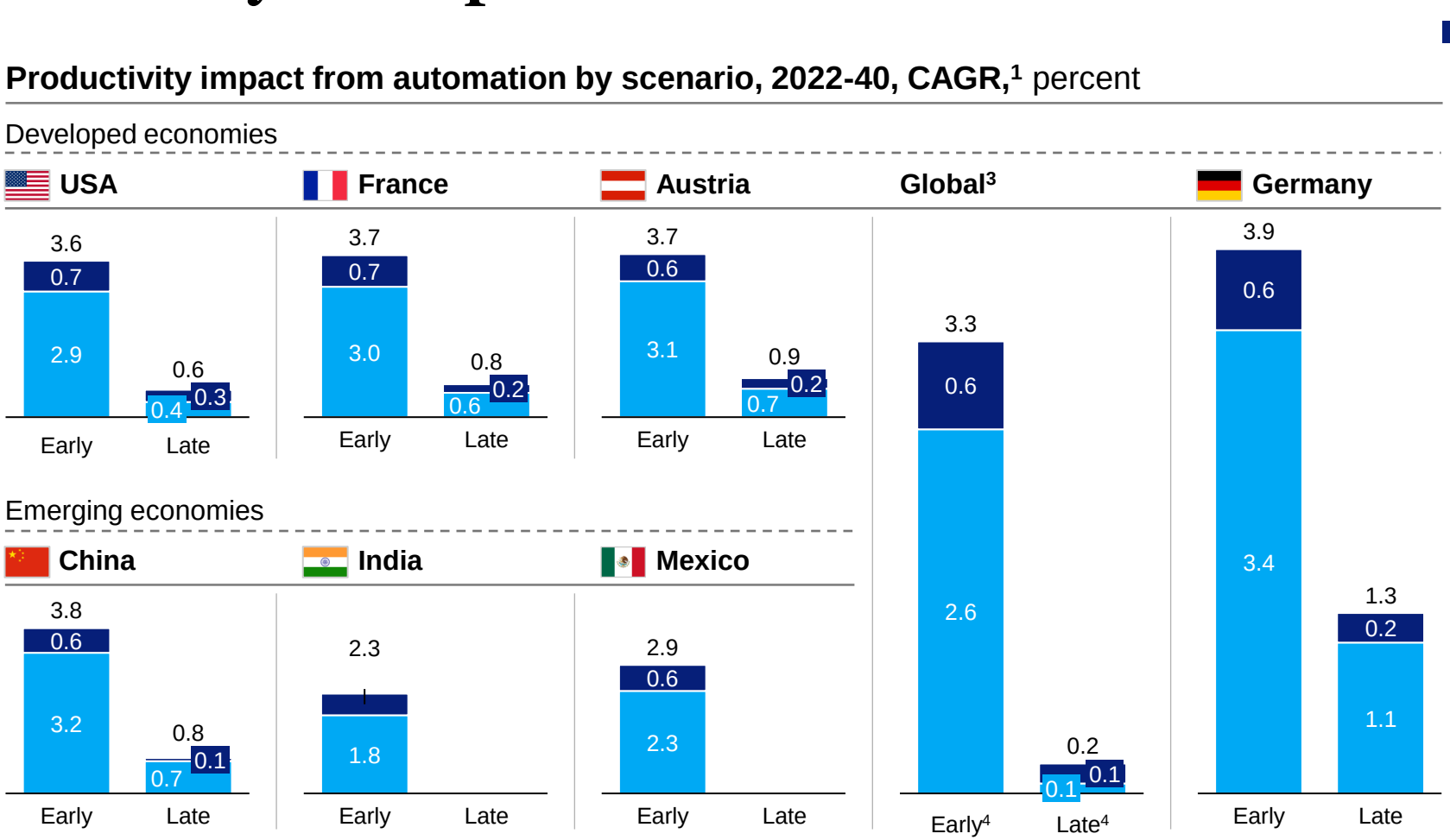
1. Previous assessment of work automation before the rise of GenAI, including analytical AI, machine leanrning, and deep learning
2. Applying expertise to decision making, planning, and creative tasks
3. Managing and developing people
4. Performing physical activities and operating machinery in unpredictable 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

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



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.

