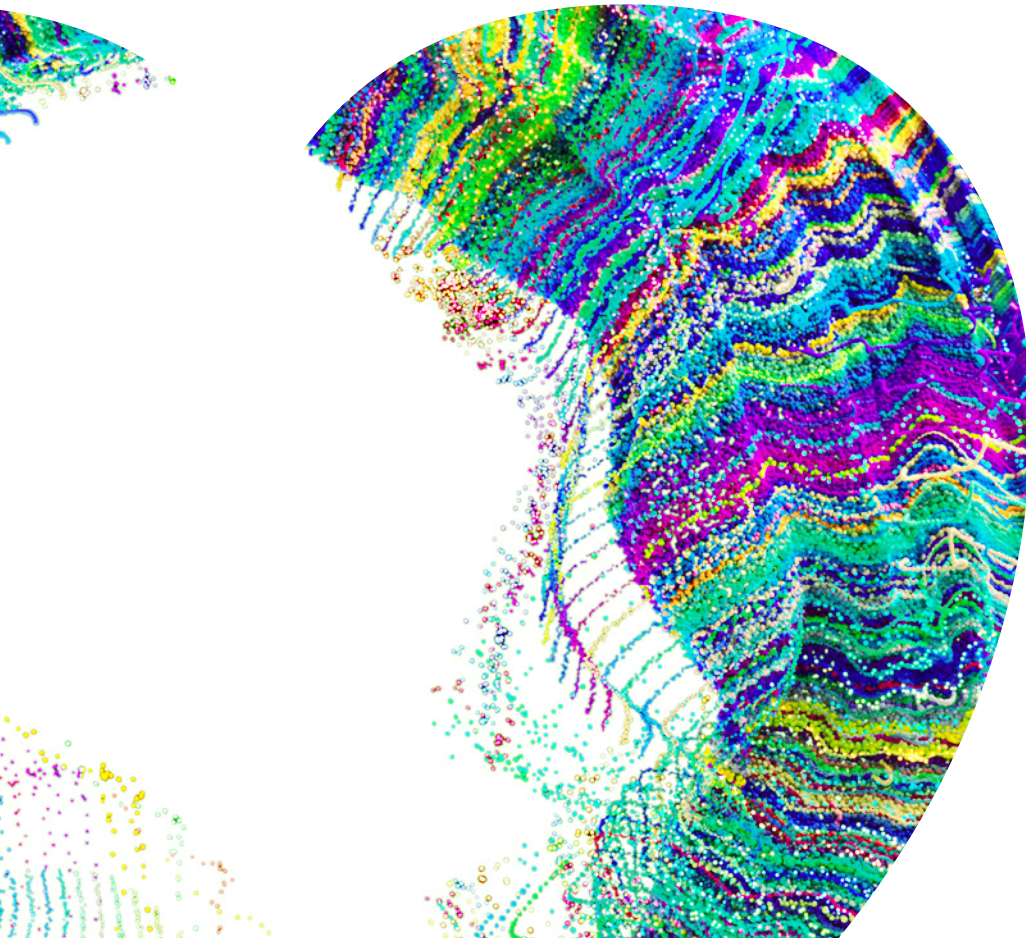


Cluster ranking 2024

The GII reveals the world's top 100 science and technology (S&T) clusters and identifies the most S&T-intensive top global clusters.



The GII 2024 top 100 science and technology clusters

The Global Innovation Index (GII) ranks the world's leading economies according to their innovation capabilities. A common thread among top-performing nations is the presence of thriving science and technology (S&T) clusters. Since 2016, the GII has employed a bottom-up approach to identifying such clusters. This methodology disregards administrative or political borders and instead pinpoints those geographical areas with a high density of inventors and scientific authors. The resulting clusters identified in this way often span several municipal districts, sub-federal states, and sometimes even two or more countries.

Two innovation metrics are used to compile the top 100 GII S&T clusters worldwide (see methodological Appendix IV for details). The first metric focuses on the location of inventors listed in published patent applications under the WIPO Patent Cooperation Treaty (PCT).¹ The second metric considers the authors listed on published scientific articles.

S&T clusters – which can be entire regions or cities – serve as the backbone of a robust national innovation ecosystem. Situated in areas such as San Francisco's Silicon Valley, Cambridge, Munich and Paris in Europe, or Bengaluru, Seoul, Shenzhen and Tokyo in Asia, these S&T clusters are home to renowned universities, brilliant scientists, R&D-intensive companies, and prolific inventors. It is the collaboration among these entities that results in the groundbreaking scientific advancements and inventions that propel national, regional and global innovation forward.

The GII recognizes the significance of these regional hubs and charts annually the world's top 100 S&T clusters (Map 1). These areas boast the highest density of inventors and scientific authors globally.

The GII 2024 also presents S&T clusters beyond the top 100 in order to shed light on other areas around the world with an appreciably high level of science and technology. In addition, the GII 2024 takes a first step toward highlighting S&T clusters within Africa, a region whose output is typically not taken account of when clustering at the global level.

