National Science Board

The State of U.S. Science & Engineering

***Science & Engineering Indicators* 2024**

Tuesday, March 26, 2024

Speakers:

Maureen Condic

Chair, NSB Committee on National S&E Policy

Associate Professor of Neurobiology and Anatomy

University of Utah, School of Medicine

Christina Freyman

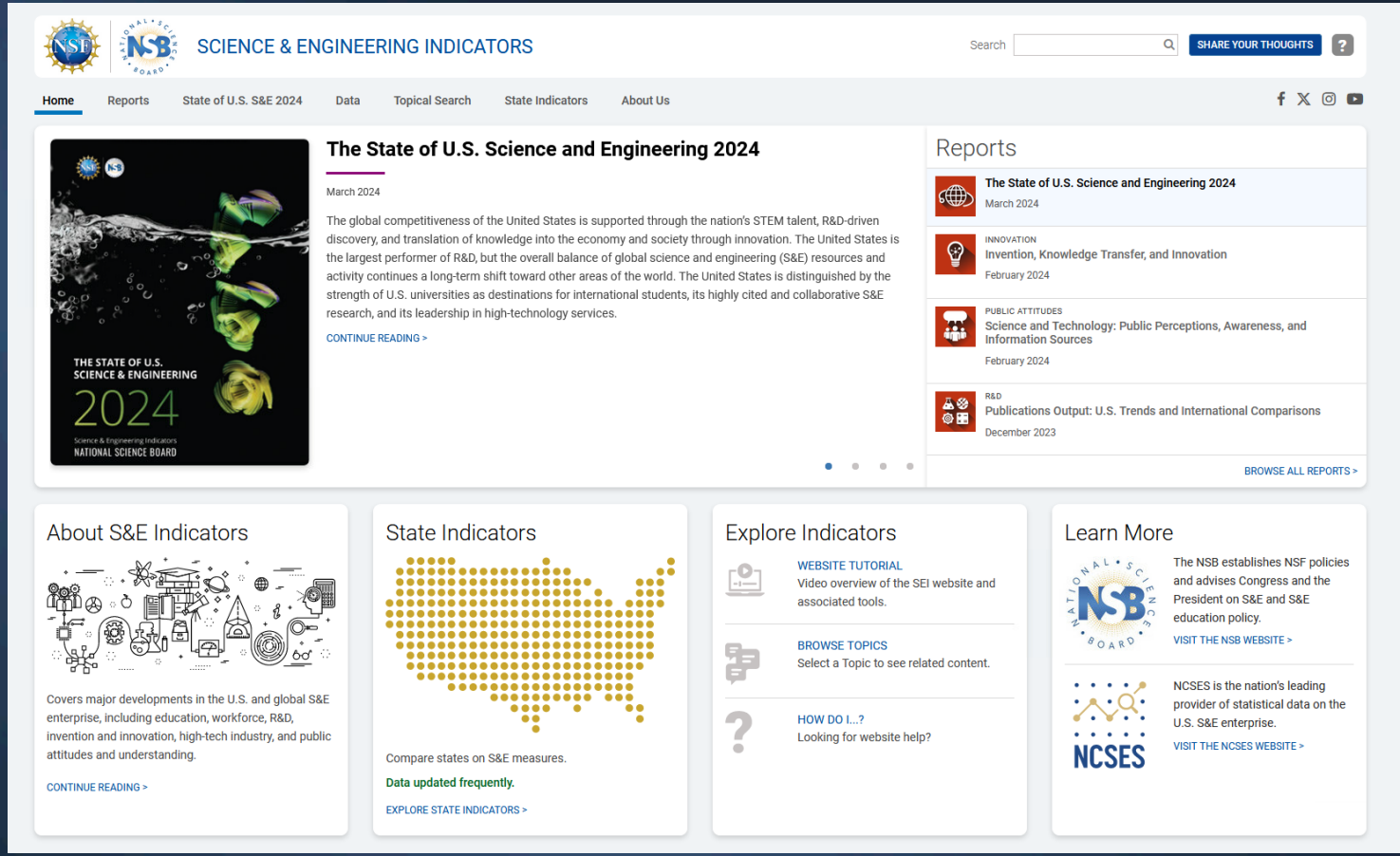
Deputy Director

National Center for Science and Engineering Statistics

The National Science Board

Science and Engineering Indicators

- ***The State of U.S. Science and Engineering***: Talent, Discovery, and Translation
- **Thematic reports** on key topics
- **State Indicators** tool



https://ncses.nsf.gov/indicators

National Science Board

The State of U.S. Science & Engineering

- The U.S. performs more total R&D than any other country
- But the nation's global position is slipping, as countries in East and Southeast Asia, particularly China, increase their activities.
- The nation's ability to compete in S&E depends on robust and sustained national investments in STEM talent, R&D-driven discovery, knowledge translation, and innovation.

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NSB Policy Messages: Talent is the Treasure

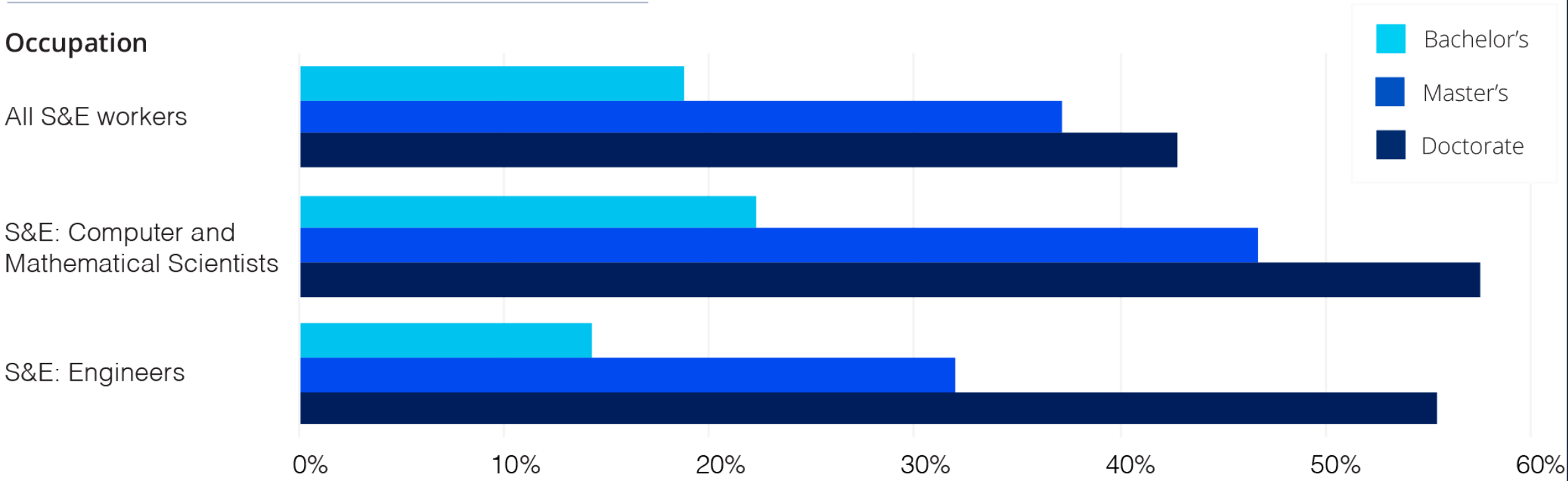
- The U.S. needs a robust, resilient STEM workforce for a strong economy and national security
- But the nation is facing a STEM talent crisis
- Strategic action is sorely needed across educational and workforce levels

Need for Robust, Resilient STEM Workforce

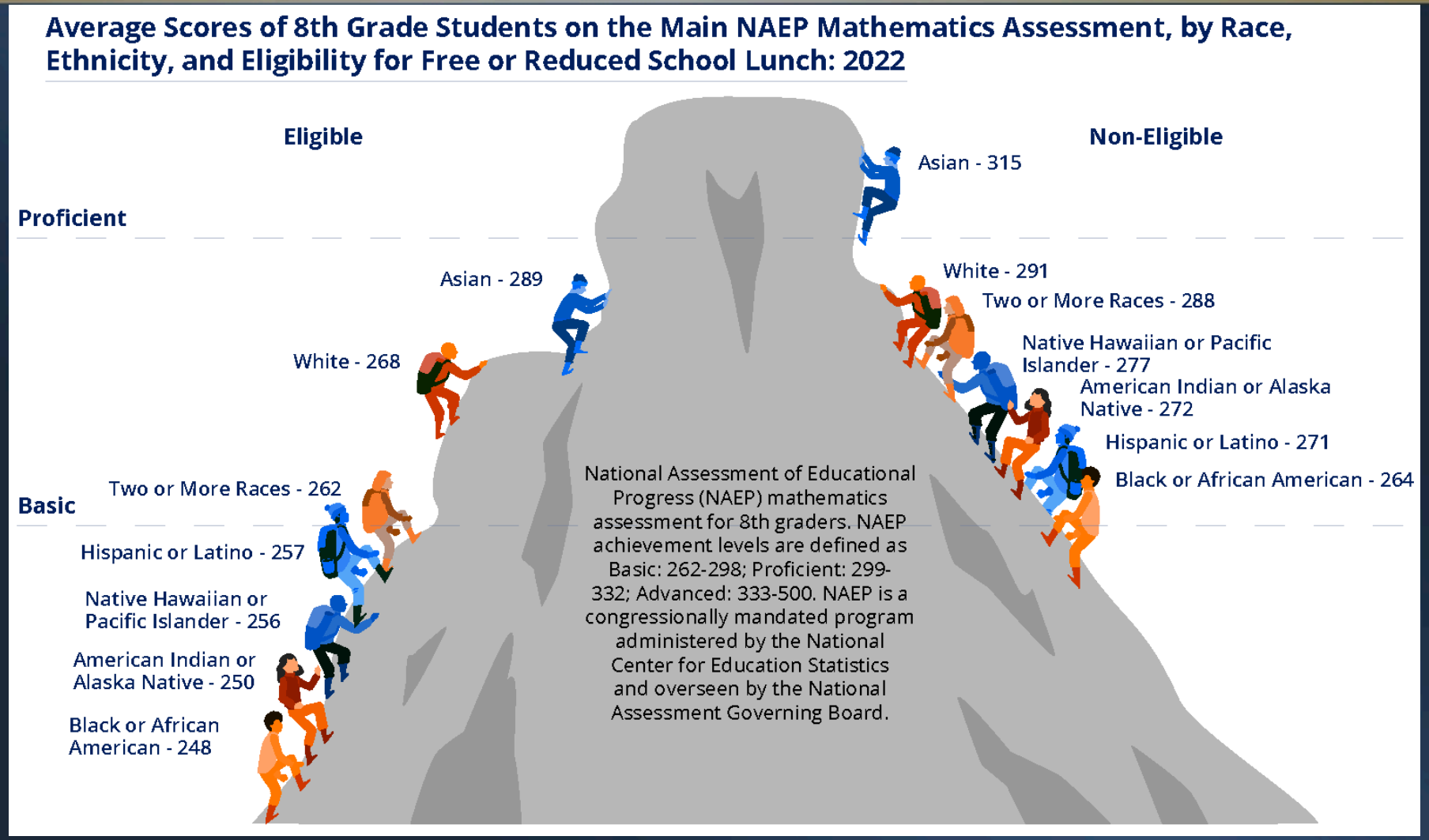
- STEM workforce: 37 million people
- With bachelor's degree: 18 million
- Without bachelor's degree (Skilled Technical Workforce): 19 million

Leadership Risk: Talent Supply Chain

Foreign-born Share of Workers with a Bachelor's Degree or Higher, by Highest Degree Level and Major Occupation: 2021



