FROM RESEARCH TO RENEWAL, PART 2: STATES REALIZING THE POTENTIAL OF RESEARCH INSTITUTIONS

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PRESIDENT'S NOTE

Many public universities are organized within state university systems for governance and the provision of centralized resources. Examples include the University of Texas System that has 13 institutions buckled underneath it or the State University System of Florida that is composed of 12 institutions. Principal authors Dr. Maryann Feldman and Minoli Ratnatunga extend Heartland Forward's analysis of university technology transfer and commercialization to the state level. Our previous report titled Research to Renewal: Advancing University Tech Transfer focused on individual campuses, including private universities, as the units of evaluation, while in this latest report, Feldman and Ratnatunga accomplish the following:

- Provide the first new benchmark comparison for public universities structured as part of a state system.
- Include research institutions (hospitals, private research institutes and federal labs) that do not grant degrees but are important sources of research and innovation that can bolster state economies by being fixtures in the local business ecosystem.

The methodological framework is consistent with our original approach, except we only evaluate formal technology transfer metrics (invention disclosures, number of licenses and options, licensing income and startups formed), along with unique citing of patents, in the case of research institutions.

It is important to acknowledge that we explored the idea of creating a comprehensive state-level measure of commercialization success but concluded that the results would be biased because several universities lacked comprehensive reporting to the Association of Universities Technology Managers (AUTM) or did not submit metrics. Through this, we do know:

- Massachusetts and California are leaders, with New York close behind, in possessing institutions that drive economic growth, based upon discovery and translation into commercial applications.
- Universities receiving federal research grants should be required to publicly report translation metrics to ensure they are good stewards of the investment. At a minimum, universities should more broadly report these metrics to AUTM so that best practices can be identified and the evolution of this critical activity over time can be monitored.
- Additionally, governors, state agencies and state legislatures need such information in order to make informed decisions concerning public investments in higher education.

The University of California System has greatly contributed to that state's dominant position in hightech industries and ranks No. 1 in the nation on our technology and commercialization index. Its individual campuses specialize in technological areas including biotechnology, communications technology and agricultural science. Cedars Sinai Medical Center is fifth among research institutions.

The State University System of Florida ranks second overall, led by the top public university campus in the nation: the University of Florida, Gainesville. Among heartland states, the University of Texas System is best and No. 3 in the nation. Its scale and commercialization productivity places it in the top three in all but one of the raw measures in our index. All UT System campuses and medical institutions operate their own technology transfer office, but the collective breadth is impressive. The Texas A&M University System (No. 15) boasts the highest percentage of master's students graduating in STEM fields in the nation and plays a central role in providing talent.



The University System of Ohio is fourth among state systems in the nation and second for the number of invention disclosures, and produces many graduate students in STEM fields. The Ohio IP Promise is an initiative across 14 public universities in the state to redesign the technology transfer process to boost efficiency. After benchmarking best practices at top universities in their respective fields, the Ohio schools are developing streamlined licensing processes to smooth commercialization of university inventions. The Cleveland Clinic has long been among the elite research hospitals in commercialization and was eighth among all institutions in the nation. The Nationwide Children's Hospital, at No. 14, is a top performer among institutions, as well.

The University of Illinois System ranks sixth on our technology and commercialization index, scoring particularly high on gross licensing income, as well as the number and share of STEM graduates.

Among other heartland states, the University of Missouri and University of Wisconsin systems rank 11th and 13th, respectively. Minnesota doesn't have a formal system, but the University of Minnesota was the highest-ranked (10th) individual campus in the heartland and stood fifth among public universities in the nation in our previous report. Another key innovation asset for Minnesota is the Mayo Clinic. Medical and life sciences advances by the Mayo Foundation for Medical Education and Research led to the highest invention disclosures and startups of any institution evaluated and produces therapies and technologies that are licensed worldwide.

Public research universities are underinvested assets in the heartland states, and it's imperative that the gap in knowledge-based industries be closed to drive overall economic growth. Progress is being made at the federal level. In August 2022, President Biden signed into law the CHIPS and Science Act, a massive, once-in-a-generation investment into the nation's science infrastructure. This sweeping law includes many elements, but what stands out is a stated intention to invest in bringing underrepresented places and people into the innovation economy. Heartland states seem well positioned to receive a portion of the \$10 billion to help create regional technology and innovation hubs where "leading technology centers" do not currently exist. These tech hubs will require research universities, whether a system or otherwise, to distribute innovation to more locations and become leaders in commercialization and tech transfer.

Ross DeVol

President and CEO Heartland Forward

CONTENTS

Executive Summary	7
Research to Renew State Economies	9
State University Systems	12
Research Institutions	13
Research To Renewal: State Tech Transfer Profiles	15
Endnotes	



Heartland Forward's mission is to improve economic performance in the center of the United States by advocating for fact-based solutions to foster job creation, knowledge-based and inclusive growth and improved health outcomes. We conduct independent, data-driven research to facilitate action-oriented discussion and impactful policy recommendations.







EXECUTIVE SUMMARY

Technology transfers – or sharing the results of research that leads to innovation – are an essential fuel for the economic growth of state economies. A better understanding the technology transfer activities in each state helps governors, state agencies and state legislatures – the ultimate guardians of economic development – to make informed decisions about the future.

The summaries in this report provide leaders with state-by-state data and analyses on tech transfer activities that can inform economic policy decisions. The summaries lean heavily on "Research to Renewal"¹, a comprehensive report on the transfer activities of universities across the United States. This report, however, includes two new comparisons: a ranking of state university systems and a ranking of non-university institutions that conduct research and transfer technology.

