Matthew J. McBride

Manager, Science IP

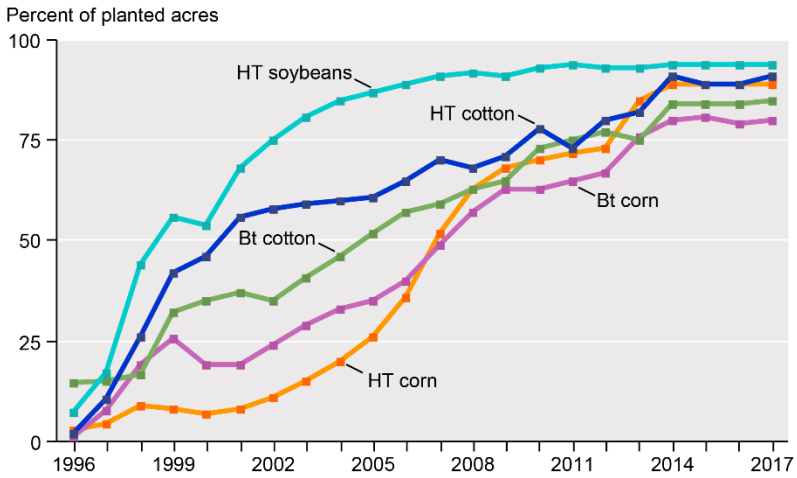
mmcbride@cas.org

Biotechnology in Agriculture – Trends

Recent IP Protection Developments in Biotechnology Innovations in the Agricultural Sector

Agricultural Biotechnology – Public Perception

Adoption of genetically engineered crops in the United States, 1996-2017



Data for each crop category include varieties with both HT and Bt (stacked) traits.
Sources: USDA, Economic Research Service using data from Fernandez-Cornejo and McBride (2002) for the years 1996-99 and USDA, National Agricultural Statistics Service, *June Agricultural Survey* for the years 2000-17.

- Engineering of pharmaceuticals via biotechnology strongly supported by public in US, while the use in healthier foods and pest-resistant crops is often not supported
- Public fails to associated agricultural biotechnology with improvements in vaccines, antibiotics, fuels and fibers
- Opinion impacts issues from policy to law, but education remains a challenge

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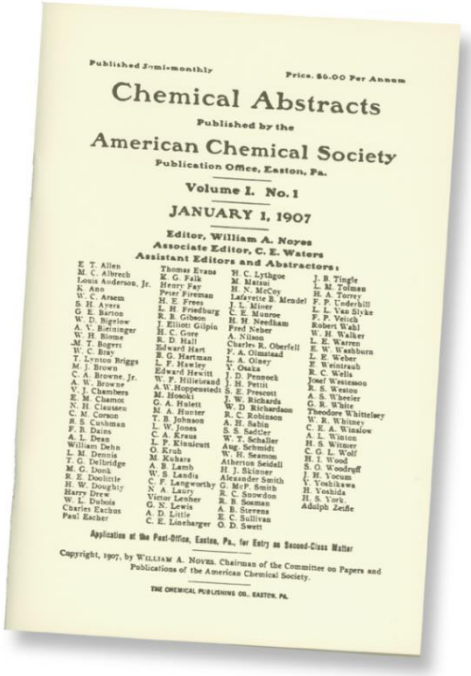

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The Chemical Publishing Co., Easton, Pa.

- Founded in 1907 to monitor, abstract and index the world's chemistry-related literature and make it available to the scientific community
- Work first published in *Chemical Abstracts*
- Headquartered in Columbus, Ohio
- Approximately 1,400 staff members – including CAS scientists, speaking more than 50 languages among them
- Coverage of biotechnology from the inception of industrial fermentation in the 19th century to CRISPR

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CAS provides access to patent information on chemistry and related scientific disciplines