Source: Oxford Economics; The Conference Board Total Economy Database; McKinsey Global Institute analysis

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

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

Education level	Overall technical automation potential, comparison[2]	Additional automation potential,[2] pp	Share of population, %	Population-weighted skilled labor shortage mitigation potential
Tertiary education (Bachelor and above)	60 / 36	24	19	Medium
High school (Diploma or equivalent)	64 / 51	13	56	Large
None (No degree)	63 / 54	9	25	Small

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

Source: Statistisches Bundesamt (DeStatis); McKinsey Global Institute analysis

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

With GenAI Without GenAI[1]

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 / 14	**40**	3	Medium	39
Business/legal professionals	68 / 32	**36**	6	High	30
Creatives and arts management	51 / 22	**29**	1	Medium	25
STEM professionals	57 / 28	**29**	7	High	29
Office support	85 / 63	**22**	19	High	21
Community services	67 / 45	**22**	6	High	26
Managers	49 / 29	**20**	3	Medium	17
Health professionals	45 / 28	**17**	2	Medium	14
Customer service and sales	70 / 60	**10**	9	Medium	12
Production work	75 / 67	**8**	13	Medium	9
Property maintenance	37 / 30	**7**	4	Low	9
Transportation services	59 / 53	**6**	3	Low	7
Health aides, technicians, and wellness	40 / 34	**6**	9	Medium	9
Builders	55 / 50	**5**	5	Low	4
Food services	66 / 61	**5**	4	Low	8
Mechanical installation and repair	68 / 63	**5**	4	Low	6
Agriculture	66 / 62	**4**	1	Low	4
Total	65 / 49	**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**

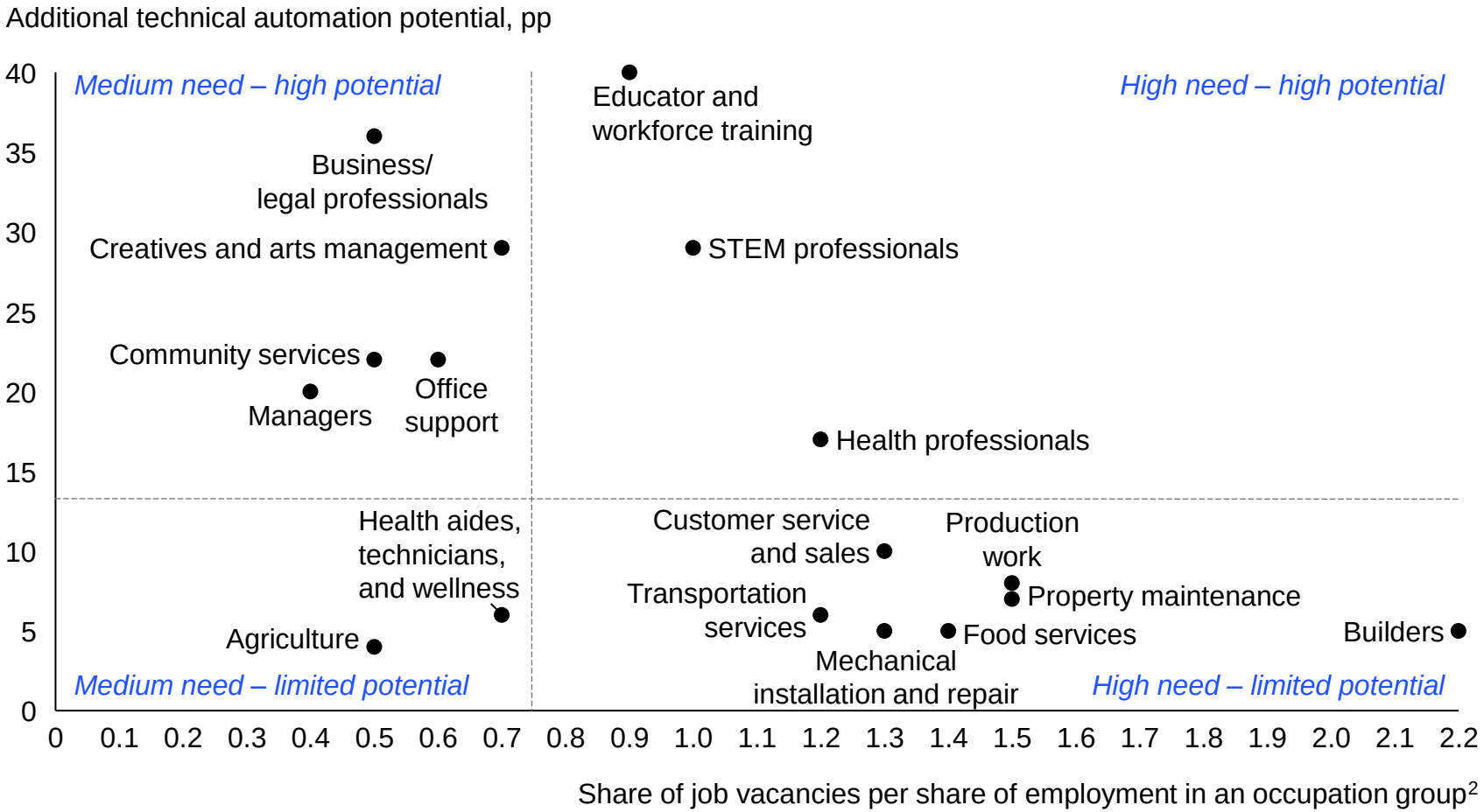
Based on relative employment in Germany and the world, STEM and **community services might profit more in Germany,** while workforce training and customer service might profit less than the global average

