SIDEBAR

Patenting That Addresses Environmental Sustainability

Patenting that addresses climate change through mitigation and adaptation is of increasing interest internationally, and renewable energy generation is identified as a critical or emerging technology (NSTC 2022). Based on an analysis of Patent and Trademark Office (USPTO) utility patents, the foreign locations where inventors have the highest numbers of patents that address environmental sustainability through climate change mitigation and adaptation are the European Union (EU-27), China, Japan, and South Korea. Climate change mitigation in energy generation, transmission, or distribution has the highest numbers of USPTO patents granted.

The following analysis of utility patents that address this topic is based on a set of classification codes developed by the United Nations and the European Patent Office. This classification system for patent documents identifies climate change mitigation technologies (CCMT), climate change adaptation technologies (CCAT), and environmental management technologies that explicitly and cleanly correspond to existing patent classification systems that are used by USPTO and the World Intellectual Property Organization (Veefkind et al. 2012; Haščič and Migotto 2015). In 2022, more than 32,000 USPTO utility patents were granted in these environmental technologies, a threefold increase since 2000 (Table SINV-A). These 10 technologies are classified as follows:

- Environmental management

- CCMT in energy generation, transmission, or distribution

- CCMT in capture, storage, sequestration, or disposal of greenhouse gases

- CCMT in transportation

- CCMT in buildings

- CCMT in wastewater treatment or waste management

- CCMT in the production and processing of goods

- CCMT in information and communications technologies

- CCAT

- Sustainable ocean economy

Climate change mitigation in energy generation, transmission, or distribution have the highest numbers of USPTO patents granted in each of the five most active countries or regions, with a global total of about 7,900 USPTO patents granted in 2022 (Table INV-A). The classification used for this analysis includes patenting related to a sustainable ocean economy: 280 such USPTO utility patents were granted in 2022. Additionally, almost 700 patents within these 10 categories address sustainable technologies for agriculture and forestry (Table INV-A).

Table INV-A

USPTO patents granted to selected regions or countries in environmental sustainability technologies: 2022

(Number)

Technology area	World	China	EU-27	Japan	South Korea	United States
Environmental management	5,288	295	873	890	268	2,321
CCMT in energy generation, transmission, or distribution	7,943	757	1,103	1,622	1,154	2,544
CCMT in capture, storage, sequestration, or disposal of greenhouse gases	199	7	25	25	11	98
CCMT in transportation	5,170	172	983	1,105	353	2,035
CCMT in buildings	2,317	258	341	325	156	996
CCMT in wastewater treatment or waste management	557	42	88	51	17	262
CCMT in the production or processing of goods	3,975	306	635	710	286	1,542
CCMT in information and communication	3,428	447	260	304	410	1,532
CCAT	2,974	140	364	198	87	1,722
Sustainable ocean economy	280	18	45	19	15	131
Addendum						
CCAT in agriculture, forestry, livestock, or agroalimentary production	442	36	38	20	14	262
CCMT in agriculture, livestock, or agroalimentary industries	245	24	31	7	11	134

CCAT = climate change adaptation technology; CCMT = climate change mitigation technology; EU-27 = European Union; USPTO = Patent and Trademark Office.