Lastly, to complement this section of the GII, a series of “Top Clusters Briefs” (link) provide further details on top ranking hotspots. This complements other work undertaken by WIPO to better measure and understand sub-national innovation activity (de Rassenfosse, G. and S. Wunsch-Vincent, 2024).²

Tokyo –Yokohama plus six other Asian and three US clusters lead the top 100 S&T clusters

Among the top 100 S&T clusters, Tokyo–Yokohama (Japan) is the top performing cluster, followed by Shenzhen–Hong Kong–Guangzhou (China and Hong Kong, China). Both clusters rank one and two owing to having a large output of PCT applications, thanks in great part to patents filed by Mitsubishi Electric located in Tokyo–Yokohama and Huawei located in Shenzhen–Hong Kong–Guangzhou, respectively. When combined, Tokyo–Yokohama and Shenzhen–Hong Kong–Guangzhou account for almost one in every five PCT applications filed globally.

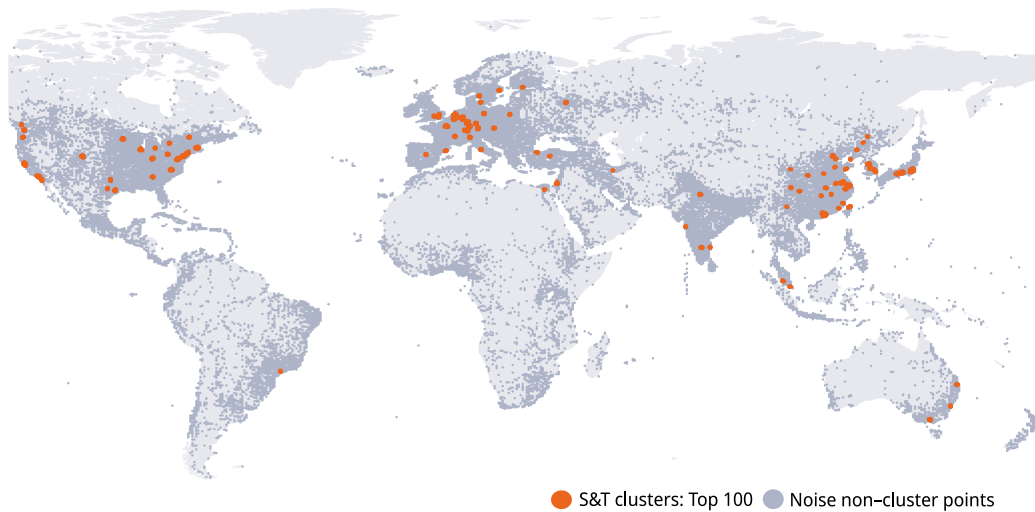
Beijing (China), Seoul (Republic of Korea) and Shanghai–Suzhou (China) follow, ranking 3rd, 4th and 5th, respectively. Beijing (China) reclaims third spot in the rankings, overtaking Seoul (Republic of Korea) in fourth, in 2024. Shanghai–Suzhou (China) is in the top 5, primarily owing to

1 The WIPO Patent Cooperation Treaty (PCT) assists applicants in seeking patent protection internationally for inventions, helps patent offices with patent granting decisions, and facilitates public access to a wealth of technical information relating to those inventions. By filing one international patent application under the PCT System, applicants can simultaneously seek protection for an invention in a large number of countries (<https://www.wipo.int/pct/en>).

2 See Box 2 in GII 2024 Results and “WIPO General Assemblies 2024 – Side Event Global Innovation Index: Measuring and Promoting Sub-national Innovation Performance: The Role of Regional Innovation Indices,” July 12, 2024, and “Workshop – Global Innovation Index Sharing of Experiences in the Creation & Implementation of Regional Innovation Indices,” June 7, 2022.

a strong growth in PCT filings. San Jose–San Francisco, CA (United States of America (US)) follows in 6th position.

Map 1 Top 100 clusters worldwide, 2024



Note: Noise refers to all inventor/author locations not classified as being within a cluster.
WIPO Statistics Database, April 2024.

The four remaining top 10 clusters are unchanged from the previous year, with the exception of Nanjing (China), replacing San Diego, CA (United States), which is 10th and New York City, NY, which is now 11th. Nanjing's growth was spurred by its scientific article output, primarily from authors affiliated with Southeast University and Nanjing University.

This year five clusters entered the top 100 for the first time. Nanchang (China) located in the eastern part of Jiangxi Province secures the 94th position. Cairo (Egypt) enters the top 100 ranked 95th. This marks the first time that a Northern African cluster is represented within the top 100 S&T clusters. Following closely behind Cairo's entrance are two Chinese clusters entering the top 100 for the first time: Kunming, the capital of Yunnan Province China (98th), and Macao Special Administrative Region of China–Zhuhai (Macao SAR–Zhuhai) (100th).

