Mapping Innovations

Patents and the Sustainable Development Goals

WIPO


1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

Mapping Innovations

Patents and the Sustainable Development Goals

WIPO
WORLD
INTELLECTUAL PROPERTY
ORGANIZATION

Contents

Foreword

The United Nations Sustainable Development Goals (SDGs) are hanging in the balance. Halfway toward implementing Agenda 2030, only 15% of the goals are on track. Behind this number stand the world's most vulnerable people. We must do more, we must do it together, and we must do it now to create the conditions for countries to achieve the SDGs.

To deliver this, we need to harness the innovation and creative potential of humankind, with intellectual property (IP) critical to making this happen. IP incentivizes innovation, rewards creativity and brings new technologies, ideas and concepts to the market. All these can help us address common global challenges like climate change or the next pandemic. That is why this year's World Intellectual Property Day 2024 is themed "IP and the SDGs: Building our common future with innovation and creativity."

However, there is a challenge in understanding the pathways of innovation. Almost 70% of technology data is captured in patent data, most of which is publicly available, but is not easy to understand.

This creates an opportunity through patent analytics to transform patent data into actionable insights that both highlight the trajectory of technological advancement, as well as measure and track technological progress in areas of interest. Patent analytics also provides us with a sharper sense of the gaps that exist and points to where more resources need to be directed into research, development and translation.

It is intended that by presenting an extensive analysis of patents mapped to the SDGs this report will serve as a guide, illuminating the path forward in a world where innovation and sustainability go hand in hand. It is hoped that its insights will also serve as catalysts inspiring stakeholders across industries, governments and academia to use intellectual property to make a positive difference and truly leave no one behind.

Daren Tang
Director General, World Intellectual Property Organization

Acknowledgments

This publication was prepared under the stewardship of Marco Alemán (Assistant Director General, IP and Innovation Ecosystems Sector) and under the direction of Alejandro Roca Campaña (Senior Director, IP for Innovators Department) and Andrew Czajkowski (Director, Technology and Innovation Support Division), and was led by Christopher Harrison (Patent Analytics Manager, IP Analytics Section, Technology and Innovation Support Division).

The report was prepared by a project team led by Christopher Harrison that included Marco Richter, William Mansfield and Dirk Caspary (all from LexisNexis Intellectual Property Solutions), as well as Hong Kan (Patent Analytics Officer, IP Analytics Section, Technology and Innovation Support Division) and Lakshmi Supriya (Patent Analytics Officer, IP Analytics Section, Technology and Innovation Support Division). Additional thanks go to Catherine Jewell (former Senior Information Officer, Information and Digital Outreach Division), Manuela Ramos Cacciatore (WIPO Knowledge Center) and Aleksandr Belianov (former Young Expert, Technology and Innovation Support Division) for their additional support.

Our thanks also go to Matthew Bryan (Director, PCT Legal Division) and Intan Hamdan-Livramento (Senior Economist, Innovation Economy Section) for reviewing the report and providing valuable input. Finally, our gratitude to the WIPO editorial and design team led by Charlotte Beauchamp (Head, Publications and Design Section).

Executive summary

This comprehensive report presents an extensive analysis of patents mapped to the United Nations Sustainable Development Goals (SDGs). These SDGs, established by the UN General Assembly in 2015,[1] comprise 17 global objectives, with 169 specific targets[2] covering social, economic and environmental issues and offering a blueprint for global peace and prosperity by 2030.

The patent mapping methodology[3] conducted by experts at LexisNexis Intellectual Property Solutions identified 100 distinct technology categories linked to the SDGs covering areas such agriculture, medical devices, renewable energy and transportation. Patent searches were tailored to each technology, employing various strategies designed to comprehensively cover the outlined scope. The results provide invaluable insights into the volume of patenting and intellectual property development trends in areas aligned with the SDGs.

Almost one in three active patent families worldwide (31.4%) are related to the SDGs. Analysis of patent trends reveals that some SDGs, like for instance SDG 9 **Industry, Innovation and Infrastructure** and SDG 13 **Climate Action**, exhibit substantial patent alignment, showcasing significant innovation activity. However, certain of the SDGs focused primarily on socioeconomic aspects have limited patent connections.

The report illustrates the state of technology development across the SDGs and highlights growth trends in SDG-related patents. Notably, SDG 9 **Industry, Innovation and Infrastructure** has the highest number of patents, indicating diverse technology landscapes within this field. Trends also show an upward growth in patent activity related to SDG 13 **Climate Action** and SDG 7 **Affordable and Clean Energy**, reflecting an increasing focus on cleaner alternatives to fossil fuels.

A deeper analysis using the WIPO technology concordance table emphasizes the alignment between specific technology fields and the SDGs. For instance, environmental technology aligns significantly with SDG 6 **Clean Water and Sanitation** and SDG 12 **Responsible Consumption and Production**.

The report also explores global patent trends and discusses the significance of foreign-oriented patents and the impact made by the growth in Chinese patent filings. The analysis showcases the different routes taken by inventors worldwide in seeking patent protection for their inventions, highlighting the seeking of international patent protection through WIPO's Patent Cooperation Treaty (PCT), in particular for SDG-related patents.

1 See https://sdgs.un.org/goals.
2 See, for example, https://sdgs.un.org/goals/goal3#targets_and_indicators for the specific targets for SDG 03 (Good Health and Well-Being).
3 See www.lexisnexisip.com/solutions/ip-analytics-and-intelligence/patentsight/sdg.

Examining where in the world inventors are located serves to reveal trends in the origin of inventions and the patent protection strategies inventors have chosen to adopt, highlighting variations in where inventions originate and the different approaches taken to patent protection across the regions. The report concludes by emphasizing the pivotal role played by patent owners and applicants in driving sustainable innovation across diverse industries, presenting a breakdown of owners based on where their headquarters are located within five key regions.

Overall, this report sheds light on the intersection of the UN SDGs and global patent activity, providing crucial insights into the importance of intellectual property in advancing global sustainability efforts. It provides both a quantifiable measure of the intellectual capital being invested into each goal and a tangible testament to the commitment to sustainable development within the global innovation landscape.

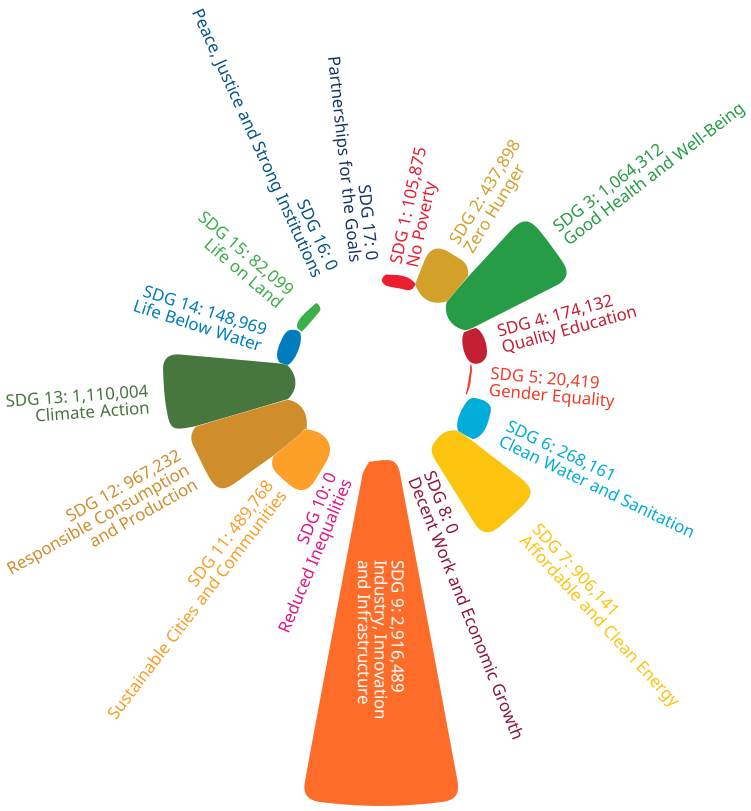
As we navigate the complex interplay between technological advancement and global sustainability, SDG-to-patent mapping functions as a beacon guiding us toward a more informed and strategic approach to innovation. It empowers decision-makers, policymakers and innovators to make data-driven choices, allocate resources effectively, and foster collaboration in those areas where inventive contributions are most needed.

The state of technology development across the United Nations Sustainable Development Goals

There are over 15.2 million active patent families[4] worldwide and over 4.7 million of these (31.4%) relate to the UN Sustainable Development Goals (SDGs). Figure 1 illustrates the current number of active patent families associated with each of the 17 SDGs that cover relevant technologies. Patent families refer to a collection of patents filed across different geographical regions that cover the same invention. This grouping prevents counting the same invention multiple times.

Figure 1 **Number of active patent families associated with each of the 17 SDGs**

13 out of the 17 SDGs are represented by patents, with SDG 9 Industry, Innovation and Infrastructure having the most patents.



Note: SDGs 8, 10, 16 and 17 are not mapped to patents because they primarily address socioeconomic rather than technological goals.
Source: WIPO, based on patent data from PatentSight, January 2024.

4 An active patent family comprises at least one pending published patent application or a granted patent that is not lapsed and has not been withdrawn, invalidated nor rejected at the respective date.

Why patents are an ideal measure of business sustainability?

A patent requires the disclosure of the technology for which protection is sought, and patent applications are often published many years before the corresponding commercial products hit the market. Patent data therefore offers a unique window into the research and development (R&D) efforts and future products of companies. This makes metrics based on patent data objective and forward-looking. Patent data can therefore also provide invaluable insights into global innovation trends, while the patents themselves offer insight into how firms are investing in SDG-related inventions.

SDG 9 **Industry, Innovation and Infrastructure** leads among the SDGs in having the highest number of patents, showcasing the expansive scope of the SDGs, and the diverse technology landscape within this particular field. SDG 9 encompasses electronics, manufacturing and materials. These three broad technology areas are heavily patented and thus feature prominently in the analysis.

SDG 13 **Climate Action** is largely driven by technologies aimed at curbing greenhouse gas emissions, while SDG 7 **Affordable and Clean Energy** benefits from advancements in renewable energy sources like solar and wind power. SDG 12 **Responsible Consumption and Production** depends on innovations in sustainable products and production methods. SDG 3 **Good Health and Well-Being** also boasts numerous medical innovations that align strongly with the UN SDGs. However, despite its alignment, SDG 3's contribution is comparatively smaller, not because of its relevance to the SDGs but because of the fewer number of patents filed for medical innovations compared to areas such as electronics.[5]

It is important to note that four out of the 17 goals – SDG 8 **Decent Work and Economic Growth**, SDG 10 **Reduced Inequalities**, SDG 16 **Peace, Justice and Strong Institutions**, and SDG 17 **Partnerships for the Goals** – do not map appreciably to patent data, as they primarily address socioeconomic developments rather than technological aspects.

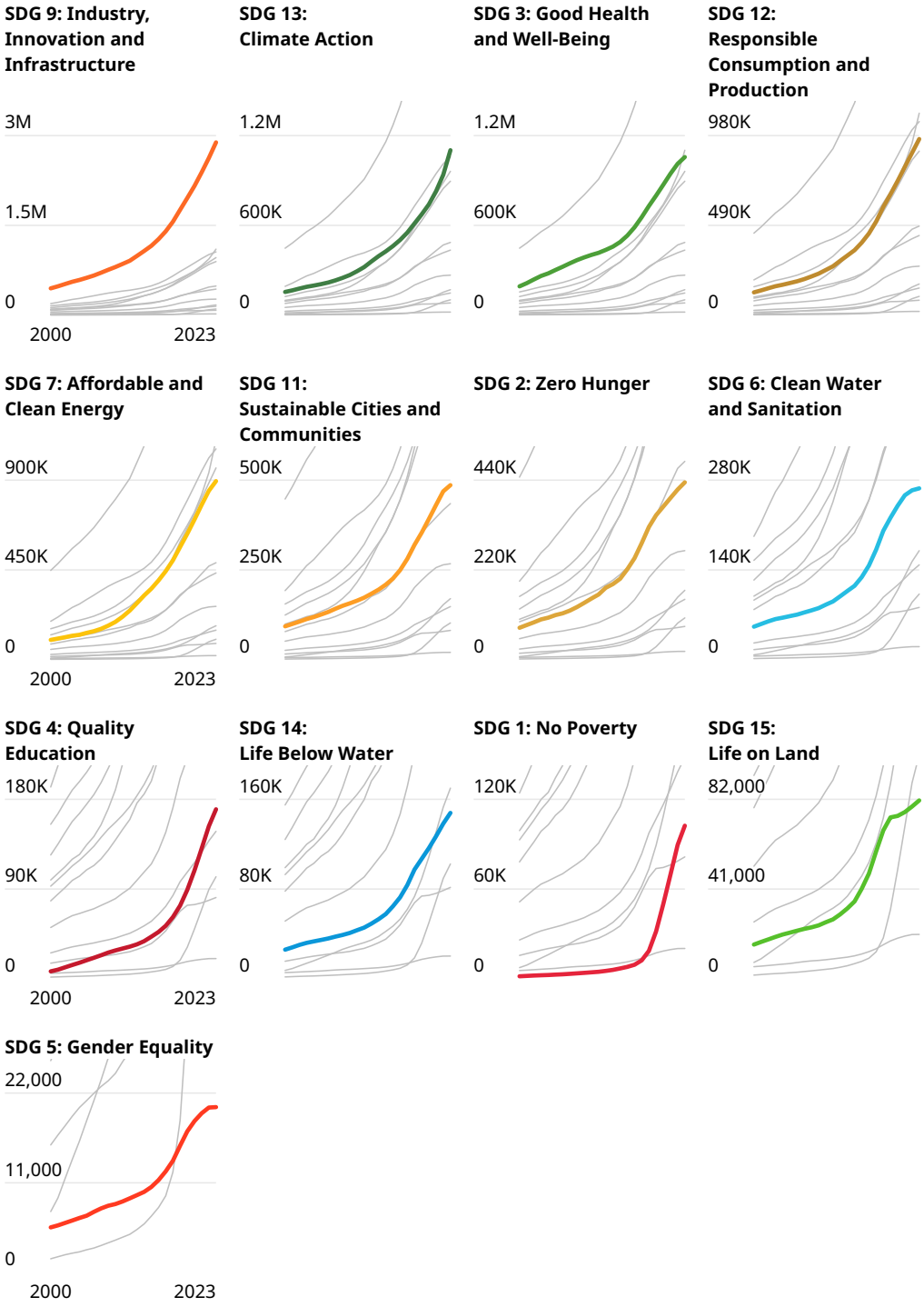
Some areas have very limited mappings to patent data. SDG 1 **No Poverty**, for example, is driven primarily by the inclusion of "blockchain" technology within this particular SDG. Indeed, blockchain notably features across multiple SDGs, as detailed in UN briefing notes.[6] These notes underscore this fact, summarizing the overall impact of blockchain on the SDGs and its influence on various SDGs. They also highlight blockchain's potential impact with respect to "the facilitation of trade transactions and access to global value chains, especially for small businesses in developing and transition economies, as well as for the provision of effective government services that support more inclusive economic and social progress."

Blockchain stands out among a handful of technologies aligned with multiple SDGs, contributing significantly to the intersections observed among the goals. As a consequence, when reconciling the number of patent families corresponding to individual SDGs, the cumulative count appears higher than the actual count of distinct patent families related to SDGs because of this overlapping.

5 See Appendix A.5 for further details on the varying propensity to patent across different technology fields.
6 See UN (2018). Briefing note on Blockchain for the United Nations Social Development Goals. United Nations, Economic and Social Council. Available at: https://unece.org/fileadmin/DAM/cefact/cf_plenary/2018_plenary/ECE_TRADE_C_CEFACT_2018_25E.pdf.

Figure 2 **Number of global SDG-related active patent families (largest to smallest), 2000–2023**

Across the board, the number of patents related to each SDG has shown a significant upward trend over the past two decades.



Note: SDGs 8, 10, 16 and 17 are not mapped to patents because they primarily address socioeconomic rather than technological goals.
Source: WIPO, based on patent data from PatentSight, January 2024.

