

# **Patent Landscape Report: Synthetic Biological Trends in Gene Editing and Artificial Organisms.**



**Author:** [Prathik Praveen](#)

[Reva University, Bangalore.](#)

## Contents

<b>Sl. No.</b>	<b>Topics</b>	<b>Page No.</b>
1.	Introduction	3
2.	Objective of the patent landscape report	4
3.	Parameters Used for Patent Landscape Analysis	4
4.	Patent Filing Trends (2016–2024)	5
5.	Distribution of Patents Based on the Assignee	6
6.	Jurisdiction-Based Global Patent Filing Trends	7
7.	Technology Classification Based on IPC Codes	8
8.	Competitor Activities by Area of Research (IPC Full)	9
9.	Estimated Top 10 Industries and Technology Areas (2014–2024)	10
10.	Estimated Top 10 Patent Owners (2014–2024)	11
11.	Estimated Top 10 Assignee Countries (2014–2024)	12
12.	Estimated Top 10 Priority Countries (2014–2024)	13-14
13.	Estimated Top 5 Publication Countries (2014–2024)	14-15
14.	Overall Analysis of the Patent Landscape on Gene Editing and Artificial Organisms	15-16
15.	Conclusion	16
16.	Disclaimer	17

## **A. Introduction**

Synthetic biology is an interdisciplinary field that uses engineering principles to redesign or create new biological systems, parts, and devices. Among the most transformative tools in this domain is gene editing, with technologies such as CRISPR-Cas9, TALENs, and ZFNs enabling precise and efficient modification of genetic material. The potential applications range from therapeutic interventions and disease eradication to sustainable agriculture and synthetic organisms designed for environmental remediation.

As the field rapidly evolves, so do the challenges surrounding intellectual property rights (IPR). One of the most contentious issues lies in the patentability of life forms and genetic sequences. The debate often hinges on ethical boundaries, the scope of patent eligibility, and the balance between incentivizing innovation and ensuring public accessibility. Moreover, international frameworks such as the Convention on Biological Diversity (CBD) and the Nagoya Protocol have introduced complexities related to bioprospecting and access and benefit sharing (ABS), particularly in resource-rich countries like India.

According to insights from WIPO, EPO, and recent articles on CRISPR patent litigation (e.g., Broad Institute vs. UC Berkeley), the legal landscape around synthetic biology patents is both dynamic and fragmented. The United States and China dominate filings, while the EU imposes more ethical constraints. Meanwhile, India, although emerging, faces structural challenges in harmonizing biodiversity protection with patent incentives.

This report aims to analyse global patent trends in synthetic biology over the past decade, focusing on gene editing and artificial organisms, while highlighting the underlying IPR challenges in this highly strategic sector.

## **B. Objective of Patent Landscape Report**

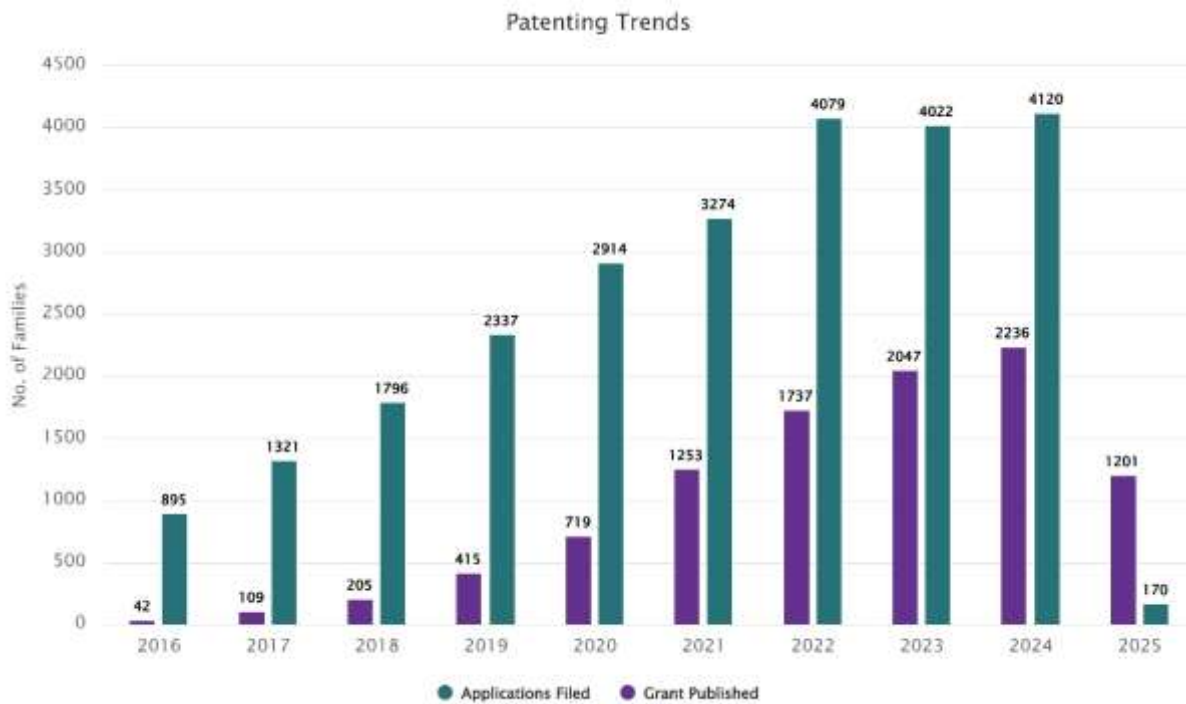
This Patent Landscape Report has been developed to analyse the evolution of innovation in synthetic biology, with a focused lens on gene editing technologies and artificial organisms over the past decade (2014–2024). The primary objective is to map global patent activity across key jurisdictions, assignees, and industries, and to identify emerging technological clusters within this domain. By utilizing a targeted combination of International Patent Classification (IPC) codes and strategically selected keywords, the report captures data on filings, grants, and ownership patterns. Special emphasis has been placed on the contributions of academic institutions such as Shanghai University, Huazhong Agricultural University, and MIT, and corporate leaders like Corteva Inc. and the Broad Institute. Additionally, the report dissects the concentration of innovation in sectors like pharmaceuticals, agriculture, and food technology. The insights aim to assist stakeholders, researchers, legal professionals, and policymakers in understanding where synthetic biology is headed, who is driving it, and how patent trends reflect the broader trajectory of biotechnology advancement worldwide.