For Nanchang (Nanchang University), Cairo (Cairo University) and Kunming (Kunming University of Science and Technology), their total output was primarily in the form of scientific articles, which experienced strong growth in all three clusters and is the reason for their entry into the top 100. Macao SAR–Zhuhai's primary output is PCT patents, thanks in large measure to the presence of GREE Electric Appliances, which accounts for almost half of Macao SAR–Zhuhai's applications. Similarly to the other three newcomers to the top 100, the driver behind Macao SAR–Zhuhai's increased standing in the ranking is a growth in published scientific articles.

Kuala Lumpur (Malaysia) ranked 93rd also appears in the top 100 S&T clusters for the first time. Kuala Lumpur achieved this status thanks to improved geocoding accuracy assigning more author and inventor locations to that city.³ MIMOS (Malaysia's National Applied Research and Development Centre) is Kuala Lumpur's top patent applicant and active in semiconductor research, and the Universiti Malaya the top publishing organization.

Clusters within China once again demonstrated significant increases in S&T output in 2024. China hosts the two fastest growing clusters globally – Hefei (+22.7 percent) and Zhengzhou (+18.9 percent).⁴ Hefei's growth was driven by a strong PCT applications growth, and in particular the growth of applications filed by ChangXin Memory Technologies headquartered in Hefei. Zhengzhou's rapid growth was instead driven by the number of scientific articles published, the largest contributor being Zhengzhou University.

³ See the methodological Appendix IV.

⁴ Net S&T output refers to a change in combined output of both components (PCT filings and SCIE articles) over time.

Clusters located in other middle-income economies besides China also experienced strong S&T output growth. Cairo (Egypt) had the highest growth rate for this group at 10.9 percent. Chennai (India) with 7.8 percent and Istanbul (Türkiye) with 7.5 percent also had a high rate of growth for this group.

High-income economy clusters generally grew at a slower pace than clusters in middle-income economies, with 37 out of the 63 high-income clusters witnessing negative net S&T output for the period. Nevertheless, notable exceptions to this trend exist among high-income economy clusters. Daejeon (Republic of Korea, +6.9 percent), Seoul (+4.1 percent) and San Diego, CA (+4.2 percent) once again had strong growth years. Warsaw (+3.1 percent) in Poland also experienced strong growth.

The top S&T clusters for each economy or cross-border region are shown in Table 5. The leading clusters per country remain unchanged from last year, except for Sydney overtaking Melbourne to become the leading Australian S&T cluster, with the University of Sydney publishing the most scientific articles and Cochlear, the medical device company, filing the most patent applications. It is notable that Samsung Electronics (Republic of Korea) is also the leading patentee in, Bengaluru Moscow and Warsaw (beyond Seoul).

Table 5 Top S&T cluster by economy or cross-border region ranked among the top 100, 2024

Rank	Cluster name	Economy	Rank change	Top applicant	Top organization
1	Tokyo–Yokohama	JP	0	Mitsubishi Electric	University of Tokyo
2	Shenzhen–Hong Kong–Guangzhou	CN/HK	0	Huawei	Sun Yat Sen University
3	Beijing	CN	1	BOE Technology	Tsinghua University
4	Seoul	KR	–1	Samsung Electronics	Seoul National University
6	San Jose–San Francisco, CA	US	0	Google	Stanford University
12	Paris	FR	–1	L'Oréal	Sorbonne Université
21	London	GB	–1	Nicoventures Trading	University College London
22	Munich	DE	–1	BMW	Technical University of Munich
25	Taipei–Hsinchu	TW*	2	Hewlett-Packard	National Taiwan University
26	Amsterdam–Rotterdam	NL	–1	TNO	Utrecht University
30	Tel Aviv–Jerusalem	IL	0	Tel Aviv University	Hebrew University of Jerusalem
31	Moscow	RU	0	Samsung Electronics	Lomonosov Moscow State University
33	Singapore	SG/MY	1	National University of Singapore	National University of Singapore
38	Tehran	IR	–3	Abdollahad, Mohammad	University of Tehran
40	Stockholm	SE	–2	LM Ericsson	Karolinska Institutet
44	Sydney	AU	0	Cochlear	University of Sydney
48	Madrid	ES	–1	LM Ericsson	Complutense University of Madrid

Table 5 Top S&T cluster by economy or cross-border region ranked among the top 100, 2024 – continued

Rank	Cluster name	Economy	Rank change	Top applicant	Top organization
50	Zürich	CH	-1	ETH Zürich	ETH Zürich
52	Milan	IT	-1	Pirelli Tyre	University of Milan
53	Brussels–Antwerp	BE	-3	Agfa	KU Leuven
54	Toronto, ON	CA	-2	DH Technologies Development	University of Toronto
56	Bengaluru	IN	1	Samsung Electronics	IISC – Bangalore
57	Copenhagen	DK	-2	Novozymes	University of Copenhagen
59	Istanbul	TR	1	Arcelik	Istanbul Technical University
71	Helsinki	FI	1	Nokia	University of Helsinki
73	São Paulo	BR	-2	Braskem	Universidade de São Paulo
74	Vienna	AT	1	Technische Universität Wien	Medical University of Vienna
90	Warsaw	PL	-1	Samsung Electronics	University of Warsaw
93	Kuala Lumpur	MY	0	MIMOS Berhad	Universiti Malaya
95	Cairo	EG	8	Si-Ware Systems	Cairo University
96	Basel	CH/DE/FR	-1	DSM IP Assets	University of Basel

China and the United States have the most S&T clusters in the top 100 S&T

In 2024, as in previous years, the top 100 S&T clusters continue to be predominantly located in three regions: North America, Europe, and Asia, with a particular concentration in two key economies: China and the United States (see Map 1).