There is no uniform reporting convention to the Association of University Technology Managers (AUTM). Some public university systems report aggregated data for all their constituent institutions, while individual campuses report separately in other states. We created synthetic systems using available data so that we could make better comparisons and rank university systems. This information enables policymakers to assess how their state systems compare.

Also, several nonuniversity institutions conduct research and transfer technology. Hospitals and medical centers, dedicated research facilities and government labs report to AUTM but are not directly comparable to universities because they lack students. Thus, we ranked them separately on a subset of our metrics. Nonuniversity research institutions that are engaged in tech transfer are another important component of a state's innovative ecosystem. It is not possible with the data available to rank states, and such a ranking would be counter-productive. We hope to encourage greater participation by public institutions, and increased participation by those that are new to formal tech transfer would have the reverse effect of bringing down overall state performance.

Rather than judging a beauty contest, this report presents data that is useful for improving technology transfer and increasing the impact of universities and research institutions on their states' economies. We analyze multiple indicators in which policymakers may decide to invest and may consider organizational improvements to improve performance. We provide data for all institutions in each state that reported to AUTM and summarizes technology transfer activity for all the reporting institutions by state.

The recommendations in this report focus on public institutions for three reasons:

- They are directly accountable to state governments. Private schools receive state funding and subsidies and are certainly subject to state laws, but they have greater accountability to their trustees and other constituencies than to state governments.
- Every state has fiduciary responsibility for its public institutions. Many states host at least one flagship research university, while other public institutions are distributed geographically and serve different constituencies.
- Many public institutions fall short of their potential on multiple measures of tech transfer performance. Realizing the promise of technologybased economic development requires attention to these deficiencies.

While these rankings and the data behind them paint a portrait of technology transfers from these institutions, they also provide information about the resources that are available to further economic development in each state. Those opportunities can be summarized in the following recommendations:

- Renew the promise of innovation-driven
 economic growth in the United States through
 investments in scientific and technological
 innovation. Industry throughout the U.S. needs
 to be revitalized and infused with the new ideas
 that academic research can provide. This priority
 is reflected in the 2022 CHIPS and Science
 Act (CHIPS), which is a once-in-a-generation
 investment aimed at increasing American
 semiconductor production, decreasing supply
 chain vulnerabilities and revitalizing American
 leadership in science and technology. CHIPS will
 not only increase federal funding for academic
 research; it will also create demand for research to
 achieve its goals.
- State government and university officials need to work together to strategically invest and deploy resources. Public universities depend on state funding to provide research and teaching infrastructure, physical plants, faculty salaries and student aid. State funding can be leveraged to increase the geographic spread of federal research funding and create opportunities for students and faculty to be more engaged with local industry. There are opportunities to initiate new bachelors and graduate programs in partnerships with local industry that would provide gainful employment and enable graduates to stay in the region. State government should invest in creating entrepreneurial ecosystems aimed at commercializing the results of scientific research through technology transfer that will create wellpaying jobs. In contrast to offering relocation incentives, investing in university ecosystems provides opportunity for residents.
- Bolster technology transfer out of regional university research-based centers of excellence.
 Every university has the potential to actively engage in technology transfer, and there is potential for every university to further engage with external organizations and increase their impact on commercial and nonprofit activity. The Bayh-Dole Act of 1980 mandated universities to commercialize their discoveries but did not provide resources to do so. It is no surprise that universities demonstrating greater formal technology transfer success are well funded, while other

programs struggle.² Recognizing the importance of commercialization success, state governors might provide funding to technology-licensing organizations as an economic development initiative.

- Encourage reporting and accountability. Greater participation in the AUTM survey by public institutions would provide additional diagnostic information. For state university systems, reporting for each individual institution—rather than for the aggregate system—would allow for greater comparison and learning between institutions of similar size.
- Pool invention disclosures and patents. Pooling invention disclosures and patents for universities without a critical mass of intellectual property (IP) allows tech transfer professionals to be shared and for the creation of synergies across institutions, as IP from multiple institutions is managed together. Pools could be based on regional considerations or technology specialization and could help smooth licensing income over time.
- Increase technology transfer efficiency by
 adopting best practices. State policies should
 create incentives for adopting best practices in
 commercialization at technology licensing offices
 (TLOs). This would help narrow the efficiency gaps
 we identified in the universities outside the top 25
 in our Technology Transfer and Commercialization
 Index. In heartland states, governors and
 legislatures should advocate for making
 commercialization a core mission of universities
 and form consortiums to exchange information
 and adopt best practices. Innovative educational
 programs should reinforce the advantages of local
 industry.
- Use alumni foundation investments as venture capital. Alumni foundations and higher-education retirement funds could allocate more of their portfolios to venture capital funds pooled across states to diversify risks while making such funds more available to startup firms.



RESEARCH TO RENEW STATE ECONOMIES

While other countries have national economic development strategies, each individual state in the U.S. has great latitude in setting priorities and investing in their public universities to ensure future prosperity for their citizens. Universities are important assets that improve the performance of state and local economies.³ The cutting-edge research performed at such schools often leads to breakthrough technologies that are invented, adapted and then launched into the private sector. And by taking part in this process, young people realize their dreams. Universities have been instrumental in defining America's technological leadership and economic prosperity. Public institutions, which are chartered, funded and accountable to state governments, play a unique role in economic development.