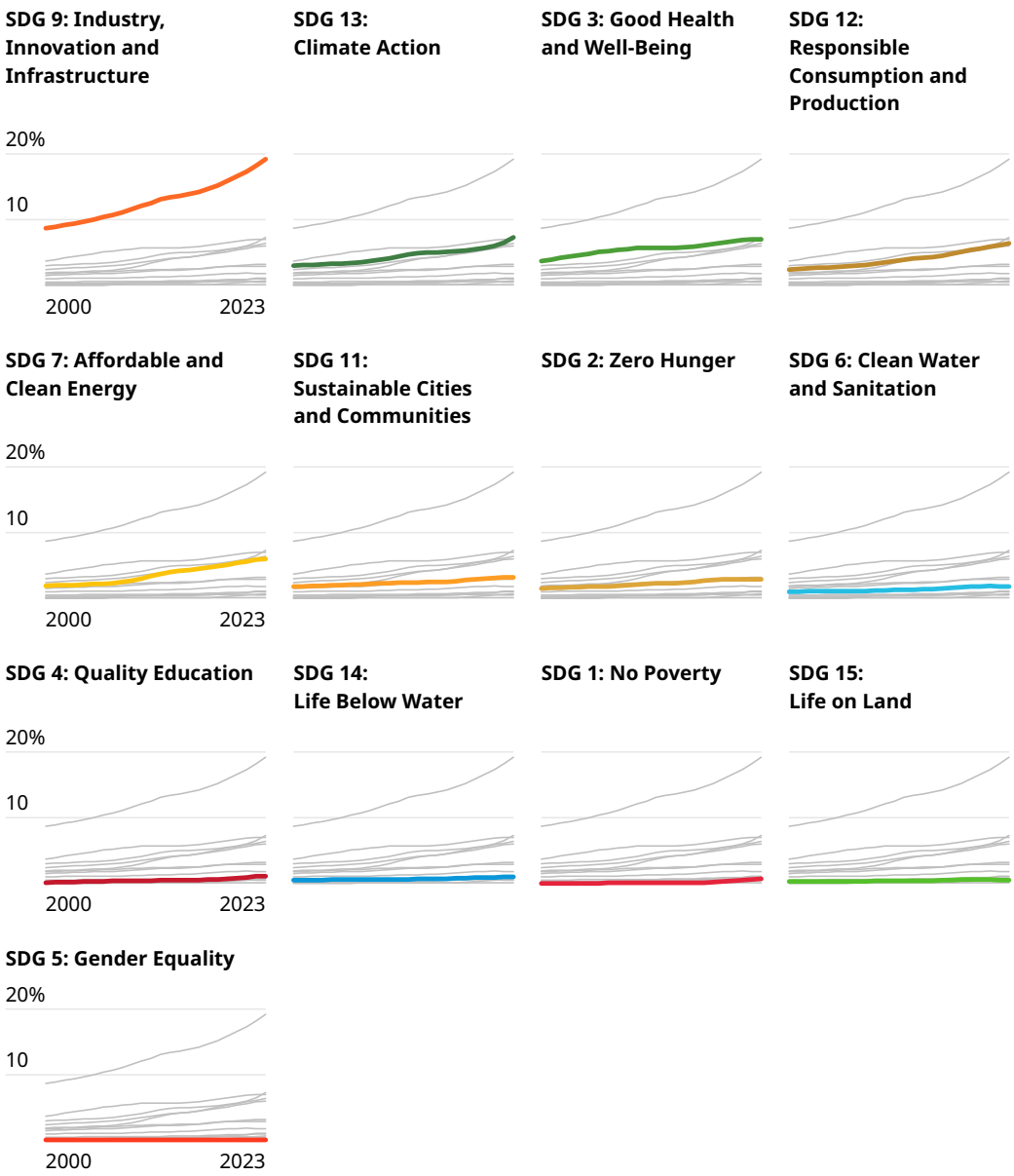
Figure 2 illustrates the growth of patent families related to the SDGs from 2000 to 2023. The line highlighted in color in each graph represents the respective SDG. The gray lines in the background depict the changes within other SDGs. Juxtaposing the highlighted line with the gray lines assists in comparing the patenting activity of the highlighted SDG to that of other SDGs.

The quantity of patents related to the SDGs reflects the scale of ongoing innovation in these areas. However, innovation is about change. And the SDGs are a framework guiding change in specific areas. Therefore, assessing the rate of innovation within the different SDG areas is crucial.

Figure 3 shows the share of all global active patents attributed to the SDGs over the past two decades. Many SDGs exhibit a noticeable upward trend in related patents, signaling not only a growth in related patents but also an increasing share among all patents. Which is to say, in many cases the SDG-related patent activity is surpassing general patent growth.

Figure 3 **Share of global active patent families attributed to each SDG (largest to smallest), 2000–2023**

SDG 9 Industry, Innovation and Infrastructure has the most patents but has also grown substantially over the past 20 years, from under 10% to about 20% of all active patents globally. SDG 13 Climate Action and SDG 7 Affordable and Clean Energy also show stronger upward trends compared to most other SDGs.



Note: SDGs 8, 10, 16 and 17 are not mapped to patents because they primarily address socioeconomic rather than technological goals. Each highlighted colored line represents the respective SDG, the gray lines in the background depict the changes within other SDGs.
Source: WIPO, based on patent data from PatentSight, January 2024.

SDG 9 **Industry, Innovation and Infrastructure** is notably the largest field, witnessing substantial recent growth from under 10% to about 20% of all active patents globally. This SDG encompasses advanced manufacturing materials and methods known for their potential to revolutionize various sectors, thus driving strong innovation and patenting activity.

SDG 13 **Climate Action**, focusing on reducing greenhouse gas emissions, and SDG 7 **Affordable and Clean Energy**, centered on renewable energy, both show a slightly stronger upward trend compared to most other SDGs. This reflects a growing awareness of and consumer preference for cleaner alternatives.[7] It is worth noting here that while so-called "green technologies" are an integral part of the SDGs they are not the sole focus. Other critical areas such as health, poverty and equality are equally significant.

The relative technological maturity of each SDG seen from a patent perspective can be assessed using an Innovation Maturity Matrix. This categorizes all SDG-related patent families according to their respective SDGs alongside their respective recency, that is, a measure of how recently the SDG-related patent applications in question were filed.[8]

Figure 4 shows the Innovation Maturity Matrix for SDG-related patents filed since 2000. Reflecting trends also seen in Figures 2 and 3, the Innovation Maturity Matrix highlights SDG 9 **Industry, Innovation and Infrastructure**, SDG 13 **Climate Action**, SDG 7 **Affordable and Clean Energy**, and SDG 12 **Responsible Consumption and Production** as current hot topics, meaning they all have a large number of patents and have recorded strong growth in recent years.

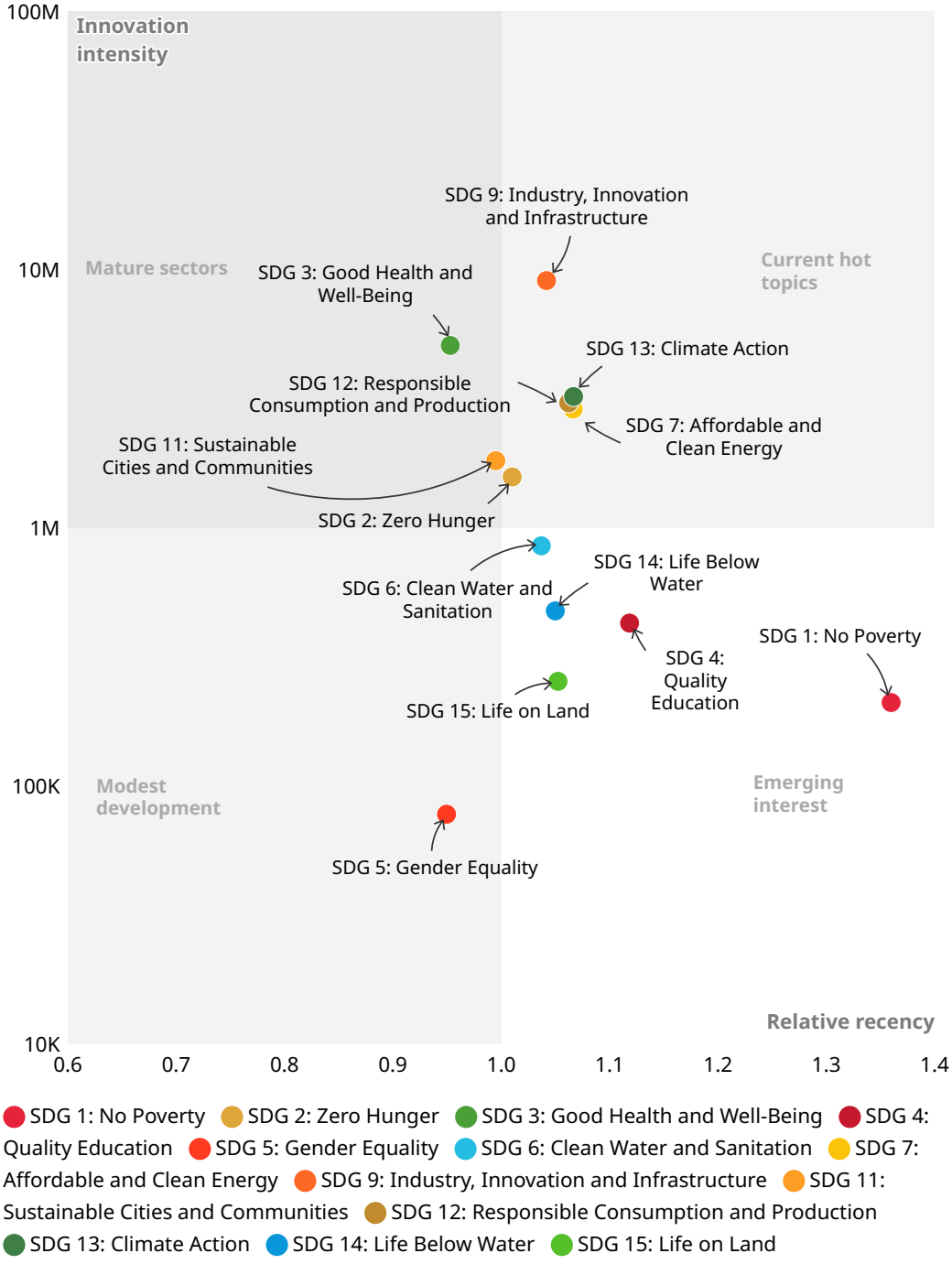
In comparison, the number of patent families related to SDG 1 **No Poverty**, SDG 4 **Quality Education**, SDG 6 **Clean Water and Sanitation**, SDG 14 **Life Below Water** and SDG 15 **Life on Land** is smaller but an emerging interest can be seen in the recent growth in patenting activity related to these five SDGs. Whereas this is difficult to detect in Figure 3, it is more clearly visible in the Innovation Maturity Matrix.

7 See McKinsey & Company (2023). Consumers care about sustainability – and back it up with their wallets. Online, February 6. Available at: www.mckinsey.com/industries/consumer-packaged-goods/our-insights/consumers-care-about-sustainability-and-back-it-up-with-their-wallets.

8 See Appendix A.4 for details on the methodology used.

Figure 4 Innovation Maturity Matrix for SDG-related patent families, 2000–2023

Although the number of patents related to SDG 1 No Poverty, SDG 4 Quality Education, SDG 6 Clean Water and Sanitation, SDG 14 Life Below Water, and SDG 15 Life on Land is relatively small, recent patent activities associated with these SDGs have been on the rise, indicating increasing attention to these SDGs.



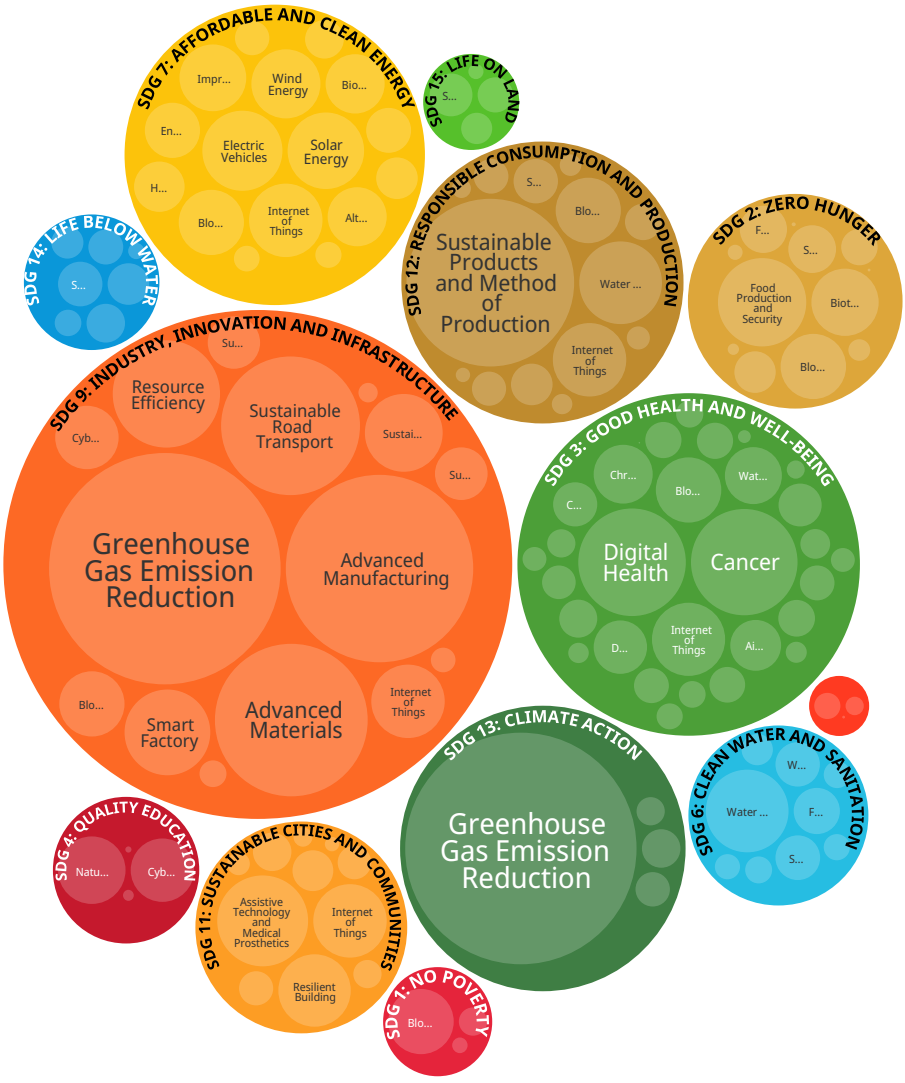
Note: Relative recency and innovation intensity are calculated on the annual volume of patent applications. SDGs 8, 10, 16 and 17 are not mapped to patents because they primarily address socioeconomic rather than technological goals.
Source: WIPO, based on patent data from PatentSight, January 2024.

Diving deeper into the mapping of SDGs and patents shown in Figure 5, it becomes evident that there are certain overlaps. For example, "Greenhouse Gas Emission Reduction" is present in both SDG 9 **Industry, Innovation and Infrastructure** (depicted in orange) and SDG 13 **Climate Action** (in dark green).

A distinct contrast emerges in the scope and number of technologies encompassed by SDG 9 and SDG 3. SDG 9 contains fewer but larger technology areas, whereas SDG 3 comprises numerous smaller, discrete medical innovations such as treatments for cancer or hepatitis. SDG 9 covers broader topic areas with high-level targeted outcomes that might have multiple potential solutions and more patent activity. For example, upgrading infrastructure and retrofitting industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally friendly technologies and industrial processes.[9] Policy documents published by UN agencies shed light on the technologies encompassed by this target, ranging from 3D printing to reducing greenhouse gas emissions in industrial processes.[10]

Figure 5 Exploring the 100 SDG-linked technologies

Each SDG encompasses a variety of technologies aimed at achieving the respective goal, although there is some overlap with, for example, "Greenhouse Gas Emission Reduction" appearing in both SDG 9, Industry, Innovation, and Infrastructure and SDG 13, Climate Action.



Note: Circle size is proportional to number of active patent families. SDGs 8, 10, 16 and 17 are not mapped to patents because they primarily address socioeconomic rather than technological goals.
Source: WIPO, based on patent data from PatentSight, January 2024.

9 See target 9.4 of SDG 9, available at: https://sdgs.un.org/goals/goal9#targets_and_indicators.
10 UNIDO (2017). Industry 4.0: Opportunities Behind the Challenge. *Background Paper, UNIDO General Conference 17,* November 27–December 1, 2017. Vienna: United Nations Industrial Development Organization. Available at: www.unido.org/sites/default/files/files/2020-06/UNIDO%20Background%20Paper%20on%20Industry%204.0_FINAL_TII.pdf.

Analyzing the spread of SDG-related technologies

WIPO has created a comprehensive technology concordance table crucial for an extensive analysis. It includes regional structures and international comparisons to identify areas of specialization. This technology concordance table[11] is based on the International Patent Classification (IPC) system, a highly detailed system of technology classification applied to almost all patents by intellectual property (IP) offices worldwide. The WIPO PCT system comprises 35 technology fields, grouped into five higher level technology sectors, namely, **Electrical engineering**, **Instruments**, **Chemistry**, **Mechanical engineering**, and **Other fields**.

Sustainable relevance within technology sectors

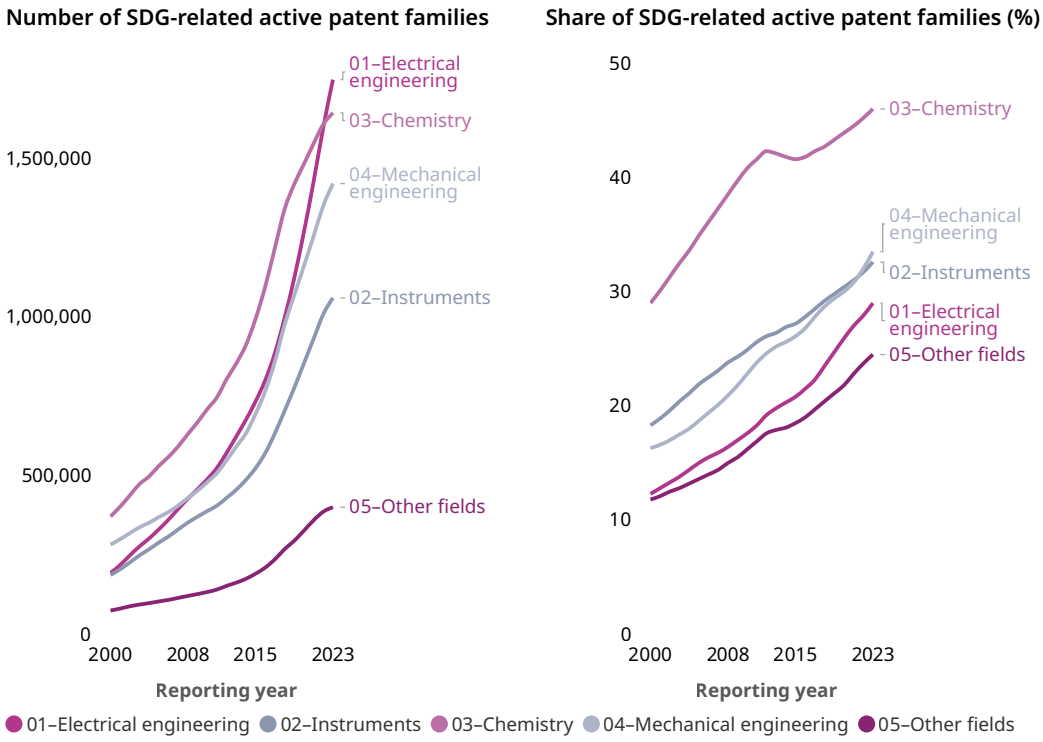
Figure 6 shows the development over time of SDG-related patents within the five higher level technology sectors. The trend shown mirrors the breakdown by SDG seen in Figures 2 and 3, This is because both analyses use the same data but organized differently, that is, by SDG or by WIPO technology sector. As mentioned in the previous section, the substantial relative increase shown hides a significant growth in the number of patents overall, which the SDG-related patents are still managing to meaningfully outpace.