Note(s):
USPTO patents are allocated according to patent inventorship information. USPTO patents are fractionally allocated among regions, countries, or economies based on the proportion of residences of all named inventors. Patents are classified under the World Intellectual Property Organization (WIPO) classification of patents, which classifies International Patent Classification (IPC) codes under 35 technical fields. IPC reformed codes take into account changes that were made to the WIPO classification in 2006 under the eighth version of the classification and were used to prepare these data. However, because PatentsView only provides the original IPC codes as they appeared on patents and not the IPC reformed codes, current Cooperative Patent Classification codes on patents were converted back to the most recent IPC classification to prepare these statistics. Fractional counts of patents were assigned to each technological field on patents to assign the proper weight of a patent to the corresponding technological fields under the classification. Beginning in 2020, the United Kingdom was no longer a member of the EU. China includes Hong Kong. See File USPTO environmental and critical technology patent data.
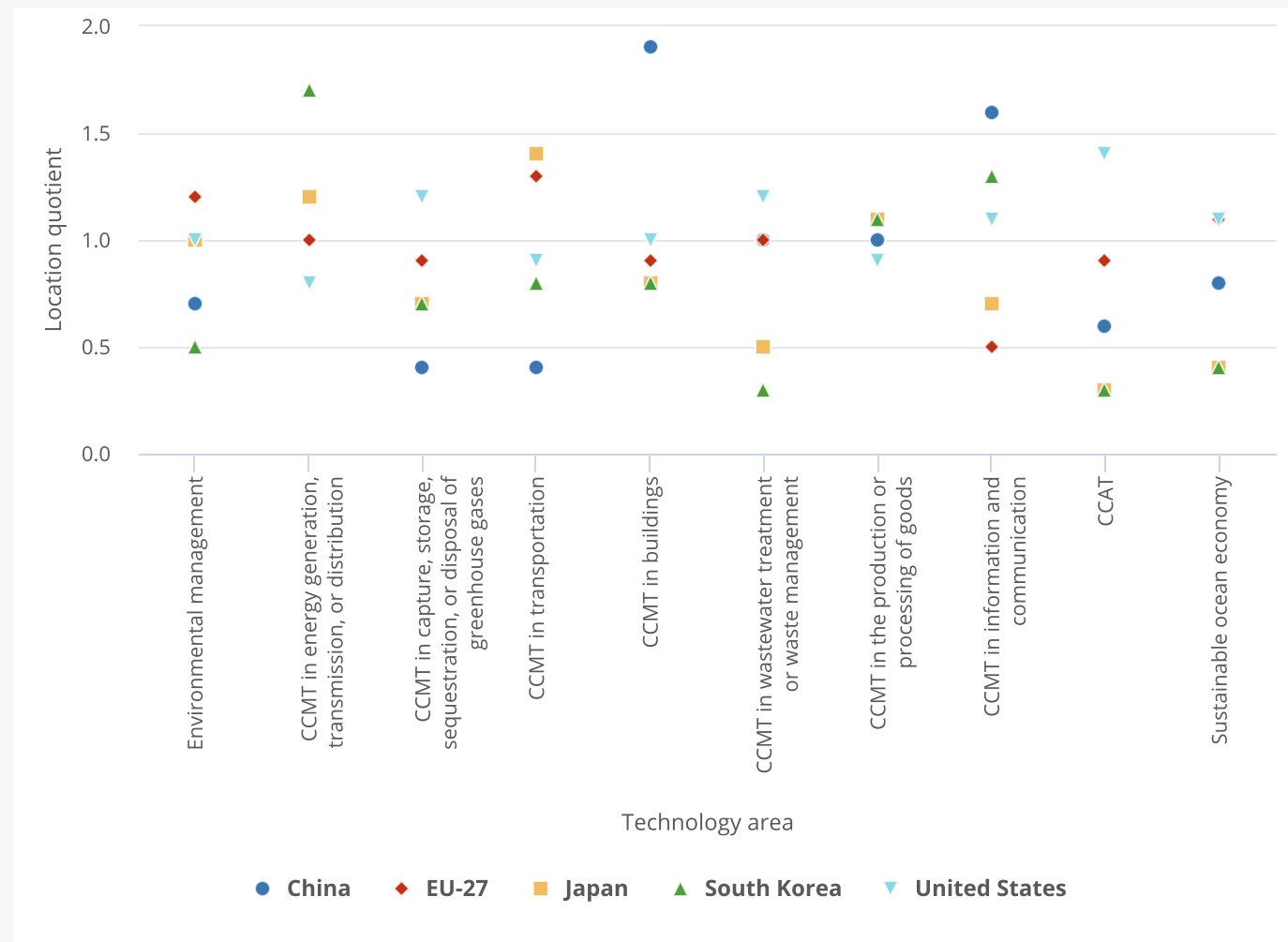
Source(s):
National Center for Science and Engineering Statistics; Science-Metrix; USPTO data hosted by Reed Tech (LexisNexis), accessed June 2023.