Since the nation's founding, there have been state funded, degree-granting higher education institutions in the United States.⁴ State institutions increased access to higher education that specialized in science and engineering, in contrast to the religious orientation at the time of the private universities. The Morrill Acts of 1862 and 1890,⁵ and the growth in postsecondary enrollments because of the GI Bill,⁶ increased the prominence of public universities. Importantly, every state hosts at least one land-grant university and about three-quarters of students in American postsecondary education are enrolled in state public colleges and universities.

Most students at public institutions are in-state residents who invest in education as a ticket to a well-paid and satisfying job. Our rankings include the number of undergraduate and graduate degrees awarded in science, technology, engineering and mathematics (STEM). While the market for Ph.D.trained scientists is national or even international, markets for undergraduate and master's degree candidates are more regional. Measures of STEM graduates at the bachelor's and master's levels are an indicator of human capital creation at a more local level. These graduates often will remain in the state if there are prospects for good employment, and the resulting growth in skilled human capital will increase productivity.

Research became more important at universities after World War II, when federal mission agencies such as the National Institutes of Health, the Department of Energy and the Department of Defense engaged in research collaborations with universities. The National Science Foundation (NSF), created in 1950, provides support for fundamental research and advanced graduate training. Through this activity, the federal government lays the foundation for new scientific discoveries and plays the role of investor and primary customer to launch strategic industries, such as telecommunications, aerospace and biotechnology and others. The federal government in 2018 provided \$42 billion in funding for university-based research.

Technology transfer is the way universities ensure that the public investment in science has impact, and that such investments enhance economic development and serve the public interest. University tech transfer advances teaching and learning while contributing to economic and social outcomes that help advance societal well-being. These efforts serve the interests of society, enhance national competitiveness and boost the economic vibrancy of the states in which those universities are located. New technologies developed at universities provide infinite opportunities, but true impact requires state investment.

The formal technology transfer process begins with federally funded research and development (R&D). The aforementioned Bayh-Dole Act of 1980 led to the development of a model of formal university technology transfer. By granting universities the intellectual property rights over discoveries from federally funded research, Bayh-Dole motivated universities and their faculty members to take an active role in technology commercialization.

University technology licensing offices (TLOs) manage the invention disclosures that result from federally funded research and operate as an interface between the supply of academic ideas and the demand for university inventions. Rather than a deterministic relationship based on the dollar amount of research funding received, formal technology transfer outcomes are influenced by incentives offered to faculty, university support for prototyping and proof of concept, and the ease of engaging with the TLO. It is also affected by the vibrancy of the local ecosystem and its ability to absorb new technologies and to fund, staff and support startup ventures.

Additional resources are required so that the scientists, inventors and entrepreneurs can take ideas forward to commercialization and the creation of profitable products and processes. The ability of American universities and research institutes to transfer technology to the commercial sphere is simply too important to go unmeasured. No matter how much money is spent on research and development, society will not benefit unless there are tangible outcomes. The path from research to societal benefit is circuitous and uncertain, but our globally competitive economy demands accountability and transparency.

Academic research provides long-term economic benefits as universities tackle problems that have a low probability of quick commercial success—but also possess strong potential to deliver high returns to existing firms, to create entire new industries, and to build on local expertise, thereby creating increased prosperity throughout the nation. Technology has become more important for all firm sizes and industry sectors. The 2022 CHIPS Act provides additional funding for research and will also increase the demand for knowledge and skilled workers to innovate new semiconductors and create robust supply chains.

The American system of innovation is predicated on partnerships between research institutions and industry to maintain an internally competitive edge. University technology transfer with industry occurs through the creation of joint ventures, participation in partnerships, cooperative research agreements, sponsored research, industry leaders serving as advisors and board members, and companies providing philanthropic contributions that set strategic directions. Systematic data on these interactions is limited, although surveys find that university research has a crucial effect on industry innovation through informal channels. An important way firms use academic research is through the literature. Patent applications contain references or documents that may be used to determine if the application meets the criteria of novelty, usefulness and non-obviousness of claimed subject matter. These citations reference earlier patents and printed documents instrumental in defining the invention described in the patent application. These data provide insights into the academic research useful to firms in their invention process.

Our rankings consider formal technology transfer, including invention disclosures, which are reports of significant technology discoveries; licenses and options, which are formal deals to use technology; gross licensing income—e.g., monetary receipts from the use of technology; and the number of startups formed from university technology. We also include a count of academic articles that are cited in industry patents, as well as degree recipients in science, technology, engineering and mathematics (STEM) for both undergraduate and masters' degrees.

In sum, our rankings are measured using threeyear averages (2017-19) for seven key indicators of technology transfers. We used four indicators from AUTM: invention disclosures, licenses and options issued, licensing income and startups formed. For citations, we used the total count of nonpatent citations for industry patents granted from 2017 through 2019 as compiled at Lens.org.⁷ Finally, we included measures of human capital transfer through the inclusion of STEM bachelors' and masters' graduates. To gauge this relative performance, the score for each variable was indexed to the highest performer, yielding a score of 100 for the top-ranked institution. Indexing was conducted for both the direct value and normalized value for each variable.