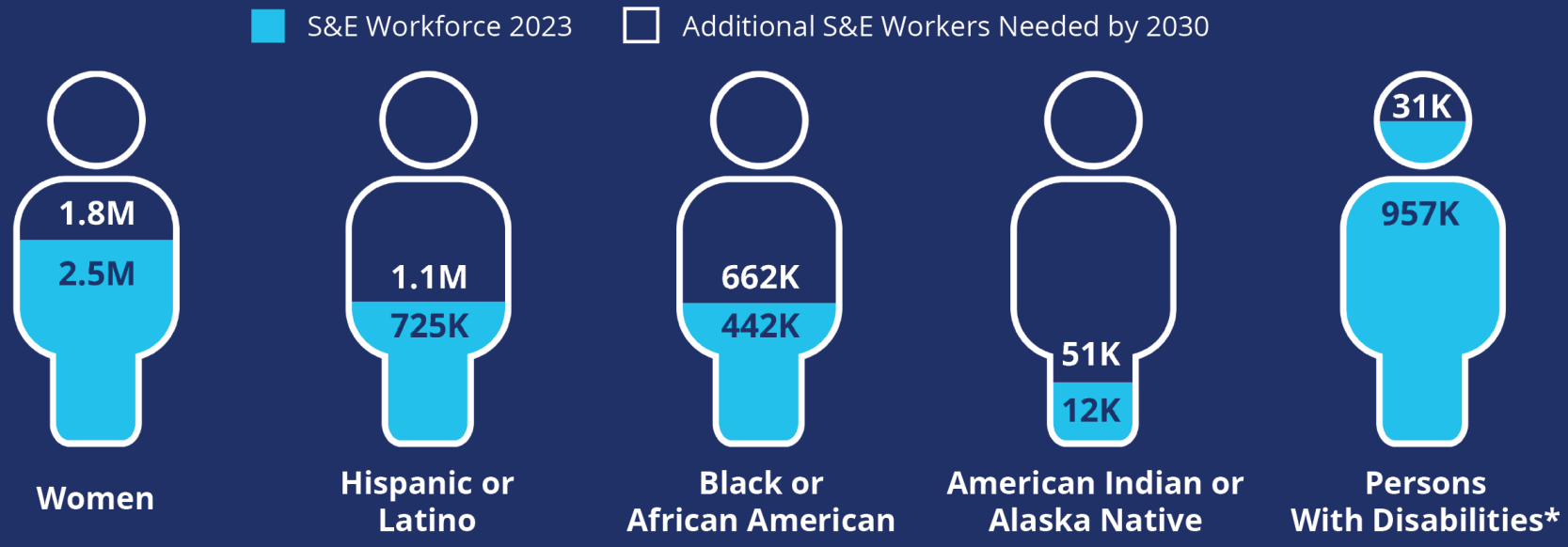
Leadership Risk: PreK-12 STEM Education



Leadership Risk: the Missing Millions

Missing Millions: Closing the Diversity Gap in the S&E Workforce by 2030

Over the past decade, the United States has seen significant growth in underrepresented groups in the science & engineering (S&E) workforce. However, the National Science Board is urging an even swifter expansion to create a more diverse workforce that mirrors the U.S. population and meets the demands of 2030.



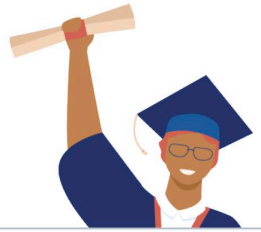
*Visual (30%), Cognitive (29%), Hearing (26%), Lifting (8%), and Walking (7%) disabilities

Source: Estimates are based on projections from the U.S. Census and Bureau of Labor Statistics, together with data from the National Center for Science and Engineering Statistics,and assume that participation of these groups in the S&E workforce increases at current rates.

Opportunities for Action

Strategic Action: Access to Higher Education

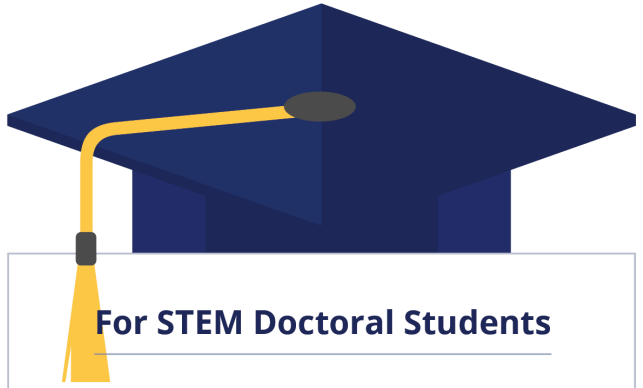
Increase scholarships for low-income individuals (e.g. S-STEM)



Initiate national service programs (e.g. Defense Civilian Training Corps)

Increase Pell grant amounts to reflect the current cost of education

Build out capacity at community colleges, Minority Serving Institutions (MSIs), and Emerging Research Institutions (ERIs)

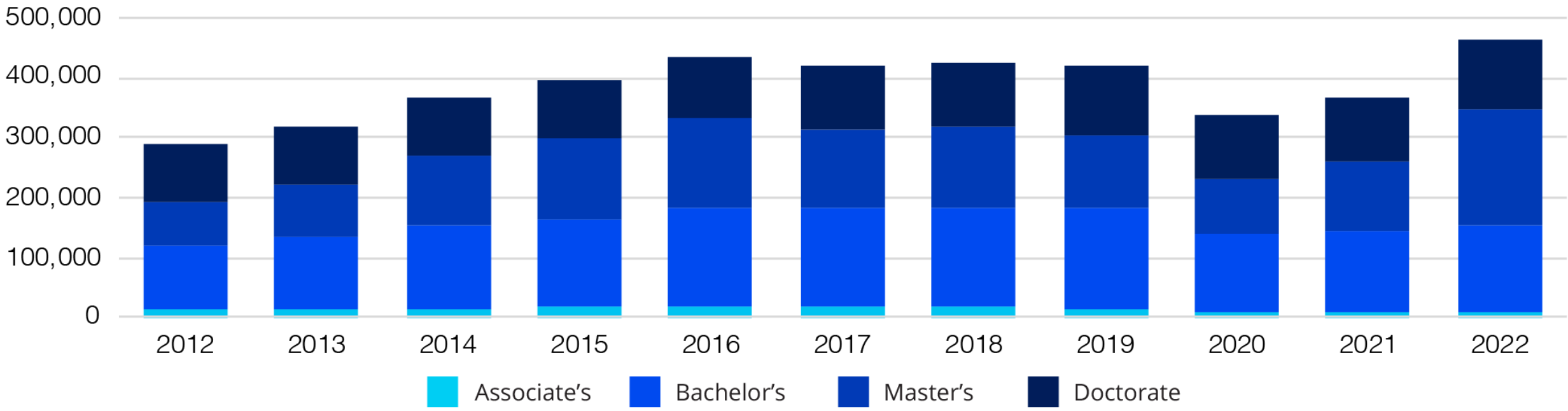


For STEM Doctoral Students

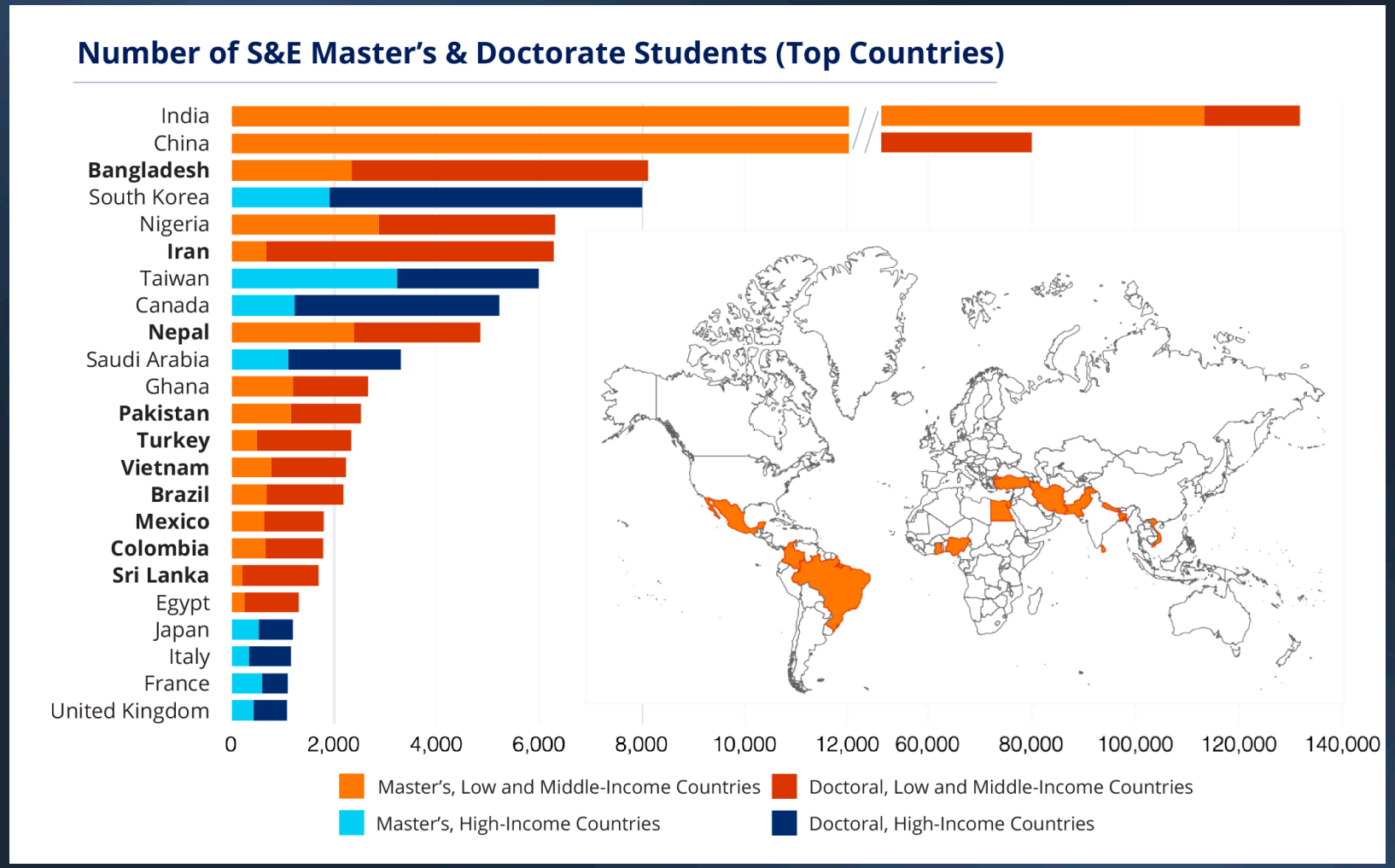
- Expand graduate fellowship programs, with an emphasis on critical and emerging technologies
- Increase doctoral stipends & annually adjust for inflation
- Provide doctoral students with benefits

Strategic Action: Emerging Science Partners

International S&E Students on Visas Enrolled in U.S. Higher Education Institutions, by Level of Enrollment: 2012–22



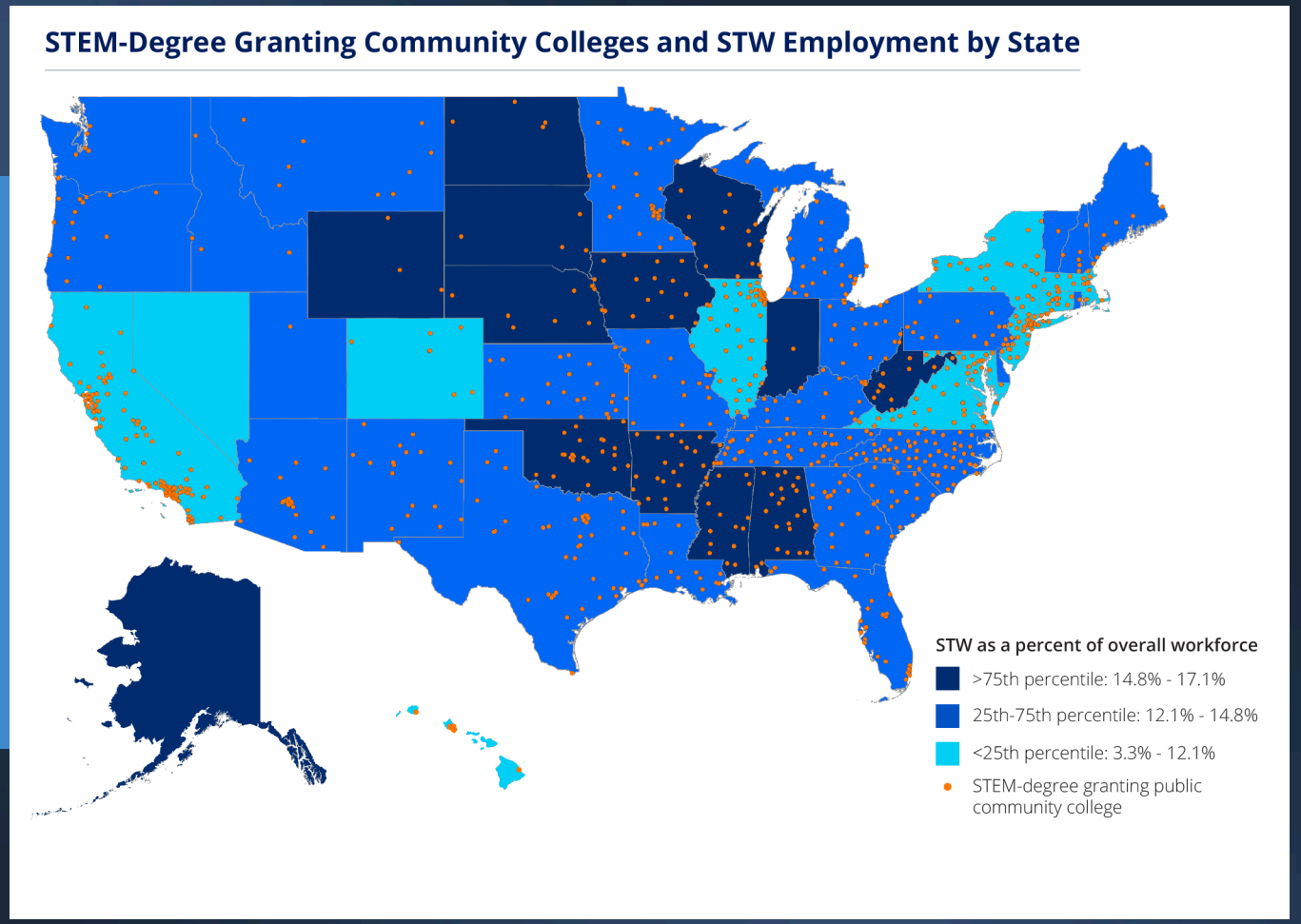
Strategic Action: Emerging Science Partners