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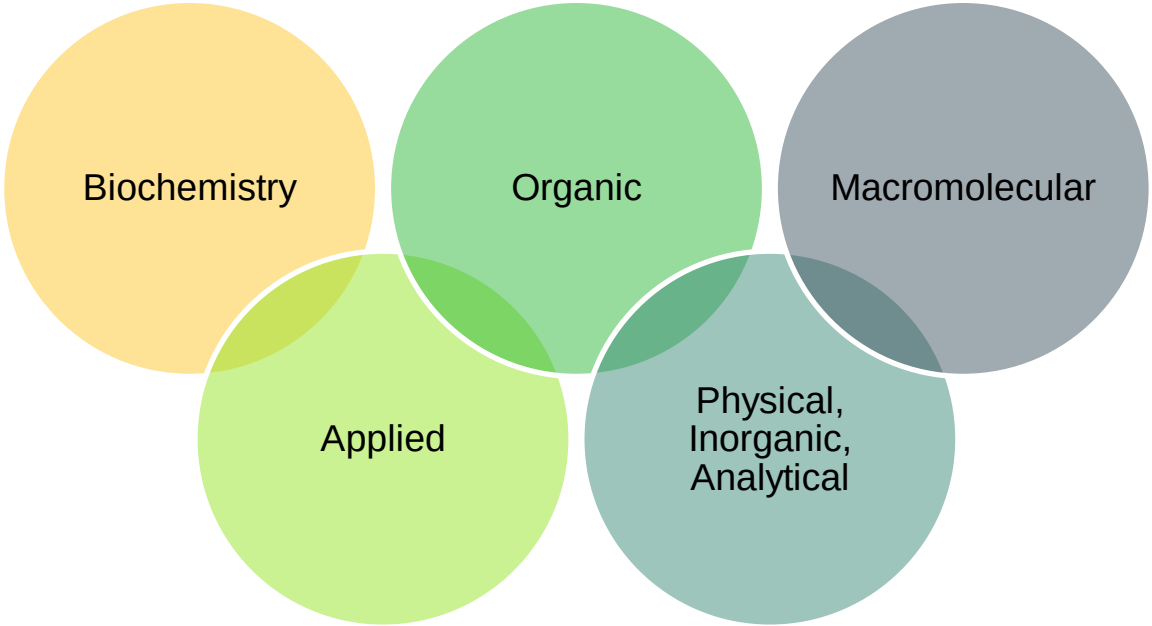
CAS provides worldwide coverage of many scientific disciplines – chemistry covers a diverse audience



CAS covers many scientific disciplines, including biomedical sciences, chemistry, engineering, materials science, agricultural science and more

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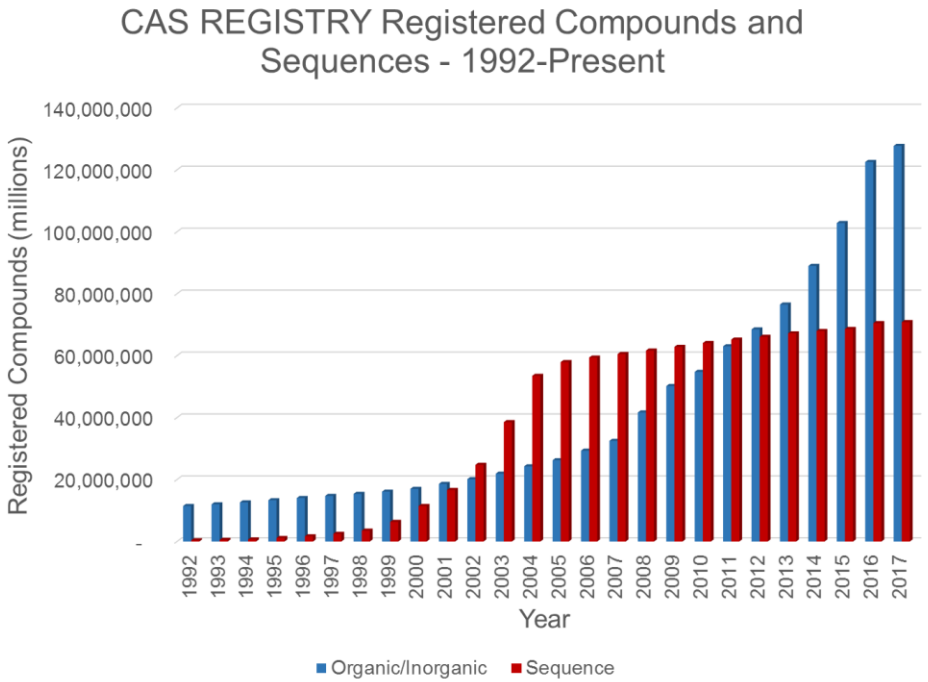
CAS REGISTRY℠ – tremendous growth in biologics and traditional chemistry over last 20 years