Science and Engineering Indicators

Along with the number of patents granted, location quotients (LQs) are a useful analytical tool for providing insight into the technological specialization by region, country, or economy relative to overall size. The LQs here compare activity in specific technology categories to overall global or national patents in environmental technologies.* For example, while the presentation shown in Table INV-A shows higher levels of patenting in energy generation, transmission, or distribution relative to other sustainable technologies, LQs show specialization. For example, an LQ of 1.5 implies that the location has 50% more activity in a given technology than would be expected based on volume alone. Inventors from China are more specialized in CCMT related to buildings (1.9) than would be expected, while the EU-27 (1.3) is more highly specialized in CCMT in transportation, as is Japan (1.4). As shown by LQs closer to 1.0, the United States is more balanced than other locations in its overall concentration of its patenting by technology area (Figure INV-A).

Figure INV-A

Specialization of patents among technology areas for the top 5 regions or countries in environmental sustainability technology: 2011−22

CCAT = climate change adaptation technology; CCMT = climate change mitigation technology; EU-27 = European Union.

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Patent and Trademark Office (USPTO) patents are allocated according to patent inventorship information. USPTO patents are fractionally allocated among regions, countries, or economies based on the proportion of residences of all named inventors. Patents are classified under the World Intellectual Property Organization (WIPO) classification of patents, which classifies International Patent Classification (IPC) codes under 35 technical fields. IPC reformed codes take into account changes that were made to the WIPO classification in 2006 under the eighth version of the classification and were used to prepare these data. However, because PatentsView only provides the original IPC codes as they appeared on patents and not the IPC reformed codes, current Cooperative Patent Classification codes on patents were converted back to the most recent IPC classification to prepare these statistics. Fractional counts of patents were assigned to each technological field on patents to assign the proper weight of a patent to the corresponding technological fields under the classification. Beginning in 2020, the United Kingdom was no longer a member of the EU. China includes Hong Kong. United States includes Puerto Rico and all other U.S. territories.
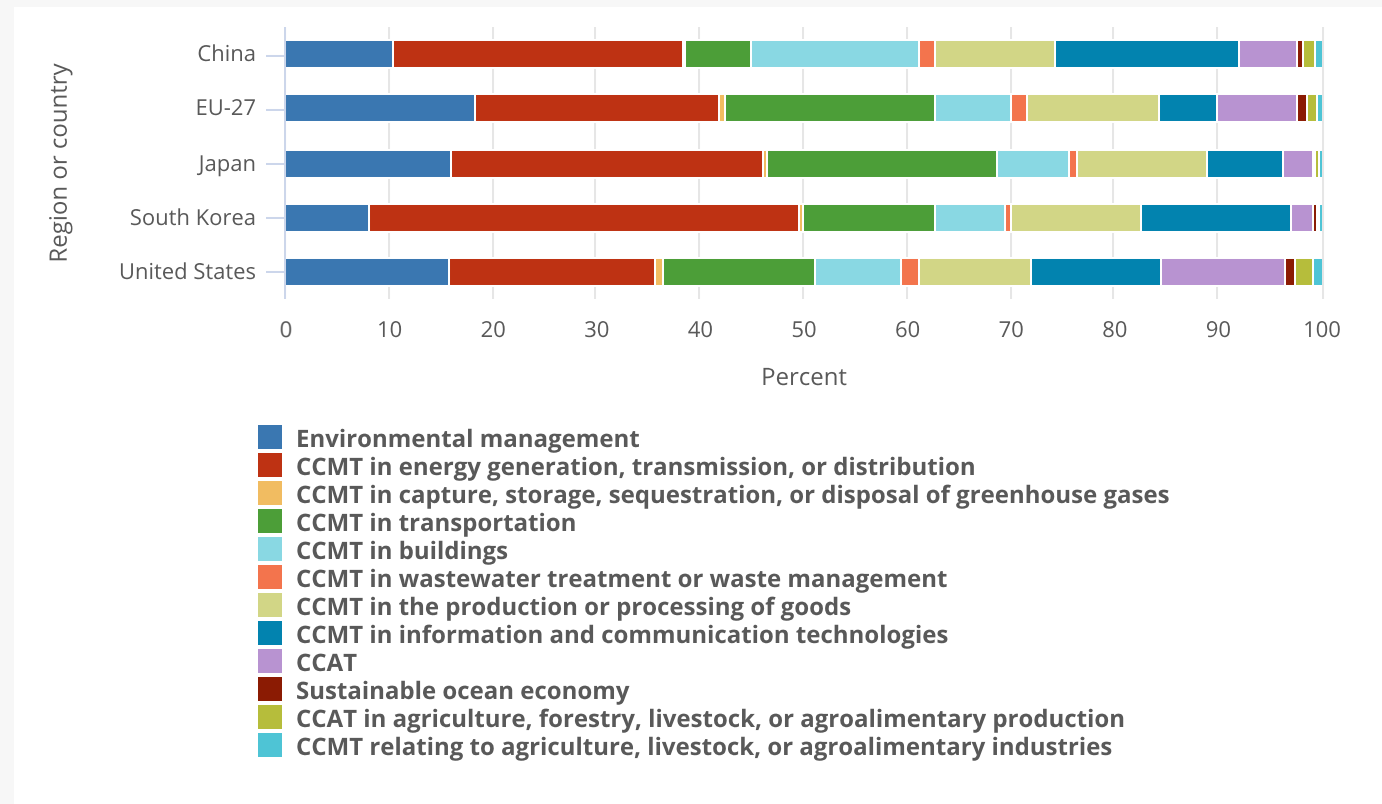
Source(s):
National Center for Science and Engineering Statistics; Science-Metrix; PatentsView, USPTO, accessed June 2023.