Strategic Action: Skilled Technical Workforce

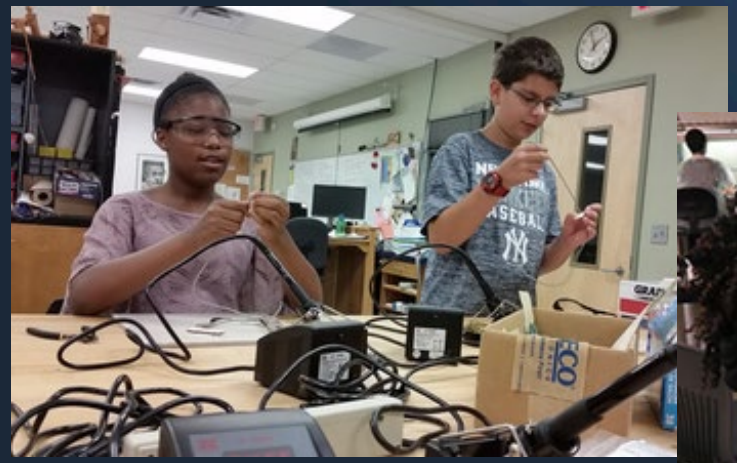
THE SKILLED TECHNICAL WORKFORCE:

Crafting America's Science & Engineering Enterprise



A Bedrock for the Nation's R&D Enterprise

With a robust and concerted effort to close the STEM talent gap - preK-12, higher education, the Skilled Technical Workforce, international talent - the U.S. can fully lean into longstanding, strategic approaches to ensure it remains a global S&E discovery powerhouse



NCSES: Measuring America's progress in science, technology, and innovation

Part of the National Science Foundation (NSF)

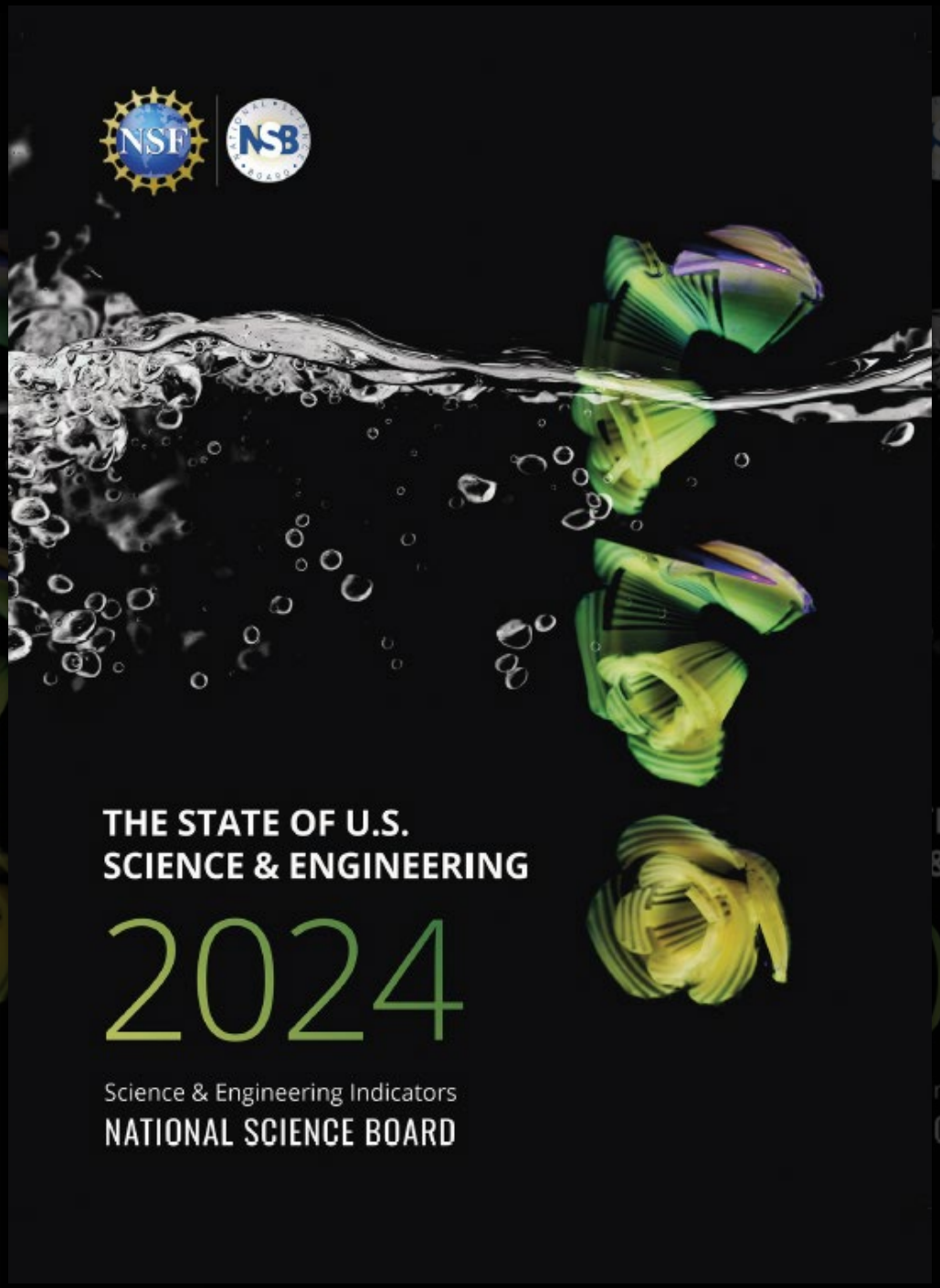
Located within the Directorate for Social, Behavioral, and Economic Sciences (SBE)

One of 13 principal federal statistical agencies

Overseen by the U.S. Chief Statistician within the White House Office of Management and Budget (OMB)

MISSION

Produce policy relevant, policy neutral **statistical information** on the **U.S. science and engineering enterprise**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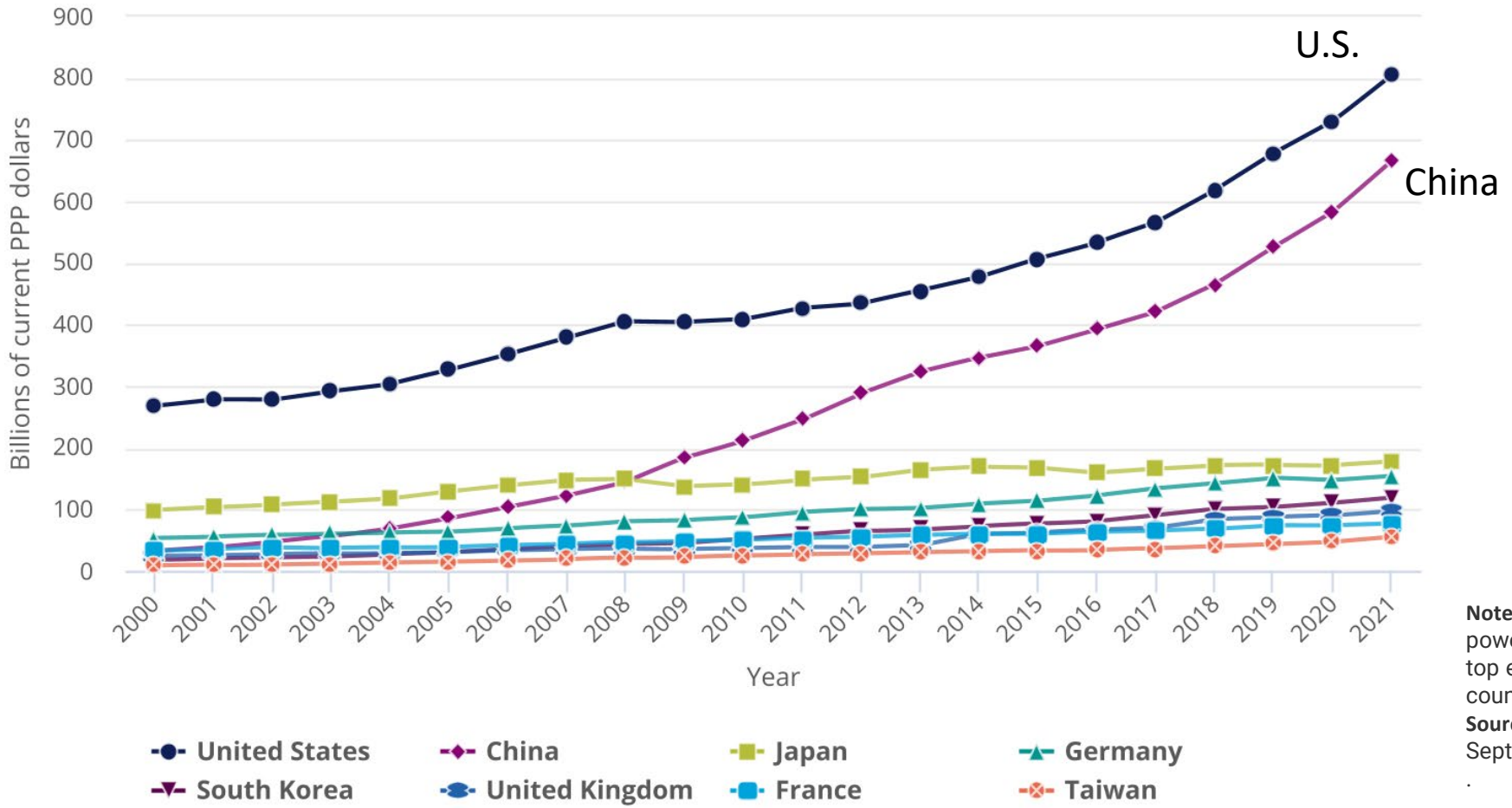
Gross Domestic Expenditures on R&D

Gross domestic expenditures on R&D, by selected country or economy: 2000–21



Note(s): PPP is purchasing power parity. Data are for the top eight R&D-performing countries or economies.
Source(s): OECD, MSTI, September 2023 release