Table 6 Economies with three or more top 100 S&T clusters, 2024

Economy	Economy name	Top 100 clusters
CN	China	26
US	United States	20
DE	Germany	8
IN	India	4
KR	Republic of Korea	4
FR	France	3
GB	United Kingdom	3
JP	Japan	3
CA	Canada	3
AU	Australia	3

Source: WIPO Statistics Database, April 2024.

China, for the second consecutive year, leads with the most clusters (26) in the top 100 (Map 2). The United States follows closely behind with 20 clusters. Germany ranks third with eight clusters in the top 100, with Munich (22nd), Cologne (27th) and Stuttgart (29th) its top three clusters. India, with its top cluster of Bengaluru (56th) in southern India, and the Republic of

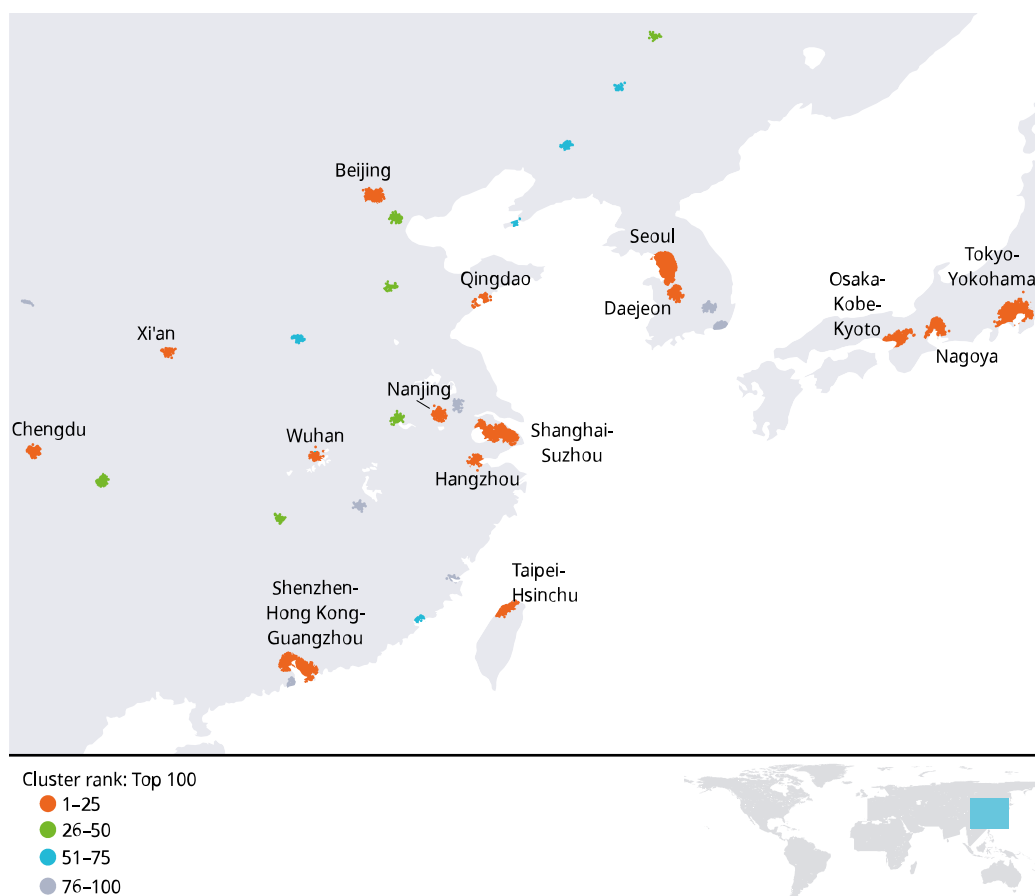
Korea both have four clusters in the top 100. France, the United Kingdom (UK), Japan and Canada each have three clusters in the top 100. Paris (12th) leads France's ranking, while London (21st) represents the United Kingdom's top cluster. Canada's top cluster is Toronto, Ontario (54th).

In addition to China, seven other middle-income economies have clusters among the top 100. They are:

- Brazil (1 cluster), with São Paulo, the sole top 100 S&T cluster within Latin America;
- Egypt (1), with Cairo, the sole top 100 S&T cluster within Africa (see Map 2);
- India (4), with Bengaluru, Delhi, Chennai and Mumbai;
- Islamic Republic of Iran (1), with Tehran;
- Malaysia (2), with Kuala Lumpur and its cross-border clusters shared with Singapore (see Map 2);
- Russian Federation (1), with Moscow; and
- Türkiye (2), with Istanbul and Ankara.