Our prior report, *Research to Renewal: Advancing University Tech Transfer*,⁸ provides full details on our methodology. Previously, we presented results and rankings for individual institutions. This was not an exhaustive list, as not all universities report to AUTM. Specifically, no institutions reported to AUTM in Maine and Wyoming. In other states, only the public flagship institution reported, or data was only available for an entire university system and not for individual campuses. Certainly, there is tech transfer activity at other institutions and encouraging participation could provide diagnostic information in the future. Details on our methodology and the limitations of the analysis are provided in *Research to Renewal*, which was released in May 2022.⁹

A related issue is that some universities report data, including research output, from affiliated hospitals and research institutions, while other entities report to AUTM separately. This report includes nondegreegranting research institutions that reported to AUTM, based on a subset of metrics relevant to these facilities. Finally, we present summaries that include all the data available for individual states.



STATE UNIVERSITY SYSTEMS

Many public institutions are affiliated with state university systems, which are typically geographically distributed but aligned both in name and governance. In *Research to Renewal*,¹⁰ we did not report on university systems that reported to AUTM, but only considered institutions for which data on individual campuses was publicly available.

Table 1 presents a ranking for 15 university systems that reported to AUTM as university systems and nine "synthetic" systems constructed by aggregating the performance of the individual member institutions that reported to AUTM. For example, the University of North Carolina system governs 16 public institutions, of which six report to AUTM. No public data exists on formal technology transfer for the remaining 10 institutions.

Thus, an open question is whether the omission of institutions is due to a lack of reporting to AUTM or a lack of formal technology transfer activity.

TABLE 1

SYSTEM RANK	UNIVERSITY SYSTEM	STATE	INDEXED SCORE
1	University of California System*	Calif.	100
2	State University System of Florida	Fla.	96.32
3	University of Texas System*	Texas	88.39
4	University System of Ohio	Ohio	87.54
5	University of North Carolina System	N.C.	82.72
6	University of Illinois System*	III.	73.09
7	Arizona Board of Regents	Ariz.	72.52
8	University of Massachusetts System*	Mass.	69.69
9	University of Georgia System	Ga.	68.56
10	University of Colorado System*	Colo.	67.42
11	University of Missouri System*	Mo.	60.06
12	University System of Maryland*	Md.	57.51
13	University of Wisconsin System*	Wis.	54.67
14	State University New York System*	N.Y.	53.82
15	Texas A&M University System*	Texas	53.26
16	Louisiana State University System*	La.	51.56
17	University of Arkansas System	Ark.	48.73
18	University of Nebraska System*	Neb.	48.16
19	University of Alabama System	Ala.	39.09
20	Texas Tech University System*	Texas	38.53
21	University of North Texas System	Texas	35.13
22	University of Oklahoma System*	Okla.	27.48
23	Nevada System of Higher Education	Nev.	21.81
24	City University New York System*	N.Y.	12.46

* Indicates "synthetic" systems that combine data from constituent universities that reported separately to AUTM.

RESEARCH INSTITUTIONS

Hospitals, private research institutions like the Salk Institutes, and federal labs—government-owned and contractor-operated (GOCO) labs, such as Lawrence Livermore Labs, and government-owned and government-operated (GOGO) labs, such as the Department of Energy labs¹¹—also are valuable sources of new inventions with commercial potential.

These facilities can conduct studies that provide valuable information through medical trials and clinical research, and their publications often are cited in patent filings. They do not award degrees, however, and cannot be directly compared with the academic institutions we evaluate, so we categorize and rank them separately from our university index. We include a subset of the variables considered for universities and university systems in the research institution ranking. This includes the formal tech transfer metrics in raw and normalized form (licenses and options issued, gross licensing income, invention disclosures, startups formed), along with unique citing patents.

These institutions are regional assets that contribute to research transfer and could serve as key partners in the National Science Foundation's (NSF) Innovation Engines program. The research institutions that report results to AUTM are ranked in the table below.

TABL	.E 2
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INSTITUTION RANK	INSTITUTION	STATE	INDEXED SCORE
1	Mayo Foundation Medical Education Research	Minn.	100.00
2	Boston Children's Hospital	Mass.	91.93
3	Wistar Institute	Pa.	91.14
4	U. of Texas Southwestern Medical Center	Texas	87.01
5	Cedars Sinai Medical Center	Calif.	86.22
6	Massachusetts General Hospital	Mass.	84.45
7	Memorial Sloan Kettering Cancer Center	N.Y.	82.68
8	Cleveland Clinic	Ohio	81.50
9	Dana Farber Cancer Institute	Mass.	81.30
10	Brigham Women's Hospital	Mass.	79.72
11	University of California, San Francisco	Calif.	77.36
12	Mount Sinai School of Medicine	N.Y.	74.80
13	Oregon Health Science University	Ore.	72.83
14	Nationwide Children's Hospital	Ohio	71.46
15	University of Colorado Anschutz	Colo.	70.47
16	U. of Texas Health Science Center, Houston	Texas	69.88
17	Baylor College Medicine	Texas	69.29
18	Whitehead Institute Biomedical Research	Mass.	68.90
19	MD Anderson Cancer Center	Texas	66.14
20	City of Hope National Medical Center	Calif.	64.96
21	University of Texas Medical Branch	Texas	62.99
22	Albert Einstein College Medicine	N.Y.	62.40