- CAS Registry database contains almost 200M disclosed substances and biologics
- Organic and inorganic disclosed substances CAGR 14.2% since 2005
- Biologics demonstrated a CAGR 52.5% from 1993-2004



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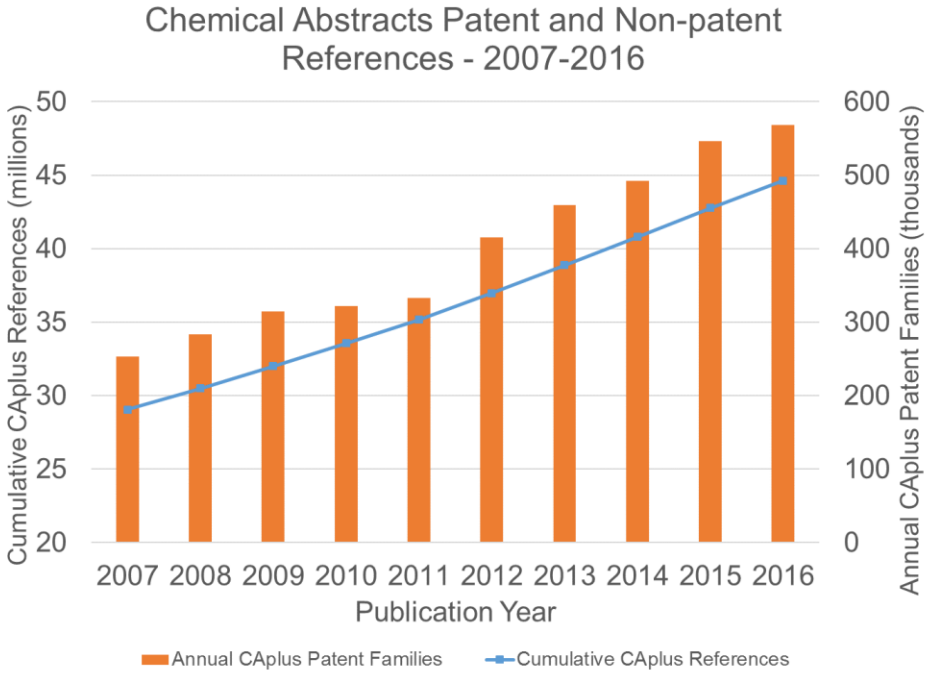
Chemical Abstracts – integrated source of journal articles and patent documents across chemistry-related disciplines



- Over 44M patent families and non-patent reference from early 1800s to present
- China Patent Office (SIPO) contributed to almost 3 million chemistry-related patent families from 2007-2016