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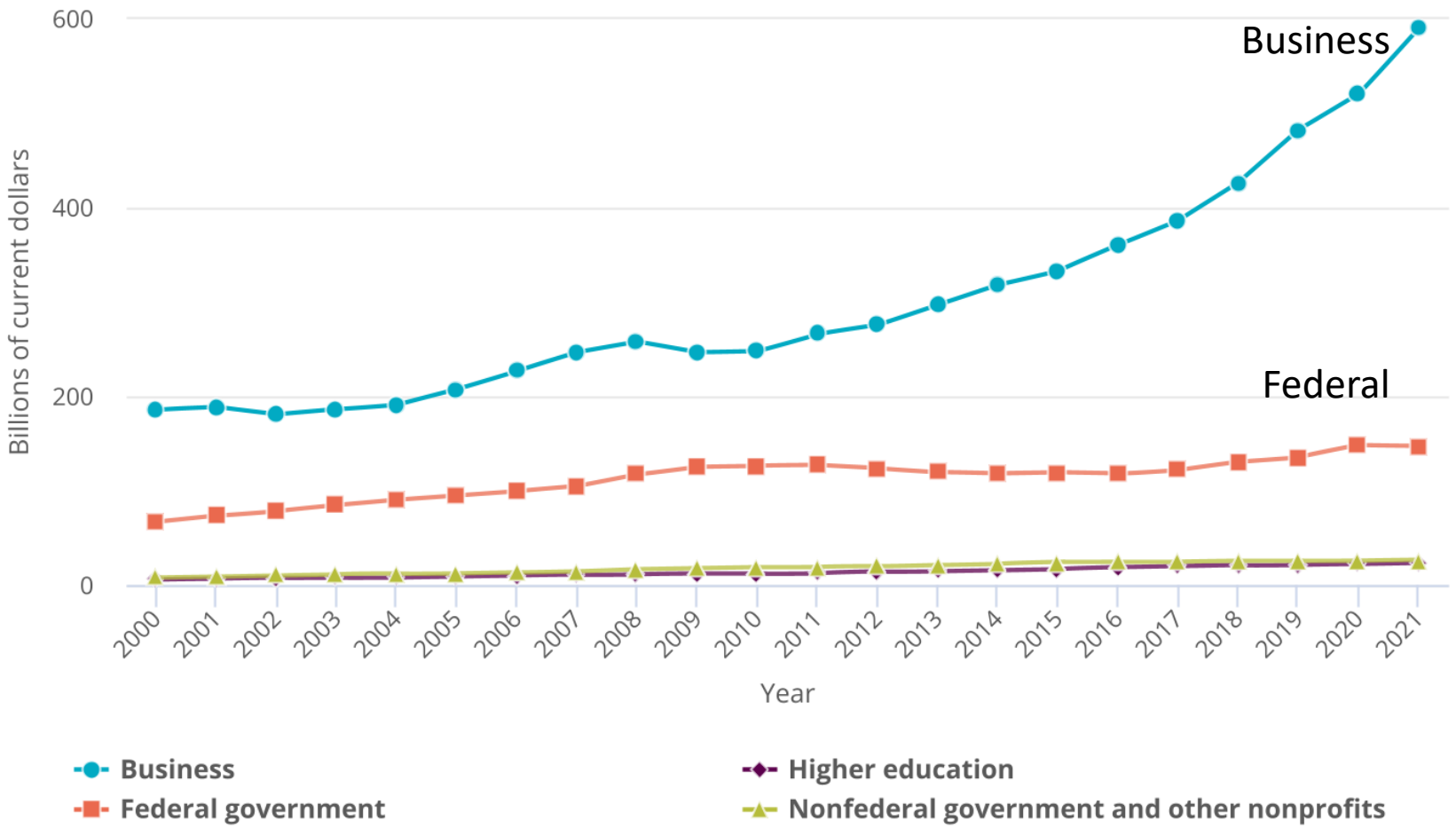
U.S. R&D Expenditures

U.S. R&D expenditures, by source of funds: 2000–21



Note(s): Some data for 2021 are preliminary and may be revised later.
Source(s): NCSES, National Patterns of R&D Resources (2021–22 edition).
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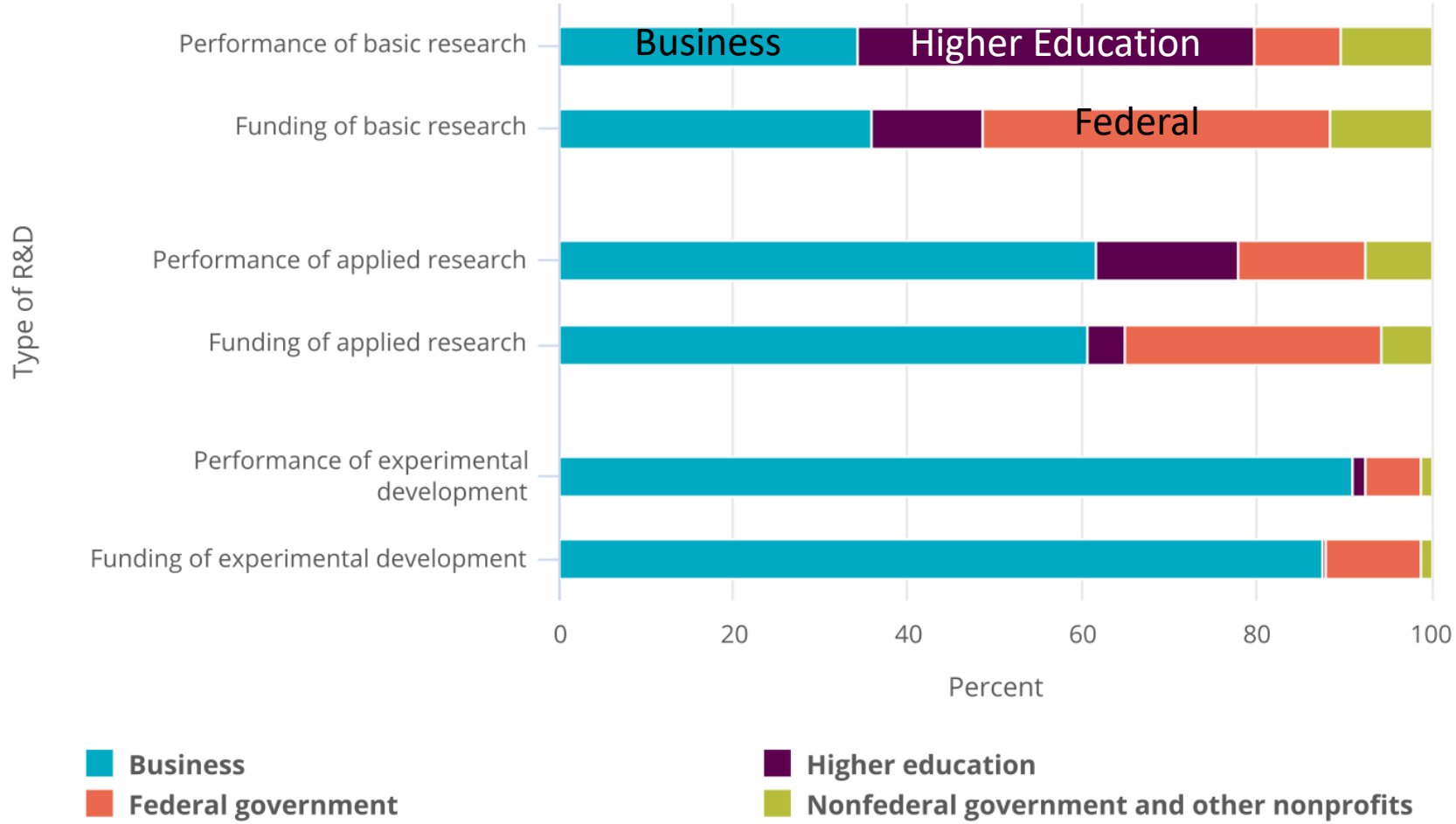
R&D Performance and Funding by Type of R&D

U.S. R&D performance and funding, by type of R&D and sector: 2021



Note(s): Some data for 2021 are preliminary and may be revised later.
Source(s): NCSES, National Patterns of R&D Resources (2021–22 edition).
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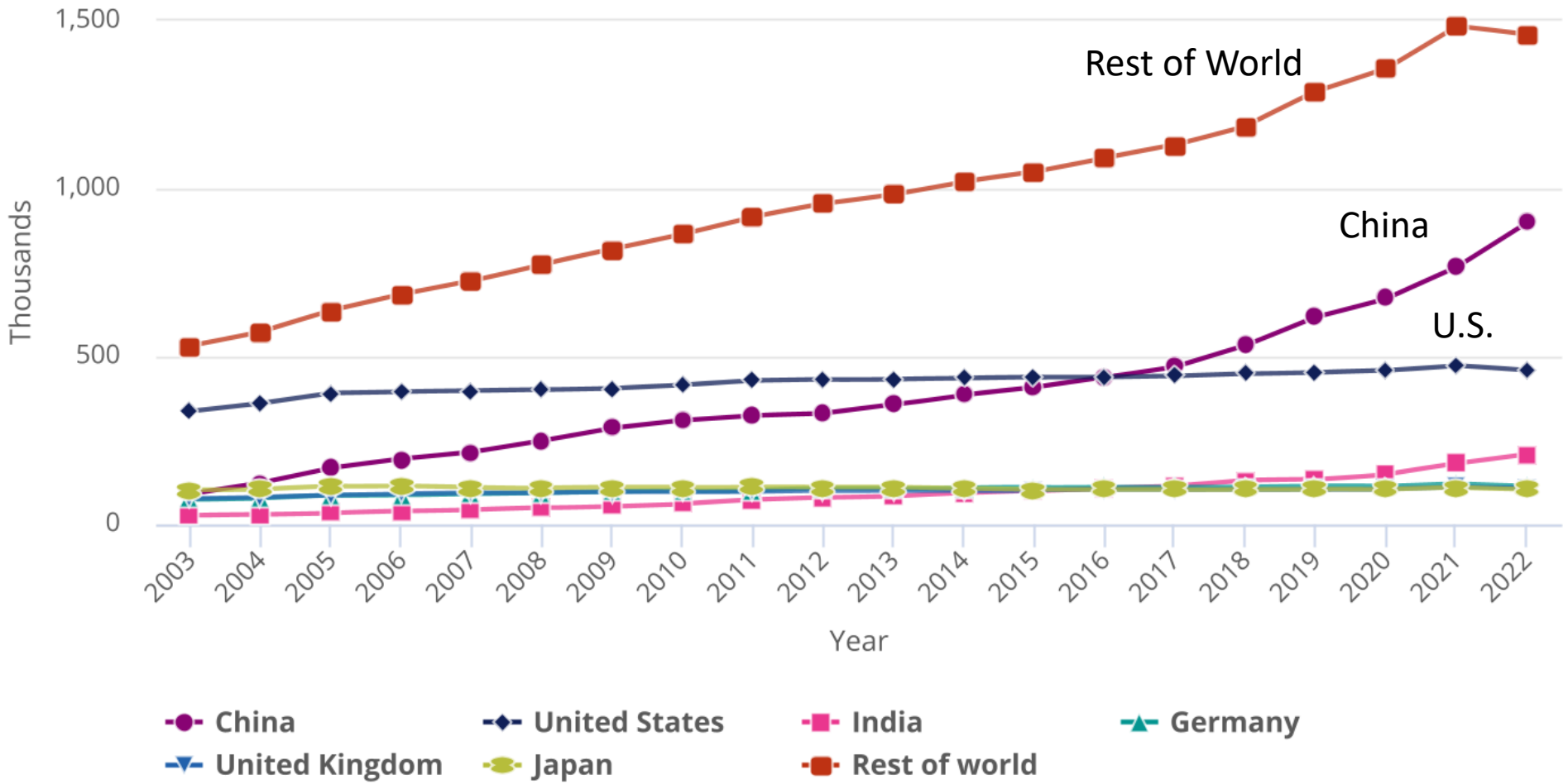
Publications