Map 2 Top S&T clusters, East Asia, United States, Middle East, Malaysia and Singapore, 2024

(a) East Asia



Source: WIPO Statistics Database, May 2024.

(b) United States



Cluster rank: Top 100

- 1-25
- 26-50
- 51-75
- 76-100



Source: WIPO Statistics Database, May 2024.

(c) Middle East



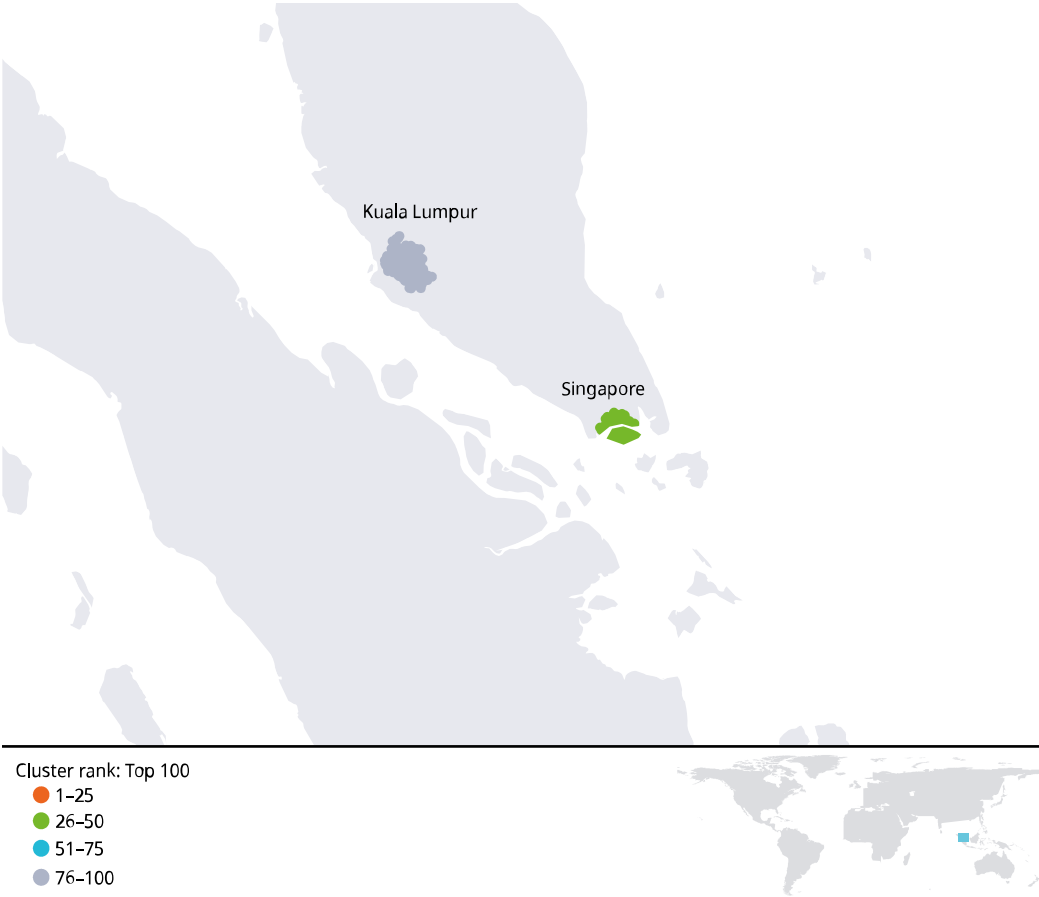
Cluster rank: Top 100

- 1-25
- 26-50
- 51-75
- 76-100



Source: WIPO Statistics Database, May 2024.

(d) Malaysia and Singapore



Source: WIPO Statistics Database, May 2024.

Beyond the top 100, Bangkok, Buenos Aires, Cairo, Kuala Lumpur and Mexico City are top middle-income economy S&T clusters

Based on the same parameters applied to produce the top 100 ranking S&T clusters globally, an additional 132 clusters were identified beyond the top 100, including 24 clusters based in the United States, 15 in China and 11 in each of France and Germany.

Table 7 identifies top S&T clusters in economies not previously represented in the top 100, including Portugal and Saudi Arabia, which each had two clusters.

Middle-income economies, Argentina, Mexico, Pakistan, Serbia and Thailand all host a top S&T cluster in the extended list, namely, Buenos Aires, Mexico City, Islamabad, Belgrade and Bangkok, respectively.