## **C. Parameters used for Patent Landscape analysis**

In this report, we studied the following parameters and trends:

1. Patenting Trends for the years 2016 to 2025
2. Distribution of Patents based on the Assignees
3. Jurisdiction based Global Patent Filing Trends
4. Technology classification based on IPC classification
5. Activities of Competitors based on the area of Research (IPC)
6. Estimated top 10 industries and technology areas between 2014 and 2024
7. Estimated top 10 owners between 2014 and 2024
8. Estimated top 10 Assignee Countries between 2014 and 2024
9. Estimated top 10 priority countries between 2014 and 2024
10. Estimated top 10 publication countries between 2022 and 2024

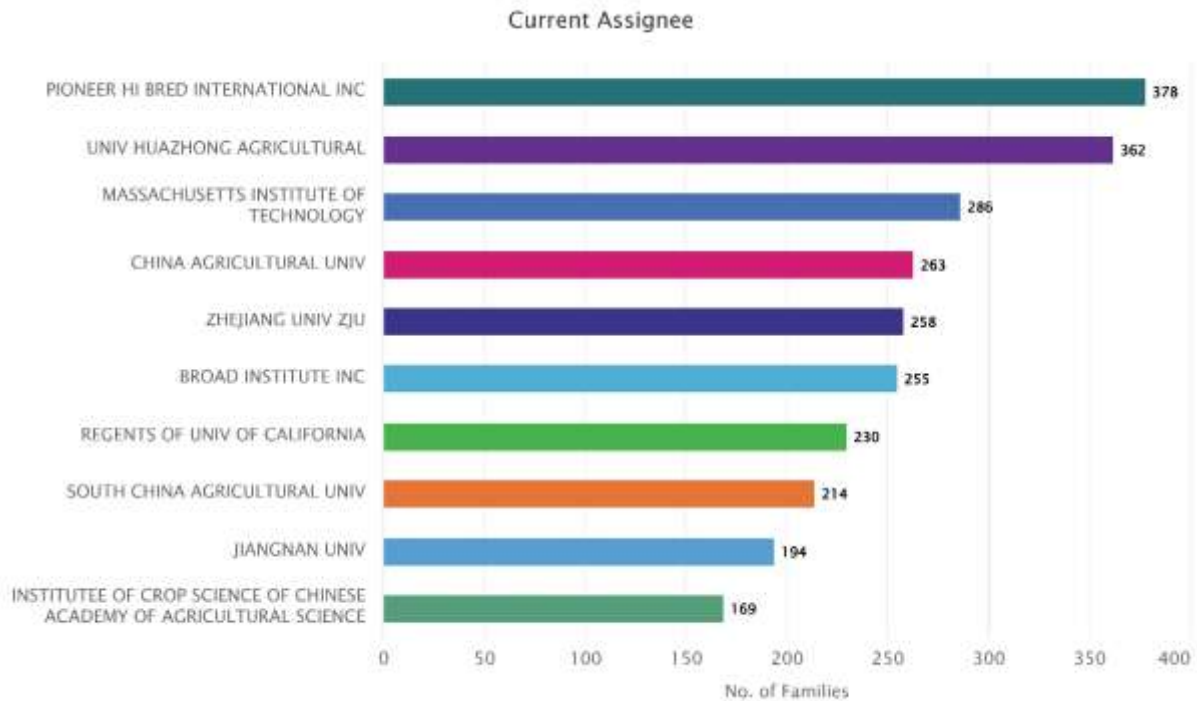
## D. Patent Filing Trends (2016–2024)



**Figure 1:** Patent filing trend between the years 2016 and 2024

The figure shows the number of patent applications filed and granted annually in the field of gene editing and artificial organisms. In 2016, filings stood at 895 with grants at just 42, growing steadily to 2,337 filings and 415 grants by 2019, and further accelerating to 4,120 filings and 2,236 grants in 2024, reflecting a near five-fold increase over the decade. Equally significant is the rising grant-to-filing ratio, climbing from roughly 4.7% in 2016 to over 54% in 2024, indicating that applications are becoming more technically mature and commercially purposeful over time. This transition signals that gene editing is steadily moving from academic exploration toward a commercially competitive IP landscape, making early and strategic patent portfolio development increasingly critical for stakeholders. Data for 2025 remains incomplete at the time of writing.