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

Source: McKinsey Global Institute analysis

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

Job-vacancy concentration[2] and corresponding automation shift in Germany



Note: Figures may not sum because of rounding

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

Source: McKinsey Global Institute analysis

Key implications for Germany

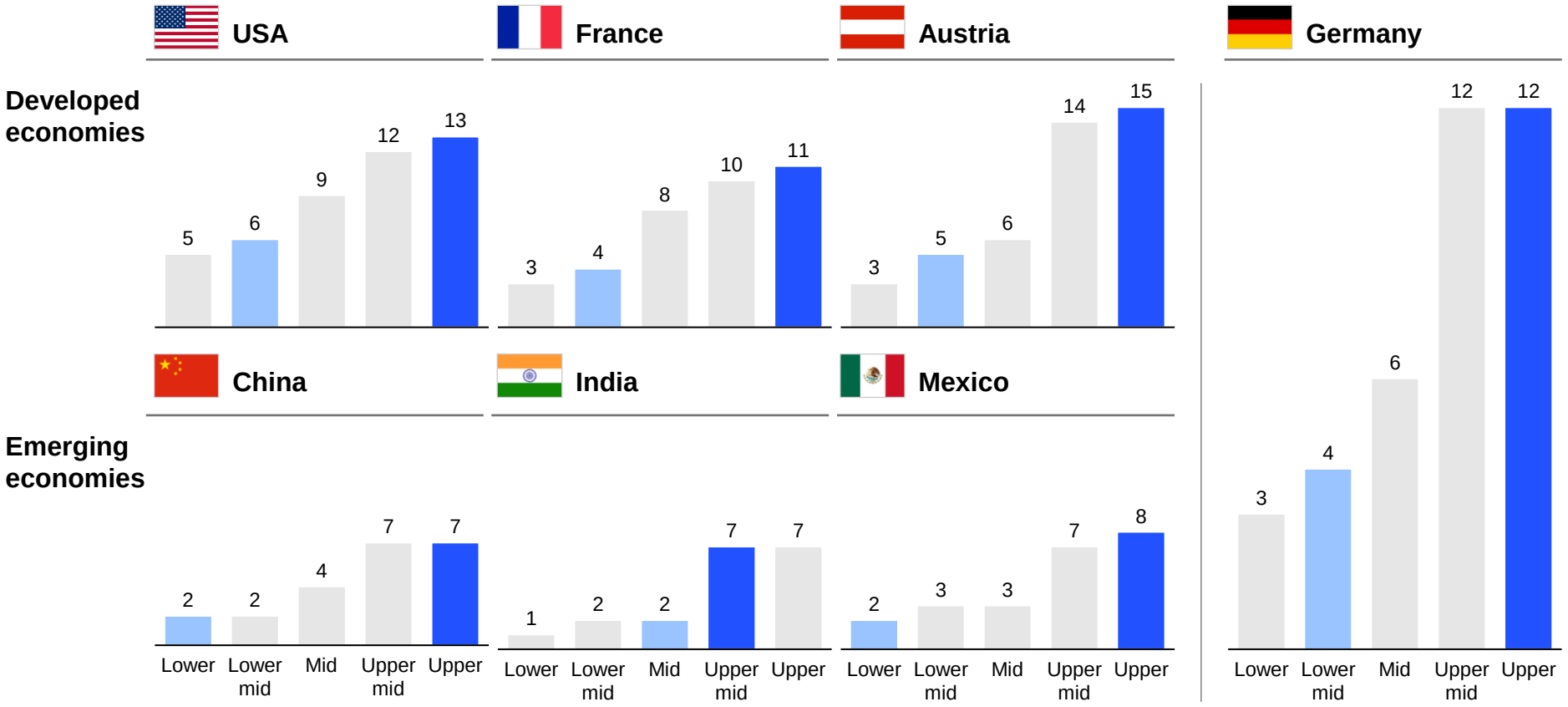
- **Highest need** (≥0.9) **and potential** for GenAI for skilled labor shortage mitigation in **workforce training (40 pp), STEM (29 pp), and health professions (17 pp)**
- This applies to **workforce trainers** like John or computer engineers (STEM) like Sara
- **High potential (≥20 pp) but medium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