Chemistry dominates the share of SDG-related patents, encompassing pharmaceuticals and innovations that enhance processes vital for fields such as greenhouse gas emissions reduction. **Mechanical engineering** and **Instruments**, including medical devices, also exhibit a similar trend. **Electrical engineering** and the **Other fields** sectors also display comparable trends, albeit from a lower base. However, in recent years, **Electrical engineering** has surged at a faster pace than the others.

11 See, IPC – Technology Concordance, downloadable at: www.wipo.int/ipstats/en/docs/ipc_technology.xlsx; for the methodology see, Schmoch, U. (2008). Concept of a Technology Classification for Country Comparisons: Final Report to the World Intellectual Property Organisation (WIPO). WIPO, available at: www.wipo.int/export/sites/www/ipstats/en/docs/wipo_ipc_technology.pdf.

Figure 6 **Number and share of SDG-related active patent families in each of the five higher level WIPO technology sectors, 2000–2023**

Chemistry dominates the share of SDG-related patents. Electrical engineering has surged at a faster pace than the other sectors.

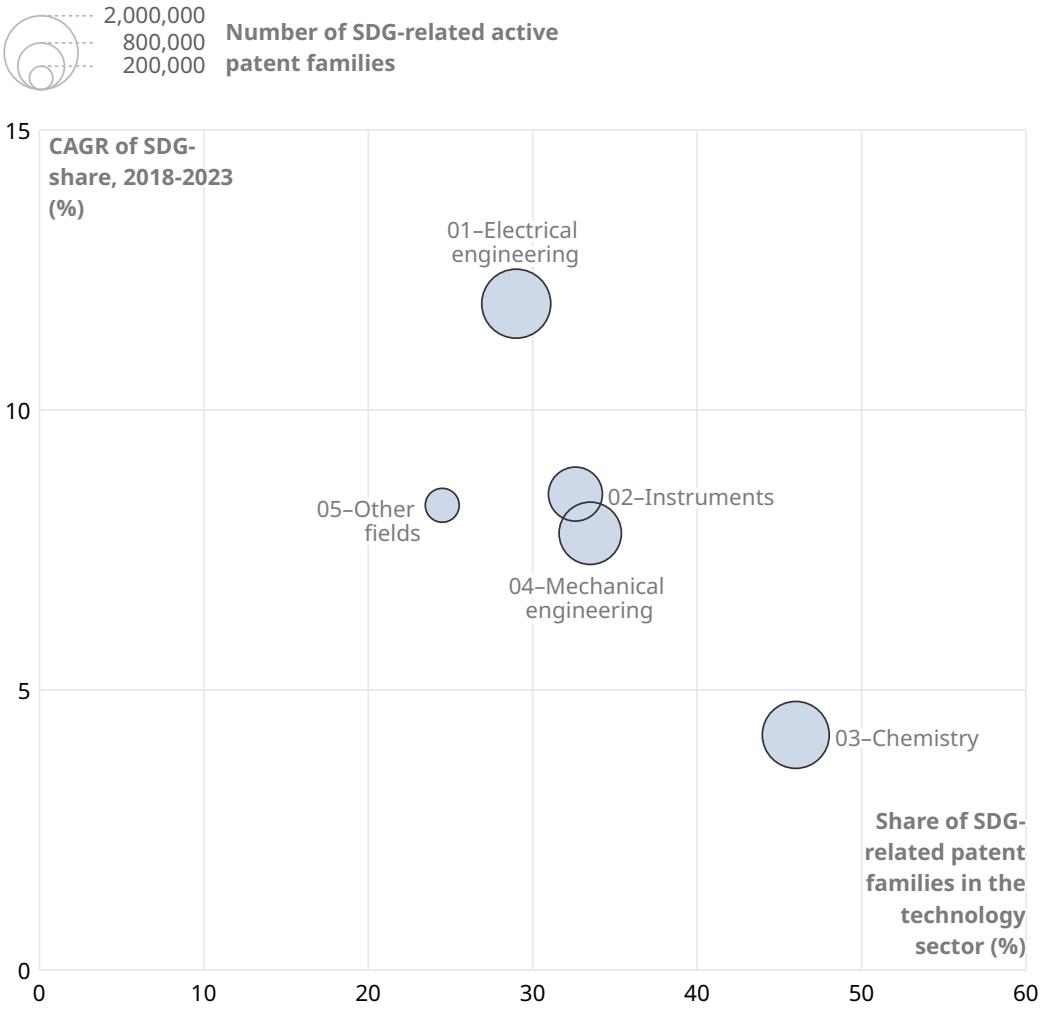


Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 7 illustrates the share of SDG-related patents within the five higher level technology sectors (horizontal axis), aligned with the compound annual growth rate (CAGR) of the share of SDG-related patents between 2018 and 2023 (vertical axis). CAGR is used instead of annual growth rate because it assumes that the growth rate is repeated (i.e., "compounded") each year, whereas a traditional growth rate does not. CAGR is preferred for patent analysis because it smooths out the volatile nature of year-by-year growth rates.

Figure 7 **Comparing the share of SDG-related active patent families in each of the five higher level WIPO technology sectors to the compound annual growth rate (CAGR), 2018–2023**

Electrical engineering shows a noticeable recent surge at around 12% CAGR, compared to approximately 8% for most other sectors. Chemistry displays a recent slowdown at just over 4% but this is due to a larger base and therefore limited growth potential.



Source: WIPO, based on patent data from PatentSight, January 2024.

Electrical engineering shows a noticeable recent surge at around 12% CAGR, compared to approximately 8% for most other sectors. **Chemistry** displays a recent slowdown at just over 4%. Higher shares of SDG-related patents typically result in a lower CAGR, there being more limited headroom for them to grow.

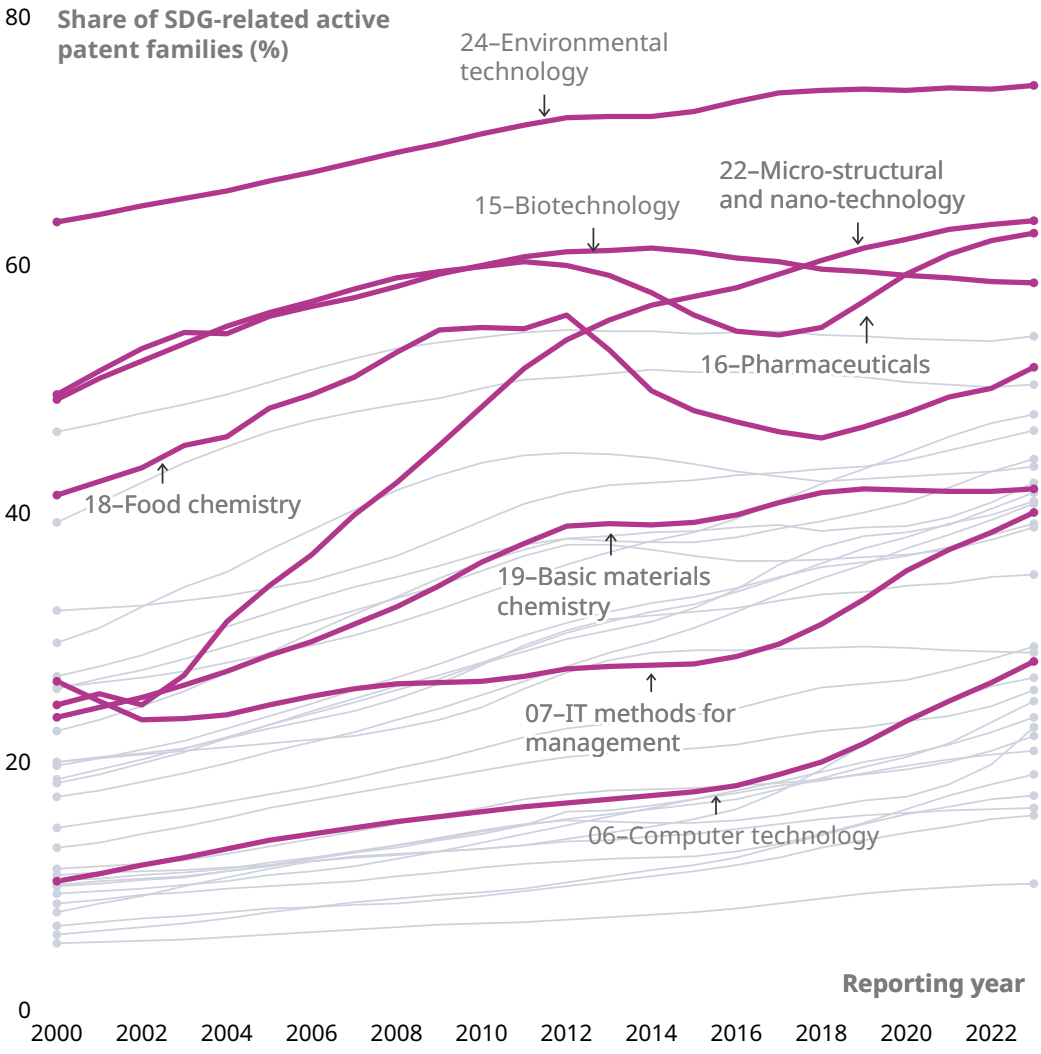
The WIPO technology sectors are fairly evenly split in size, aligning with one of the design requirements for a WIPO technology sector. This balance reinforces the significance of a difference in shares, thereby reducing possible outliers (e.g., extreme percentages) stemming from smaller fields.

Sustainable relevance within technology fields

The 35 WIPO technology fields are subdivisions of the WIPO technology sectors, providing more fine detail. They are categorized as follows: 1–8 in **Electrical engineering**, 9–13 in **Instruments**, 14–24 in **Chemistry**, 25–32 in **Mechanical engineering**, and 33–35 in **Other fields**.

Figure 8 Share of SDG-related active patent families in WIPO technology fields, 2000–2023

Environmental technology holds the largest share of SDG-related patents at about 75%. Biotechnology and Pharmaceuticals have been competing for the second and third positions for many years with consistent annual increases, but by 2018 both were overtaken by Micro-structural and nano-technology, which has seen significant growth.



Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 8 illustrates the progression over time of active SDG-related patent families, segmented by the 35 technology fields, highlighting specific fields of interest. **Environmental technology** aligns well with its description and holds the largest share of SDG-related patents at about 75%. While this share has stabilized recently, this trend often occurs when very high shares are achieved.

For many years **Biotechnology** and **Pharmaceuticals** battled for second and third spot, with consistent annual increases. However, by 2018 both were overtaken by **Micro-structural and nano-technology**, which has seen significant growth from around 25% in 2000 to nearly 65% in 2023. This aligns closely with certain SDG technologies, particularly with respect to the modernization of industrial processes.

Food chemistry shows a noticeable increase followed by a recent dip. **Basic materials chemistry** has plateaued, stabilizing at around 40%, after an increasing trend up until approximately 2017. Finally, **IT methods for management** and **Computer technology** exhibit lower shares but rapidly increasing growth rates.

Figure 9 is the same as described for Figure 7. It highlights the high growth rates of **IT methods for management** and **Computer technology** at the top of the graphic and the negative or static growth of **Food chemistry** and **Basic materials chemistry** at the bottom.

Figure 9 **Comparing the share of SDG-related active patent families in each WIPO technology field to the compound annual growth rate (CAGR), 2018–2023**

IT methods for management and Computer technology demonstrate higher growth rates, while Food chemistry and Basic materials chemistry have experienced negative or stagnant growth. Environmental technology, Microstructural and nano-technology, and Pharmaceuticals all have lower growth rates because they are progressing towards 100%.

Source: WIPO, based on patent data from PatentSight, January 2024.

With more detailed data points than the technology sectors, the partial correlation between share and CAGR for the technology fields becomes more visible. Smaller shares can more easily exhibit a high CAGR, while larger shares often have a lower CAGR. Therefore, the lower growth rates for **Environmental technology**, **Micro-structural and nano-technology**, and **Pharmaceuticals** should not be perceived negatively; rather, their positive growth, progressing towards 100%, is very impressive.

Mapping the SDGs to technology areas

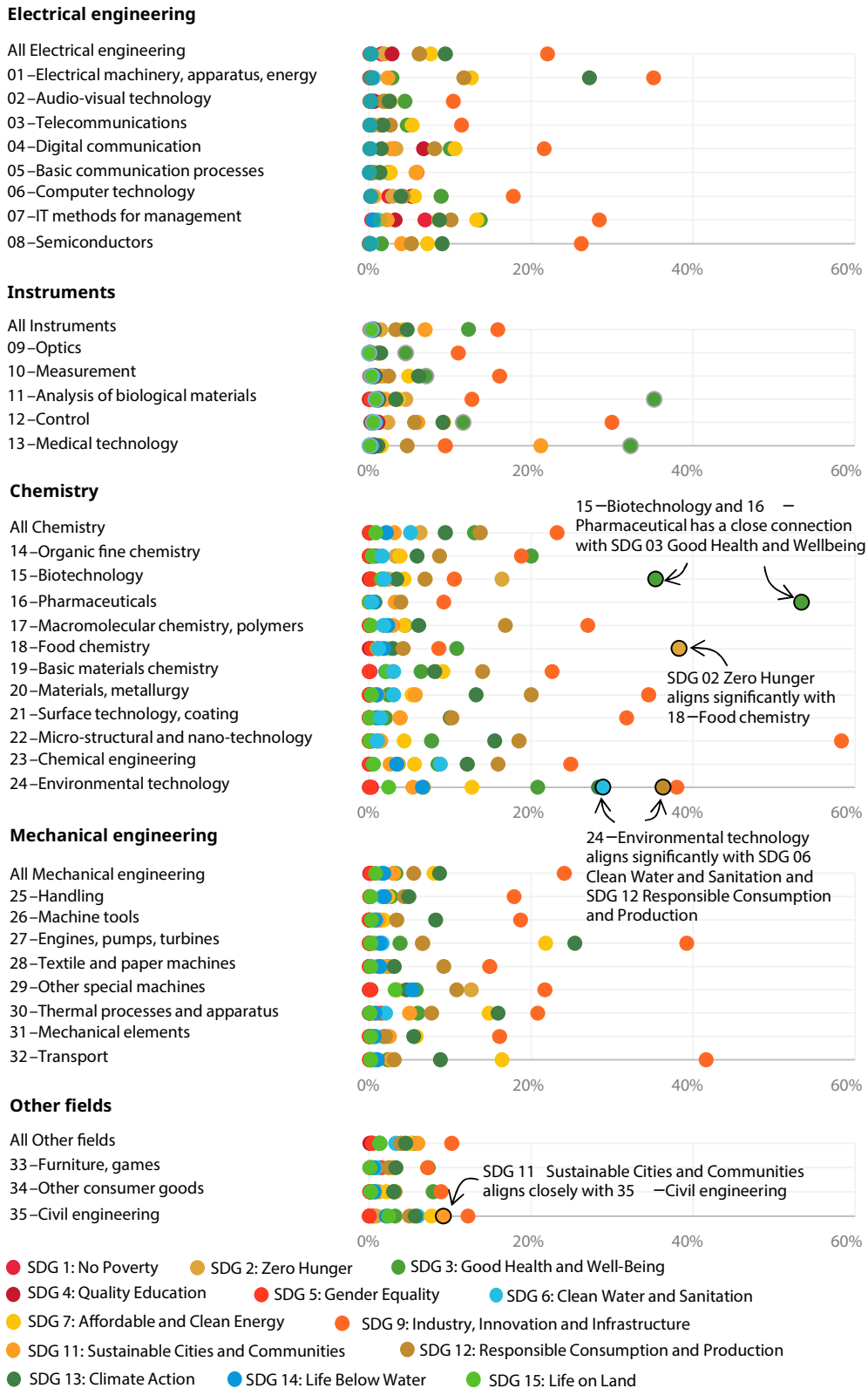
Building on this further, Figure 10 indicates the share each WIPO technology sector has and the WIPO technology field associated with specific SDGs.

At the technology sector level, the **Instruments** sector correlates 12.3% of its patents with SDG 3 **Good Health and Well-Being**. **Instruments** includes medical devices, so a higher overlap between this sector and SDG 3 is to be expected. This is also the case for the **Chemistry** sector, which includes **Pharmaceuticals**, showing a higher overlap with relevant SDGs. Larger SDG categories, such as SDG 9 **Industry, Innovation and Infrastructure**, are readily visible owing to their larger size, commanding a more substantial share.

Looking at the more granular technology field level, larger SDGs such as SDG 9 **Industry**, **Innovation and Infrastructure** and SDG 3 **Good Health and Well-Being** are clearly highlighted. The connection between SDG 3 and **Pharmaceuticals** and other biological and medical fields becomes clearer owing to the finer detail provided by the WIPO technology fields. Similarly, SDG 2 **Zero Hunger** aligns significantly with **Food chemistry**, SDG 6 **Clean Water and Sanitation** and SDG 12 **Responsible Consumption and Production** with **Environmental technology**, and SDG 11 **Sustainable Cities and Communities** with **Civil engineering**.

Figure 10 **Comparing the share of SDG-related active patent families as a proportion of the total of each WIPO technology field**

The Instruments and Chemistry sectors show a high overlap with SDG 3 Good Health and Well-Being. Food chemistry closely correlates with SDG 2 Zero Hunger, while Environmental technology aligns significantly with SDG 6 Clean Water and Sanitation and SDG 12 Responsible Consumption and Production, and Civil engineering with SDG 11 Sustainable Cities and Communities.



Note: SDGs 8, 10, 16 and 17 are not mapped to patents because they primarily address socioeconomic rather than technological goals.
Source: WIPO, based on patent data from PatentSight, January 2024.