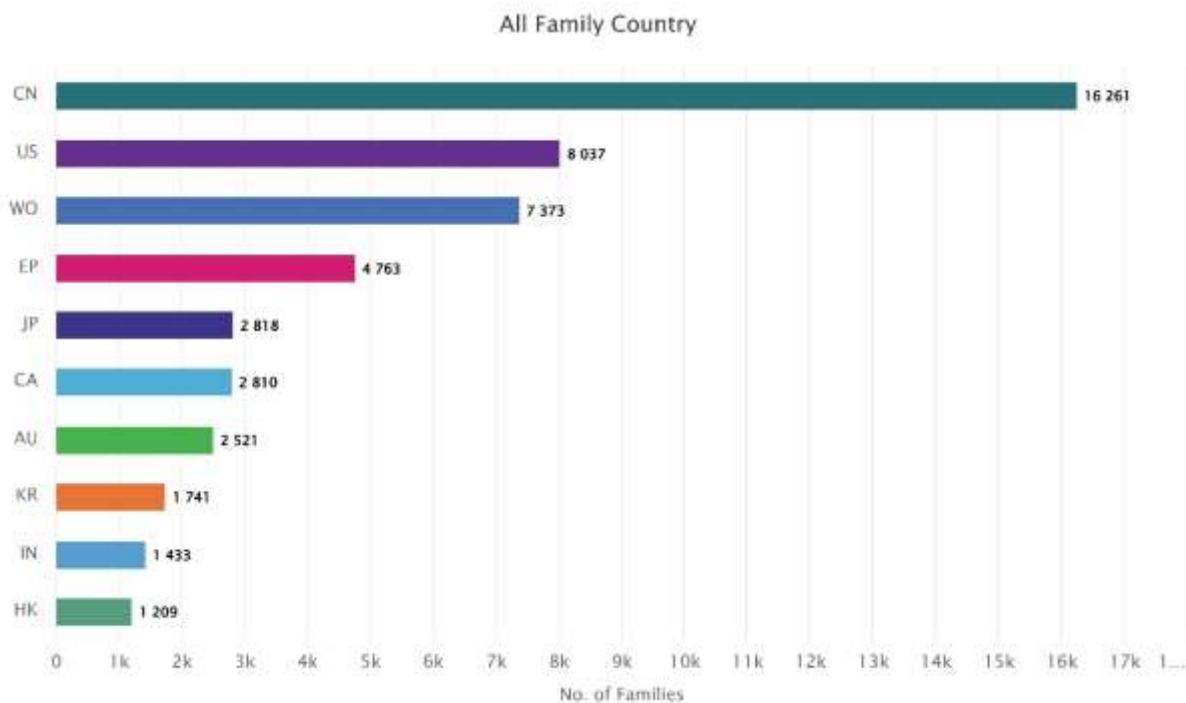
## E. Distribution of Patents Based on the Assignee



**Figure 2:** Distribution of Patents based on the Assignees

The figure presents the distribution of patent families among the top assignees in the field of gene editing and artificial organisms. [Pioneer Hi-Bred International Inc.](#) leads with 378 families, followed by [Huazhong Agricultural University](#) with 362 and [MIT](#) with 286, with the remaining top assignees ranging between 169 and 263 families. Notably, seven of the top ten are universities, underscoring that innovation in this domain remains largely driven by publicly funded academic research rather than corporate R&D. The geographic spread across Chinese and American institutions further reflects the bilateral dominance of both nations in shaping the intellectual property landscape of synthetic biology.

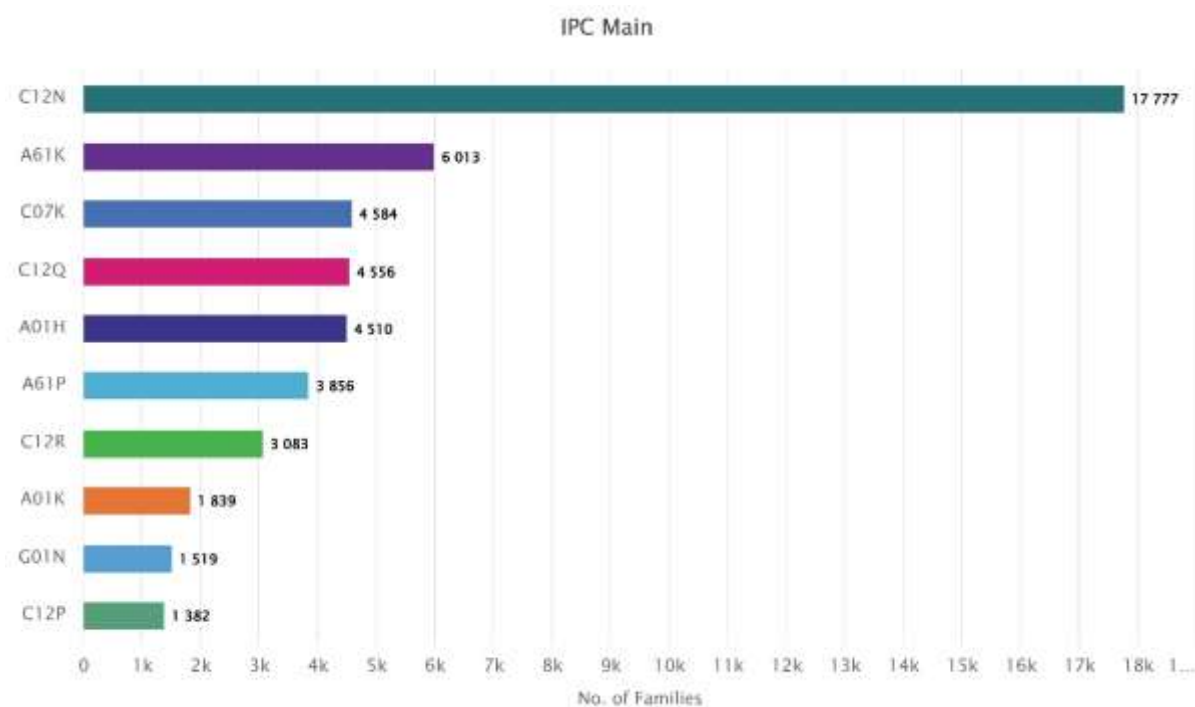
## F. Jurisdiction-Based Global Patent Filing Trends