Table 7 Top S&T clusters in extended ranking, economies not covered by the top 100 S&T clusters, 2024

Economy	Economy name	Clusters beyond top 100	Cluster name(s)
PT	Portugal	2	Lisbon and Porto
SA	Saudi Arabia	2	Dammam and Riyadh
AR	Argentina	1	Buenos Aires
CL	Chile	1	Santiago
CZ	Czech Republic	1	Prague
GR	Greece	1	Athens
HU	Hungary	1	Budapest
IE	Republic of Ireland	1	Dublin
MX	Mexico	1	Mexico City
NZ	New Zealand	1	Auckland
NO	Norway	1	Oslo
PK	Pakistan	1	Islamabad
RO	Romania	1	Bucharest
RS	Serbia	1	Belgrade
TH	Thailand	1	Bangkok

Source: WIPO Statistics Database, April 2024.

Top science or S&T clusters in Africa

The GII 2024 has sought to identify the top S&T clusters within Africa that would not otherwise have been captured by the GII methodology determining the global 100 top S&T clusters.

To begin, a similar clustering methodology used at the global level was applied to authors and inventors located within the region of Africa. By lowering the density parameter sufficiently (see Appendix IV for more details), the top 50 African clusters were identified (Map 3 and Table 7 for the results).

In addition to Cairo, which has already been highlighted as a GII S&T top 100 ranking cluster, Johannesburg (South Africa), Cape Town (South Africa), Tunis (Tunisia) and Alexandria (Egypt) comprise the top 5 S&T clusters within Africa.

Egypt has the most clusters (11, with Cairo leading), followed by South Africa (8, with Johannesburg leading), Morocco (5, with Rabat leading), Nigeria (4, with Ibadan leading), Tunisia (4, Tunis leading), Ethiopia (2, with Addis Ababa leading), Ghana (2, with Accra leading), Kenya (1, with Nairobi leading), followed by Algeria, Benin, Burkina Faso, Cameroon, the Congo, Côte d'Ivoire, the Democratic Republic of the Congo, Malawi, Senegal, Sudan, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe with each one cluster. Appendix Table 6 shows

the top patentees and publishing organizations for said clusters, with the majority of top institutions active in medical technology, and civil engineering, for example.

It is noteworthy, that many, but not all, African clusters are primarily driven by scientific articles and not PCT patenting activity. Hence in certain cases it is more appropriate to label them as African top science clusters, rather than African S&T clusters. That said, it would be wrong to assume that African S&T clusters do not patent at all. Firstly, the clusters in Egypt, South Africa, Morocco, and Tunisia, but also Algeria and Kenya, show significant international patent filing activity. Secondly, it is useful to recall that the GII methodology to determine top S&T clusters only captures patents filed under the PCT System. PCT patents tend to be patents that seek protection in more than one jurisdiction, and therefore does not include the more numerous set of patents that only seek protection in a single jurisdiction, usually the applicants domestic jurisdiction (national patents). While some clusters have modest PCT filing activity as of yet, these same clusters often still show healthy domestic patenting activity. Future editions of the GII will unpack some such clusters in greater detail, including for other world regions in addition to Africa.

Map 3 Top science or S&T clusters within Africa



Table 8 Top science or S&T clusters within Africa

Economy name	Cluster count	Clusters names
Egypt	11	Cairo, Alexandria, Mansoura, Zagazig, Banha-Shibin El Kom, Asyut, Tanta, Beni Suef, Minya, Kafr El-Shaikh, Ismailia
South Africa	8	Johannesburg, Cape Town, Durban, Bloemfontein, Pietermaritzburg, Potchefstroom, Grahamstown, Port Elizabeth
Morocco	5	Rabat, Casablanca, Marrakesh, Fès, Oujda
Nigeria	4	Ibadan, Nsukka, Lagos, Abuja
Tunisia	4	Tunis, Sfax, Monastir, Sousse
Ethiopia	2	Addis Ababa, Gondar
Ghana	2	Accra, Kumasi
Algeria	1	Algiers
Benin	1	Cotonou
Burkina Faso	1	Ouagadougou
Cameroon	1	Yaoundé
Congo	1	Kinshasa-Brazzaville
Côte d'Ivoire	1	Abidjan
Democratic Republic of the Congo	1	Kinshasa-Brazzaville
Kenya	1	Nairobi
Malawi	1	Blantyre
Senegal	1	Dakar
Sudan	1	Khartoum
Uganda	1	Kampala
United Republic of Tanzania	1	Dar es Salaam
Zambia	1	Lusaka
Zimbabwe	1	Harare

Source: WIPO Statistics Database, April 2024.

S&T intensity of the top 100 clusters: Europe and the United States occupy the top 5 spots, with Cambridge (United Kingdom) and San Jose-San Francisco, CA (United States) out in the lead

Since 2020, the GII has also presented the top 100 clusters ranked by S&T intensity. This ranking is based on the sum of patent and scientific publication shares divided by population. This work draws on geospatial imagery in order to estimate the underlying population level (see Appendix IV).