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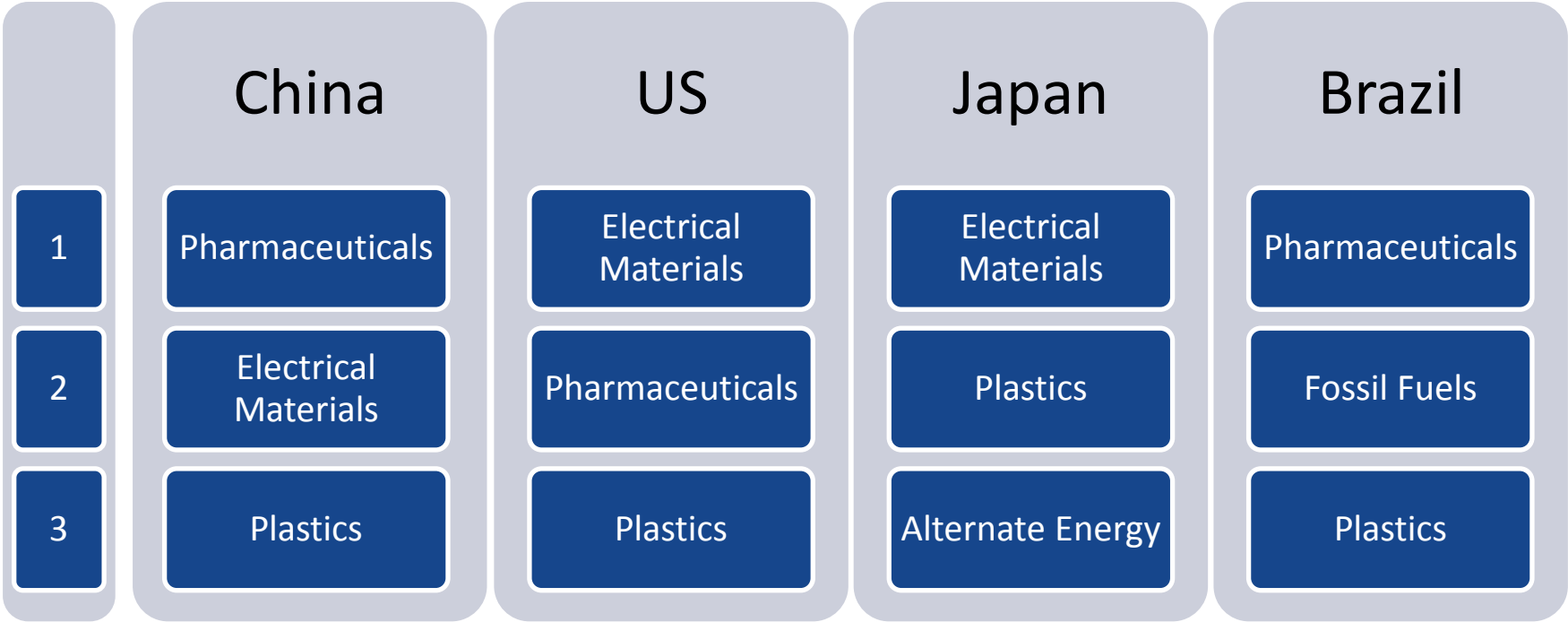
Technical areas of patenting in chemistry and biotechnology differ significantly by country (2016 data)



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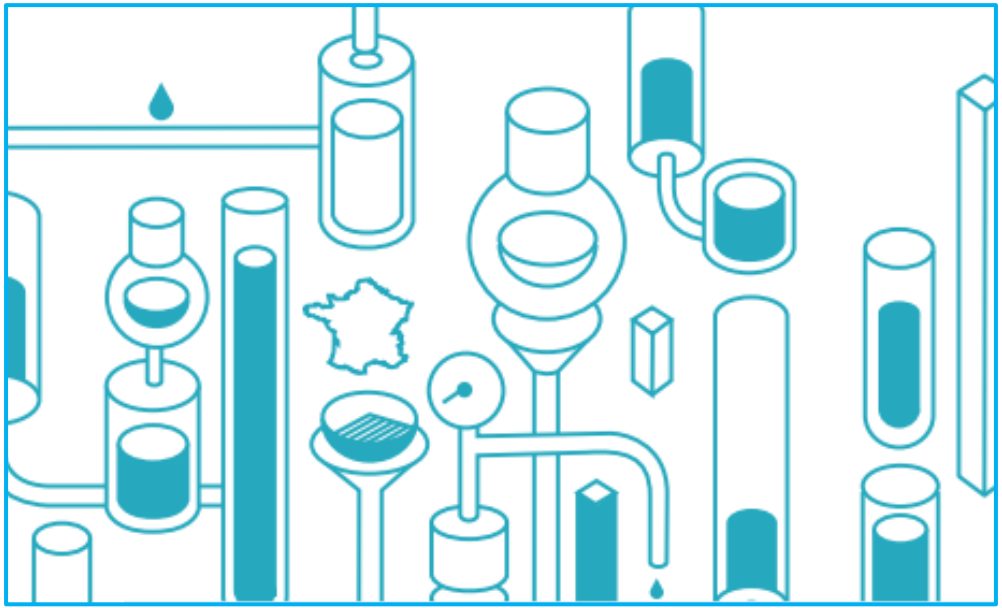
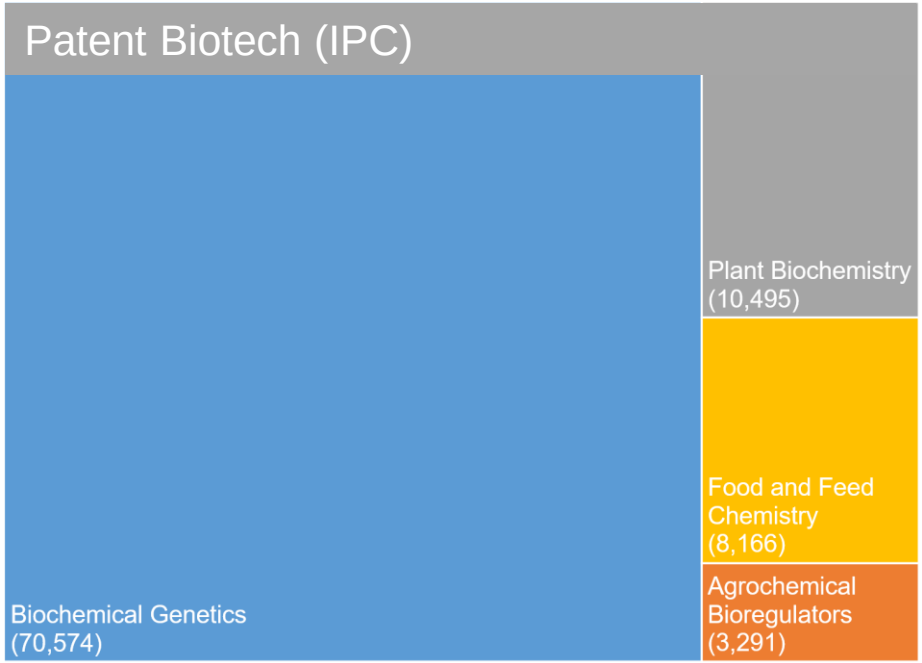
Top 5 countries with highest biotech activity