S&E articles, by selected region, country, or economy: 2003–22



Note(s): Articles are fractionally counted and classified by publication year and assigned to a region, country, or economy by author's institutional address.
Source(s): NCSES, special tabulations (2023) by Science-Metrix of Elsevier's Scopus abstract and citation database
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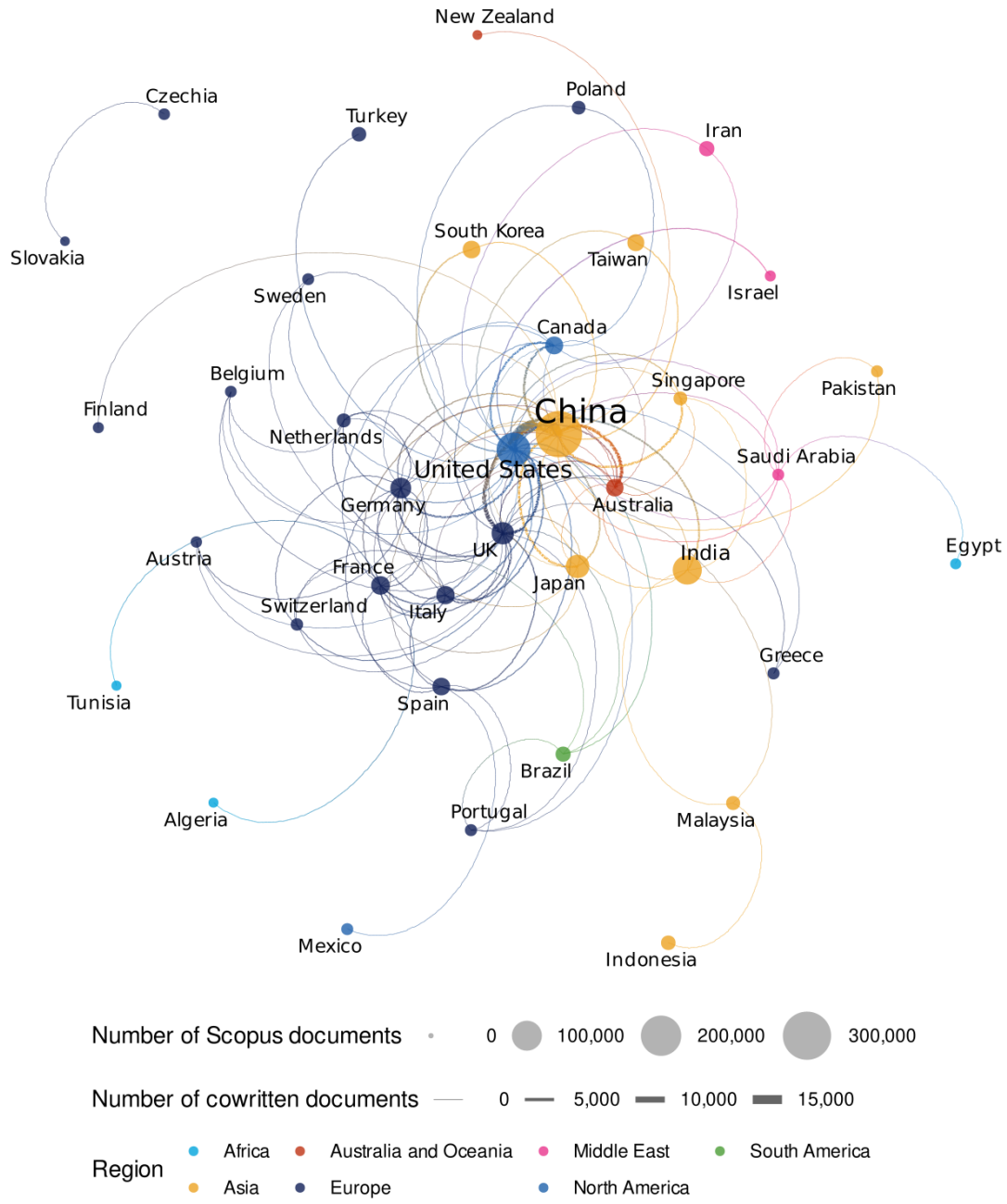
Data on artificial intelligence collaborations

AI = artificial intelligence.

Note(s): This network diagram shows the number of cowritten articles by all pairs of regions, countries, or economies within the top 60 producers of AI-related research based on whole counting for those pairs that cowrote 400 articles or more. AI article counts refer to publications from a selection of conference proceedings and peer-reviewed journals in S&E fields from Scopus that were classified as AI in the All Science Journal Classification. Articles are classified by their year of publication and are assigned to a region, country, or economy on the basis of the institutional address(es) of the author(s) listed in the article. Links are only shown in a single direction, dictated by alphabetical order. The size of the nodes is proportional to the total number of AI-related articles written by each region, country, or economy. The width of the links between nodes is proportional to the quantity of articles both regions, countries, or economies have cowritten. Positioning of nodes is defined using the Kamada-Kawai algorithm. For the list of regions, countries, and economies and their respective geographic regions in this figure, see Table SPBS-91.

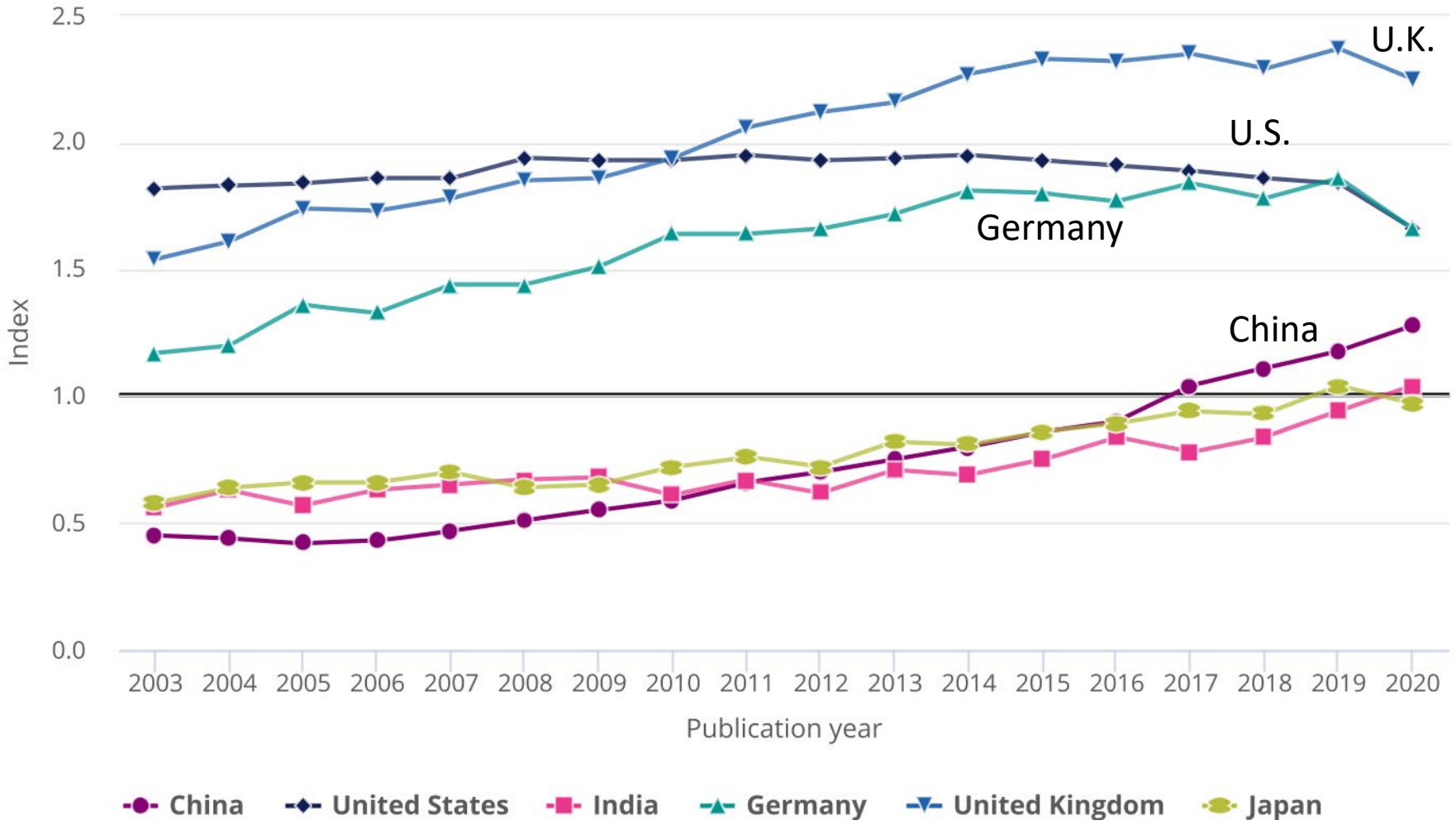
Source(s): National Center for Science and Engineering Statistics; Science-Metrix; Elsevier, Scopus abstract and citation database, accessed April 2023. *Science and Engineering Indicators* https://ncses.nsf.gov/pubs/nsb202333

AI collaboration network, by region, country, or economy: 2003–2022



Highly Cited Publications

Highly cited article index, by selected country: 2003–20



Note(s): The highly cited article index is a country's share of the top 1% most-cited S&E publications divided by the country's share of all S&E publications. The index is calculated on whole counts of publications.
Source(s): NCSES, special tabulations (2023) by Science-Metrix of Elsevier's Scopus abstract and citation database.

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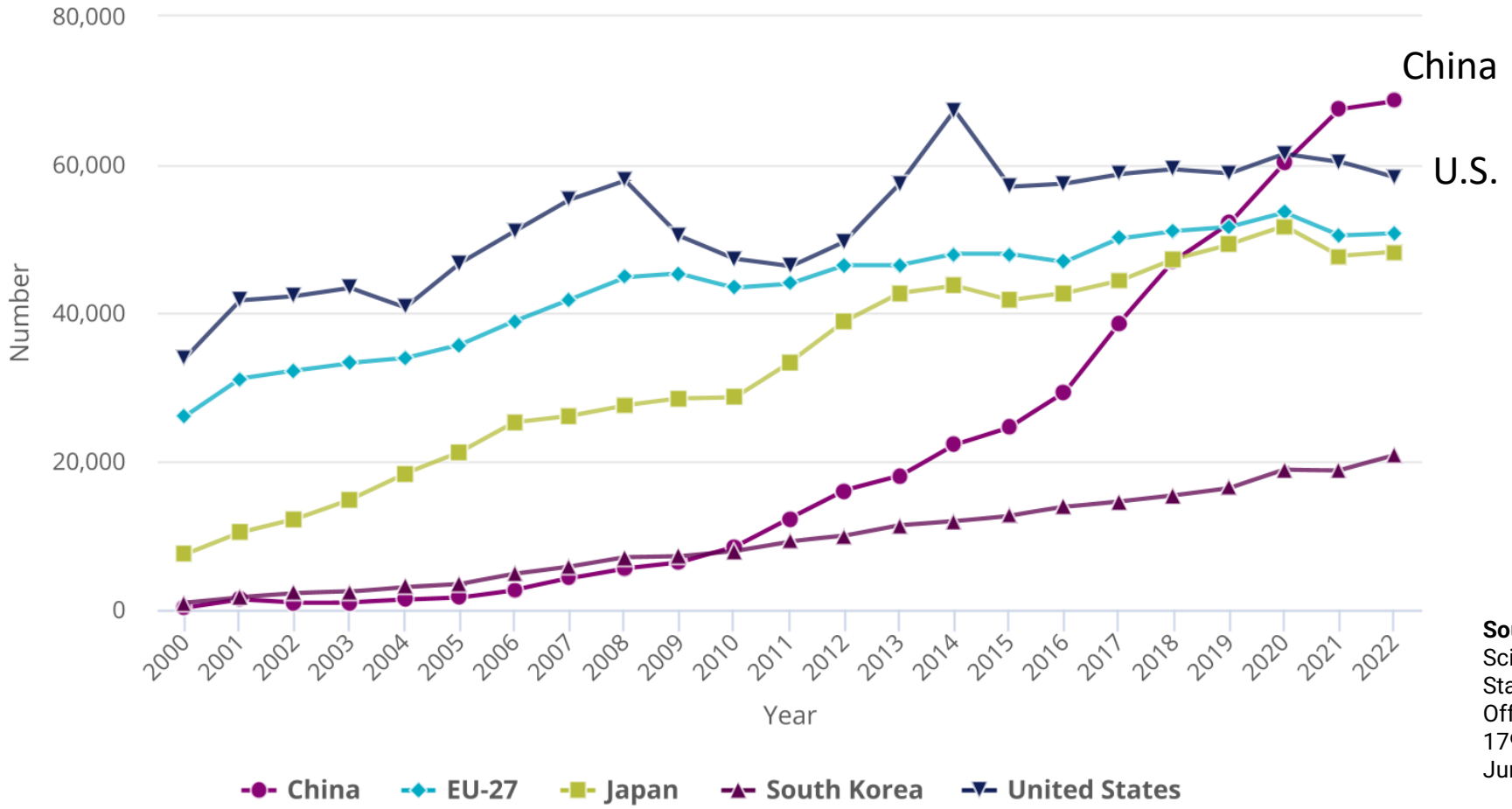
Patent Applications

Patent Cooperation Treaty applications, by selected region, country, or economy: 2000–22