Global SDG patent trends and considerations

As discussed earlier, 31.4% of all active patent families worldwide are related to the UN SDGs. The Patent Cooperation Treaty (PCT) administered by WIPO is a more popular route for SDG-related patents, with 35.4% of active PCT patents being related to the SDGs. Similarly, European patents filed through the European Patent Office (EPO) are popular for SDG-related inventions, with 42.4% of active European patents being related to the SDGs. This contrasts with 34.3% for the Republic of Korea, 33.7% for China, 32.8% for the United States of America (US), and 25.9% for Japan. There appears to be a preference for SDG-related patents to be filed through international and regional (multi-jurisdictional) routes to protection instead of through direct national filings.

In prior sections, the substantial and continuously growing number of patents has been highlighted. Academic research widely acknowledges that there is a highly skewed distribution in the value of patents,[12] with just a few patents providing the vast majority of the overall value to their owners. In the following sections, the analysis distinguishes foreign-oriented patent families – also referred to as international patent families[13] – from domestic-only ones.

International patent families concern those inventions for which the applicant has sought patent protection beyond its domestic/national IP office. International patent families are a reliable and neutral proxy for inventive activity because they provide a degree of control for patent quality and value by only representing inventions deemed important enough by the applicant to seek protection internationally. They create a population of patent families that are sufficiently homogeneous to be directly compared with one another, thereby reducing the national biases that often arise when comparing patent applications across different national patent offices.

Analysis by international patent families was not undertaken for the previous sections because they cover technologies where results are not significantly impacted. But it is undertaken for the following sections covering geographical regions and owners because this is where the results are highly impacted.

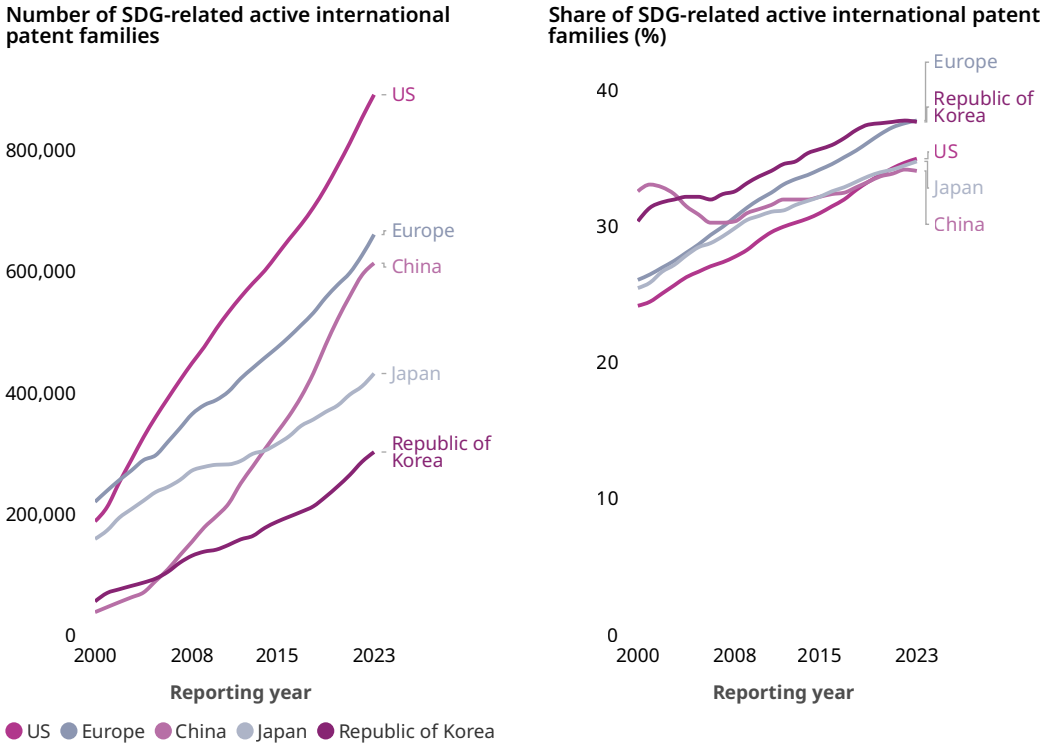
Figure 11 illustrates the geographical growth in SDG-related international patent families based on where a patent is being protected (active authority). Europe includes filings to the EPO and national patent office filings within geographical Europe, but without duplication because only one record per international patent family is counted. China's exponential increase in patents becomes evident, moving from being bottom of the five selected countries/regions to very nearly second place in 2023. There have been noticeable increases from all areas, with Japan's being a modest increase and US growth almost matching that of China.

12 Gambardella, A., D. Harhoff and B. Verspagen (2008). The value of European patents. *European Management Review*, 5, 69–84. DOI: https://doi.org/10.1057/emr.2008.10.

13 Dechezleprêtre, A., Ménière, Y. and Mohnen, M. (2017). International patent families: From application strategies to statistical indicators. *Scientometrics*, 111, 793–828. DOI: https://doi.org/10.1007/s11192-017-2311-4.

Figure 11 **Comparing the absolute number and share of SDG-related active international patent families by geographical patent coverage (active filing authority), 2000–2023**

China has experienced exponential growth in the number of SDG-related patents. The growth rate in the United States nearly matches that of China, whereas Japan has seen only modest growth.



Source: WIPO, based on patent data from PatentSight, January 2024.

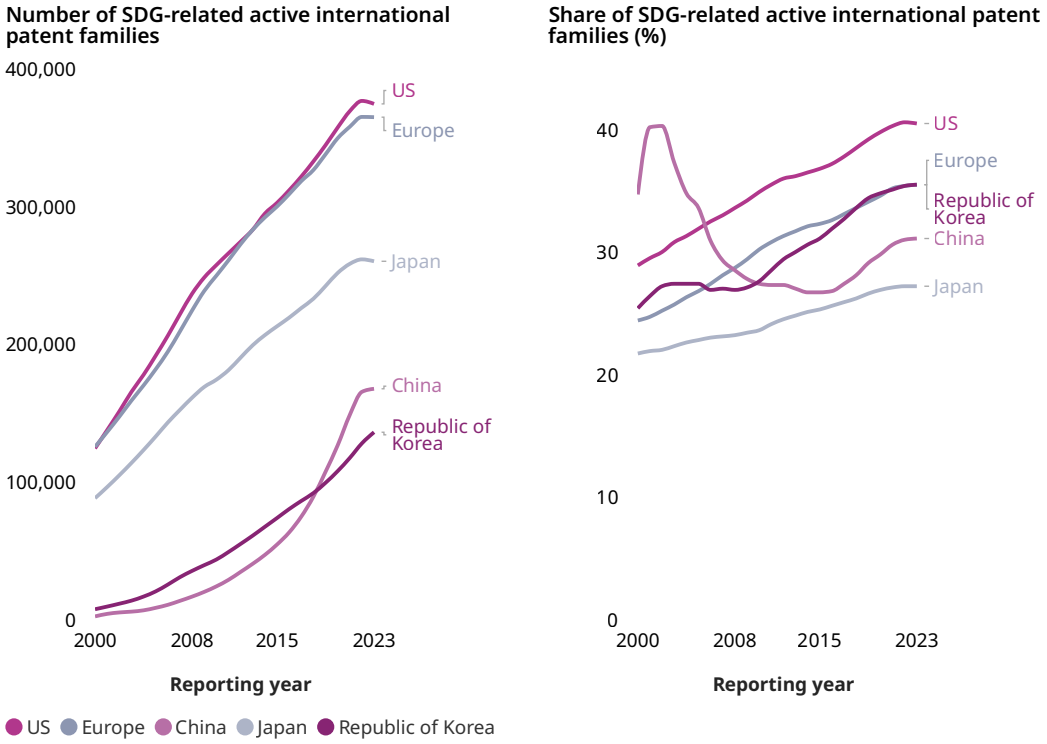
The share of SDG-related patents is quite consistent across authorities, ranging from 34% to 38% in 2023. Europe shows the fastest rate of growth, whereas for China the increase remains below average compared to other regions. There was even a decrease in China's share between 2001 and 2005; however, this is primarily due to the percentage being calculated from a smaller number of patents before the rapid growth of overall patent filings seen in China since 2011. If these trends persist, there might be a shift in the distribution among regions in the future.

The question of where inventors are located is equally as important as in which markets they seek protection for their inventions. Figure 12 depicts trends based on inventor location. Europe, Japan, and the United States demonstrate similar trends in invention origin, albeit at a higher level for the United States. The number of inventions originating from China-based inventors are lower here compared to those choosing to protect in China, primarily because of a limited internationalization of patents originating in China. Nevertheless, China displays a strong upward trajectory in recent years in contrast to the leveling off seen in most other regions.

Regarding the share of patents related to SDGs, the downward trend from China is more prominent, with only a recent increase. Other regions follow a similar trend to each other, with Japan's SDG patent share increasing more slowly, leading to a divergence over time.

Figure 12 **Comparing the absolute number and share of SDG-related active international patent families by inventor location, 2000–2023**

Europe, Japan, and the United States demonstrate similar trends in invention origin, with the United States exhibiting a higher level. The number of international patent families originating from China-based inventors is relatively low, but has shown a strong upward trend recently.



Source: WIPO, based on patent data from PatentSight, January 2024.

Who are the patent applicants driving sustainable innovation?

The development of technology, its protection, the crucial markets, and the major R&D regions are all vital aspects in patent-led innovation. But the true impetus behind innovation lies with applicants and patent owners. While numerous organizations across industries support sustainable innovation, their comprehensive representation exceeds the scope of this study. To provide a complete picture, the next section categorizes patent owners according to where their headquarters are located within the five regions previously discussed, namely, the United States, Europe, China, Japan, and the Republic of Korea. These regions were selected because they have the highest concentration of inventors, as well as being markets with the most patent filing activity, and accounting for 96 of the top 100 patent owners worldwide based on the number of SDG-related international patent families.

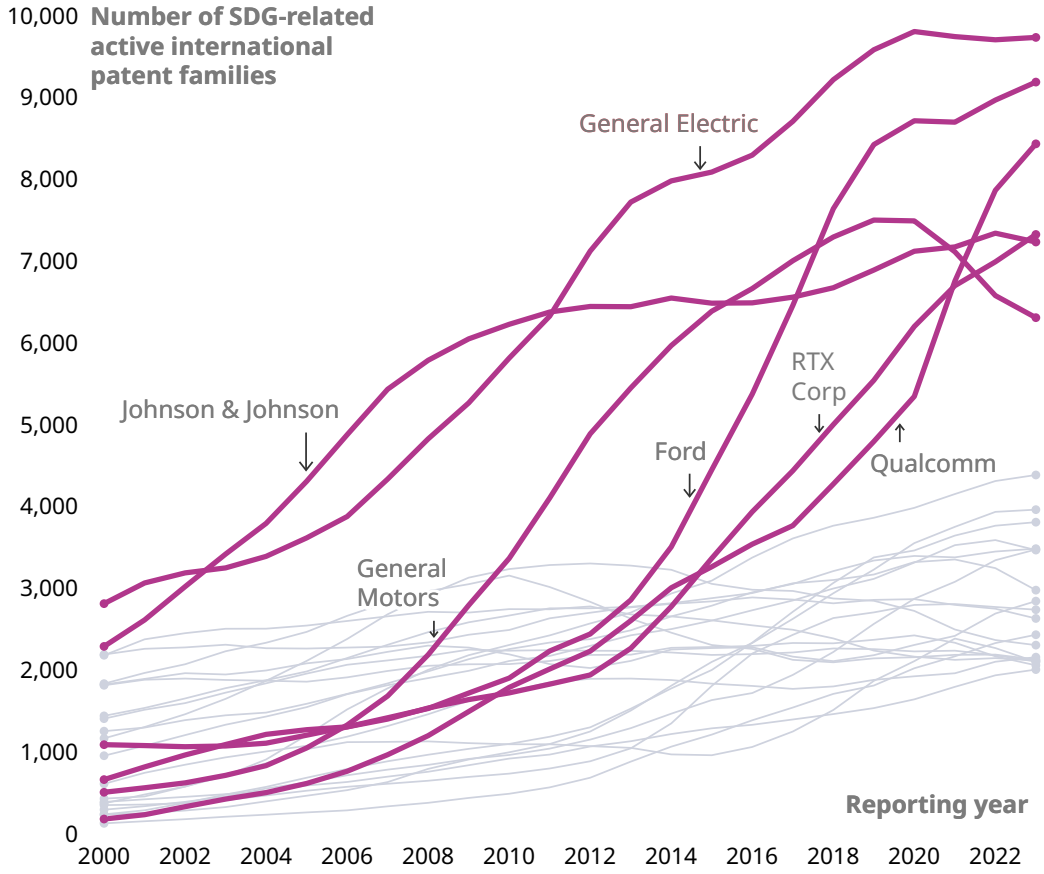
The analysis within this section provides an overview of the top 25 patent owners within each region based on the number of SDG-related international patent families, as well as a comparison of their share of SDG-related patents alongside their CAGR.

United States

The most prominent SDG-related patent owners in the United States include General Electric, Ford, Qualcomm, RTX Corp, Johnson & Johnson, and General Motors (Figure 13). While each of these entities experienced significant growth in their SDG-related patents over the past two decades, most have witnessed a slow-down in their upward trend, with General Motors even seeing a recent decline. Qualcomm stands out as the only player among the top few whose patenting activity is not leveling off, with its upward trajectory starting only very recently. However, all these top players maintain a significantly higher number of SDG-related patents compared to others within the top 25 patent owners.

Figure 13 **Top 25 patent owners from the United States based on number of SDG-related active international patent families, 2000–2023**

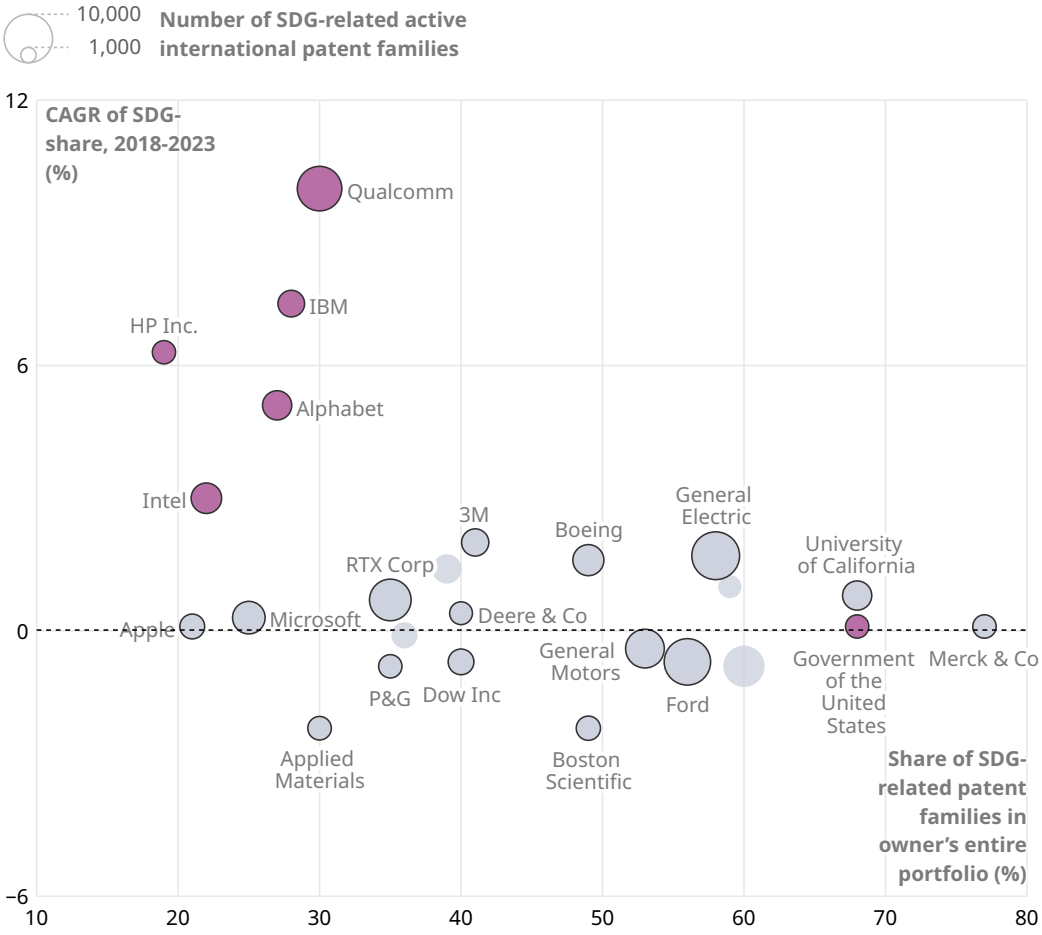
The top SDG-related patent owners in the United States have experienced significant growth in their SDG-related patents over the past two decades, but the upward trend for most entities is slowing down.



Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 14 **Comparing the top 25 patent owners from the United States by share of SDG-related patents and compound annual growth rate (CAGR), 2018–2023**

Among the major patent owners in the United States, Qualcomm exhibits the highest growth rate, at approximately 10%. Around 70% of the Government of the United States patent portfolio aligns with SDGs, similar to the University of California.



Source: WIPO, based on patent data from PatentSight, January 2024.

Qualcomm notably exhibits a growth rate around 10%, outperforming the majority of the pack, which hover around 2% (Figure 14). Other tech giants like IBM, HP, Alphabet (Google), and Intel show a similar albeit slightly lower growth rate. These companies delve into various technologies aligned with the SDGs, albeit not their core focus, such as elements of autonomous driving, blockchain and digital health contributing to their patent portfolios.

The US Government is among the top 25 patent owners, holding patents primarily in health-related innovations from the US Health Department and advancements in materials and processing from the Navy, Army, and Air Force. Around 70% of the US Government's portfolio aligns with the SDGs, similar to the University of California, while Merck & Co holds the largest share owing to its contributions to medical advancements.