**Figure 3:** Distribution of Patents based on the jurisdiction

The figure shows the distribution of patents across key global jurisdictions. China (CN) leads decisively with 16,261 filings, nearly double that of the United States (US) at 8,037, with WIPO (WO) at 7,373 and the European Patent (EP) Office at 4,763 following at a considerable distance. The sheer volume of Chinese filings reflects the country’s aggressive national innovation agenda and sustained government investment in biotechnology, while the strong WIPO representation signals that key players are actively seeking international protection. India’s presence at 1,433 filings, though modest in comparison, points to an emerging but structurally constrained ecosystem, where biodiversity-related regulatory complexities continue to temper patent activity. Overall, the data reinforces a heavily concentrated global IP landscape, with China and the United States together accounting for the dominant share of synthetic biology patent activity

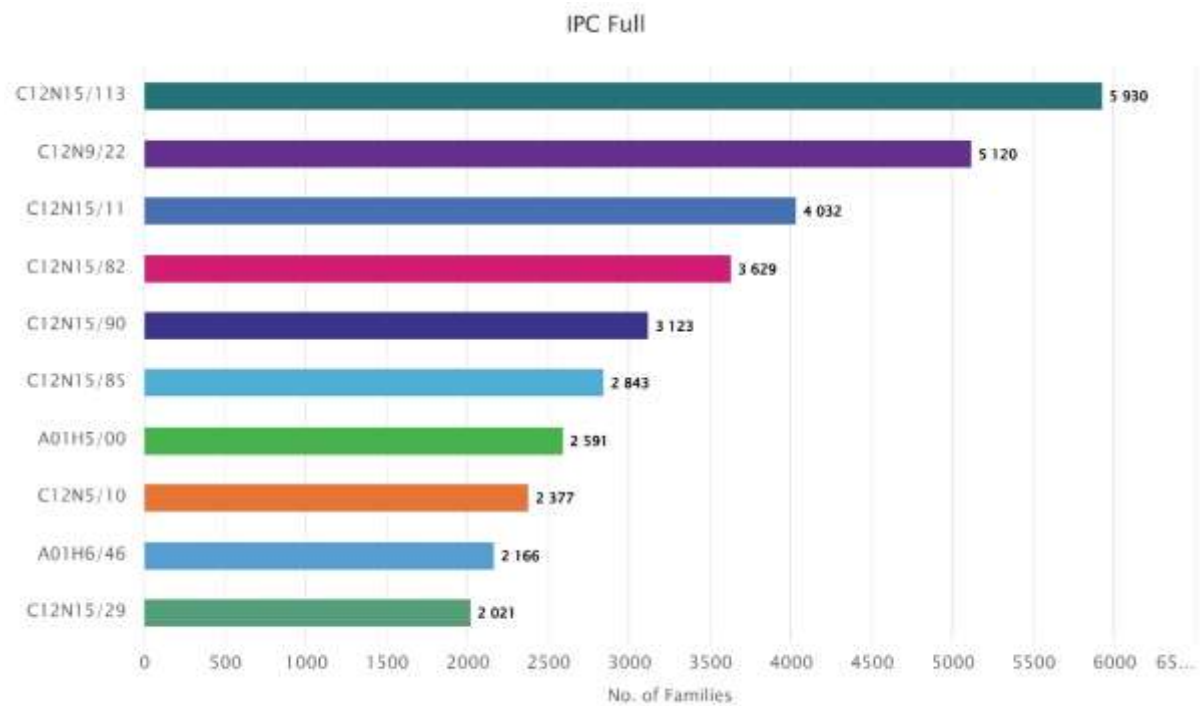
## G. Technology Classification Based on IPC Main



**Figure 4:** Synthetic Biology Patent Distribution based on main IPC Code Classification

The figure indicates the patent distribution based on the main IPC codes. C12N (Micro-organisms or enzymes) dominates overwhelmingly with 17,777 patent families, followed by A61K (Pharmaceutical preparations) with 6,013 and C07K (Peptides) with 4,584, with the remaining classifications ranging between 1,382 and 4,556 families. The clear dominance of C12N reflects the centrality of genetic manipulation and microbial engineering as the foundational layer of synthetic biology innovation, while the strong presence of A61K and A61P (Specific Therapeutic Activity) signals a decisive commercial pivot toward therapeutic and pharmaceutical applications. The simultaneous activity in A01H (New plants) further highlights that agriculture remains a key parallel frontier. Together, these classifications paint a picture of a field that is both scientifically foundational and commercially driven, with innovation concentrated at the intersection of genetic engineering and human health.

