

## SIDEBAR

**Critical and Emerging Technologies**

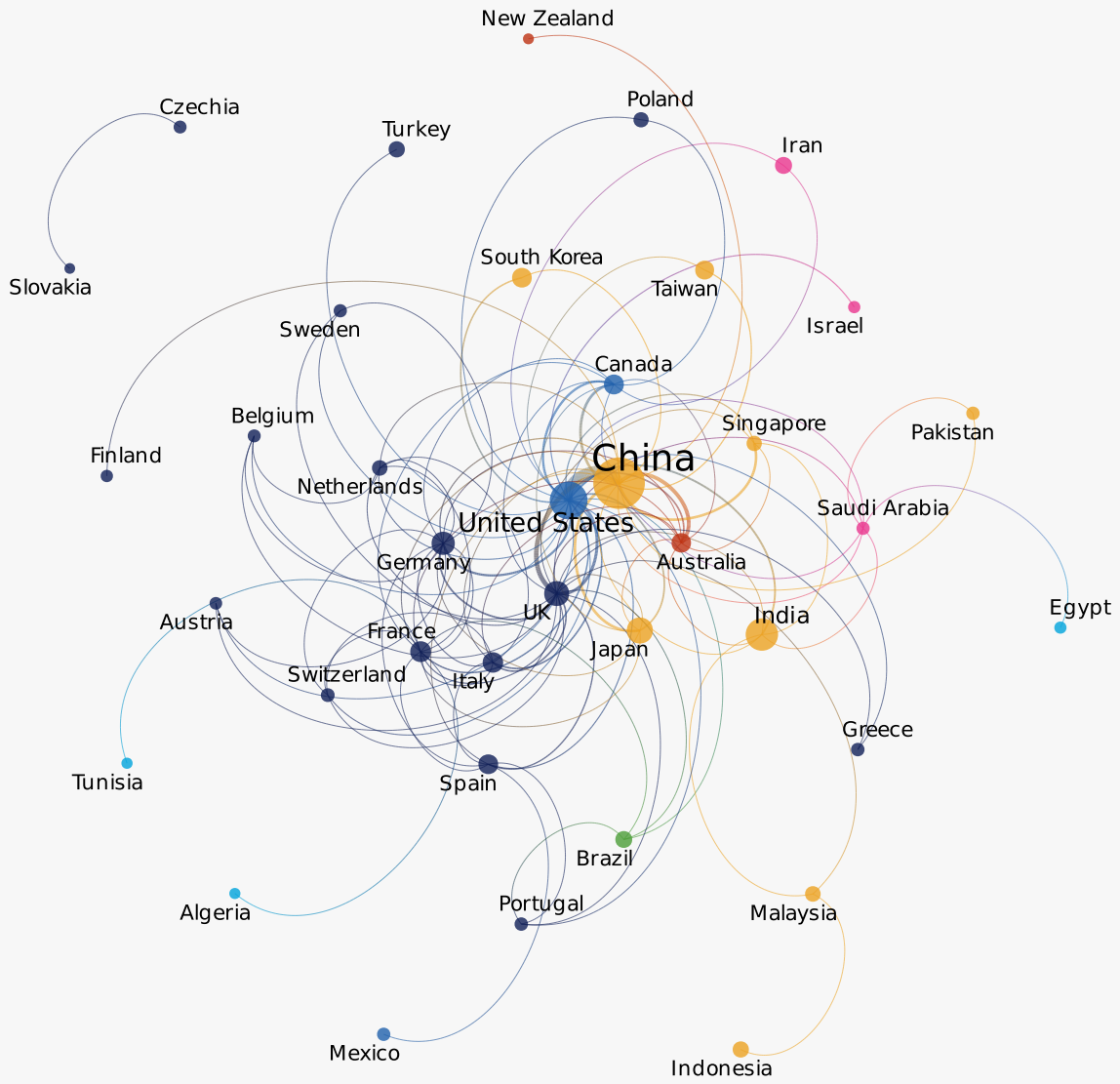
The National Science and Technology Council (NSTC) has formulated a list of critical and emerging technologies, which it identifies as a “subset of advanced technologies that are potentially significant to U.S. national security” (NSTC 2022). This sidebar provides select international comparisons of science, technology, and innovation capabilities in two technologies identified as critical and emerging by the NSTC: artificial intelligence (AI) and semiconductors.

China and the United States are the two largest contributors to AI research, both in terms of their national publications output and extent of international coauthorship (Figure A). From 2003 to 2022, researchers from China authored 274,000 AI-related articles (measured on a whole-count basis), and researchers from the United States authored 134,000 articles. Collaborative research between the United States and China resulted in the largest number of coauthored articles of any country pair (14,000); furthermore, all of the 10 largest coauthorship country pairs include either the United States or China. India and Japan each produced more total AI-related publications than the United Kingdom, but the United Kingdom coauthored more AI-related publications with both the United States and China than either India or Japan.

International comparisons of AI-related patenting indicate the extent to which inventors across the world are developing intellectual property of potential commercial value that relies on AI, including AI capabilities developed via published AI research. After a period of slow growth in the early 21st century, AI patenting has expanded rapidly in the past several years—most prominently in China. The leading countries for international patents granted in AI are China (40,000 in 2022), the United States (9,000), South Korea (5,000), and Japan (3,000). From 2000 to 2016, U.S. inventors were granted the most international AI patents but were surpassed by Chinese inventors in 2017. In terms of functional applications, AI patents by Chinese inventors have specialized in computer vision, whereas U.S. inventors have received a comparatively large proportion of patents in knowledge representation.