Despite the alignment of medical and pharmaceutical innovations with the SDGs, there are few pharmaceutical or drug companies among the top 25, largely because the selection is based on the absolute number of SDG-related patents (Table 1). In a field such as pharmaceuticals companies file relatively fewer patents to protect their innovations compared to the electronics or automotive industries.[14]

14 See Appendix A.5 for further details on the varying propensity to patent across different technology fields.

Table 1 Top 25 patent owners from the United States based on number of SDG-related active international patent families, 2000–2023

Patent owner	SDG-related active international patent families	Share of SDG-related patent families in owner's entire portfolio (%)	CAGR of SDG-share, 2018–2023 (%)
General Electric	9,723	58	1.7
Ford	9,177	56	–0.7
Qualcomm	8,422	30	10.0
RTX Corp	7,314	35	0.7
Johnson & Johnson	7,222	60	–0.8
General Motors	6,297	53	–0.4
Microsoft	4,374	25	0.3
Boeing	3,950	49	1.6
Intel	3,797	22	3.0
Honeywell	3,473	39	1.4
Alphabet	3,463	27	5.1
University of California	3,456	68	0.8
3M	2,966	41	2.0
IBM	2,832	28	7.4
Halliburton	2,727	36	–0.1
Dow Inc	2,620	40	–0.7
Apple	2,421	21	0.1
Boston Scientific	2,294	49	–2.2
Applied Materials	2,147	30	–2.2
Merck & Co	2,118	77	0.1
P&G	2,106	35	–0.8
Government of the United States	2,093	68	0.1
HP Inc.	2,090	19	6.3
Exxon Mobil	2,047	59	1.0
Deere & Co	1,995	40	0.4

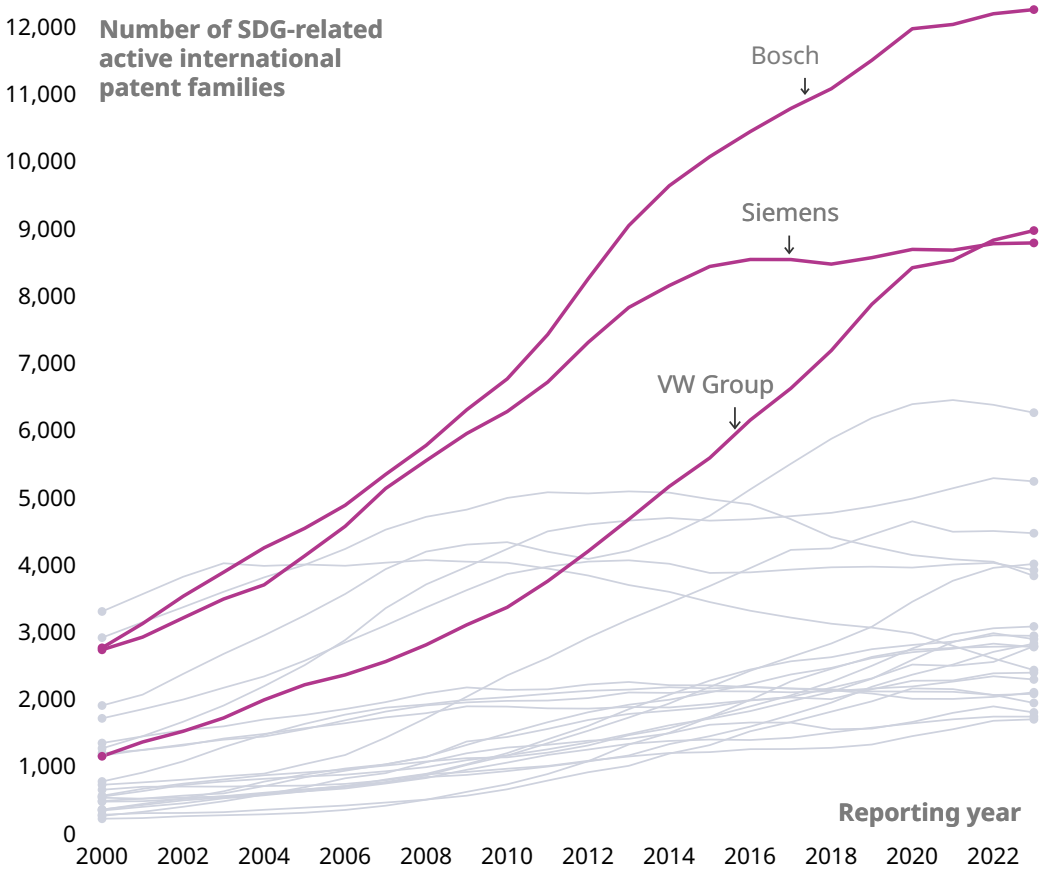
Note: CAGR is the compound annual growth rate.
Source: WIPO, based on patent data from PatentSight, January 2024.

Europe

In Europe, Bosch and the VW Group lead the pack with strong and sustained positive innovation momentum (Figure 15). Siemens, while noticeable in the analysis, has experienced limited growth since around 2012 and was recently overtaken by the VW Group. However, Siemens maintains a positive growth rate for its share of SDG-related patents, exceeding 50%, placing it among the higher ranking entities within the top 25 patent owners. Siemens Energy, a recent spin-out from Siemens' wind energy division, also exhibits remarkable growth and has a significant share among the top 25 patent owners (Figure 16).

Figure 15 **Top 25 patent owners from Europe based on number of SDG-related active international patent families, 2000–2023**

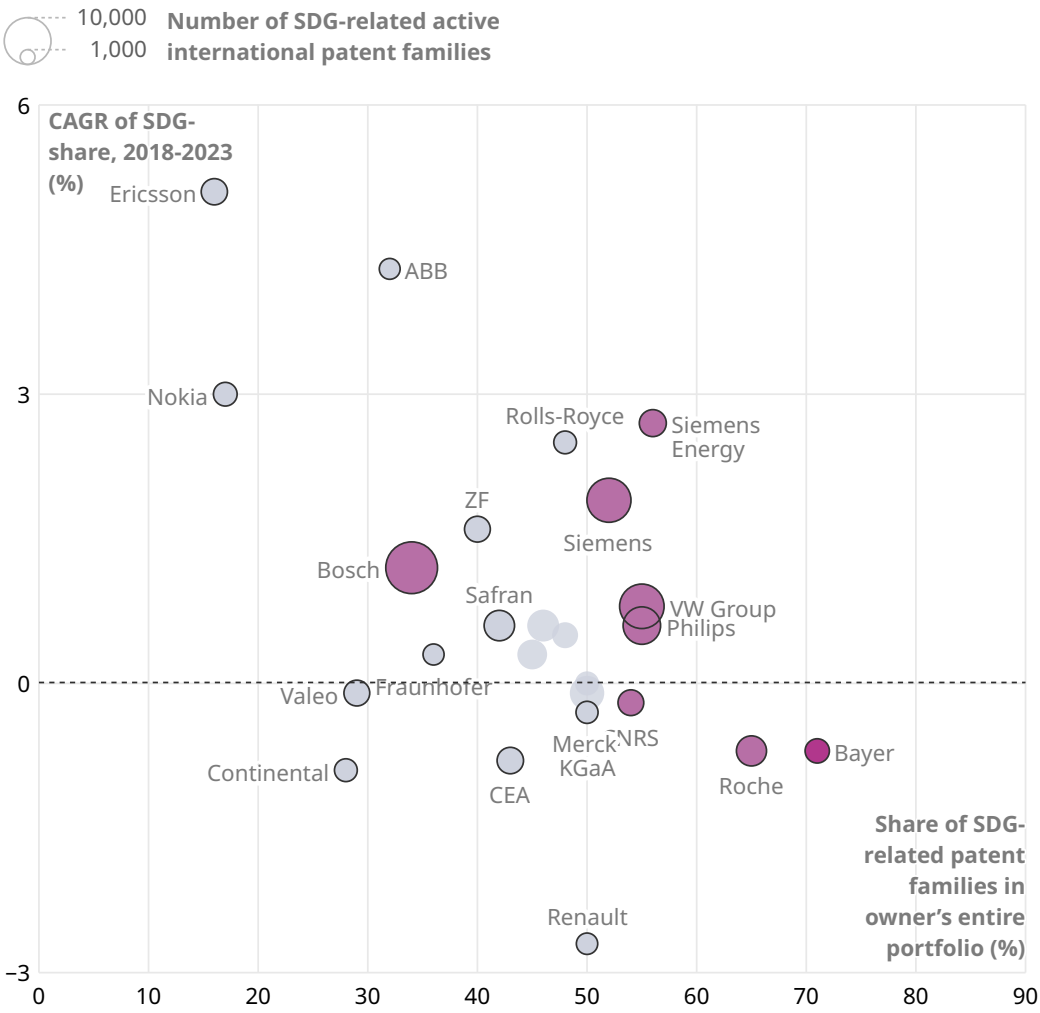
In Europe, Bosch and VW Group are leading the pack with strong and sustained momentum in SDG-related innovation, whereas Siemens' growth has leveled off in recent years.



Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 16 **Comparing the top 25 patent owners from Europe by share of SDG-related patents and compound annual growth rate (CAGR), 2018–2023**

Among these top owners, there is a significant disparity in the share of SDG-related patents, ranging from 16% to 71%. Bayer holds the highest share, followed by Roche.



Note: CEA is the French Alternative Energies and Atomic Energy Commission; CNRS is the Centre National de la Recherche Scientifique.
Source: WIPO, based on patent data from PatentSight, January 2024.

Among these top owners, there is a wide range in the share of SDG-related patents, varying from 16% to 71%. Bayer, a German pharmaceutical and biotechnology company, holds the highest share, followed by Roche, also operating a pharmaceuticals division along with medical diagnostics. Other owners with a notable share of SDG-related patents include Siemens Energy, Philips, the VW Group, and CNRS (Centre National de la Recherche Scientifique).

Table 2 ranks the top 25 patent owners by total SDG-related patent families. Bosch leads with over 12,000 patent families, followed closely by the VW Group and Siemens, with over 8,000 each. Predominantly comprising automotive sector entities, other sectors represented include engineering, energy, telecommunications, and electronics.

Table 2 Top 25 patent owners from Europe based on number of SDG-related active international patent families, 2000–2023

Patent owner	Headquarters location	SDG-related active international patent families	Share of SDG-related patent families in owner's entire portfolio (%)	CAGR of SDG-share, 2018–2023 (%)
Bosch	Germany	12,246	34	1.2
VW Group	Germany	8,959	55	0.8
Siemens	Germany	8,775	52	1.9
Philips	Netherlands	6,250	55	0.6
Medtronic	Ireland	5,228	50	–0.1
Airbus Group	Netherlands	4,457	46	0.6
Safran	France	4,000	42	0.6
Roche	Switzerland	3,907	65	–0.7
BASF	Germany	3,823	45	0.3
Siemens Energy	Germany	3,070	56	2.7
CEA	France	2,931	43	–0.8
Ericsson	Sweden	2,882	16	5.1
BMW	Germany	2,815	48	0.5
ZF	Germany	2,776	40	1.6
Valeo	France	2,774	29	–0.1
CNRS	France	2,764	54	–0.2
Bayer	Germany	2,421	71	–0.7
Stellantis	Netherlands	2,383	50	0.0
Nokia	Finland	2,282	17	3.0
Continental	Germany	2,091	28	–0.9
Rolls-Royce	United Kingdom	2,068	48	2.5
Merck KGaA	Germany	1,932	50	–0.3
Renault	France	1,791	50	–2.7
Fraunhofer	Germany	1,729	36	0.3
ABB	Switzerland	1,689	32	4.3

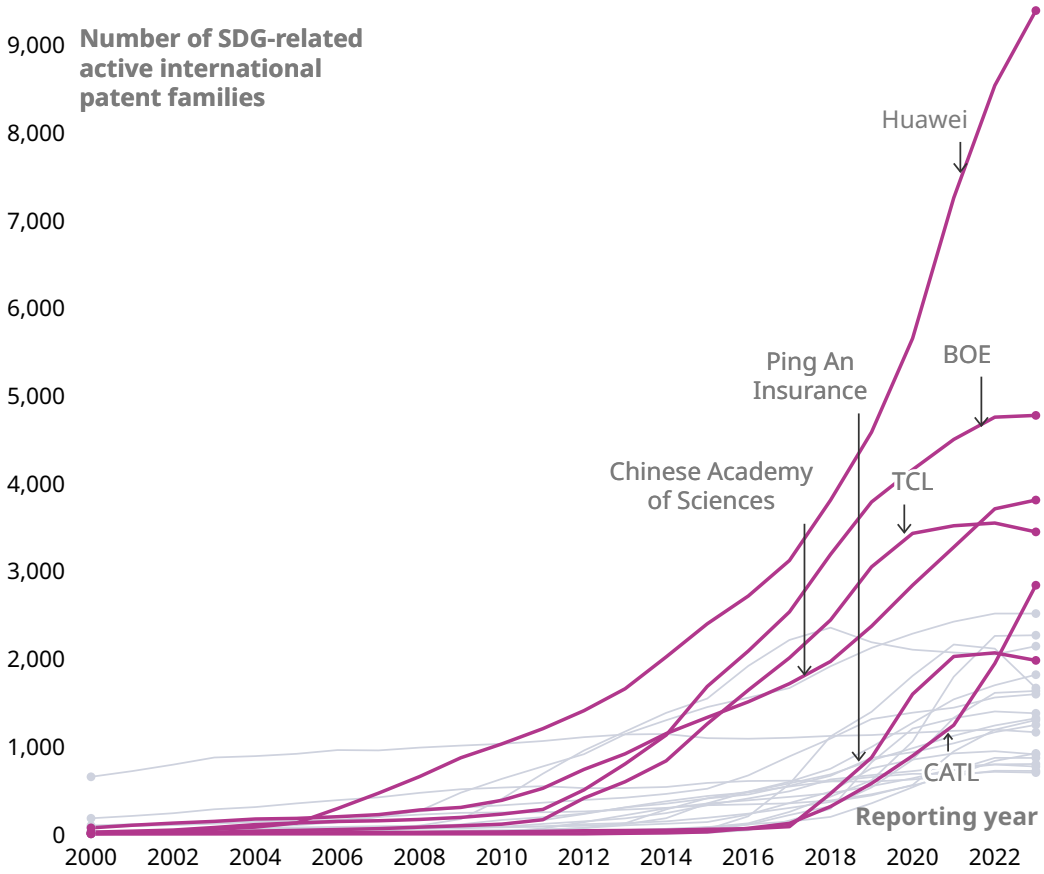
Note: CAGR is the compound annual growth rate.
Source: WIPO, based on patent data from PatentSight, January 2024.

China

In China, well-known organizations dominate the top ranks, led by Huawei, followed by BOE (known for display manufacturing), the Chinese Academy of Sciences, and TCL (Figure 17). All these entities exhibit positive developments, particularly in the past 5–10 years, aligning with the overall trend among the top 25 patent owners in China.

Figure 17 **Top 25 patent owners from China based on number of SDG-related active international patent families, 2000–2023**

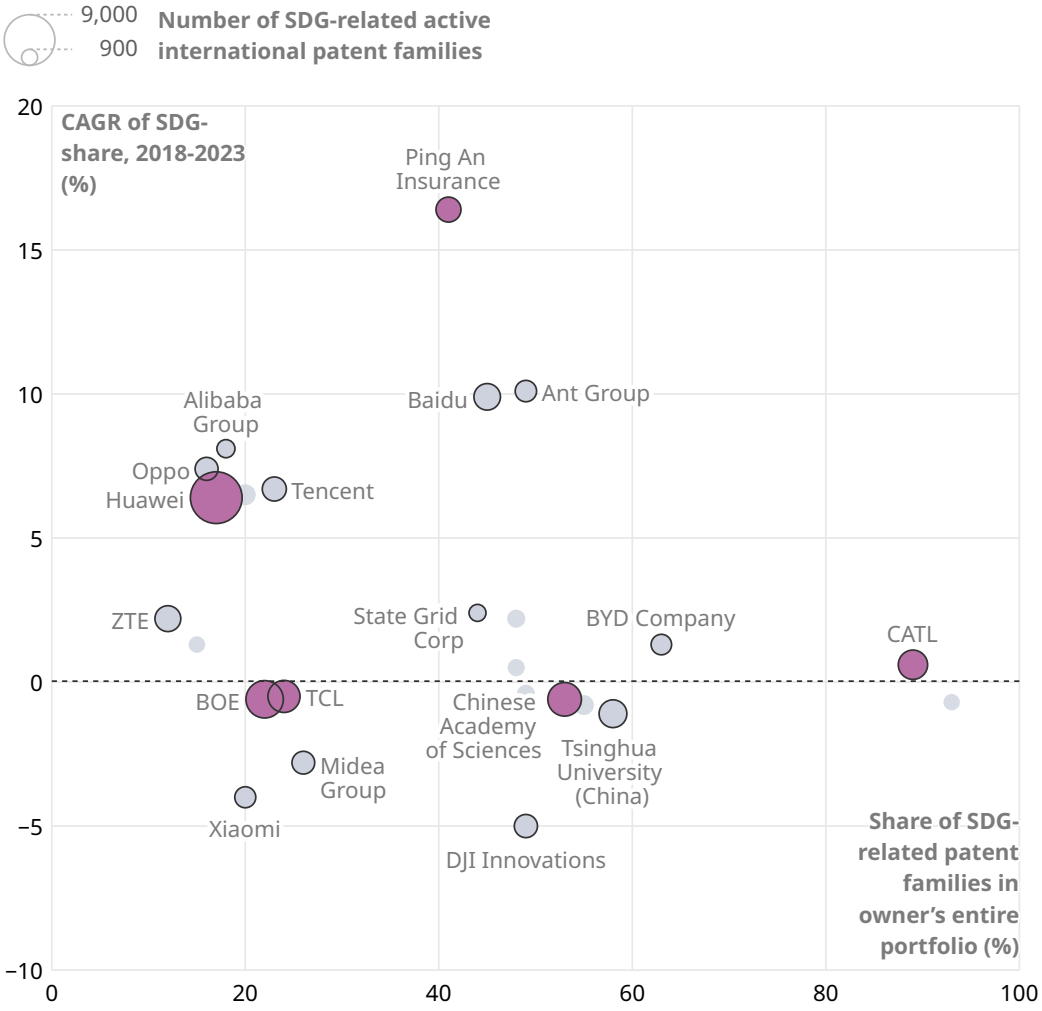
Over the past 5–10 years, the top 25 patent owners in China have all shown positive growth. Among them, Huawei, BOE Technology Group, the Chinese Academy of Sciences, and TCL dominate.



Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 18 **Comparing the top 25 patent owners from China by share of SDG-related patents and compound annual growth rate (CAGR), 2018–2023**

The top patent owners in China exhibit diversity in size. Huawei is the largest, but less than 20% of its portfolio is related to SDGs, whereas Ping An Insurance demonstrates the strongest growth rate.



Source: WIPO, based on patent data from PatentSight, January 2024.

China's top 25 patent owners exhibit a diversity in size. Huawei is the largest in terms of absolute size but less than 20% of its portfolio is relevant to the SDGs, ranking lower among the top 25 patent owners (Figure 18). Notably, Ping An Insurance stands out as having the strongest growth rate, primarily attributable to the contribution it has made to blockchain development.

CATL (Contemporary Amperex Technology), a major Li-ion battery manufacturer supporting decarbonization, holds the second largest share of SDG-related patents among the top 25 patent owners in China. Table 3 details the key metrics for these entities, highlighting Huawei's leading position, with over 9,000 patent families in its SDG portfolio, followed by BOE, the Chinese Academy of Sciences, and TCL. Additionally, Ping An Insurance boasts the highest CAGR among the top 25.

Table 3 Top 25 patent owners from China based on number of SDG-related active international patent families, 2000–2023

Patent owner	SDG-related active international patent families	Share of SDG-related patent families in owner's entire portfolio (%)	CAGR of SDG-share, 2018–2023 (%)
Huawei	9,385	17	6.4
BOE	4,770	22	–0.6
Chinese Academy of Sciences	3,805	53	–0.6
TCL	3,442	24	–0.5
CATL	2,834	89	0.6
Tsinghua University (China)	2,511	58	–1.1
Baidu	2,264	45	9.9
ZTE	2,139	12	2.2
Ping An Insurance	1,977	41	16.4
Tencent	1,814	23	6.7
DJI Innovations	1,662	49	–5.0
Oppo	1,629	16	7.4
Midea Group	1,592	26	–2.8
Ant Group	1,374	49	10.1
Xiaomi	1,317	20	–4.0
Haier	1,297	20	6.5
BYD Company	1,242	63	1.3
Sinochem Holdings	1,158	55	–0.8
Zhejiang Geely	917	48	2.2
Alibaba Group	906	18	8.1
Zhejiang University	865	49	–0.4
SMIC	796	48	0.5
State Grid Corp	767	44	2.4
Lenovo	717	15	1.3
Envision Energy	698	93	–0.7

Note: CAGR is the compound annual growth rate. CATL is Contemporary Amperex Technology; SMIC is Semiconductor Manufacturing International Corporation.
Source: WIPO, based on patent data from PatentSight, January 2024.

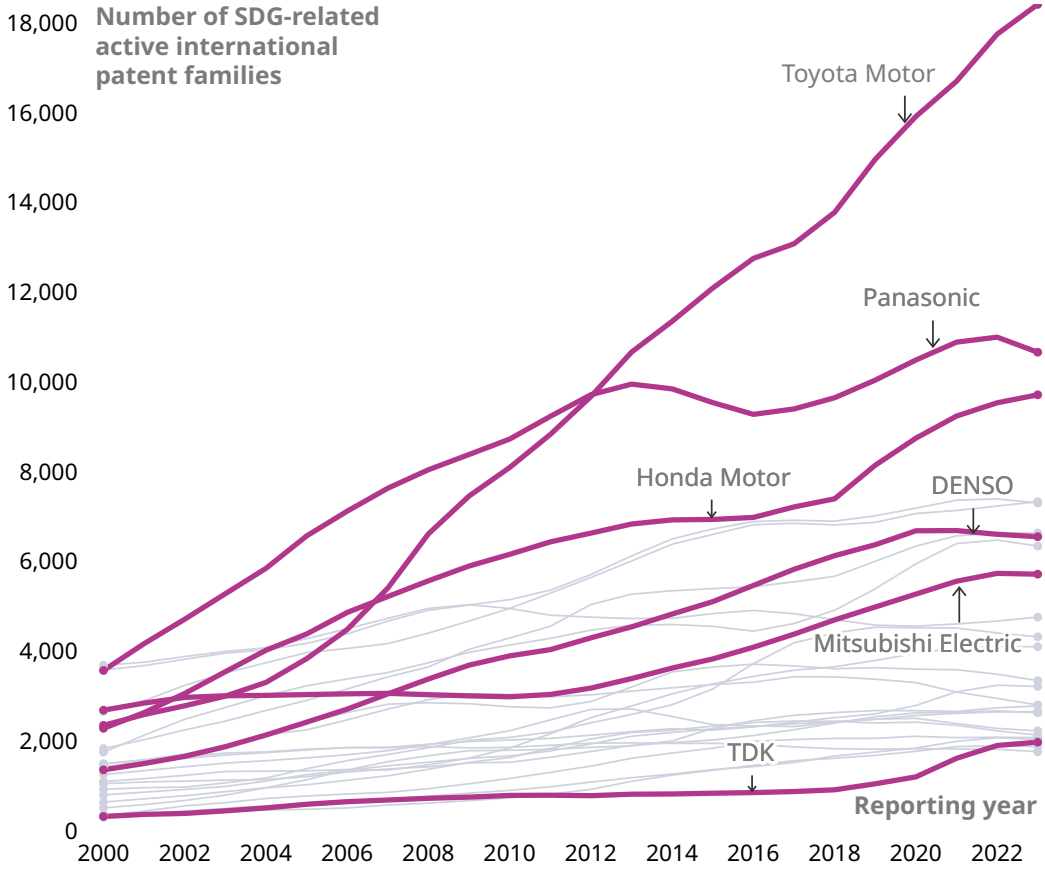
Japan

The top 25 patent owners headquartered in Japan exhibit various trends in their development. Toyota Motor stands out with a consistent upward trajectory in its number of SDG-related active patent families, surpassing Panasonic in 2013. Indeed, Panasonic's growth in patents has slowed over the past decade. Other notable developments come from Honda Motor, DENSO, and Mitsubishi Electric, all showing a substantial upward trend in Figure 19.

At the lower end of the chart, TDK has experienced a recent but noticeable surge, doubling its rate of growth since around 2020. This is especially visible in Figure 20. This spike in TDK's growth in SDG-related patents, with a CAGR of above 10%, is attributable to its initially limited SDG portfolio and recent significant expansion.

Figure 19 **Top 25 patent owners from Japan based on the number of SDG-related active international patent families, 2000–2023**

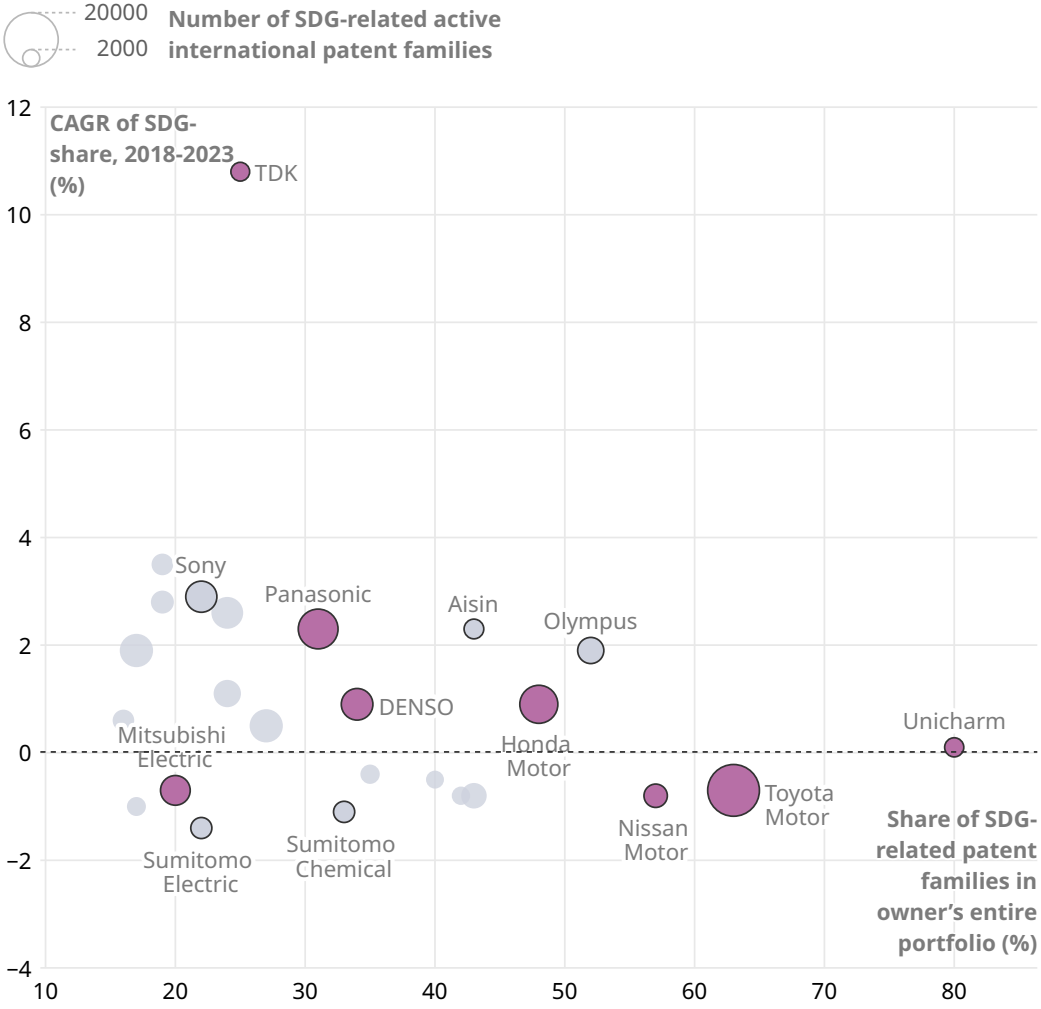
Toyota Motor demonstrates a sustained upward trend in the number of SDG-related active patent families, whereas Panasonic's patent growth has slowed over the past decade.



Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 20 **Comparing the top 25 patent owners from Japan by share of SDG-related patents and compound annual growth rate (CAGR), 2018–2023**

TDK has experienced a recent surge in SDG-related patents, but Unicharm holds the largest share of SDG-related patents.



Source: WIPO, based on patent data from PatentSight, January 2024.

Toyota Motor displays robust absolute development among the top 25 patent owners, despite having a negative CAGR (Table 4). This indicates that, while Toyota's absolute numbers of SDG-related patents continue to grow, the proportion they constitute within the company's overall portfolio is decreasing. Nissan Motor and Honda Motor also demonstrate having made innovative strides in alternative propulsion methods, such as batteries and fuel cells, contributing to their positions.

The patent owner with the largest share of their portfolio being SDG-related is Unicharm, boasting around 80%, which surpasses Toyota's 63%. This predominance is primarily owing to Unicharm's technologies catering to daily personal care activities, thereby aligning strongly with the UN SDGs.

Table 4 Top 25 patent owners from Japan based on number of SDG-related active international patent families, 2000–2023

Patent owner	SDG-related active international patent families	Share of SDG-related patent families in owner's entire portfolio (%)	CAGR of SDG-share, 2018–2023 (%)
Toyota Motor	18,397	63	–0.7
Panasonic	10,644	31	2.3
Honda Motor	9,695	48	0.9
Canon	7,314	17	1.9
Hitachi	7,284	27	0.5
Fujifilm	6,617	24	2.6
DENSO	6,532	34	0.9
Sony	6,323	22	2.9
Mitsubishi Electric	5,697	20	–0.7
Toshiba	4,740	24	1.1
Olympus	4,301	52	1.9
Mitsubishi Heavy	4,082	43	–0.8
Nissan Motor	3,326	57	–0.8
NEC	3,194	19	2.8
Fujitsu	2,783	19	3.5
Epson	2,761	16	0.6
Sumitomo Chemical	2,633	33	–1.1
Sumitomo Electric	2,607	22	–1.4
Aisin	2,205	43	2.3
Semiconductor Energy Lab	2,110	35	–0.4
Unicharm	2,056	80	0.1
Murata Manufacturing	2,014	17	–1.0
TDK	1,953	25	10.8
Toray	1,854	42	–0.8
MCG Group	1,741	40	–0.5

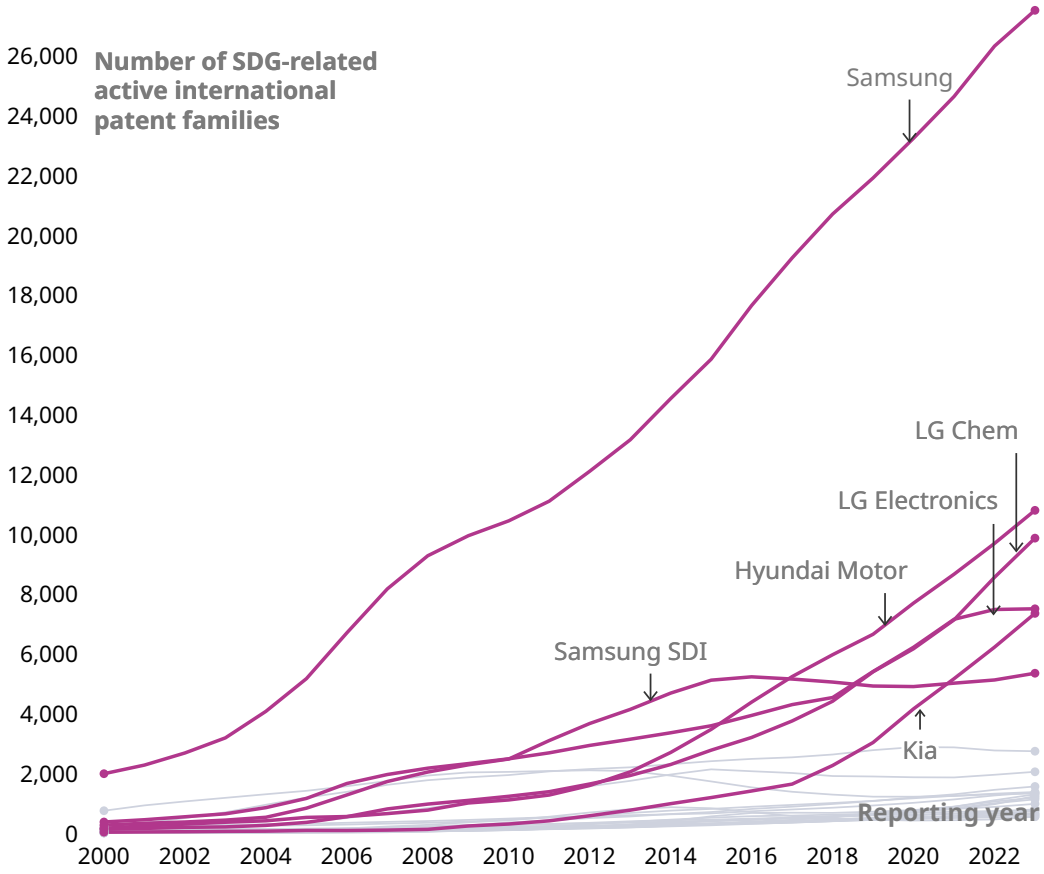
Note: CAGR is the compound annual growth rate.
Source: WIPO, based on patent data from PatentSight, January 2024.

Republic of Korea

Samsung, one of the world's largest patent holders, unsurprisingly dominates the top 25 patent owners from the Republic of Korea (Figure 21). Samsung's consistent positive development in SDG-related patents aligns with its overall portfolio growth, resulting in a stagnant 0% growth rate for its SDG-related share, which stands at approximately 25% of the total portfolio.

Figure 21 **Top 25 patent owners from the Republic of Korea based on number of SDG-related active international patent families, 2000–2023**

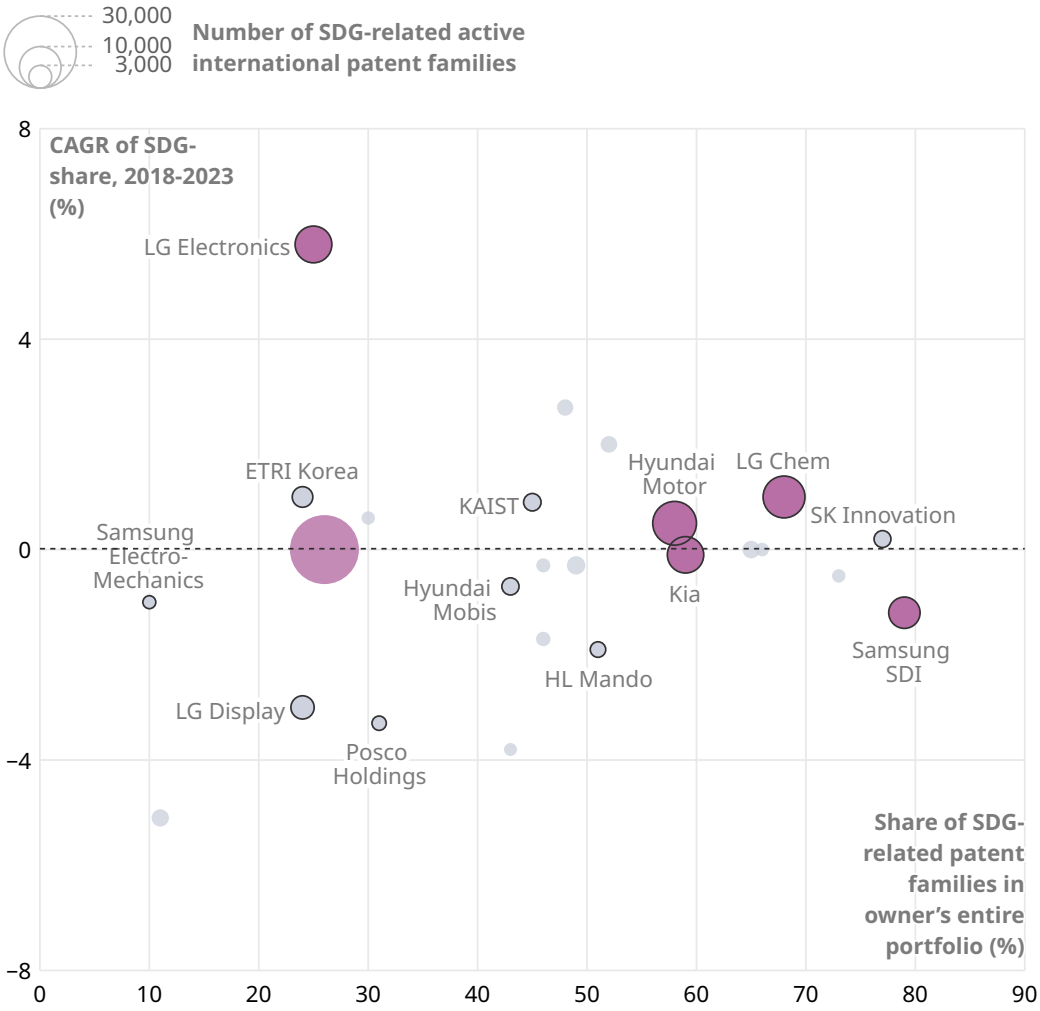
Samsung dominates among the top patent owners in the Republic of Korea.



Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 22 **Comparing the top 25 patent owners from the Republic of Korea by share of SDG-related patents and compound annual growth rate (CAGR), 2018–2023**

Samsung's rapidly increasing portfolio of SDG-related patents has resulted in stagnant growth, but SDG-related patents account for 25% of its total portfolio.



Source: WIPO, based on patent data from PatentSight, January 2024.

Other notable Republic of Korea players exhibiting larger and positive development trends include Hyundai Motor, LG Chemical (a major Li-ion battery supplier), LG Electronics, and Kia (Figure 22). Samsung SDI (another major Li-ion battery supplier) is present in trend analysis but has experienced limited positive development since around 2015, resulting in a negative growth rate at this time. Despite this, Samsung SDI still maintains the largest share of SDG-related patents among the Republic of Korea top 25 patent owners. However, this might change if the current trajectory continues.

The Republic of Korea landscape appears more diverse compared to other regions, with significant differences in the size of players, a wide range of SDG shares, and a varying growth rate that ranges from highly positive to highly negative. This diversity likely stems from market consolidation within the Republic of Korea, where a few major players hold the majority of patents. As a result, the Republic of Korea top 25 patent owners include entities ranging from the largest identified SDG patent holder, with over 27,000 active patent families, to the smallest with under 1,000 patents (Table 5). This consolidation process has provided space for smaller patent applicants to enter the top 25 and highlights there are numerous academic and research organizations within the landscape.

Table 5 Top 25 patent owners from the Republic of Korea based on number of SDG-related active international patent families, 2000–2023

Patent owner	SDG-related active international patent families	Share of SDG-related patent families in owner's entire portfolio (%)	CAGR of SDG-share, 2018–2023 (%)
Samsung	27,508	26	0.0
Hyundai Motor	10,786	58	0.5
LG Chem	9,856	68	1.0
LG Electronics	7,493	25	5.8
Kia	7,340	59	–0.1
Samsung SDI	5,338	79	–1.2
LG Display	2,730	24	–3.0
ETRI Korea	2,042	24	1.0
Seoul National University	1,551	49	–0.3
KIST Korea	1,366	65	0.0
KAIST	1,351	45	0.9
SK Hynix	1,317	11	–5.1
Hyundai Mobis	1,289	43	–0.7
SK Innovation	1,230	77	0.2
Korea University	1,180	52	2.0
Yonsei University	1,120	48	2.7
HL Mando	969	51	–1.9
Hanyang University	786	46	–1.7
Posco Holdings	760	31	–3.3
Sungkyunkwan University	723	46	–0.3
Korea Electric Power	653	66	0.0
KRICT	620	73	–0.5
Hahn & Company	606	30	0.6
CJ Corporation	544	43	–3.8
Samsung Electro-Mechanics	540	10	–1.0

Note: CAGR is the compound annual growth rate. ETRI is the Electronics and Telecommunications Research Institute; KAIST is the Korea Advanced Institute of Science and Technology; KIST is the Korea Institute of Science and Technology; KRICT is the Korea Research Institute of Chemical technology.
Source: WIPO, based on patent data from PatentSight, January 2024.

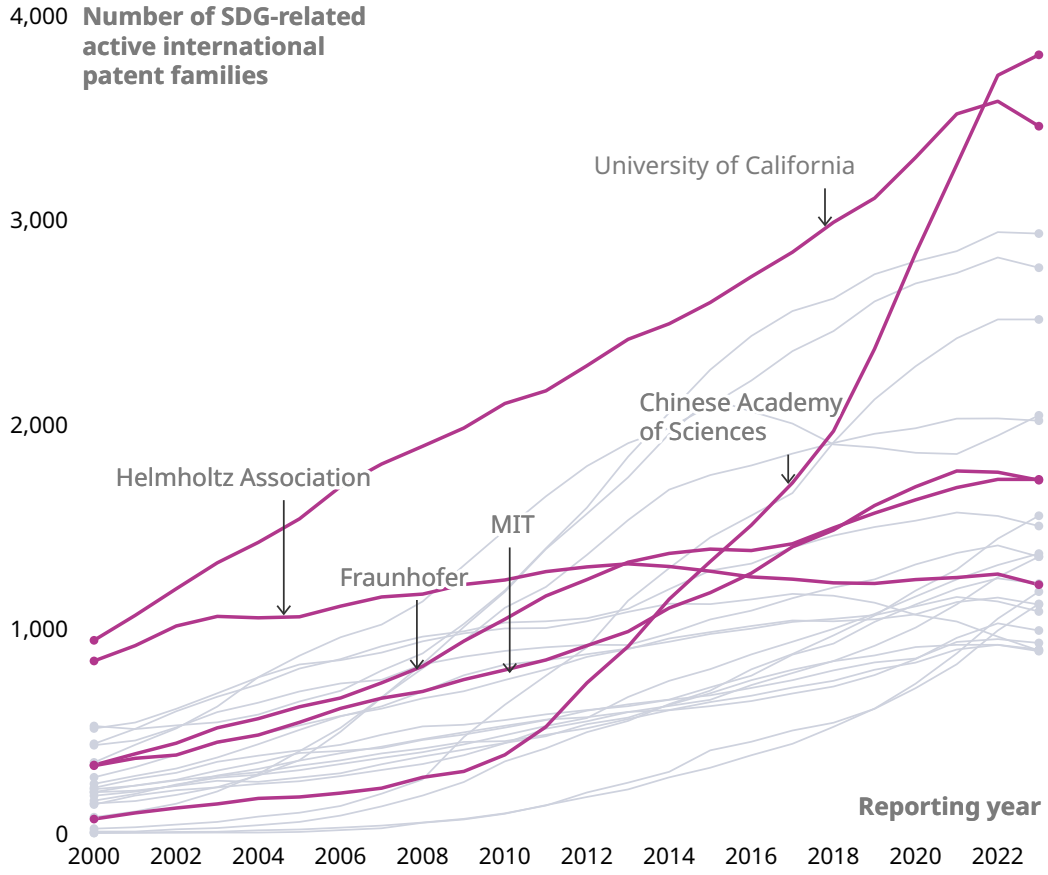
Exploring the role of academia and research organizations in supporting innovation for the SDGs

In an academic and research landscape of sustainable innovation measured by patents aligned with the SDGs as shown in Figure 23, the University of California held a remarkable position as the foremost contributor for the better part of two decades. However, in recent times, its lead has been eclipsed by the Chinese Academy of Sciences, marking a significant shift in global innovation trends. France has demonstrated a strong presence with both the CEA (French Alternative Energies and Atomic Energy Commission) and the CNRS (Centre National de la Recherche Scientifique) consistently ranking high in the list. Similarly, the Republic of Korea has showcased its innovation prowess through institutions like ETRI (Electronics and Telecommunications Research Institute), while Germany's Fraunhofer has been a notable contributor.

MIT (Massachusetts Institute of Technology), a prominent US academic institution, is among the top contributors and, although it has an upward trajectory, its growth is less than some of the high-growth performers in recent years. Another entity experiencing limited growth is the Helmholtz Association from Germany, having dropped down from the second to the 16th position over the past two decades.

Figure 23 Top 25 patent owners from academia and research organizations based on number of SDG-related active international patent families, 2000–2023

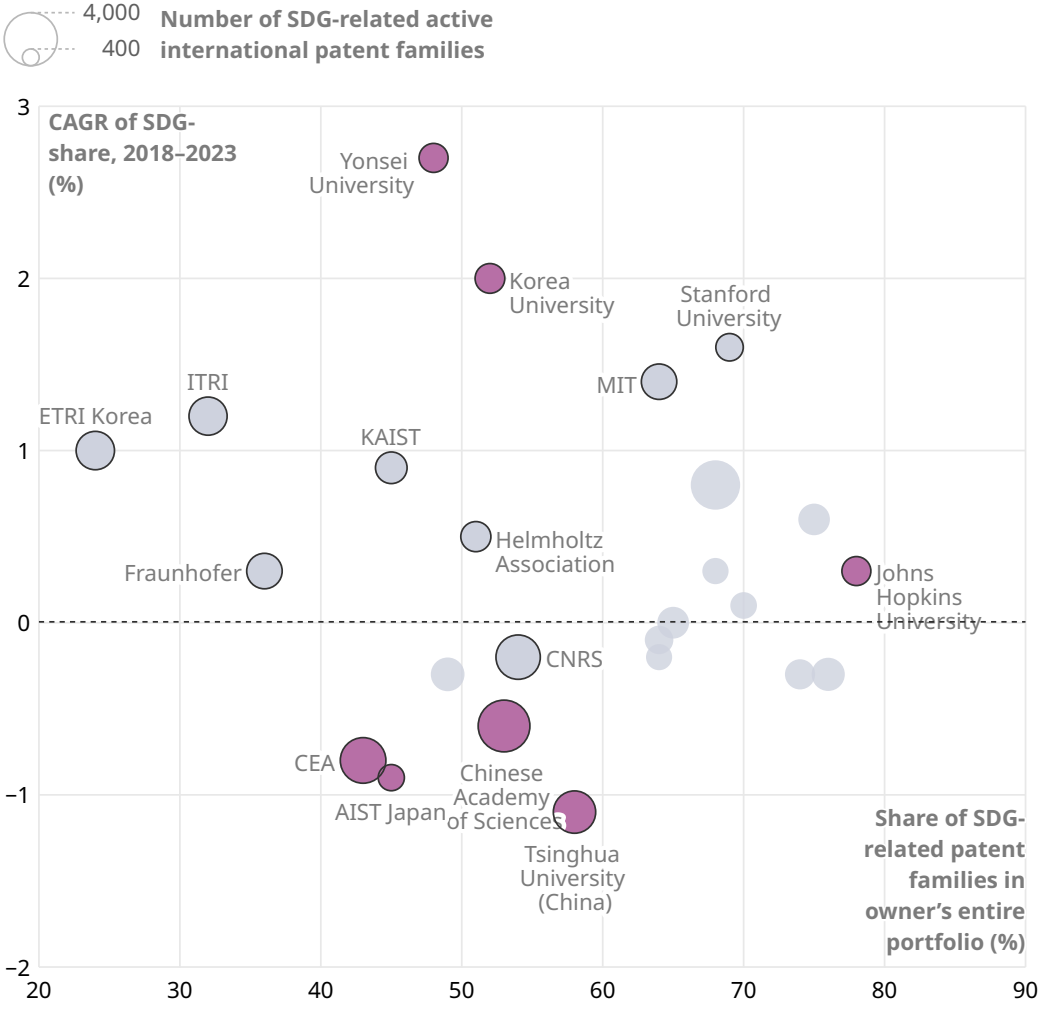
The University of California has held a prominent position as one of the most significant contributors for much of the past two decades. However, in recent years, it has been eclipsed by the Chinese Academy of Sciences.



Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 24 **Comparing the top 25 patent owners from academia and research organizations by share of SDG-related patents and compound annual growth rate (CAGR), 2018–2023**

Johns Hopkins University stands out for its remarkably high share of SDG-related patents, primarily aligned with SDG 3 Good Health and Well-Being.



Source: WIPO, based on patent data from PatentSight, January 2024.

Yonsei University and Korea University, both from the Republic of Korea, have exhibited the most impressive CAGR, underscoring their rapid innovation strides (Figure 24). Conversely, institutions such as Tsinghua University, the Chinese Academy of Sciences, AIST (National Institute of Advanced Industrial Science and Technology) Japan, and the CEA have displayed negative CAGRs.

Medical institutes, exemplified by Johns Hopkins University in the United States, dominate the patent landscape owing to their extensive coverage of medical innovations, which are particularly aligned with SDG 3 **Good Health and Well-Being**. This trend is further emphasized by the substantial contribution of SDG 3 to Johns Hopkins University's overall SDG share, as shown in Table 6.

Moreover, certain organizations, including KIST (Korea Institute of Science and Technology), University of Michigan, and CEA France, stand out for their notable emphasis on SDG 7 **Affordable and Clean Energy**, accounting for 3% to 11% of their patents. Noteworthy shares in SDG 2 **Zero Hunger**, SDG 12 **Responsible Consumption and Production**, and SDG 13 **Climate Action** have also been observed among specific institutions such as KIST, MIT, and the CEA (Figure 25).

An intriguing pattern emerges in the patent families of Asian institutions like KIST, KAIST (Korea Advanced Institute of Science and Technology) and the Chinese Academy of Sciences. That is, they seem to exhibit a more balanced distribution of patent families across the various SDGs compared to their US and European counterparts, who tend to concentrate on a more specialized focus areas in their innovation endeavors. Such a diversity in focus areas could suggest there are different strategic approaches to addressing sustainable development challenges being taken across global research institutions.

Table 6 Top 25 patent owners from academia and research organizations based on number of SDG-related active international patent families, 2000–2023

Patent owner	Location	SDG-related active international patent families	Share of SDG-related patent families in owner's entire portfolio (%)	CAGR of SDG-share, 2018–2023 (%)
Chinese Academy of Sciences	China	3,805	53	–0.6
University of California	United States	3,456	68	0.8
CEA	France	2,931	43	–0.8
CNRS	France	2,764	54	–0.2
Tsinghua University (China)	China	2,511	58	–1.1
ETRI Korea	Republic of Korea	2,042	24	1.0
ITRI	Taiwan Province of China	2,016	32	1.2
Fraunhofer	Germany	1,729	36	0.3
MIT	United States	1,725	64	1.4
Seoul National University	Republic of Korea	1,551	49	–0.3
Mass General Brigham	United States	1,501	76	–0.3
KIST Korea	Republic of Korea	1,366	65	0.0
KAIST	Republic of Korea	1,351	45	0.9
University of Texas System	United States	1,351	75	0.6
Inserm	France	1,219	74	–0.3
Helmholtz Association	Germany	1,214	51	0.5
Korea University	Republic of Korea	1,180	52	2.0
Yonsei University	Republic of Korea	1,120	48	2.7
Johns Hopkins University	United States	1,117	78	0.3
State University System of Florida	United States	1,083	64	–0.1
Stanford University	United States	990	69	1.6
Commonwealth System (Pennsyl-vania)	United States	929	70	0.1
University of Michigan	United States	897	68	0.3
AIST Japan	Japan	892	45	–0.9
Harvard	United States	889	64	–0.2

Note: CAGR is the compound annual growth rate. AIST is the National Institute of Advanced Industrial Science and Technology; CEA is the French Alternative Energies and Atomic Energy Commission; CNRS is the Centre National de la Recherche Scientifique; ETRI is the Electronics and Telecommunications Research Institute; ITRI is the Industrial Technology Research Institute; KAIST is the Korea Advanced Institute of Science and Technology; KIST is the Korea Institute of Science and Technology; Inserm is L'Institut national de la santé et de la recherche médicale; and MIT is the Massachusetts Institute of Technology.
Source: WIPO, based on patent data from PatentSight, January 2024.

Figure 25 **Comparing the proportion of international patent families for each of the top 25 patent owners from academia and research organizations with each SDG**

Patents related to SDG 9 Industry, Innovation and Infrastructure hold a considerable proportion among the top academia and research organizations. Innovations from Inserm, Johns Hopkins University, and Mass General Brigham are more aligned with SDG 3 Good Health and Well-Being. AIST Japan, CEA, and ITRI hold a higher proportion of patents related to SDG 13 Climate Action, whereas ETRI Korea's patents align with SDG 4 Quality Education.

Note: Some patents may be associated with multiple Sustainable Development Goals (SDGs), leading to overlapping representation in different segments of the pie chart. Therefore, the total number of patents related to each SDG for each patent owner, which is the sum of the number of relevant patents in each part of the pie chart, may be greater than the actual number of SDG-related patents owned by that patent owner. SDGs 8, 10, 16 and 17 are not mapped to patents because they primarily address socioeconomic rather than technological goals. AIST is the National Institute of Advanced Industrial Science and Technology; Inserm is L'Institut national de la santé et de la recherche médicale.
Source: WIPO, based on patent data from PatentSight, January 2024.

Conclusion

The intersection of technologies on which patent protection is being sought and the UN SDGs directs a unique lens onto the role of IP in advancing global sustainability efforts. As this report has shown, patent-related data provide a measurable indicator with which to track innovation that is aligned with the SDGs across diverse technology landscapes.

While certain goals such as SDG 9 **Industry, Innovation and Infrastructure** and SDG 13 **Climate Action** exhibit substantial patent activity, others focused on socioeconomic aspects have limited patent connections. Nevertheless, upward trends in SDG-related patents, particularly for renewable energy and emissions reduction, reflect the growing focus on sustainable technologies.