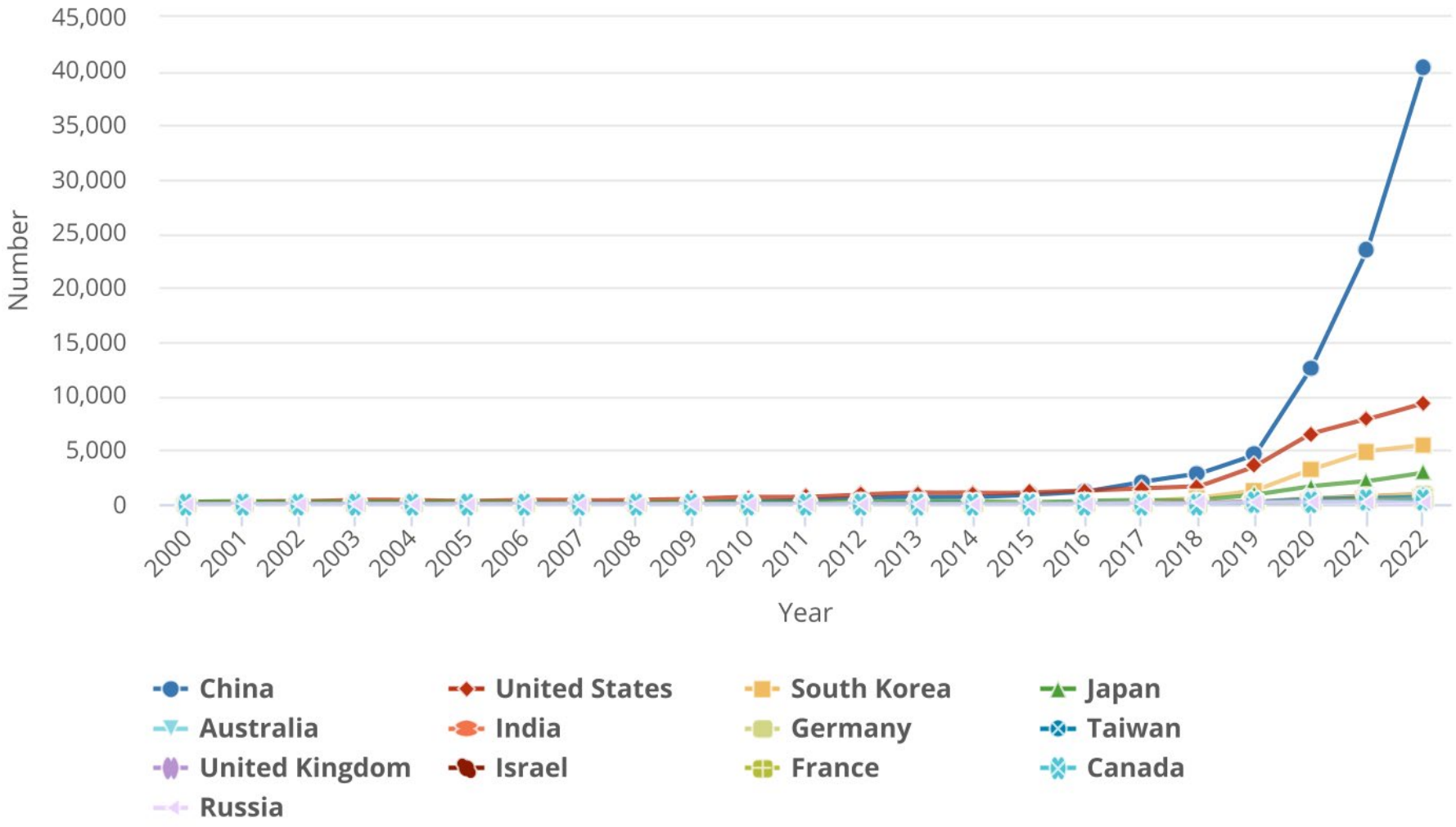


Source(s): National Center for Science and Engineering Statistics; European Patent Office Global Patent Index; 1790 Analytics, accessed June 2023

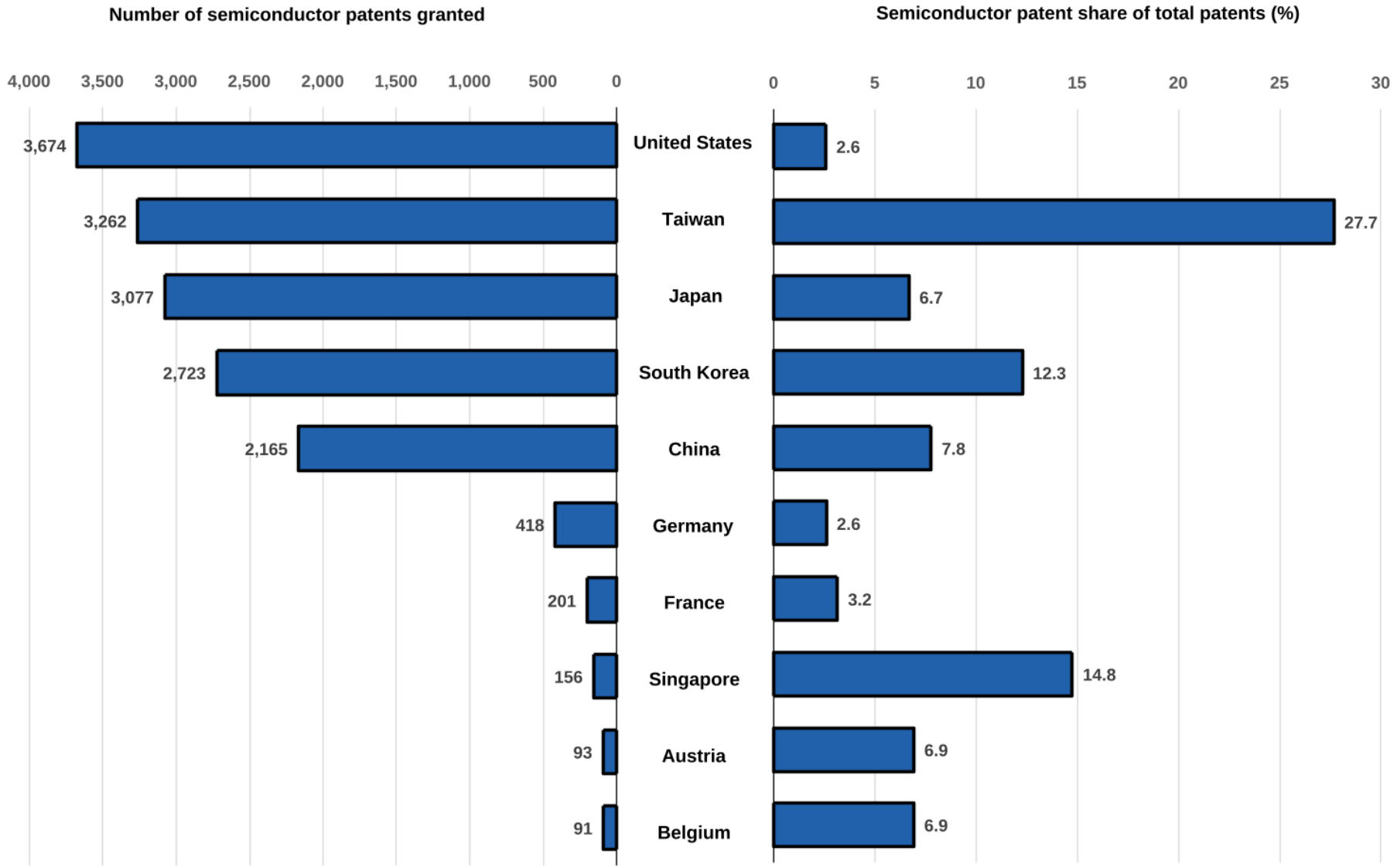
Worldwide utility patents in AI granted to inventors, by selected country or economy: 2000–22

Note(s): Granted patents for all patent authorities are allocated according to patent inventorship information. AI patents are identified and divided into categories using filters consisting of Cooperative Patent Classifications and International Patent Classifications plus keywords and phrases. Details of these filters can be found at https://github.com/georgetown-cset/1790-ai-patent-data/. Only the first granted patent in each patent family is counted so as to avoid double counting the same invention. Patent families containing no granted patents are excluded. Country assignments are based on fractional counting of countries of residence of inventors as listed in the associated record from the Global Patent Index. If no inventor countries are listed, the priority country is used (i.e., where the first application in the patent family was filed). China includes Hong Kong.

Source(s): National Center for Science and Engineering Statistics; European Patent Office Global Patent Index; 1790 Analytics, accessed June 2023.



USPTO utility patents granted in semi-conductors, by country or economy: 2022



Note(s): USPTO is Patent and Trademark Office. USPTO patents are fractionally allocated among countries or economies based on the proportion of residences of all named inventors.

Source(s): NCSES, special tabulations (2023) by Science-Metrix of USPTO PatentsView.

USPTO Utility Patents Granted in Critical Technology Categories: 2022

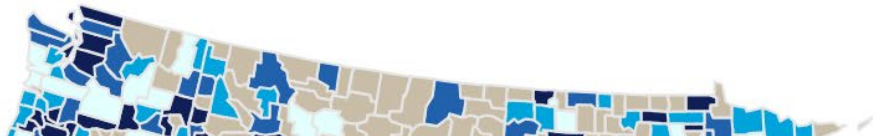
Category	Worldwide	U.S. inventors
All critical technology categories	192,754	85,739
Artificial intelligence, machine learning, autonomy, and related advances	16,288	8,245
High-performance computing, semiconductors, and advanced computer hardware and software	42,064	19,529
Quantum information science and technology	2,019	907
Robotics, automation, and advanced manufacturing	4,450	2,356
Natural and anthropogenic disaster prevention or mitigation	15,402	6,146
Advanced communications technology and immersive technology	28,056	13,384
Biotechnology, medical technology, genomics, and synthetic biology	21,853	11,366
Data storage, data management, distributed ledger technologies, and cybersecurity, including biometrics	18,246	9,551
Advanced energy and industrial efficiency technologies, including (but not limited to) the purposes of electric generation	29,150	8,968
Advanced materials science, including composites 2D materials, other next-generation materials, and related manufacturing technologies	15,226	5,287

USPTO = Patent and Trademark Office.
Note(s): Patents are allocated according to patent inventorship information. Patents are credited on a fractional-count basis (i.e., for patents with collaborating institutions, each institution receives fractional credit on the basis of the proportion of inventors from participating institutions). See File USPTO environmental and critical technology patent data.
Source(s): National Center for Science and Engineering Statistics; Science-Metrix; PatentsView, USPTO, accessed June 2023.
Science and Engineering Indicators

USPTO utility patents granted to inventors per 1,000 residents, by U.S. count 2022

USPTO patents are allocated to count according to the address for each inv listed on a patent. U.S. addresses we geocoded to 3,143 U.S. counties acc U.S. states, U.S. cities, and ZIP Codes appearing in these addresses. Becaus absence of ZIP Codes for most U.S. a in the patent data, coassignment to m U.S. counties occurred for addresses accounting for about 14% of all U.S. p counts, mostly in populous cities encompassing multiple counties. Fur manual disambiguation was perform on information available to assign so ambiguous addresses to a single cou more than one county remained for a on a patent, the fraction of the patent associated to this address was split e across all the counties. See File USPT patents, by county and technical field and the Technical Appendix for additional detail.

Source(s): National Center for Science and Engineering Statistics; Science-Metrix; PatentsView, USPTO, accessed June 2023. Population data from the Census Bureau, https://www2.census.gov/programs-surveys/popest/tables/2020-2022/counties/totals/co-est2022-pop.xlsx, accessed June 2023.