Figure A

AI collaboration network, by country: 2003–22



Number of Scopus documents    •    0    ● 100,000    ● 200,000    ● 300,000

Number of cowritten documents    —    0    — 5,000    — 10,000    — 15,000

Region    ● Africa    ● Australia and Oceania    ● Middle East    ● South America  
● Asia    ● Europe    ● North America

**Note(s):**

AI is artificial intelligence. UK is United Kingdom. Network diagram shows the number of cowritten articles by all pairs of countries 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 country 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 country. The width of the links between nodes is proportional to the quantity of articles both countries have cowritten. Positioning of nodes is defined using the Kamada-Kawai algorithm.

**Source(s):**

NCSES, special tabulations (2023) by Science-Metrix of Elsevier's Scopus abstract and citation database.

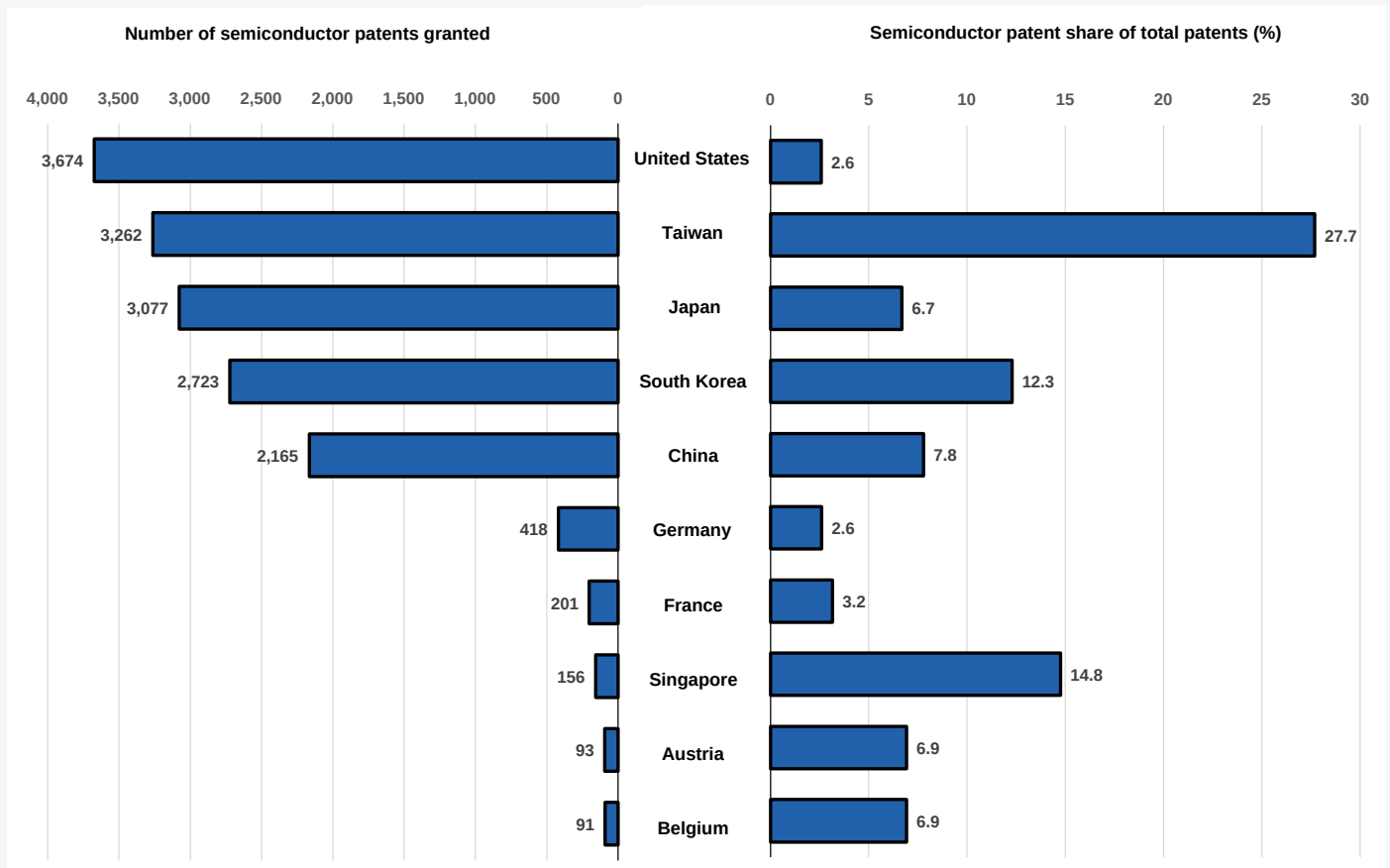
*Indicators 2024: Publications Output*

---

Patent and Trademark Office (USPTO) utility patents granted in semiconductors show how inventors from both the United States and abroad are seeking commercial protection for their inventions in this critical technology in the U.S. market. Approximately 3,700 USPTO semiconductor patents, 22% of the total, were granted to U.S.-based inventors in 2022, with the remainder of semiconductor patents issued to foreign inventors (Figure B). The most common foreign inventor locations for USPTO semiconductor patents—Taiwan, Japan, South Korea, and China—collectively accounted for 68% of all USPTO patents granted in this technology category. These locations also had considerably higher shares of their total USPTO patents granted in semiconductors than did inventors from the United States. Taiwan, the most common foreign inventor location, had 28% of its USPTO patents granted in semiconductors in 2022, one of the largest shares of any country or economy. Several European countries were also among the top foreign inventor locations, although semiconductors generally accounted for small shares of the total USPTO patents granted to these countries.

Figure B

**USPTO utility patents granted in semiconductors, 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):**

NCSSES, special tabulations (2023) by Science-Metrix of USPTO PatentsView.

Indicators 2024: Innovation