1. USA
2. Singapore
3. Denmark
4. New Zealand
5. Australia



According to **IP** and ability to protect it, **intensity**, being defined as spending on R&D, availability of **venture capital and support**, availability of **expert manpower** and the overall country's ranking in terms of **entrepreneurship** and other **foundations**. Source: Scientific American Worldview Scorecards, 2016.

CAS Biotechnology Trends in Agriculture – 2007-2016



- Approx. 30% of technology covered in patent inventions
- Agriculture research focused in Biochemical Genetics, Plant Biochemistry, Food and Feed Chemistry, and Agrochemical Bioregulators
- Food and Feed Chemistry exhibiting 15% CAGR for past 10 years, while Biochemical Genetics leads total patenting

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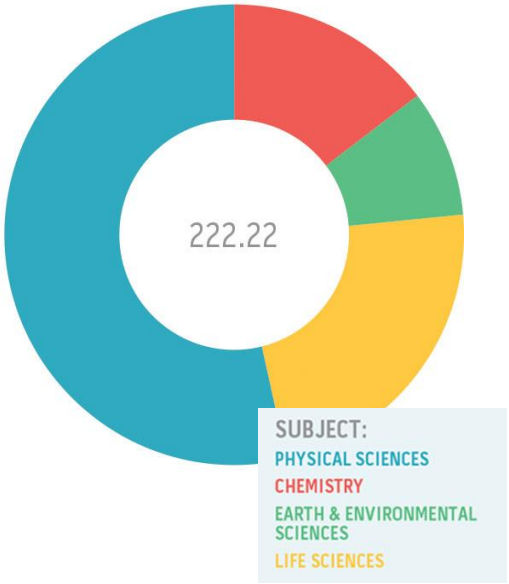
Scientific American Worldview 2017: Brazil ranking in Biotechnology

SAWV Scorecard

Nature Index



- Brazil ranks in the bottom quarter of the analysis, however it ranks near the top quarter for Intensity, which gives an indicator of how hard a country works at creating the necessary environment for innovative biotechnology.

SAWV: http://www.saworldview.com/wv/scorecard/worldviewguide/
Nature Index: October 2014-September 2015