Public Use Files

DOWNLOAD FILES

FILE	TYPE	TITLE	DOWNLOAD
SWBINV-1	Excel	USPTO patents, by county and technical field	(.xlsx 14.4 MB)
SWBINV-2	Excel	USPTO patents, by region, country, economy, and technical field	(.xlsx 797 KB)
SWBINV-3	Excel	USPTO environmental and critical technology patent data	(.xlsx 5.4 MB)
SWBINV-4	Excel	USPTO trademarks, by county and product	(.xlsx 4.3 MB)

PREVIOUS SECTION

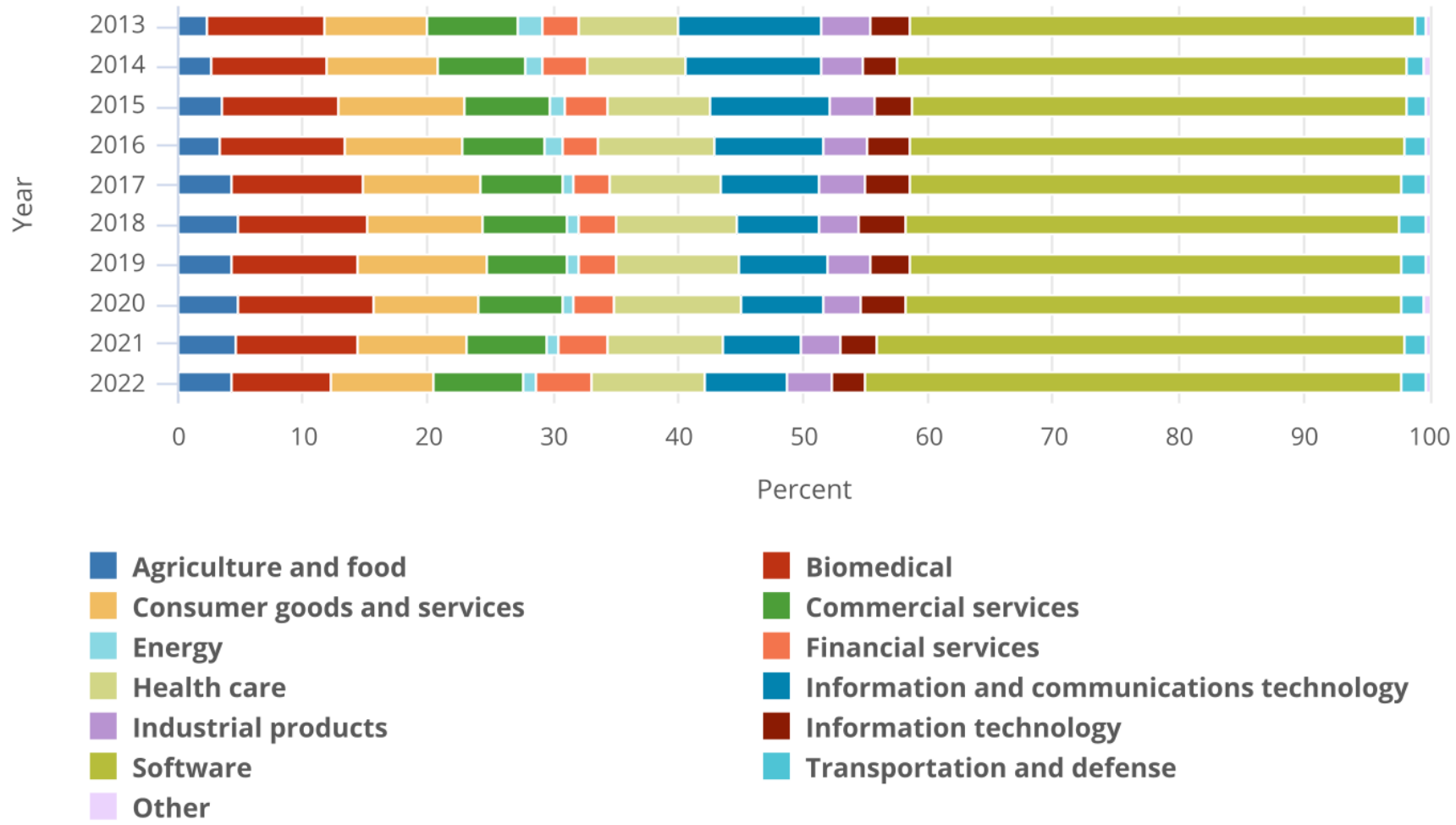
NEXT SECTION

artile:
.058
iartile:
.113
artile:
.232
artile:
.513

USPTO = Patent and Trademark Office.

Capital Investment by Industry

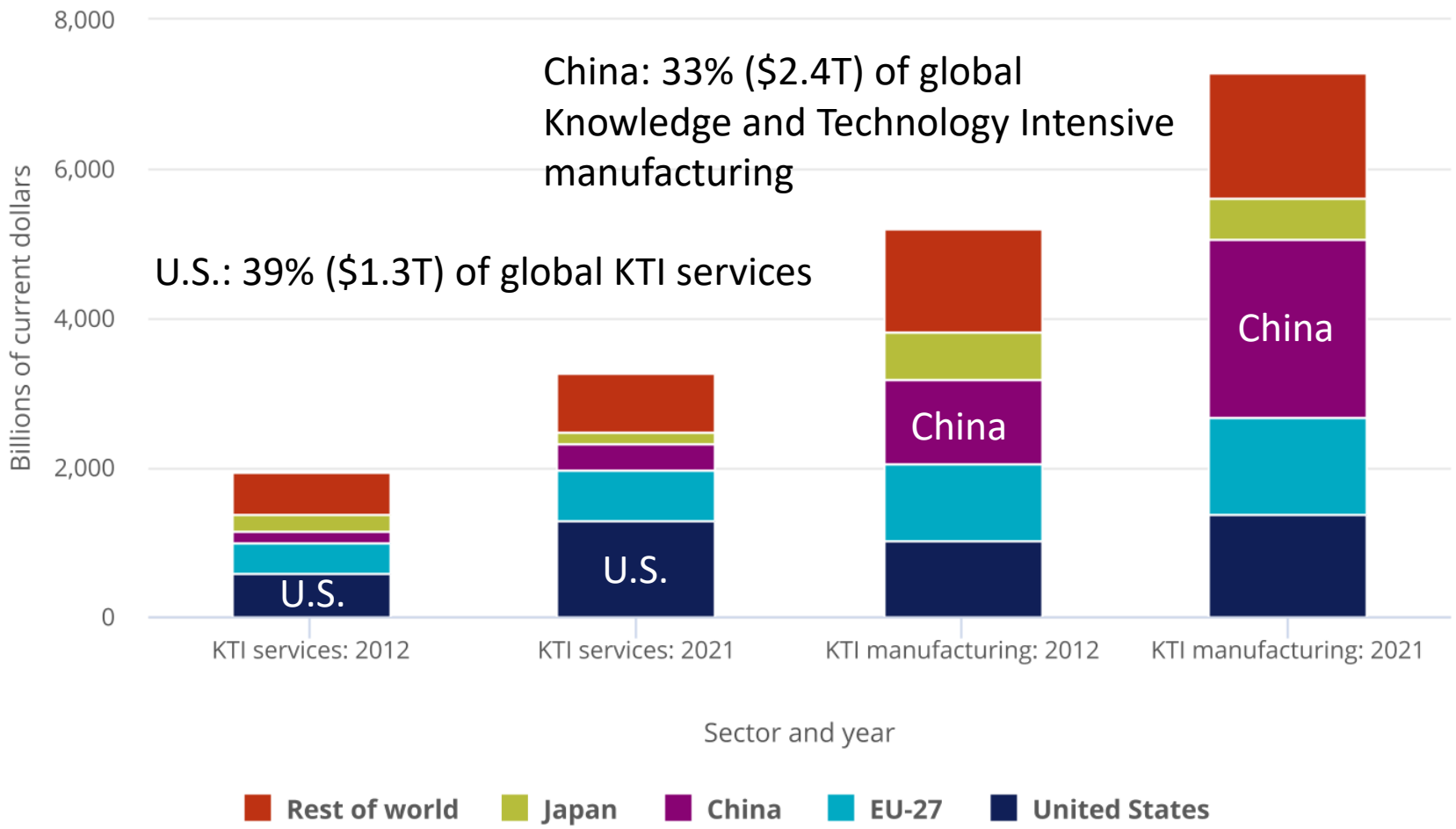
Firms headquartered in the United States receiving venture capital investment, by industry: 2013–22



Note(s): Industry categories are aggregates of PitchBook Primary Industry Codes based on product or service markets.
Source(s): PitchBook, venture capital and private equity database, special tabulations, accessed September 2023.

Knowledge- and Technology-Intensive Industries

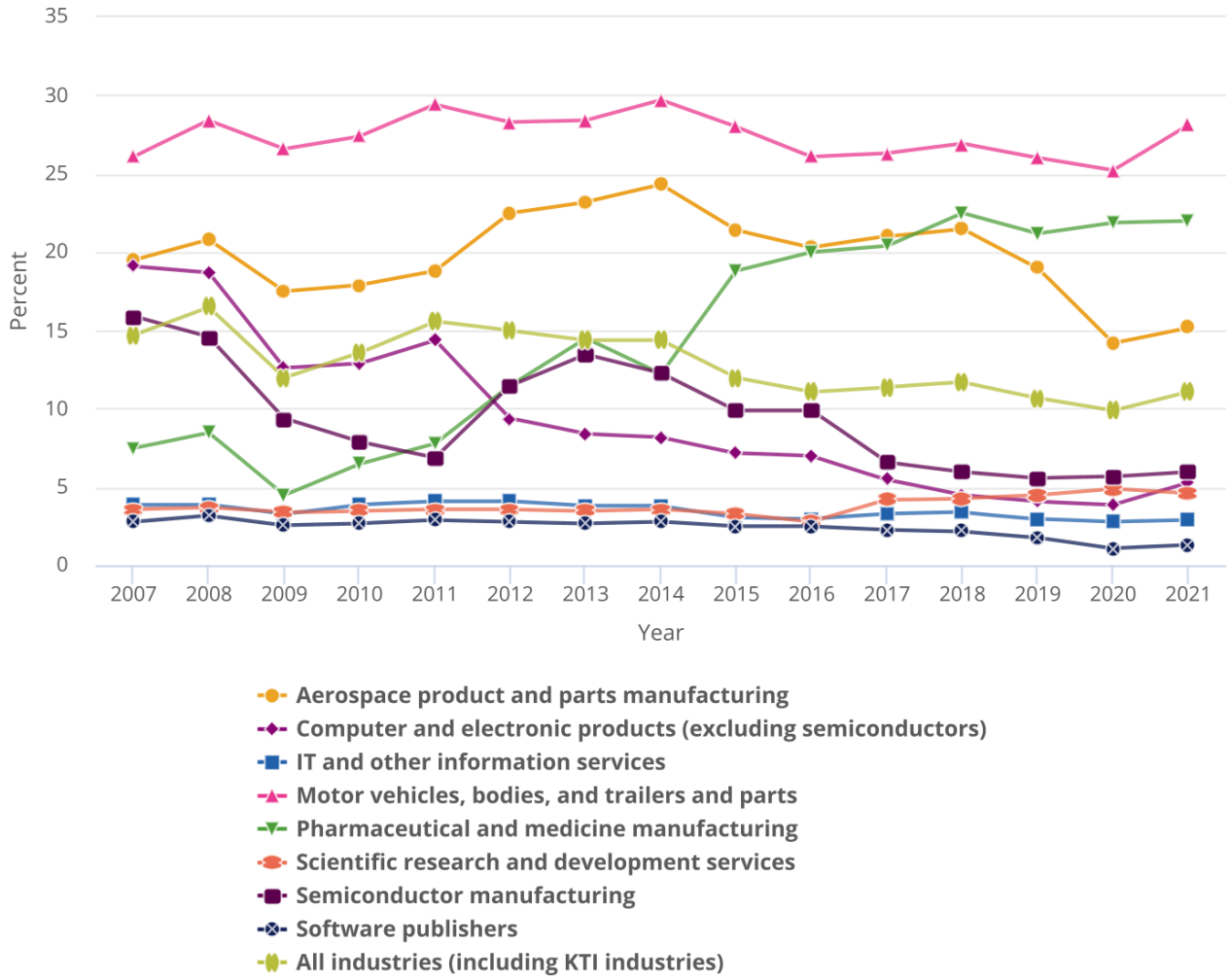
Value-added output of KTI industries, by selected region, county, or economy and by sector: 2012 and 2021



Note(s): EU-27 is European Union. KTI is knowledge and technology intensive.
Source(s): S&P Global IHS Markit, special tabulations (2023) of the Comparative Industry Service Database.