23	University of Arkansas for Medical Sciences	Ark.	61.61
24	Medical University of South Carolina	S.C.	60.63
25	Beth Israel Deaconess Medical Center	Mass.	59.45
26	U. of Texas Health Science Center, San Antonio	Texas	58.27
27	Fred Hutchinson Cancer Research Center	Wash.	57.87
28	Cold Spring Harbor Laboratory	N.Y.	57.68
29	Children's Hospital Cincinnati	Ohio	56.69
30	University Hospitals	Ohio	51.18
31	H Lee Moffitt Cancer Center Research Institute	Fla.	49.61
32	Fox Chase Cancer Center	Pa.	44.29
33	Salk Institute of Biological Studies	Calif.	42.13
34	Saint Jude Children's Research Hospital	Tenn.	41.93
35	Hospital Special Surgery	N.Y.	39.57
36	U. of North Texas Health Science Center	Texas	38.58
37	Tufts Medical Center	Mass.	37.40
38	Children's Hospital, Philadelphia	Pa.	35.04
39	Johns Hopkins University Applied Physics Lab	Md.	35.04
40	Medical College of Wisconsin	Wis.	31.50
41	Seattle Children's Research Institute	Wash.	28.35
42	Hackensack University Medical Center	N.J.	22.24
43	Woods Hole Oceanographic Institute	Mass.	17.13
44	Rosalind Franklin University Medicine Science	.	13.58



RESEARCH TO RENEWAL: STATE TECH TRANSFER PROFILES

The following state profiles highlight the key university systems, research institutions and universities that contribute to the transfer of technology and skills into the economy.¹²

Some of these universities and institutions have focused on the formal aspects of technology transfer, while others have embraced a broader role as part of an innovation and entrepreneurial ecosystem, providing services and spaces for connection and relevant support.

The Heartland Forward icon () is used to identify those states that make up the heartland.



UNIVERSITIES (INDEX SCORE)	RANK
University of Alabama at Birmingham (57)	91
Auburn University (56)	95
University of Alabama at Huntsville (46)	112
University of Alabama (46)	113
University of South Alabama (38)	131

ALASKA

Alaska's technology transfer infrastructure is relatively small and faces challenges given its geographic scale and remoteness. The Office of Intellectual Property and Commercialization at the University of Alaska Fairbanks (No. 146) supports patenting and licensing of university research with commercial potential, while the Alaska Center for Innovation, Commercialization and Entrepreneurship helps with further development of inventions.

UNIVERSITIES (INDEX SCORE)	RANK
University of Alaska Fairbanks (28)	146
University of Alaska Anchorage (15)	163

ALABAMA

The University of Alabama System (No. 19 among systems ranked) contains four universities included in our index. The highest ranked—the University of Alabama at Birmingham (UAB), is home to the Bill L. Harbert Institute (BLHI) for Innovation and Entrepreneurship. This office contains the UAB Research Foundation, a nonprofit through which the university manages its formal tech transfer. The private sector sees the potential to leverage research conducted at UAB to create a local life-sciences cluster and in 2021 launched the First Avenue Ventures Life Sciences Fund in partnership with BLHI.¹³

Technology transfer has been recognized as a core component of Alabama's economic future by state leaders. The Alabama Innovation Commission report, released in 2021, suggested increasing commercialization as a core policy recommendation to support the state's economy.¹⁴ The Alabama Innovation Corporation was established in 2021 by the state legislature with an initial appropriation of \$10 million to fund and support commercialization of research in Alabama.

ARIZONA

The Arizona Board of Regents governs the three public universities on our index – Arizona State University (33), the University of Arizona (34) and Northern Arizona University (134). The system ranked seventh, with strong aggregate performance on both ends of the commercialization pipeline, ranking in the top five for both total invention disclosures and number of startups. Over the period evaluated, Arizona State University tied Harvard, the University Minnesota, and Caltech for startup launches. While each Arizona university on our list has its own robust technology transfer office, the Board of Regents maintains a shared database of research available for commercialization.¹⁵

SYSTEMS (INDEX SCORE)	RANK
Arizona Board of Regents (73)	7

UNIVERSITIES (INDEX SCORE)	RANK
Arizona State University (78)	33
University of Arizona (78)	34
Northern ArizonaUniversity (36)	134

ARKANSAS

The University of Arkansas System ranks 17th and has invested in building infrastructure to support both the mechanics of tech transfer and the culture of entrepreneurship among its researchers. BioVentures facilitates the formal tech transfer process for university researchers and faculty affiliated with the University of Arkansas for Medical Sciences. The University of Arkansas at Fayetteville (No. 69) is home to the Office of Entrepreneurship and Innovation, which offers training and mentorship for students and faculty interested in commercialization. An annual commercialization retreat helps build community among entrepreneurial researchers, along with providing information and opportunities for collaboration.¹⁶

The Arkansas Research Alliance, a public-private partnership, operates statewide and partners with research universities and the U.S. Food and Drug Administration's National Center for Toxicological Research to foster collaboration in pursuit of knowledge-based economic growth.¹⁷

SYSTEMS (INDEX SCORE)	RANK
University of Arkansas System (49)	17
	1

INSTITUTIONS (INDEX SCORES)	RANK
University of Arkansas for Medical Sciences (62)	23

UNIVERSITIES (INDEX SCORE)	RANK
University of Arkansas at Fayetteville (65)	69



CALIFORNIA

A wealth of institutions contribute to California's hightech industries through the development and transfer of new technologies, commercial partnerships, startups and graduating STEM students every year.

The University of California is the top system for technology licensing and commercialization on our index, and the individual campuses are large enough to specialize in different sectors and perform well on our university index. Biotech and medical innovation are a particular strength, with institutions like Cedars Sinai and UC San Francisco in the top tier. Stanford (4) and the California Institute of Technology (19) join UC San Diego (8), UCLA (9) and UC Berkeley (25) in the top 25 universities—creating the highest concentration of toptier tech transfer universities.