Table 9 Top 25 S&T clusters by S&T intensity, 2024

Rank per-capita	Cluster name	Economy	Top applicant	Top scientific organization
1	Cambridge	GB	ARM	Cambridge University
2	San Jose–San Francisco, CA	US	Google	Stanford University
3	Eindhoven	NL	Philips Electronics	Eindhoven University of Tech.
4	Oxford	GB	Oxford University	Oxford University
5	Boston–Cambridge, MA	US	MIT	MIT
6	San Diego, CA	US	Qualcomm	University of California San Diego
7	Daejeon	KR	LG Chem	KAIST
8	Ann Arbor, MI	US	University of Michigan	University of Michigan
9	Seattle, WA	US	Microsoft	University of Washington Seattle
10	Munich	DE	BMW	Technical University of Munich
11	Beijing	CN	BOE Technology	Tsinghua University
12	Göteborg	SE	LM Ericsson	University of Gothenburg
13	Raleigh, NC	US	Duke University	Duke University
14	Stockholm	SE	LM Ericsson	Karolinska Institutet
15	Tokyo–Yokohama	JP	Mitsubishi Electric	University of Tokyo
16	Copenhagen	DK	Novozymes	University of Copenhagen
17	Helsinki	FI	Nokia	University of Helsinki
18	Zürich	CH	ETH Zürich	ETH Zürich
19	Basel	CH/DE/FR	DSM IP Assets	University of Basel
20	Stuttgart	DE	Robert Bosch	Eberhard Karls University of Tübingen
21	Nuremberg–Erlangen	DE	Siemens	University of Erlangen Nuremberg
22	Seoul	KR	Samsung Electronics	Seoul National University
23	Qingdao	CN	Qingdao Haier Air Conditioner General	Qingdao University
24	Minneapolis, MN	US	3M Innovative Properties	University of Minnesota Twin Cities
25	Pittsburgh, PA	US	University of Pittsburgh	University of Pittsburgh

Notes: KAIST, Korea Advanced Institute of Science & Technology; MIT, Massachusetts Institute of Technology.

Source: WIPO Statistics Database, April 2024.

Cambridge in the United Kingdom and San Jose–San Francisco, CA, in the United States were the two most S&T-intensive clusters, globally, followed by Eindhoven (Kingdom of the Netherlands), Oxford (United Kingdom), and Boston–Cambridge, MA (United States) (Table 9).

Cambridge's position as the top cluster by S&T-intensiveness was once again thanks to the presence of Cambridge University and central processing unit (CPU) maker ARM. Cambridge produced the most articles per capita, at just over 35,000 per one million people (see Appendix Table 4). San Jose–San Francisco, CA, leads on PCT filings per capita, producing roughly 7,900 per one million people, followed by Eindhoven, with 7,536 per million.

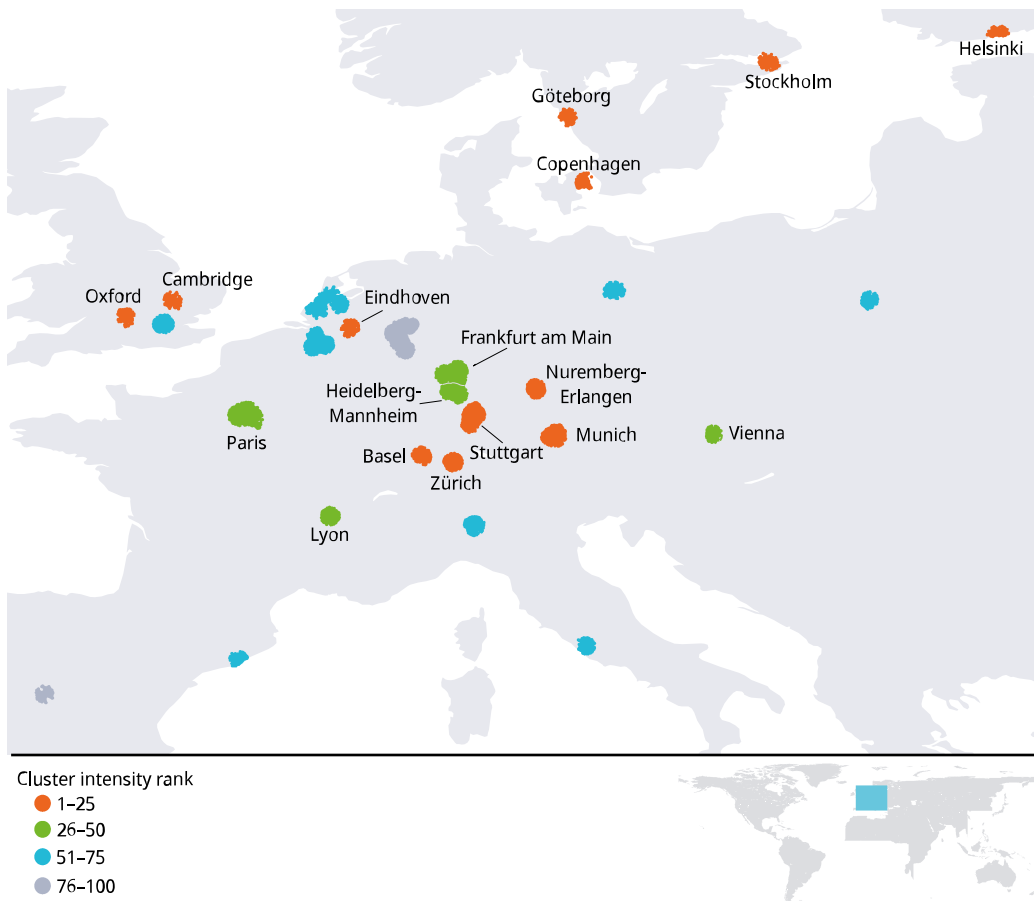
There are three clusters among both the global top 10 and the top 10 for intensity, all in the United States: San Jose–San Francisco, CA; Boston–Cambridge, MA, and San Diego, CA.