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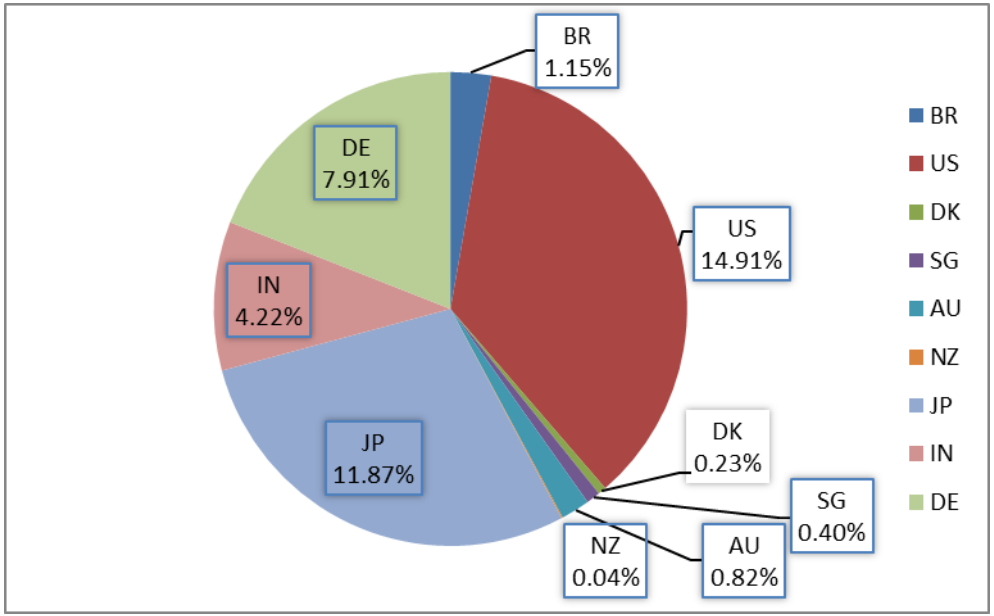
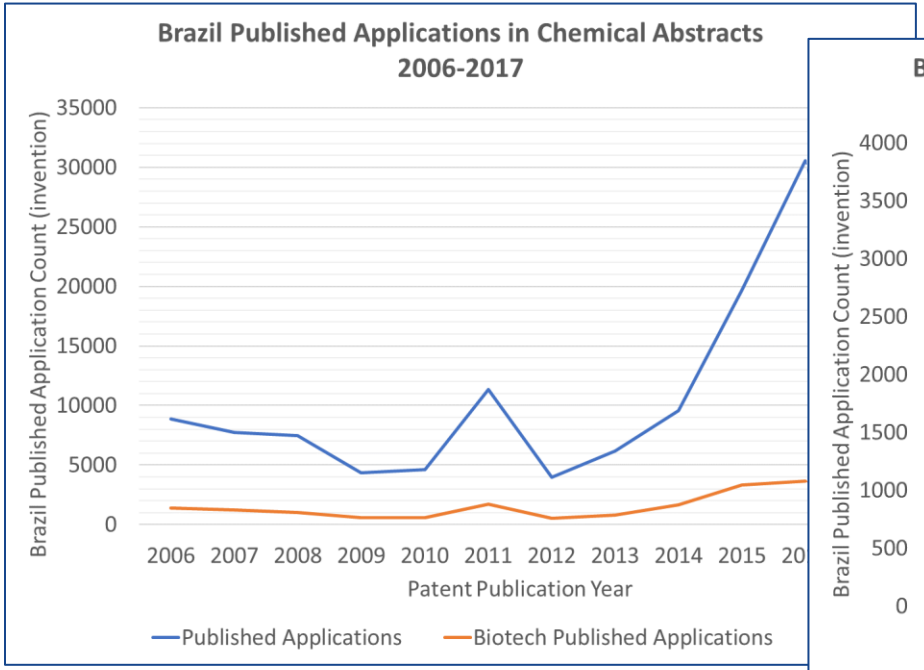
Percentages by country of total Biotech patenting and publications according to CAplus