Science and Engineering Indicators

The percent distribution of each region's or country's patenting across environmental sustainability technology areas shows where its patenting activity is greatest. For each of the five leading regions or countries in environmental sustainable technology patenting, climate change mitigation technologies in energy generation, transmission, or distribution represent the largest share of patents (Figure INV-B).

Figure INV-B

Share of environmental sustainability technology patents for the top 5 regions or countries, by technology area: 2011−22

CCAT = climate change adaptation technology; CCMT = climate change mitigation technology; EU-27 = European Union.

Note(s):
Patent and Trademark Office (USPTO) patents are allocated according to patent inventorship information. USPTO patents are fractionally allocated among regions, countries, or economies based on the proportion of residences of all named inventors. Patents are classified under the World Intellectual Property Organization (WIPO) classification of patents, which classifies International Patent Classification (IPC) codes under 35 technical fields. IPC reformed codes take into account changes that were made to the WIPO classification in 2006 under the eighth version of the classification and were used to prepare these data. However, because PatentsView only provides the original IPC codes as they appeared on patents and not the IPC reformed codes, current Cooperative Patent Classification codes on patents were converted back to the most recent IPC classification to prepare these statistics. Fractional counts of patents were assigned to each technological field on patents to assign the proper weight of a patent to the corresponding technological fields under the classification. Beginning in 2020, the United Kingdom was no longer a member of the EU. China includes Hong Kong. United States includes Puerto Rico and all other U.S. territories.
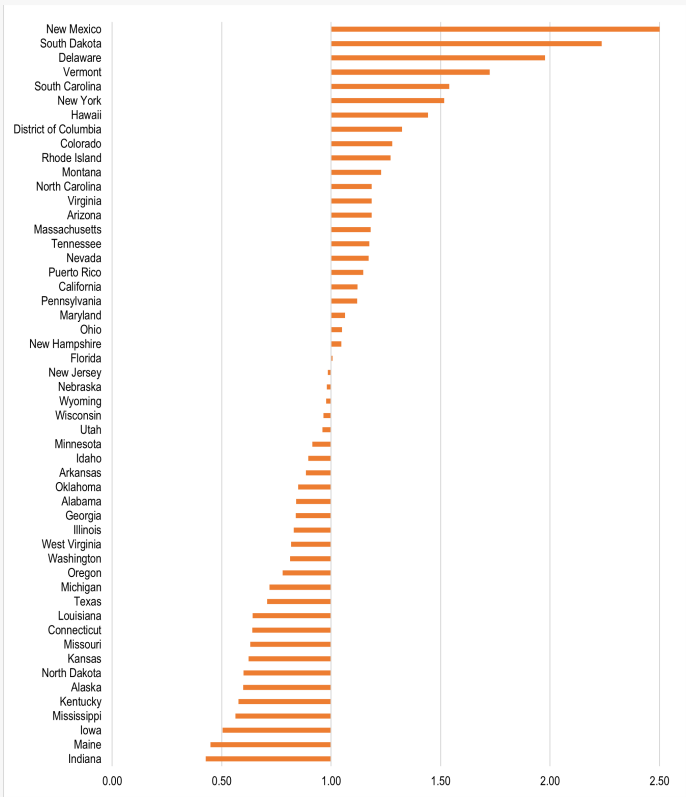
Source(s):
National Center for Science and Engineering Statistics; Science-Metrix; PatentsView, USPTO, accessed June 2023.