Daejeon (Republic of Korea) is the highest-ranking Asian S&T cluster by intensity

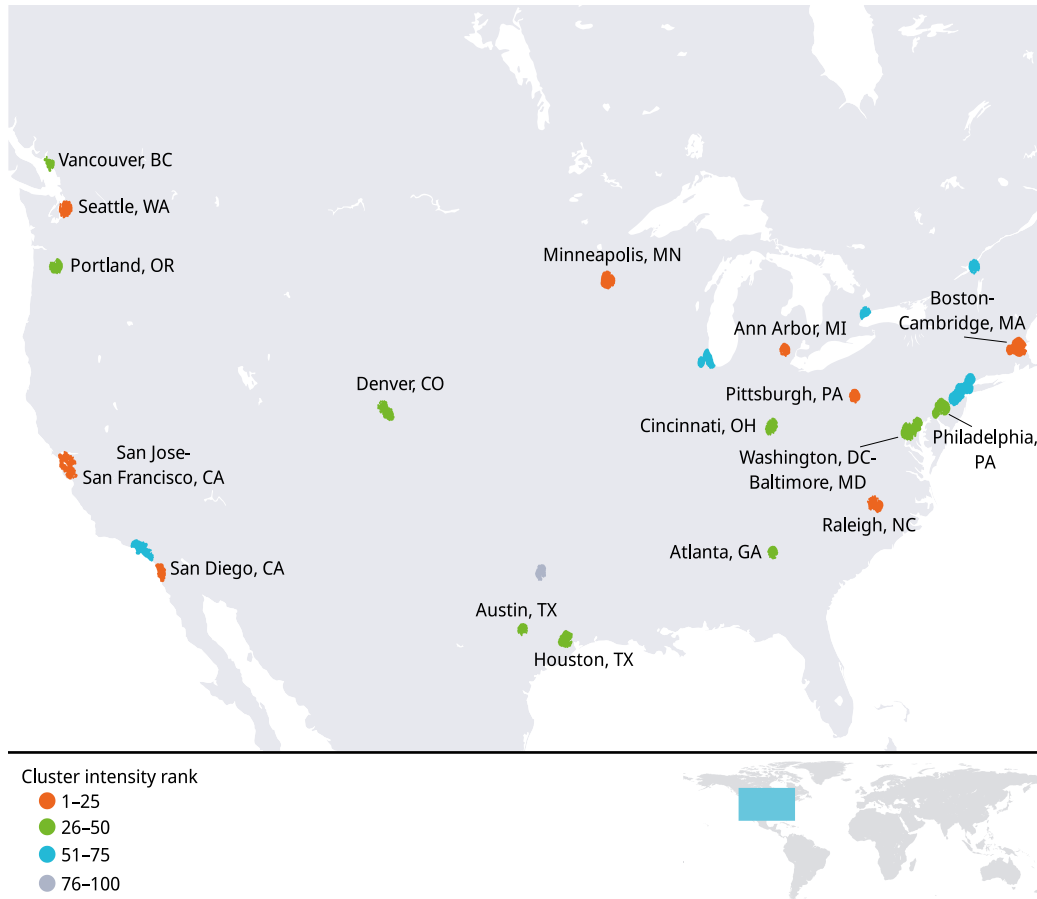
When viewed with a focus on intensity, many clusters within Europe and North America display a higher level of S&T activity compared to their Asian counterparts. Twelve of the top 25 clusters by intensity are located within Europe. North America had eight clusters in the top 25 by intensity and Asia had five clusters, which is markedly different than the 15 clusters in the global top 25 that were located in Asia (Map 4 and Table 9). Asia's top cluster by intensity was Daejeon (Republic of Korea) ranked 7th, owing to the presence of LG Chem and LG Energy Solutions. Daejeon was followed by the much larger metropolises of Beijing (China) ranked 11th (up from 14th last year), and Tokyo–Yokohama ranked 15th (up from 17th last year). A new entrant to the top 25 for China was Qingdao, with Qingdao Haier Air Conditioner being the top patentee and Qingdao University the top publishing organization.

Map 4 European and North American S&T clusters by intensity, 2024

(a) **Europe**



Source: WIPO Statistics Database, April 2024.



Source: WIPO Statistics Database, April 2024.

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