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 GenAI[1]

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

Source: McKinsey Global Institute analysis

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

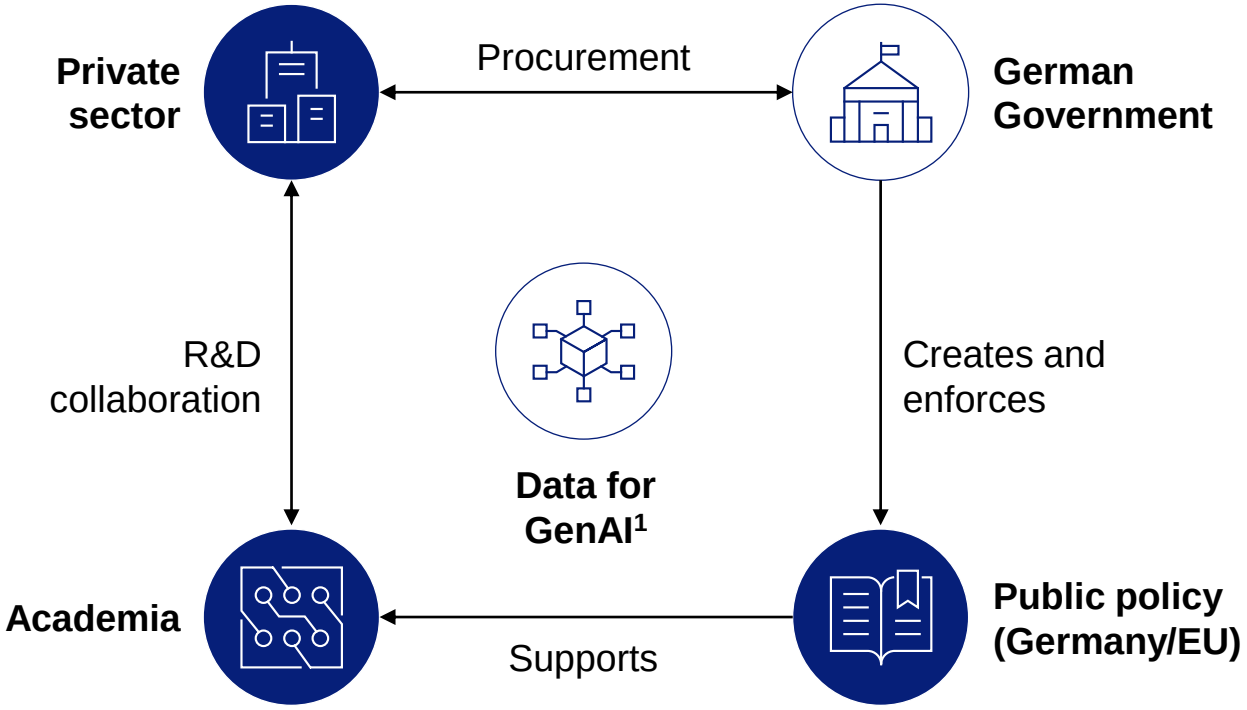
• **Analyzing the skills and competence profiles** of current employees and existing open positions that cannot be recruited from the labor market • **Establishing employer branding** and targeted recruiting to attract best-in-class talent
• **Identifying the remaining necessary qualifications**
• **Creating 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 increase productivity
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