Innovation has fueled the high-tech industries, with private sector partnerships and graduating students maintaining a circular flow of research findings from the universities into firms and back into the academy.

SYSTEMS (INDEX SCORE)	RANK
University of California System (100)	1

INSTITUTIONS (INDEX SCORE)	RANK
Cedars Sinai Medical Center (86)	5
University of California, San Francisco (77)	11
City of Hope National Medical Center (65)	20
Salk Institute for Biological Studies (42)	33

UNIVERSITIES (INDEX SCORE)	RANK
Stanford University (96)	4
University of California, San Diego (93)	8
University of California, Los Angeles (91)	9
California Institute of Technology (86)	19
University of California, Berkeley (84)	25
University of California, Davis (83)	26
University of California, Irvine (81)	29
University of California, Santa Barbara (75)	41
University of Southern California (75)	44
San Diego State University (61)	80
University of California, Riverside (61)	81
University of California, Santa Cruz (56)	92
University of California, Merced (24)	155



COLORADO

Colorado has a vibrant innovation ecosystem, thanks in part to its universities. The University of Colorado system (No. 10) operates its technology transfer operations through Venture Partners and CU Innovations. In addition to facilitating patents, licensing and options, training and mentoring programs are offered to faculty, researchers and graduate students. The ASCENT Accelerator, for example, is a four-month program run by Venture Partners that focuses on new science and engineering firms that include a large research component. The program helps guide startups in evaluating their market fit, building a team, securing funding and setting up their company.¹⁸

CU Innovations heads up the commercialization services focused on biomedical technology that come from the University of Colorado System, including at the Anschutz Medical Campus. SPARK | REACH Colorado awards up to \$200,000 to projects developing novel therapeutics, medical devices or diagnostics to help applicants commercialize their research.¹⁹

At Colorado State (No. 59), CSU Ventures operates a FUEL program that also offers R&D seed funding of up to \$200,000 and a series of commercialization workshops for early-stage ventures interested in understanding the commercial potential of their work.²⁰

SYSTEMS (INDEX SCORE)	RANK
University of Colorado System (67)	10
INSTITUTIONS (INDEX SCORES)	RANK
INSTITUTIONS (INDEX SCORES) University of Colorado Anschutz Medical	RANK 15

UNIVERSITIES (INDEX SCORE)	RANK
Colorado State University (68)	59
Colorado School Mines (60)	84
University of Denver (30)	145

CONNECTICUT

The University of Connecticut (No. 58) operates its tech transfer services out of the Office of the Vice President for Research. The Technology Incubation Program (TIP) has been expanded to include a digital incubator in Stamford, which opened in early 2021 and works with startups in the machine learning and artificial-intelligence space. To connect university research with the manufacturing sector, UConn has a contract with the Air Force Research Laboratory to improve aerospace manufacturing processes in partnership with locally based aerospace companies.²¹

UNIVERSITIES (INDEX SCORE)	RANK
University of Connecticut (68)	58



DELAWARE

The University of Delaware (No. 100) Office of Economic Innovation and Partnerships supports formal technology transfer. Through partnerships with private and public agencies, the university connects researchers to practical problems they can help solve as part of the local entrepreneurial ecosystem. The Delaware Center for Advanced Technology (CAT) supports applied-research collaborations between university researchers and the private sector who are conducting bioscience studies in Delaware with grants of up to \$100,000.²²

UNIVERSITIES (INDEX SCORE)	RANK
University of Delaware (54)	100

FLORIDA

The University of Florida (UF) was the highestplaced public university on our university ranking, and the State University System of Florida was No. 2 among systems. It performed well across the board, contributing to the transfer of technology on all dimensions. It outperformed the top-ranked University of California system for licenses and options issued, and on gross licensing income and number of invention disclosures when the latter two measures were scaled by research expenditures. The impact of UF on the local economy is significant, and UF Innovate reports that its innovation ecosystem has created more than \$10.4 billion in private investment.

RANK
2
RANK
31

UNIVERSITIES (INDEX SCORE)	RANK
University of Florida (99)	2
University of Miami (79)	30
University of South Florida (75)	40
University of Central Florida (61)	76
Florida State University (54)	99
University of North Florida (22)	157
University of West Florida (10)	165



GEORGIA

The University System of Georgia (No. 9) includes a varied group of schools. Georgia Tech (60) performs well on the number of highly trained STEM graduates at the undergraduate and graduate levels, while the University of Georgia (45) excelled in number of licenses and options issued, with key strengths in agriculture and biotech. This combination of formal and informal tech transfer contributes to Georgia's economy. Augusta University (130) hosts the Life Sciences Business Development Center, which allows firms to collocate with researchers and to aid commercialization and the research-fueled formation of new firms.

SYSTEMS (INDEX SCORE)	RANK
University of Georgia System (69)	9

UNIVERSITIES (INDEX SCORE)	RANK
University of Georgia (75)	45
Emory University (75)	47
Georgia Institute of Technology (67)	60
Augusta University (38)	130
Georgia State University (37)	133

IDAHO

Two Idaho schools appear on our index: the University of Idaho (No. 128) and Boise State University (153). To promote the commercialization of university research, the state implemented the Idaho Global Entrepreneurial Mission grant program, which provides funding for researchers with viable technologies to collaborate with the private sector. These commercialization partnerships support the innovation ecosystem, and the program operates across Idaho universities.