## H. Activities of Competitors Based on Area of Research (IPC Full)

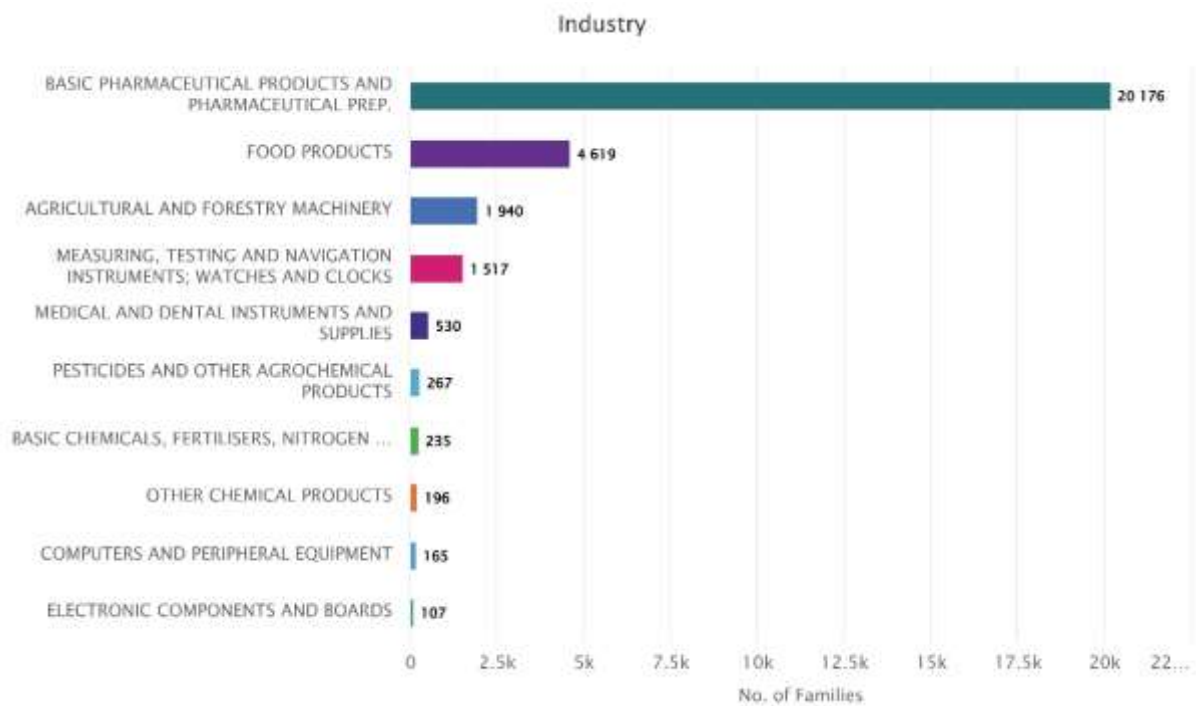


**Figure 5:** Synthetic Biology Distribution of Patents based on Competitors and Area of Research (IPC)

The figure presents competitor activity mapped against specific IPC subclassifications. C12N15/113 leads with 5,930 families, followed closely by C12N9/22 with 5,120, with the remaining subclasses ranging between 2,021 and 4,032 families. The dominance of C12N15/113 (non-coding nucleic acids involved in gene silencing, including antisense and RNAi mechanisms) and C12N9/22 (endonucleases, including CRISPR-associated proteins) reflects the intense global focus on precision gene editing tools, confirming CRISPR and related technologies as the primary battleground for IP competition. The significant activity in plant-related vectors (C12N15/82) and stable gene integration (C12N15/90) further highlights agriculture as a strategically contested space alongside therapeutics. Overall, the spread across these subclasses suggests that competitors are staking claims across the full gene editing pipeline, from fundamental molecular tools to

delivery mechanisms, indicating a maturing and increasingly fragmented IP landscape where broad exclusivity is becoming harder to secure.

## I. Estimated Top 10 Industries and Technology Areas (2014–2024)



**Figure 6:** Synthetic Biology Distribution of Patents based on Industries & Technology.

The figure indicates the major industries and technology areas contributing to patent filings between 2014 and 2024. Basic Pharmaceutical Products and Pharmaceutical Preparations overwhelmingly lead with 20,176 patents, followed distantly by Food Products with 4,619 and Agriculture and Forestry Machinery with 1,940, with all remaining sectors falling below 1,600 patents. The sheer dominance of pharmaceuticals is unsurprising given that gene editing technologies hold transformative potential for drug development, disease therapeutics, and personalised medicine. The presence of food and agriculture in second and third place reinforces that synthetic biology's impact extends well beyond healthcare,

with crop improvement and food security emerging as significant parallel innovation fronts. Notably, sectors such as manufacturing and interdisciplinary bioengineering remain comparatively underrepresented, suggesting untapped opportunity for innovation and patent strategy in those spaces.