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

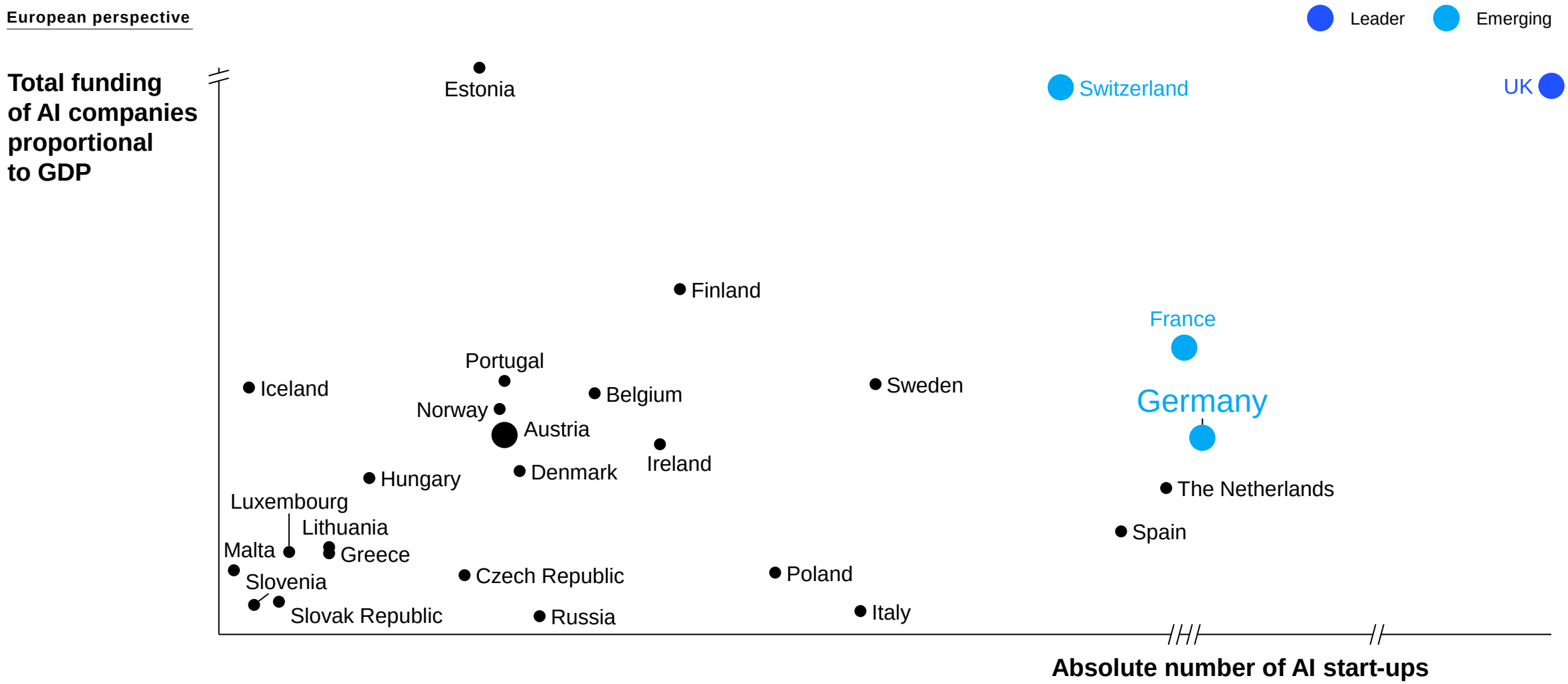
1. We apply a GenAI focus to this framework because GenAI builds on the workforce, skillsets, and capabilities, which grew the AI market