Imported content share of U.S. gross exports

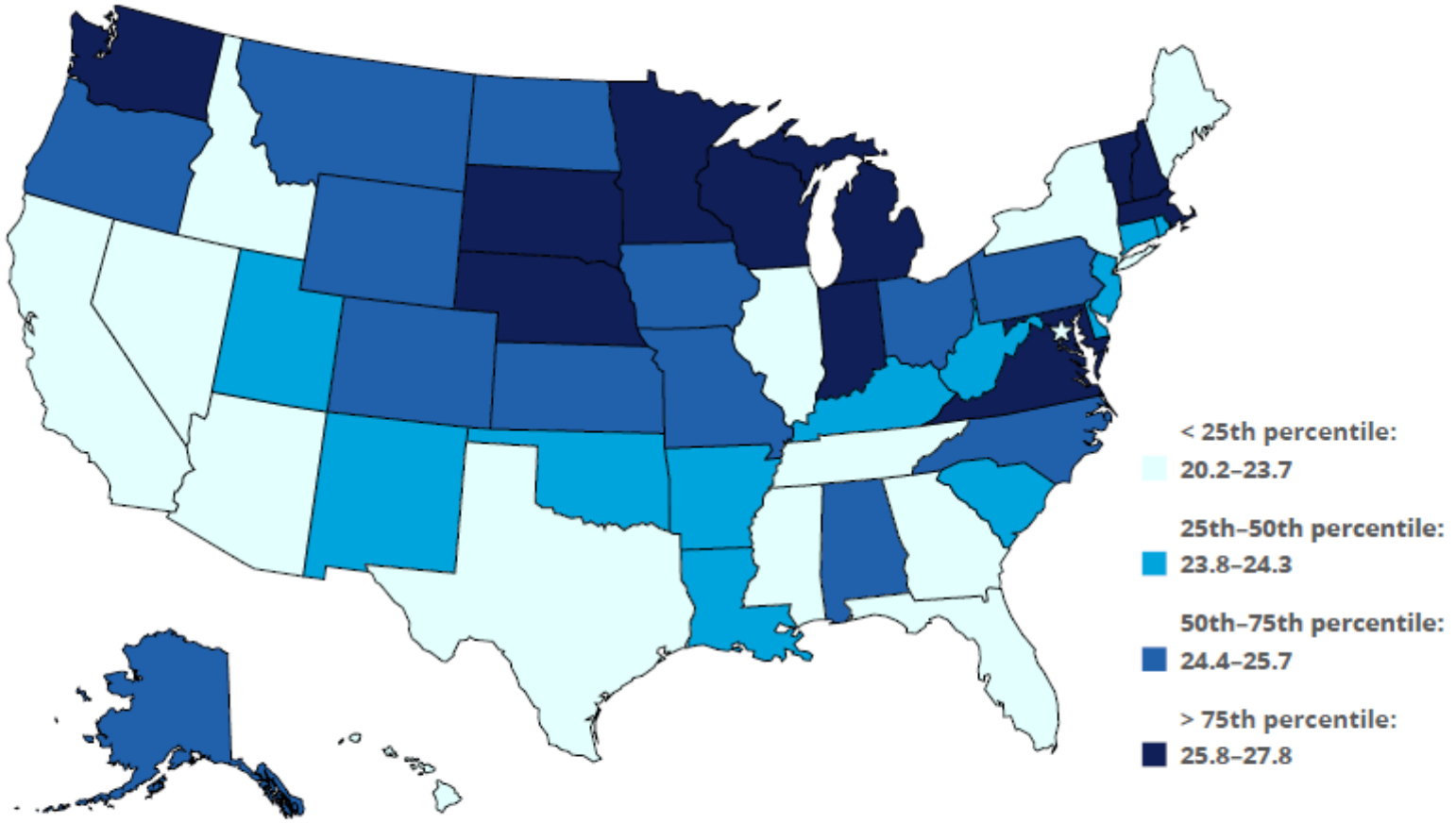
Imported content share of U.S. gross exports, by exporting industry: 2007–21



Note(s): IT is information technology. KTI is knowledge and technology intensive. Industry data are based on the North American Industry Classification System.
Source(s): BEA, Trade in Value Added Data.

STEM Talent

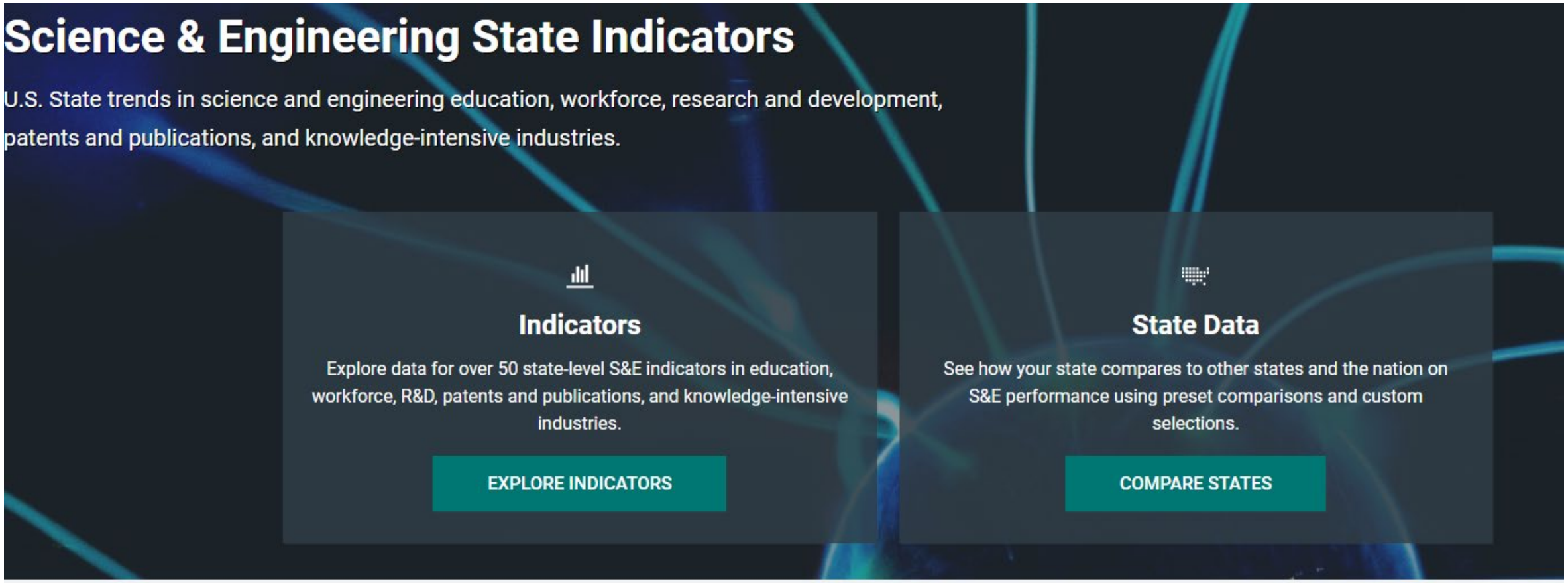
Figure 8. Employment in the STEM workforce, by state: 2021



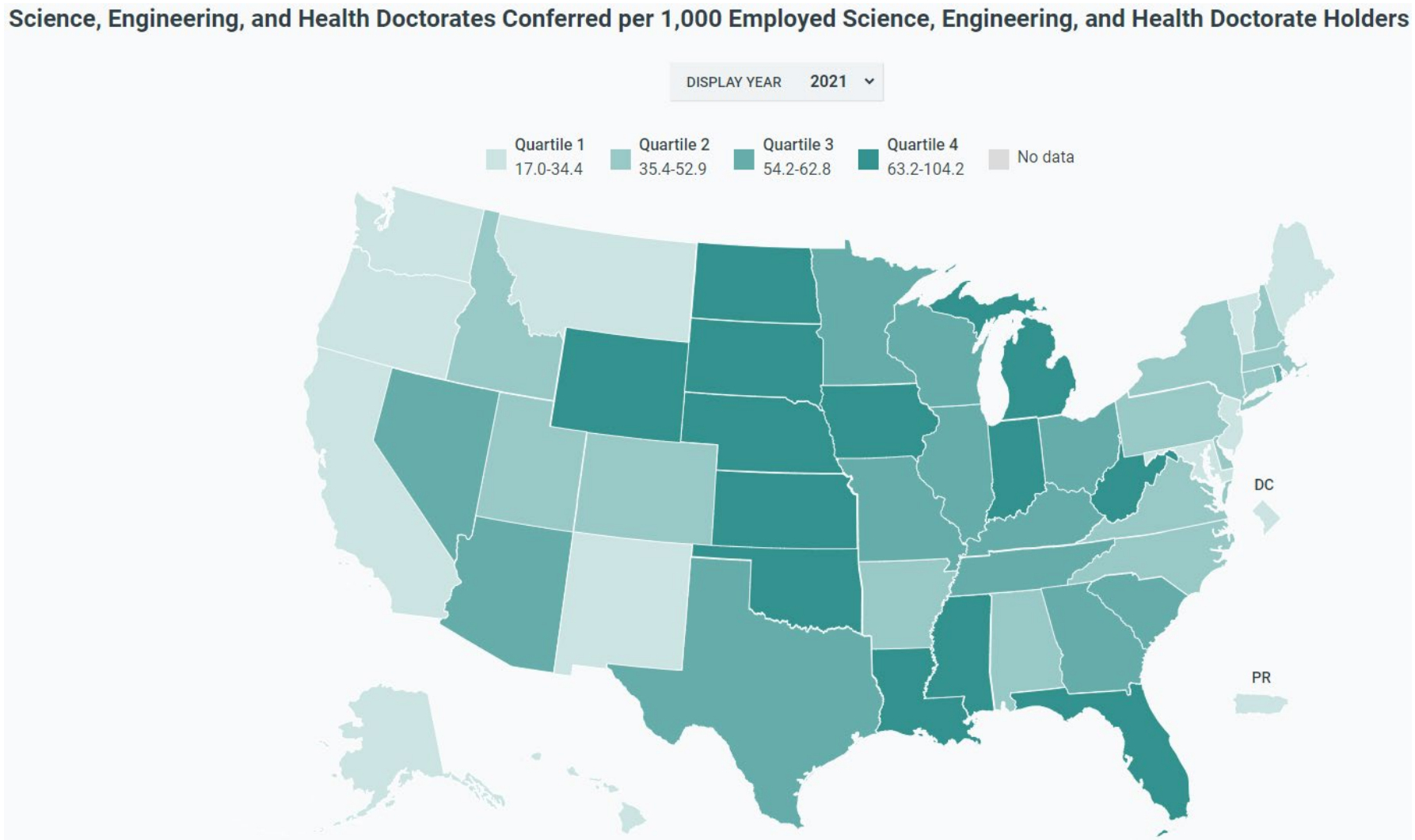
Note(s): STEM is science, technology, engineering, and mathematics. Quartiles are based on point estimates and do not account for sampling variability.

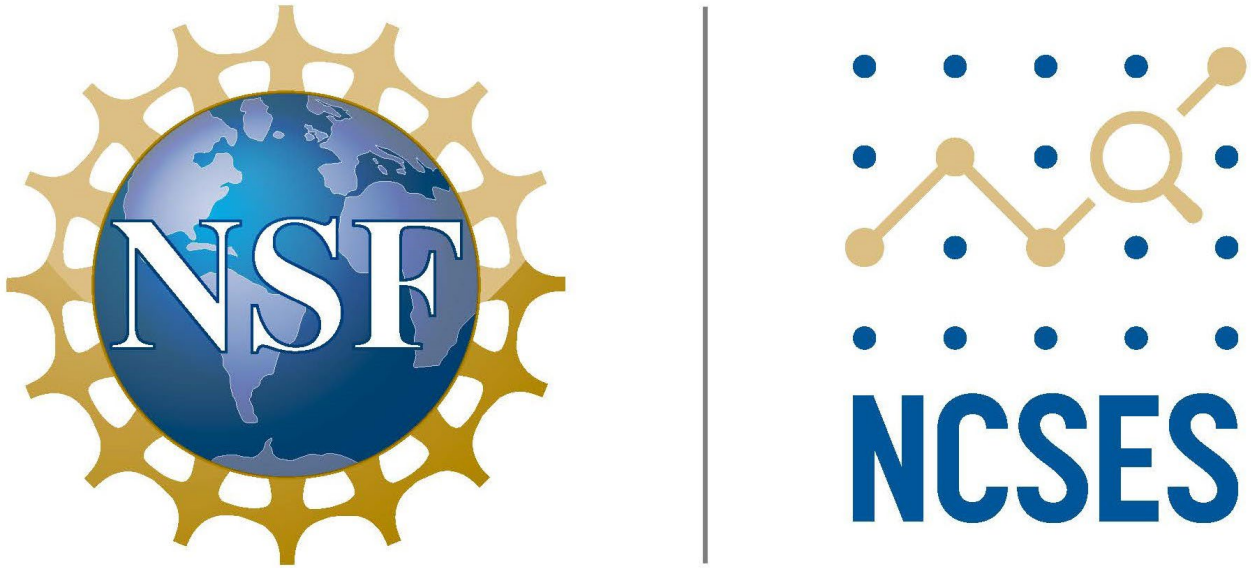
Source(s): Census Bureau, ACS, 2021. *Indicators 2024: Labor Force*

SEI State Data Tool



SEI State Data Tool: Degrees Conferred





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