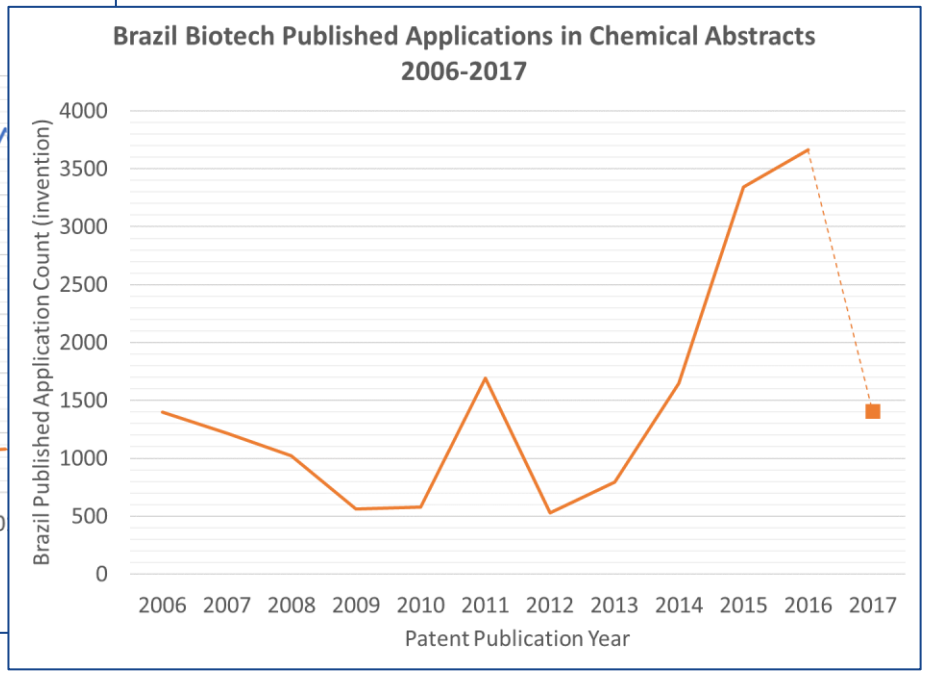


Country	Total	%
US	57,036	14.91%
JP	45,427	11.87%
DE	30,248	7.91%
IN	16,149	4.22%
BR	4,403	1.15%
AU	3,131	0.82%
SG	1,517	0.40%
DK	878	0.23%
NZ	145	0.04%

Publications in CAplus by First Authors' Country or Corporate Source
MEDLINE and 3,000 peer reviewed journals. Our biology coverage is indexed based on its related chemistry.

Brazil Published Application Pace Increasing in Chemistry Since 2012





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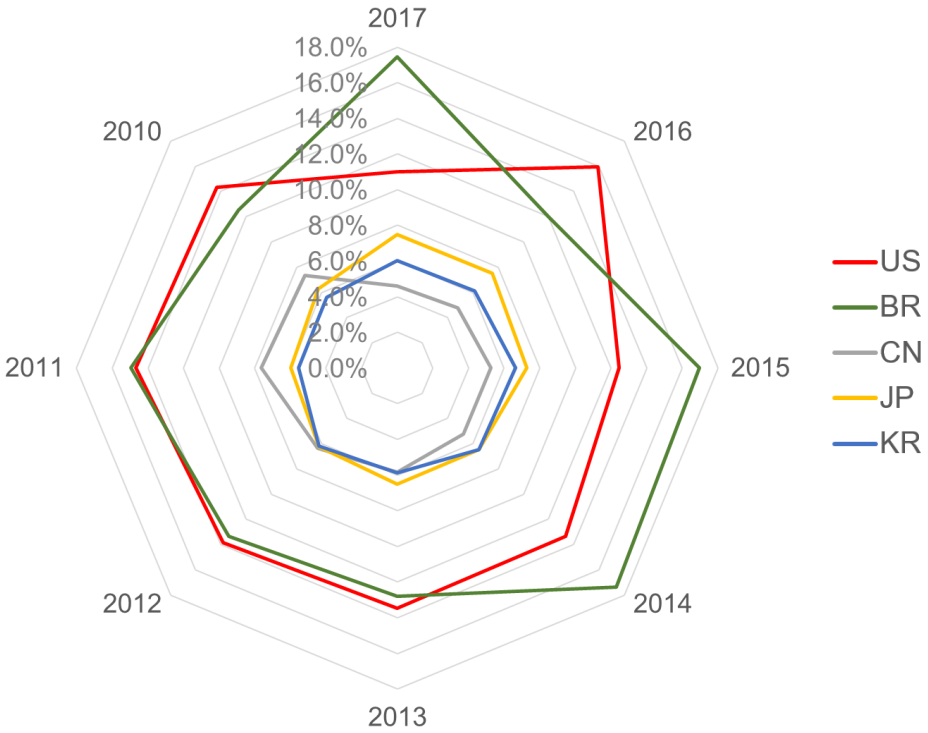
Brazil Leads with High Percentage of Biotechnology Patent Inventions in Chemistry Compared to ROW (2010-2017)



- US and China lead in pace of biotechnology-related patents, followed by EP and JP
- However Brazil closely mirrors US in biotechnology as percentage of total chemistry publications

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