Source: Oxford Publication

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

Private sector

European perspective

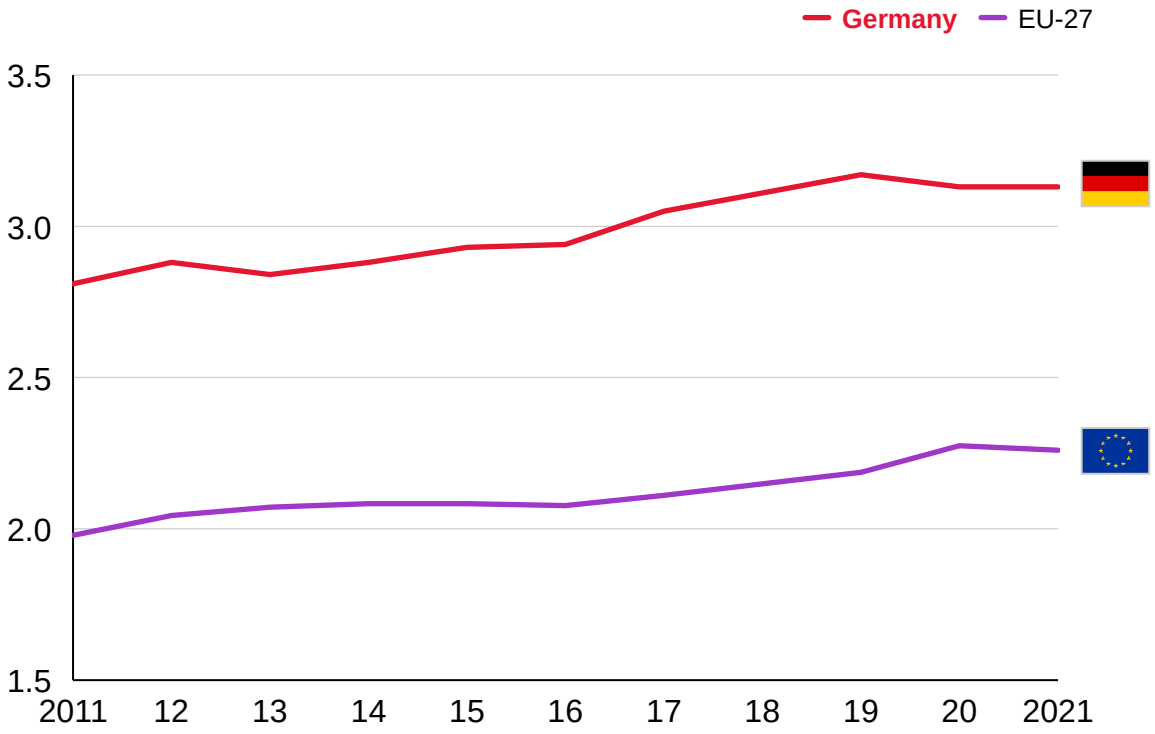


Source: The Global AI, Index, Tortoise AI Report, Tortoise Media

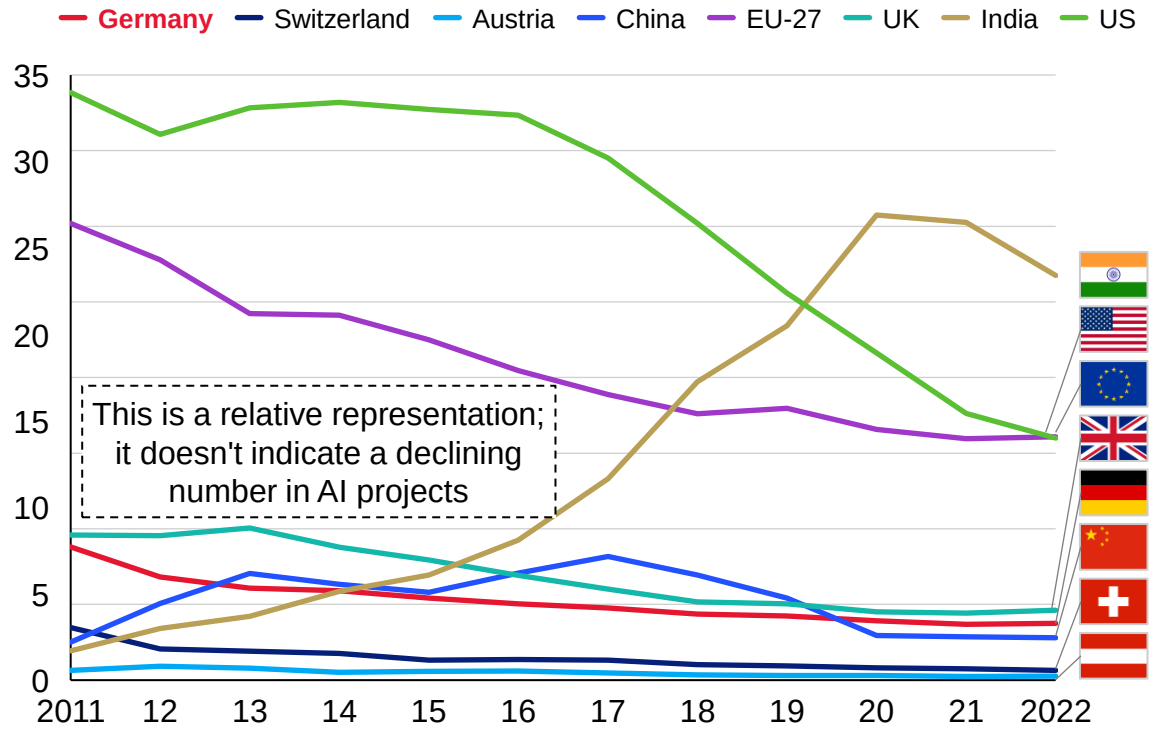