## J. Estimated Top 10 Patent Owners (2014–2024)

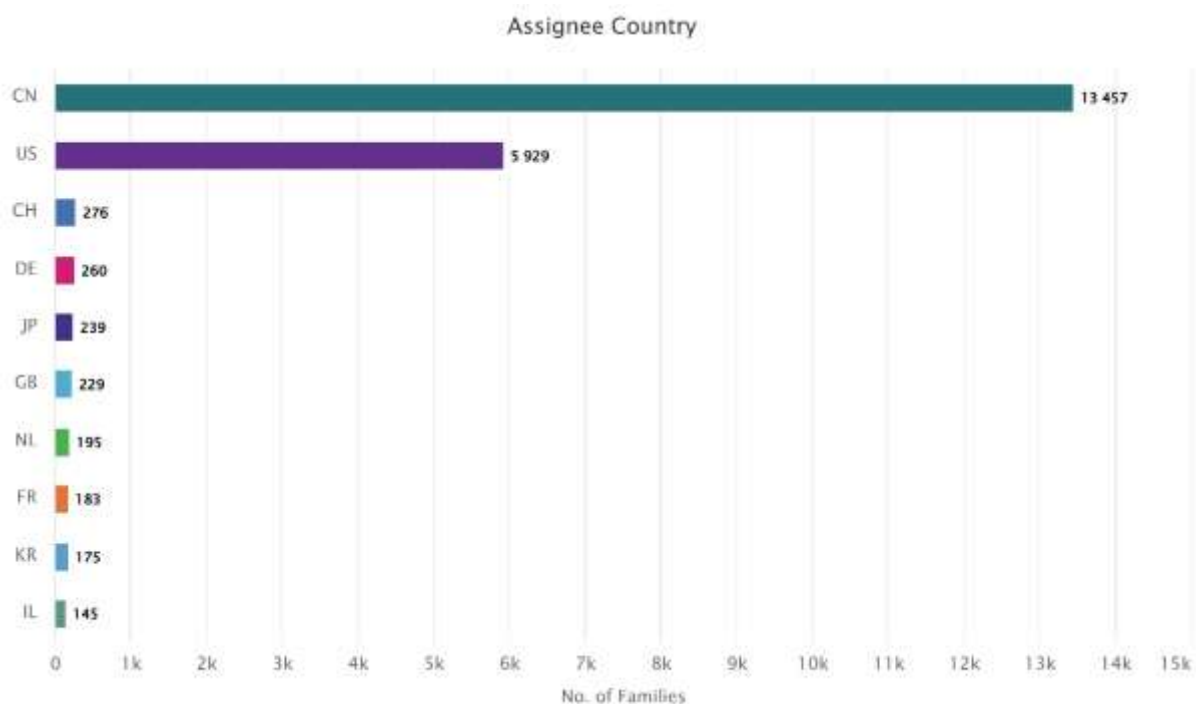


**Figure 7:** Synthetic Biology Distribution of Patents based on Current Owner

The figure shows the estimated top 10 current patent owners in the domain of gene editing and artificial organisms between 2014 and 2024. [Shanghai University](#) leads with 516 patent families, followed by [Corteva Inc.](#) with 418, [MIT](#) and [Huazhong Agricultural University](#) both at 362, and the remaining owners ranging between 214 and 318 families. The dominance of universities across this list — including [Nanjing University](#), the [University of California](#), [China Agricultural University](#), [Zhejiang University](#), and [South China Agricultural University](#) — is particularly telling, as it reinforces that foundational

innovation in synthetic biology continues to be driven largely by academic institutions rather than corporations. The lone corporate presence of [Corteva Inc.](#) in second place, however, signals that industry is actively consolidating IP in this space, particularly in agricultural biotechnology where commercial stakes are high.