Mapping patents to the SDGs also reveals intersections, with cross-cutting technologies like blockchain contributing to multiple goals. Analyzing trends by technology sectors and fields therefore gives a measurable insight into the alignment of specific areas, such as environmental and pharmaceutical innovations, with the SDGs.

Overall, this report illuminates the pivotal role of IP in steering development toward sustainability. With insights from patents mapped to the UN SDGs, we can actively shape our common future.

Appendices

A.1 Data source

All patent analysis was conducted using LexisNexis PatentSight.[15] The patent data in PatentSight is derived from patent office databases around the world,[16] for example, the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO). This wealth of patent data consists of over 100 million patent documents.

PatentSight uses a patent family definition following the principles of the DOCDB simple family defined by the EPO.[17] Simple patent families refer to a collection of patent applications filed across different geographical regions that cover the same invention. This grouping prevents double-counting the same invention multiple times.

PatentSight analysis was conducted on active patents[18] (i.e., simple patent families that include at least one active member in the form of at least one pending published patent application or a granted patent that is not lapsed, withdrawn, invalidated or rejected at the respective date) as of December 31, 2023. Patents remain active through regular fee payments and typically have a maximum lifespan of 20 years from the date of filing. Analysis on active patents offers insights not only into innovation but also into the continuous dedication to specific areas, with patent owners choosing to continue to maintain the patent by paying the relevant renewal fees, emphasizing an ongoing commitment beyond the initial invention.

Patent applicants/owners within PatentSight are based on the current owner of each patent family at a consolidated level. To define the ultimate owner of a patent family, PatentSight takes into account and manually checks the corporate structure of a company, and also considers all reassignments, mergers and acquisitions. An ultimate owner has no known majority shareholder and owns patent families that belong to its portfolio either directly or through its group companies, subsidiaries, and/or associate companies (each being majority-owned by the ultimate owner who holds at least 50% of shares).

15 See PatentSight+, available at: www.lexisnexisip.com/solutions/ip-analytics-and-intelligence/patentsight.
16 See Nexis Data+, available at: www.lexisnexis.com/en-us/professional/data/nexis-data-plus.page.
17 EPO. DOCDB simple patent family. European Patent Office, available at: www.epo.org/searching-for-patents/helpful-resources/first-time-here/patent-families/docdb.html.
18 Except for the Innovation Maturity Matrix which requires counts of all published patents. See Appendix A.4 for methodology used.

A.2 Patent-to-SDG mapping methodology

LexisNexis Intellectual Property Solutions conducted an in-depth mapping exercise connecting global patent data to the 17 United Nations SDGs, as outlined in Table 7, providing insights into how cutting-edge innovations across various industries contribute to achieving the UN goals and targets. Mapping these patent data to the SDGs provides insights into how current technologies on which patent protection is being sought could contribute to achieving the UN goals.

The mapping methodology involved initially identifying all patentable technologies mentioned in the Goals, Targets, Indicators, Meta data, or Policy documents provided by the UN.[19] This led to the identification of 100 distinct technology categories, encompassing fields such as renewable energy, transportation, agriculture, water treatment, and medical devices. Each of these technologies corresponds to one or more of the SDGs, facilitating the aggregation of patents related to these goals.

For each technology, a patent search strategy was developed to comprehensively cover the technology's scope as outlined by the SDGs. These searches specifically focus on elements explicitly mentioned and employ various strategies tailored to each technology. The approach involves utilizing IPCs (International Patent Classifications), CPCs (Cooperative Patent Classifications), F-Terms (File forming terms), along with English Title, Abstract, Claims, and Descriptions, with machine-translations of patents where official translations are unavailable.

The mapping shows that some SDG goals, such as SDG 9 **Industry, Innovation and Infrastructure** and SDG 3 **Good Health and Well-Being** contain a high number of patents and technology categories, highlighting significant innovation activity (Figures 1 and 5). However, four of the 17 SDGs do not appear to cover patentable technology areas, but instead primarily address socioeconomic developments rather than technological aspects, for example, SDG 17 **Partnerships for the Goals**. The patent mapping methodology therefore only applies to 13 of the 17 SDGs, and subsequent analysis of the mapped patent data reveals technology trends, top owners, geographical distribution, and opportunities for further IP development and collaboration around key SDGs.

The mapping provides a quantifiable measure of the intellectual capital being invested in each goal, offering a tangible representation of the commitment to sustainable development within the global innovation landscape.

19 See https://sdgs.un.org/goals.

Table 7 An overview of the 17 United Nations Sustainable Development Goals (SDGs)

	SDG 1: No Poverty	End poverty in all its forms everywhere
	SDG 2: Zero Hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
	SDG 3: Good Health and Well-Being	Ensure healthy lives and promote well-being for all at all ages
	SDG 4: Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
	SDG 5: Gender Equality	Achieve gender equality and empower all women and girls
	SDG 6: Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all
	SDG 7: Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all
	SDG 8: Decent Work and Economic Growth*	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
	SDG 9: Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
	SDG 10: Reduced Inequalities*	Reduce inequality within and among countries
	SDG 11: Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable
	SDG 12: Responsible Consumption and Production	Ensure sustainable consumption and production patterns
	SDG 13: Climate Action	Take urgent action to combat climate change and its impacts
	SDG 14: Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
	SDG 15: Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
	SDG 16: Peace, Justice and Strong Institutions*	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
	SDG 17: Partnerships for the Goals*	Strengthen the means of implementation and revitalize the global partnership for sustainable development

* Note that four of the 17 SDGs (SDGs 8, 10, 16 and 17) do not cover patentable technology areas, but instead primarily address socioeconomic developments rather than technological aspects. The patent mapping methodology therefore applies to 13 of the 17 SDGs only.

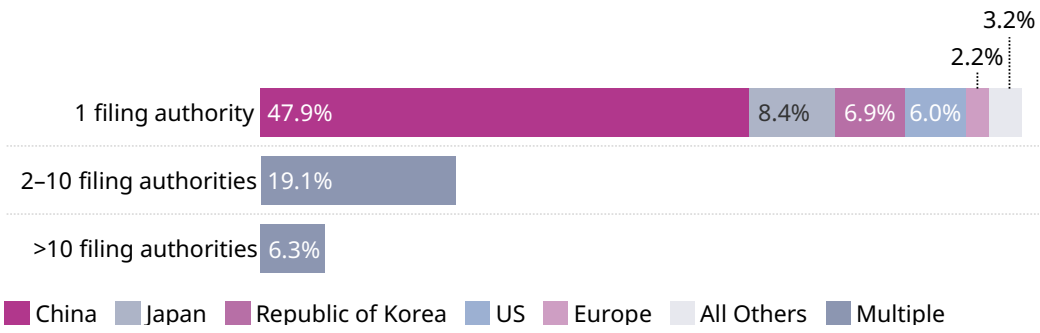
A.3 Foreign-oriented patent families (international patent families)

Some of the analysis in this report is limited to foreign-oriented patent families (international patent families). Foreign-oriented patent families concern those inventions for which the applicant has sought patent protection beyond its home patent office (i.e., filing in more than one authority/jurisdiction). Of the 15.2 million active patent families worldwide, 26% (3.9 million) are foreign-oriented patent families (international patent families).

Analysis by international patent families is highly effective for the largest patent-seeking entities making critical decisions on a daily basis about the perceived value of their patents and the strategic allocation of limited budgets for patent filing and maintenance. However, it also has limitations. Smaller entities may have groundbreaking inventions to protect, but lack the resources to do so broadly. Government-funded organizations may be focused on the domestic market, arguably overly so. Certain technology areas may also have very limited geographical scope, reducing the need for internationalization beyond a single market. While these are the limitations, they are more the edge cases rather than the majority case, at least at the global level covered by the analysis in this report.

Analysis by international patent families also limits any bias introduced for China. Among all active patent families today (not just SDG-related), roughly 50% were filed only in China, as shown in Figure 26. This wealth of domestic-only patents in China means there is a notable bias in the global patent data toward China. This bias is another reason to only consider international patent families for geographical patent analysis and analysis by owners.

Figure 26 Share of active patent families by number of filing authorities

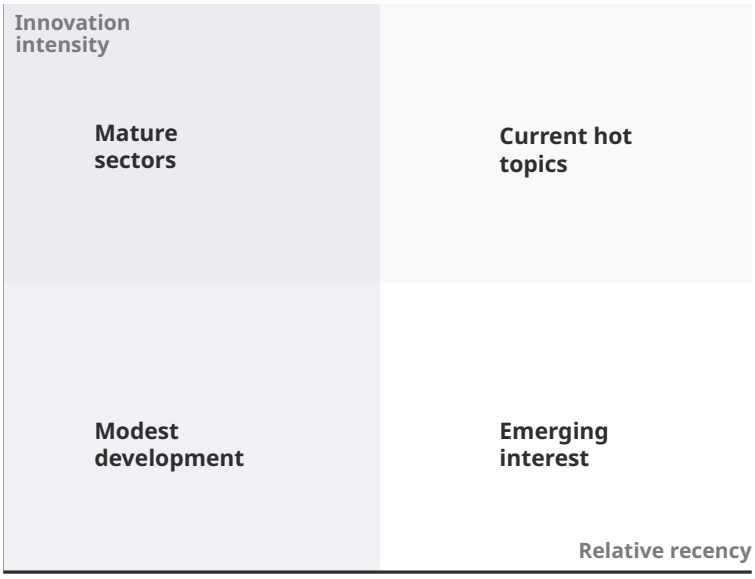


Source: WIPO, based on patent data from PatentSight, January 2024.

A.4 Innovation Maturity Matrix

The Innovation Maturity Matrix[20] depicts innovation intensity against the relative recency of innovation for each SDG, based on SDG-related patent applications filed worldwide.

Figure 27 Defining the Innovation Maturity Matrix



Innovation intensity is measured by absolute number of published patent families (it is not limited solely to active patent families).

Recency measures quantitatively how recently patent applications were first filed for certain technologies. It is calculated by a weighted average of patent applications, whereby a higher weighting is given to inventions filed in more recent years. **Relative recency** refers to a normalized recency, where the recency of the overall SDG-related patent dataset is 1.

Recency formula:

$$\bar{R} = \frac{\sum_{i=1}^{n}(w_i \times i)}{n \times \sum_{i=1}^{n} w_i}$$

where $i = 1$ for the first year of the survey period, and i increases by 1 for every subsequent year in chronological order; n is the total number of years of the survey period; and w_i is the number of patent applications filed in the year i.

The four-quadrant matrix helps identify the following:

- Emerging interest – areas with related patent families that have the most recent priority year, but are not yet large in volume. Such areas are emerging and gaining rapid industry traction.
- Current hot topics – research areas that are the current industry focus and have a high number of accumulated patent families.
- Mature sectors – areas with a high number of patent families, but which are no longer the current key focus, as most patent families were published in the relative past.
- Modest development – areas that are not of recent focus and have a small number of filings. These could already have arrived at the final stage of the technology cycle, that is, at the decline stage; or else be areas that have been explored for a (relatively) long period of time, but had not gained traction at the time of the patent analytics report.

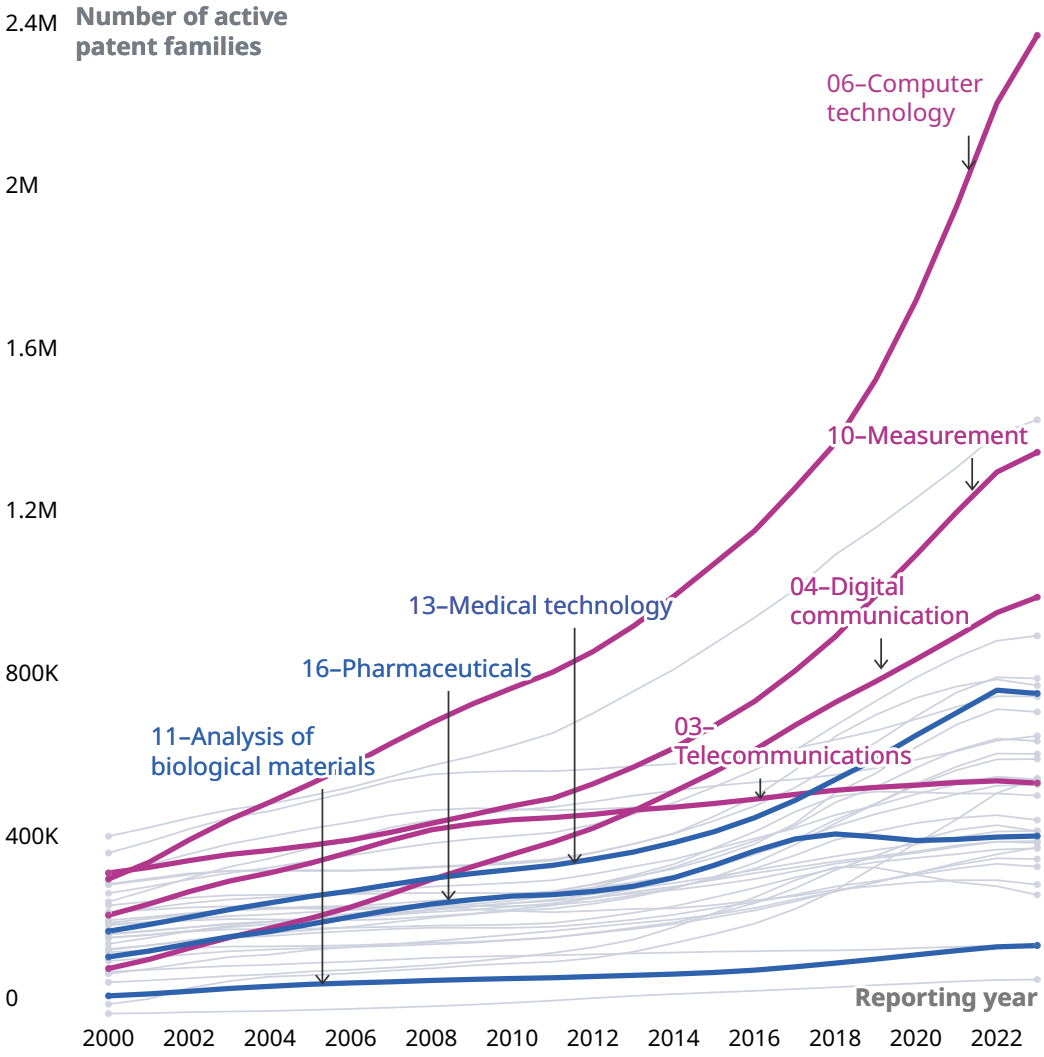
20 A methodology developed by IPOS International https://iposinternational.com/

A.5 Relative development of technology areas

It is mentioned in the report that some technology areas produce more patents than others. This does not directly mean one area is more inventive than another, as it can be the forces of industry, the market or the technology itself that causes this. Comparing the number of patent families in two very distinct technology areas in absolute terms may not therefore be an effective measure. For this reason, most of the report also considers the share of the technology area that is SDG-related, rather than just the absolute number of patents.

When discussing the number of active patent families associated with each of the SDGs, as shown in Figure 1, the lower number of patents filed for medical innovations is mentioned and compared to areas like electronics. This does not necessarily say anything about the relative level of innovation in these two technology areas, but simply that other external factors mean there is a greater propensity to seek patents for electronic innovations than medical innovations. In Figure 28, the development in number of active patent families in the 35 WIPO technology fields is shown. Technology fields 3, 4, 6 and 10 are highlighted to represent "electronics" and technology fields 11, 13, and 16 are highlighted to represent "medical", and there is a noticeable difference in the absolute number of patents between the two areas.

Figure 28 Number of active patent families in each of the 35 WIPO technology fields, 2000–2023



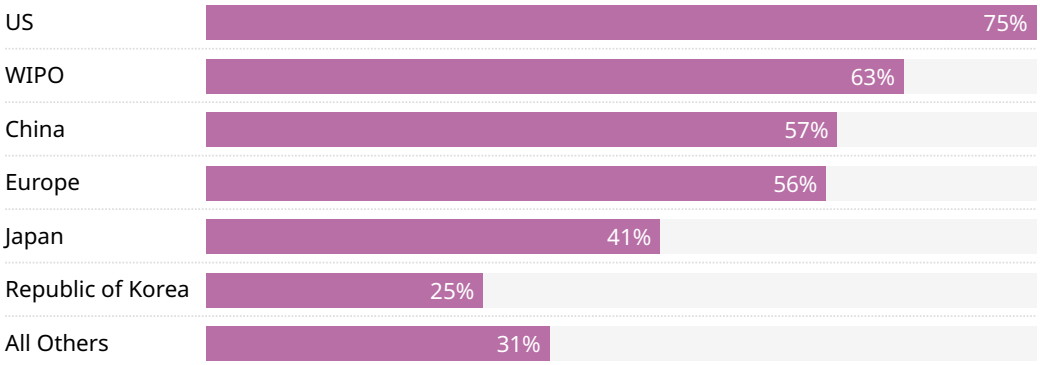
Source: WIPO, based on patent data from PatentSight, January 2024.

A.6 Selecting geographical regions for analysis

The report focuses on five major regions, and in some cases also patents filed via the PCT system (WIPO). These regions are the United States of America, Europe, China, Japan, and the Republic of Korea. Europe includes filings at the EPO and national patent office filings within geographical Europe, but without duplication because only one record per international patent family is counted.

There are many other patent authorities around the world. However, to limit the scope of the report only the five listed above were selected. They were selected as they are the largest patent authorities by number of filings and active patents. Figure 29 shows the share of active international patent families today in these five regions, with 'All others' shown separately. The 'All others' is only slightly larger than the Republic of Korea, and smaller than all other regions shown in the report.

Figure 29 Share of active international patent families by filing authority



Source: WIPO, based on patent data from PatentSight, January 2024.

Cover: Getty Images/Tetiana Lazunova / WIPO Reference RN2024-18EN; DOI: 0.34667/tind.49301

WIPO
WORLD INTELLECTUAL PROPERTY ORGANIZATION