Private sector Academia

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 projects[1]



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

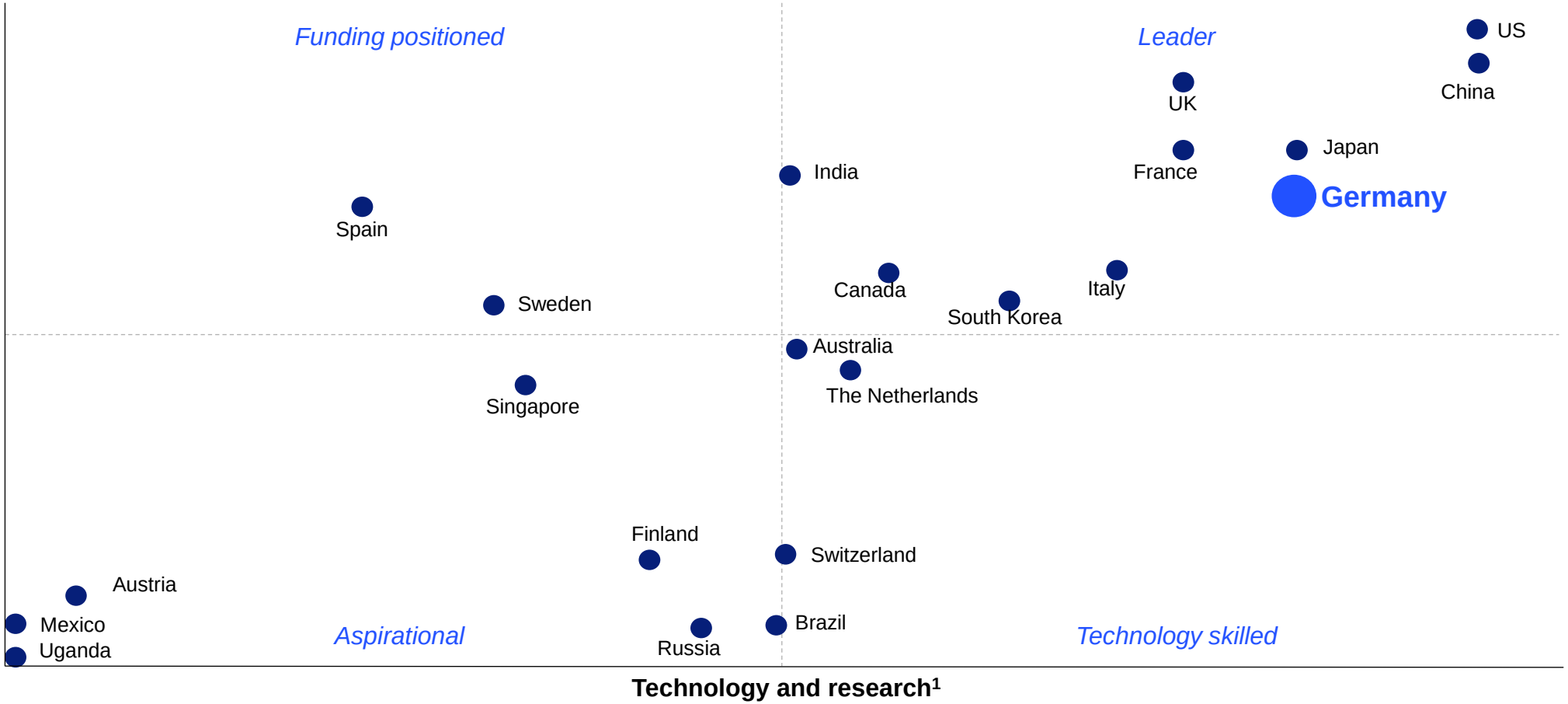
1. fractional count based on contributions