### K. Estimated Top 10 Assignee Countries (2014–2024)

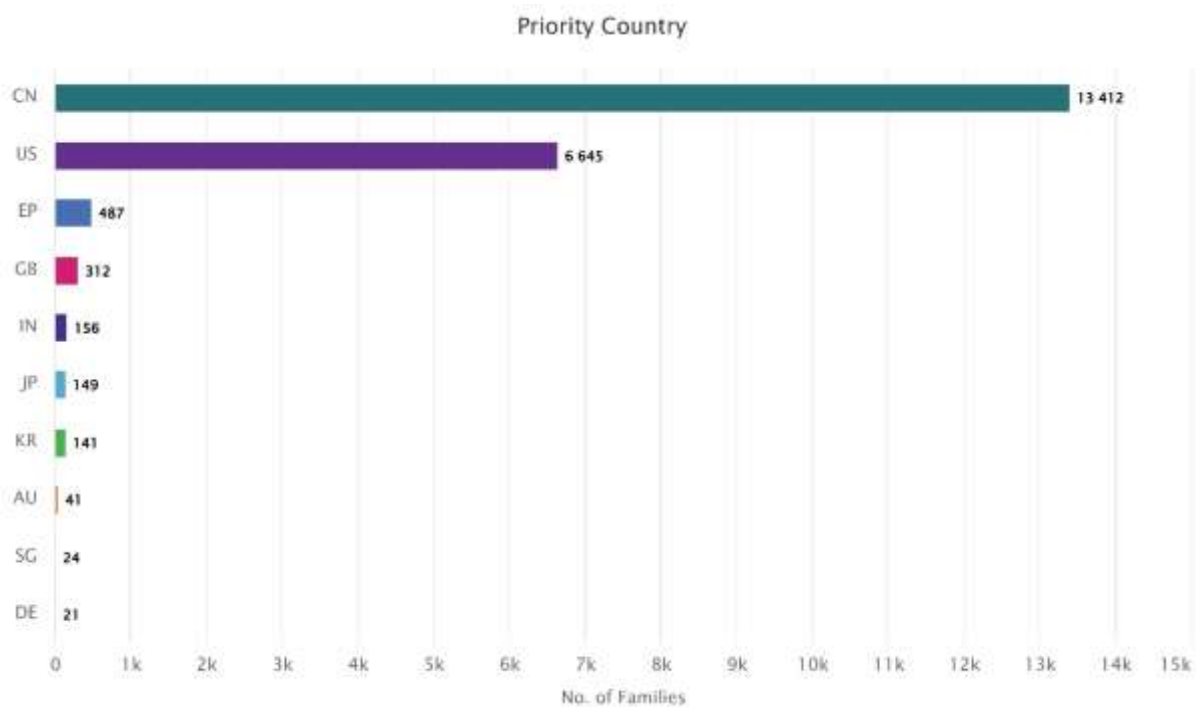


**Figure 8:** Distribution of Patents based on Assignee Countries

The figure shows the top 10 assignee countries by patent families in gene editing and artificial organisms between 2014 and 2024. China (CN) leads by a significant margin with 13,457 families, followed by the United States (US) with 5,929, with all remaining countries — Switzerland (CH), Germany (DE), Japan (JP), the United Kingdom (GB), the Netherlands (NL), France (FR), South Korea (KR), and Israel (IL) — each holding fewer than 300 families. The vast gap between China and the United States versus the rest of the

world underscores the extent to which patent ownership in synthetic biology is concentrated in these two nations, driven by their scale of investment in biotech R&D and the sheer volume of their research institutions. The presence of European nations such as Switzerland (CH), Germany (DE), and the United Kingdom (GB), though modest in volume, reflects a quality-over-quantity approach, with these countries known for strategically high-value filings in pharmaceutical and biotech innovation.

### L. Estimated Top 10 Priority Countries (2014–2024)

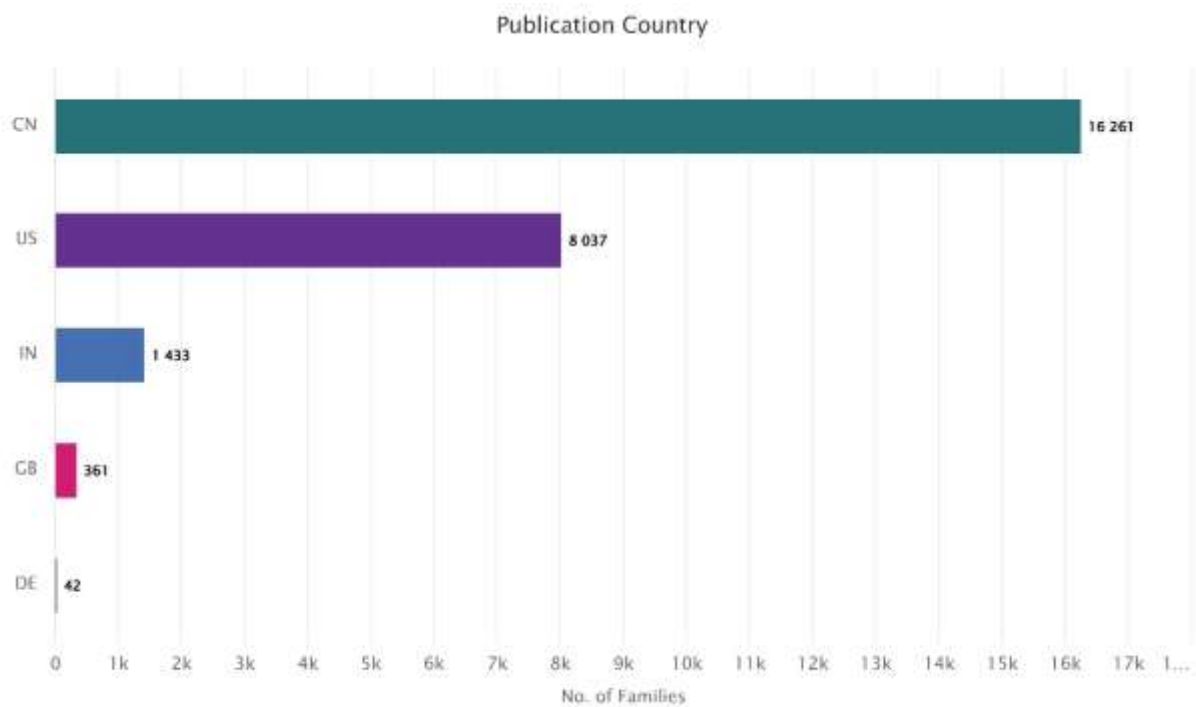


**Figure 9:** Distribution of Patents based on Priority Countries

The figure presents the top 10 priority countries where the earliest patent applications were filed in gene editing and artificial organisms between 2014 and 2024. China (CN) ranks