Science and Engineering Indicators

Based on inventor addresses within the United States, the state of New Mexico has the highest degree of specialization in patents in the critical or emerging technology of renewable energy generation and storage among all states. Inventors in New Mexico are 2.5 times more specialized in this technology than would be expected (Figure INV-C). For environmental management technologies, Louisiana has the highest degree of specialization, more than 2.1 times what would be expected (Figure INV-D). Supplementary tables and public-use data sets released with this report provide annual state-level USPTO patent counts by sustainability category that will allow for additional analysis (File USPTO environmental and critical technology patent data).

Figure INV-C

Location quotients of U.S. states for patents in climate change mitigation technologies in energy generation, transmission, or distribution: 2011−22

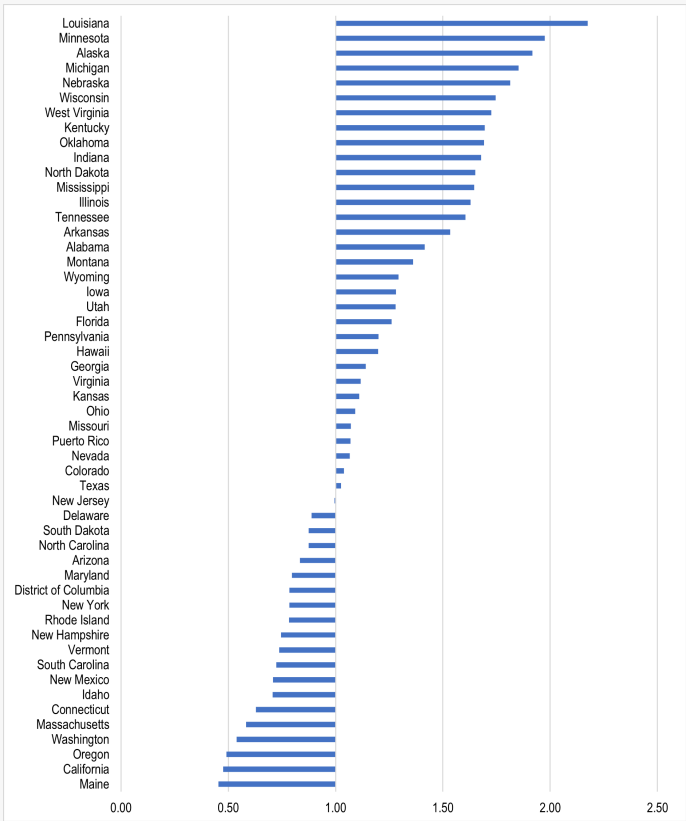CCMT = climate change mitigation technology.

Note(s):
Patents are attributed to states using a fractional count based on the states listed as the residences of inventors. Location quotient measures each state's concentration of patenting in a technology area among sustainable technologies relative to the U.S. concentration of patenting in that area.

Source(s):
National Center for Science and Engineering Statistics; Science-Metrix; PatentsView, USPTO, accessed June 2023.

Science and Engineering Indicators

Figure INV-D

Location quotients of U.S. states for patents in environmental management: 2011−22

Note(s):
Patents are attributed to states using a fractional count based on the states listed as the residences of inventors. Location quotient measures each state's concentration of patenting in a technology area among sustainable technologies relative to the U.S. concentration of patenting in that area.

Source(s):
National Center for Science and Engineering Statistics; Science-Metrix; PatentsView, USPTO, accessed June 2023.

Science and Engineering Indicators

* A location quotient of 1.0 in each technology means that particular subregion and the entire area are equally specialized in the technology based on patents granted. A location quotient greater than 1.0 means that the subregion is relatively more specialized than the entire area in that technology. A public-use file released with this report provides region, country, or economy data along with U.S. state-level data for these patents (File USPTO environmental and critical technology patent data).