Source: Eurostat.- November 2022; GitHub; Preqin; oecd.ai

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

Private sector Academia

Global perspective – relating to both AI and GenAI in 2022



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

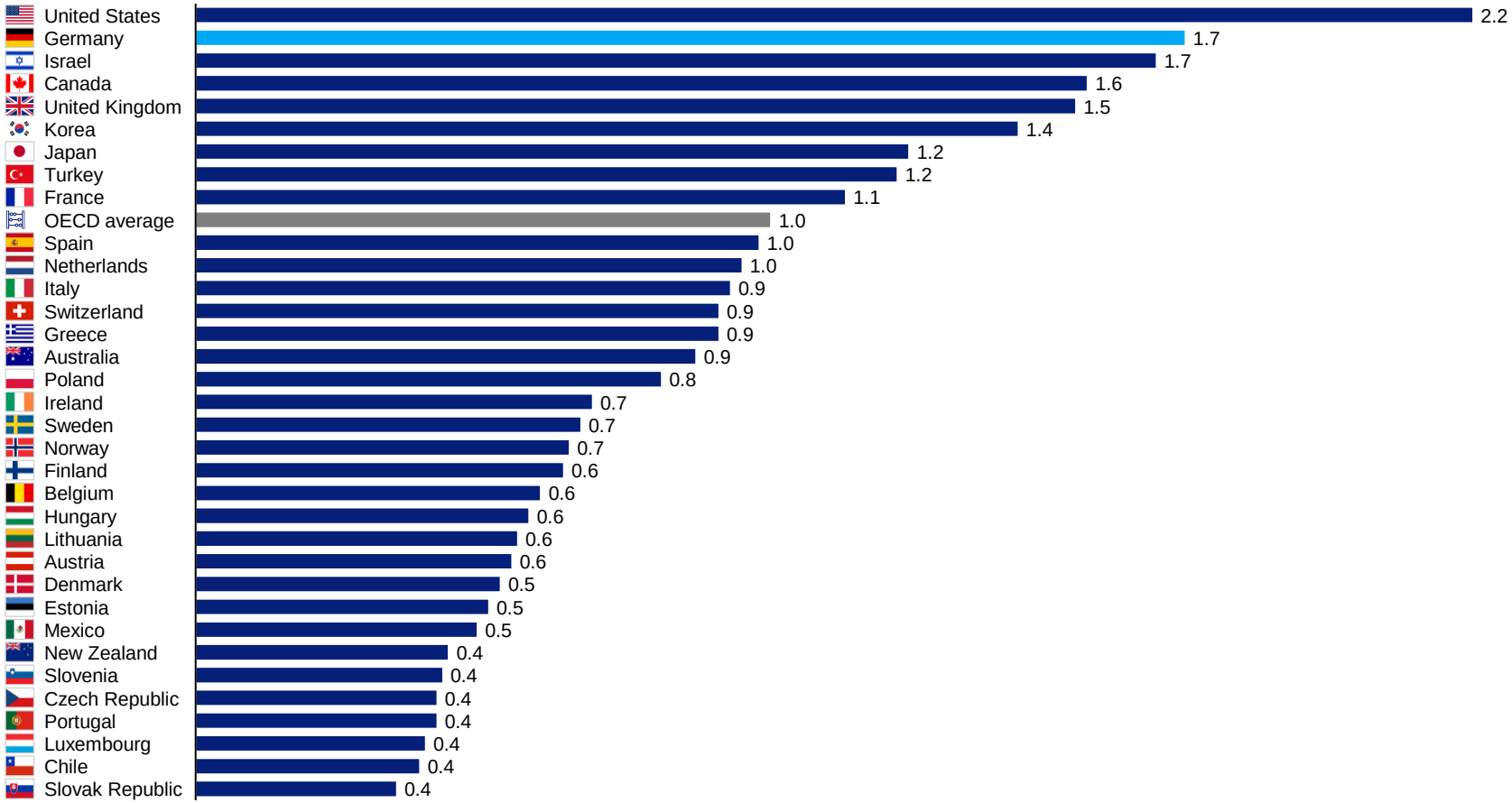
Source: Brookings, 2022

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 country[1]



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 second 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

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