first with 13,412 families, followed by the United States (US) with 6,645, with the European Patent Office (EP) at 487 and the United Kingdom (GB) at 312, and the remaining countries — India (IN), Japan (JP), South Korea (KR), Australia (AU), Singapore (SG), and Germany (DE) — each recording fewer than 160 families. Priority filings are particularly significant as they represent where inventors chose to first seek protection, making them a strong indicator of where core innovation is originating. The overwhelming concentration in China and the United States confirms both nations not merely as filing hubs but as the true epicentres of early-stage synthetic biology innovation. India's modest but notable presence at 156 families signals a slowly growing domestic research base, though it remains constrained by regulatory and structural challenges that continue to limit its global IP competitiveness in this field

### M. Estimated Top 5 Publication Countries (2014–2024)



**Figure 10:** Synthetic Biology Distribution based on Publication Countries

The figure displays the top 5 countries where patents related to gene editing and artificial organisms were published between 2014 and 2024. China (CN) tops the list with 16,261 publications, followed by the United States (US) with 8,037, with India (IN) at 1,433, the United Kingdom (GB) at 361, and Germany (DE) at just 42. Publication counts reflect where patent information was officially disclosed, and the overwhelming dominance of China and the United States here is consistent with their leadership across filing, ownership, and priority trends observed throughout this report. India's third-place position is noteworthy — while its assignee and priority counts are modest, its relatively higher publication count suggests active disclosure activity, pointing to a growing awareness of IP strategy among Indian research institutions.

## **N. Overall Analysis of the Patent Landscape on Gene Editing and Artificial Organisms**

The patent landscape for gene editing and artificial organisms between 2014 and 2024 reveals a field that has moved decisively from academic curiosity to a globally contested innovation frontier. The near five-fold growth in annual filings, combined with a sharply rising grant-to-filing ratio, signals not just increased activity but a maturing IP ecosystem where applications are becoming more technically refined and strategically purposeful.

China's dominance across filings, ownership, priority, and publication count is unambiguous, yet the United States maintains a strong counterbalance through high-value assignees such as [MIT](#), the [Broad Institute](#), and the Regents of the [University of California](#) — institutions that have shaped the foundational technologies underpinning the entire field. The concentration of ownership among academic institutions, led by [Shanghai University](#), [Huazhong Agricultural University](#), and [Pioneer Hi-Bred International Inc.](#), reflects a research ecosystem still rooted in public funding, though the presence of [Corteva Inc.](#) signals that corporate consolidation is underway, particularly in agricultural biotech.

Technologically, the landscape is anchored in genetic manipulation (C12N) and pharmaceutical applications (A61K), with CRISPR-related endonucleases and gene silencing mechanisms emerging as the most actively contested IP subclasses. Agriculture

represents a significant and growing parallel frontier, as evidenced by strong activity in plant vectors and crop-related IPC classifications. Geographically, while China and the United States remain dominant, the emergence of India, South Korea, and select European nations points to a gradual diversification of the global innovation base. The most notable white spaces; interdisciplinary bioengineering, manufacturing applications, and cross-sector integration, present clear opportunities for stakeholders seeking to build differentiated patent portfolios in less saturated areas of synthetic biology.

## **O. Conclusion**

The patent landscape analysed in this report makes clear that gene editing and synthetic biology have entered a phase of rapid commercialisation, with intellectual property serving as a primary competitive instrument. China and the United States have firmly established themselves as the twin engines of global innovation in this domain, together accounting for most filings, grants, and ownership across the decade studied.

The sustained dominance of academic institutions, particularly [Shanghai University](#), [MIT](#), [Huazhong Agricultural University](#), and [China Agricultural University](#) underscores that the field's foundational advances continue to emerge from publicly funded research. However, the growing footprint of corporate players like [Corteva Inc.](#) and the [Broad Institute](#) suggests an accelerating transition toward commercialisation, where academic breakthroughs are increasingly being translated into proprietary technologies. Pharmaceuticals remain the dominant application sector, though agriculture and food technology are closing the gap, pointing to a broadening impact of synthetic biology across industries.

For stakeholders, the key takeaway is one of both urgency and opportunity. The IP space in core gene editing technologies is becoming increasingly crowded, making early and strategic filing critical. At the same time, comparatively underexplored areas such as bioengineering, environmental applications, and cross-sector integration offer meaningful room for differentiated innovation. As the global patent ecosystem around gene editing continues to evolve, those who invest in both breadth and depth of IP strategy will be best positioned to lead in this transformative field.

## **Disclaimer**

This report is based on patent data available as of 2025. The patent applications and granted patents referenced herein were sourced from publicly accessible databases, including free and subscription-based government repositories. The accuracy of these records is subject to the maintaining standards of the respective patent offices and registries, the author assumes no responsibility for errors, omissions, or outdated information contained therein.

The analysis and conclusions presented in this report represent the Author's independent judgment and should not be attributed to any affiliated institution. Readers are advised that patent landscapes are dynamic, and the competitive and legal positions described herein may have changed subsequent to the date of publication.