At the University of Idaho, agro-tech has been a particular strength with the development of new varieties of wheat that are well suited to the Northwest region of the country. The state is also home to the Idaho National Laboratory (INL), the U.S. Department of Energy's nuclear energy research and development center, where numerous faculty members at Idaho State, Boise State and the University of Idaho hold joint appointment.

UNIVERSITIES (INDEX SCORE)	RANK
University of Idaho (39)	128
Boise State University (25)	153

HAWAII

The University of Hawaii (No. 142) manages its technology transfer efforts through the Office of Innovation and Commercialization (OIC). Between 2014 and 2021, the OIC reports \$10.4 million in revenue generated and more than 140 startups supported, indicating the smaller scale of the endeavor when compared to top-ranked public schools like the behemoth University of Florida. UH has identified the Hawaii Innovation Initiative as one of four strategic priorities in its 2015-2021 strategic plan to help the island state diversify its economy away from dependence on tourism and military spending. Increased commercialization of university inventions is a key tactic in this approach.²³

UNIVERSITIES (INDEX SCORE)	RANK
University of Hawaii (32)	142





The University of Illinois System (No. 6) ranks in the top tier of systems assessed on our index, thanks to robust performance on gross licensing income and the number and share of STEM graduates.

Northwestern University (13) has generated commercially valuable intellectual property and ranks second for both the raw and normalized gross licensing income components of our index. It ranks third overall among Heartland universities.

A large share of students at the University of Chicago graduate with a degree in a STEM discipline, adding to the state's overall good performance in this area. The Polsky Center for Entrepreneurship at the University of Chicago—in partnership with the Chicago Quantum Exchange, the University of Illinois Urbana-Champaign, Argonne National Laboratory and the technology advocacy group P33—launched Duality, a new quantum technology startup accelerator.²⁴

SYSTEMS (INDEX SCORE)	RANK
University of Illinois System (73)	6

INSTITUTIONS (INDEX SCORES)	RANK
Rosalind Franklin University Medicine Science (14)	44

UNIVERSITIES (INDEX SCORE)	RANK
Northwestern University (91)	13
University of Chicago (84)	24
Southern Illinois University (46)	115
Loyola University Chicago (40)	126
Northern Illinois University (38)	129
Illinois State University (21)	159



Purdue University (No. 11, tie) ranks second among Heartland universities and excels in startup formation. The Purdue Research Foundation (PRF) helps manage the intellectual property created by researchers at the university. PRF fosters entrepreneurship through the Purdue Foundry and administers the Trask Innovation Fund, which was established in 1974 and offers shortterm grants to develop the commercial potential of Purdue research.

Life sciences are a core strength at Purdue and other institutions in the state. Indiana University recently published a list of its pipeline of potential pharmaceutical drug candidates in development, highlighting the number currently moving from the lab to market.²⁵ At Notre Dame, the IDEA Center offers support to researchers interested in developing and commercializing the results of their research.

UNIVERSITIES (INDEX SCORE)	RANK
Purdue University (91)	11
Indiana University (67)	63
University of Notre Dame (60)	86
Ball State University (40)	125

IOWA

lowa State University (No. 43) technology transfer and sponsored research are managed by the Iowa State University Research Foundation (ISURF) and the Office of Intellectual Property and Technology Transfer (OIPTT). ISURF also manages tech transfer operations for the Ames Laboratory, a U.S. Department of Energy national lab focused on new materials and co-located on the Iowa State campus. Initiatives to foster a bioscience cluster include BioConnect Iowa, which has funded bioscience research at Iowa State and the University of Iowa and is developing a startup accelerator program.

UNIVERSITIES (INDEX SCORE)	RANK
Iowa State University (75)	43
University of Iowa (52)	103
University of Northern Iowa (28)	149



The University of Kansas (No. 41) Office of Research offers its Swift Startup license to streamline the licensing process for companies wanting to use intellectual property of the university. The KU Innovation Park offers space for new firms to grow and partner with researchers at the Lawrence and Medical Center campuses.

At Kansas State University (70), K-State Innovation Partners group helps protect inventions and facilitates collaboration between researchers and firms. It also offers opportunities to co-locate with university researchers.

State programs aim to support commercialization in keeping with the Kansas Framework for Growth innovation pillar.²⁶ The Kansas Innovation and Technology Enterprise (KITE) works with both forprofit and faculty-led companies to develop research into new ventures. The program includes proof-ofconcept grants and other resources.

UNIVERSITIES (INDEX SCORE)	RANK
University of Kansas (75)	41
Kansas State University (65)	70

KENTUCKY

The University of Kentucky (No. 71) refreshed its Office of Technology Commercialization in 2019 and offers the CATalyst proof-of-concept fund to help researchers prepare their technologies for commercialization. It also offers researchers access to a mentorship program, an accelerator and a pitch competition to help them develop and market their technologies.

At the University of Louisville (74), the Office of Research and Innovation offers similar support to its faculty, including a faculty entrepreneurial leave policy that signals its commitment to startup activity.

Kentucky Commercialization Ventures was launched in 2020 to offer tech transfer services to universities that lack those services in-house.²⁷ The program includes a two-month Innovation Fellowship program that builds commercialization capacity among university inventors.²⁸

UNIVERSITIES (INDEX SCORE)	RANK
University of Kentucky (64)	71
University of Louisville (62)	74



LOUISIANA

The Louisiana State University System (No. 16) performs well on our scaled measures for gross licensing income, invention disclosures and startups. At its flagship campus in Baton Rouge, the LSU I-Corps program allows researchers to participate in a variety of brief training programs in mixed teams to develop a technology for commercialization. At Louisiana Tech University (140), the Office of Intellectual Property and Commercialization protects LTU intellectual property and joins with industrial partners to commercialize technology. At Tulane University (76), a number of pharmaceutical inventions have been successfully commercialized, along with other life sciences technologies.²⁹

SYSTEMS (INDEX SCORE)	RANK
Louisiana State University System (52)	16

UNIVERSITIES (INDEX SCORE)	RANK
Tulane University (61)	76
Louisiana Tech University (34)	140
University of Louisiana at Lafayette (24)	154

MAINE

None of the systems, institutions or universities in Maine reported sufficient data to be included in our analysis. The University of Maine, the state's largest research university, performs technology licensing through its Office of Innovation and Economic Development and partners with businesses to connect their talent and deploy the university's licensable technology in the private sector.³⁰ Maine is home to aircraft and marine engineering firms, as well as pharmaceutical and biotech material manufacturers—all industries that are potential employers for STEM graduates.³¹

MARYLAND

The University System of Maryland (No. 12) encompasses 12 institutions and performs well, thanks in part to the large number and share of graduating students in STEM fields. The Maryland Innovation Initiative (MII) is a partnership between five universities and the State of Maryland aimed at promoting tech transfer by facilitating collaboration between the universities and providing financial support for qualified university startups.³²

Morgan State University (137) is the largest of Maryland's historically Black colleges and universities ranked on our index, and it performed in the top 10 for normalized number of startups and normalized number of invention disclosures.

Johns Hopkins University (27) licenses technology through Johns Hopkins Technology Ventures, which offers a variety of funding options. Additionally, MII grants draw from three translational research funds for seed and proof-of-concept work.

SYSTEMS (INDEX SCORE)	RANK
University System of Maryland (58)	12
INSTITUTIONS (INDEX SCORES)	RANK
Johns Hopkins University Applied Physics	39
Laboratory (35)	
UNIVERSITIES (INDEX SCORE)	RANK

UNIVERSITIES (INDEX SCORE)	RANK
Johns Hopkins University (82)	27
Morgan State University (36)	137



MASSACHUSETTS

The University of Massachusetts System (No. 8) ranked first for the normalized amount of gross licensing income generated.

At UMass Amherst, the Manning Innovation Program provides funding for applied science and engineering research and development at the Institute of Applied Life Sciences. The program aims to facilitate the creation of new intellectual property and new firms.

Massachusetts is home to top-tier medical research institutions, including Boston Children's Hospital (2), which produced the second-highest number of academic articles cited in industry patents, and Massachusetts General Hospital (6), which generated the most licenses and options of all the institutions we evaluated.

The state is also home to top universities, including Harvard University (5) and Massachusetts Institute of Technology (11, tie). Harvard had the most academic articles cited in industry patents among its peers, and MIT had the best record for invention disclosures, an indication of the innovation created by its researchers.

SYSTEMS (INDEX SCORE)	RANK
University of Massachusetts System (70)	8

INSTITUTIONS (INDEX SCORE)	RANK
Boston Children's Hospital (92)	2
Massachusetts General Hospital (84)	6
Dana Farber Cancer Institute (81)	9
Brigham Women's Hospital (80)	10
Whitehead Institute for Biomedical Research (69)	18
Beth Israel Deaconess Medical Center (59)	25
Tufts Medical Center (37)	37
Woods Hole Oceanographic Institute (17)	43

UNIVERSITIES (INDEX SCORE)	RANK
Harvard University (95)	5
Massachusetts Institute of Technology (91)	11 (tie)
Tufts University (81)	28
Northeastern University (75)	46
Worcester Polytechnic Institute (67)	61
University of Massachusetts Boston (67)	62
Brandeis University (66)	65
Boston University (58)	88

MICHIGAN

The University of Michigan (No. 16) is a major source of transferrable inventions. It ranked in the top five for the raw number of invention disclosures received and for the number of licenses and options issued, and it graduates a lot of students with STEM degrees.

Through its Innovation Partnerships program, UM is supporting the local entrepreneurial ecosystem and helping connect research to the private sector. The university also supports regional innovation by leading the Great Lakes Innovation Corps Hub for the National Science Foundation, serving eight states.³³

Michigan State University (82) supports the Michigan Translational Research and Commercialization (MTRAC) Innovation Hub for AgBio in partnership with the Michigan Economic Development Corporation. The Innovation Hub focuses on research relevant to food, fuel and fiber that has the potential for successful commercialization.

UNIVERSITIES (INDEX SCORE)	RANK
University of Michigan (88)	16
Michigan State University (60)	82
Michigan Technological University (51)	105
Wayne State University (45)	116
Western Michigan University (44)	119

MINNESOTA

The Mayo Foundation for Medical Education Research is the top-performing research institution on our index. Its medical and life sciences research produced the most startups and invention disclosures of any institution evaluated, and its therapies and technologies are licensed worldwide.

The University of Minnesota (No. 10) performed consistently well across the technology transfer parameters evaluated, with particular strengths in number of startups and average number of licenses and options issued. It was the highest-ranked heartland university. The Technology Commercialization Office (TCO) works with outside companies through Minnesota Innovation Partnerships, which provides a low-risk "Try & Buy" contracting program for companies interested in licensing university technologies.³⁴ The university has also been a source of new firms, with the TCO reporting that three out of four startups created put down roots in Minnesota, contributing to the local economy.

SYSTEMS (INDEX SCORE)	RANK
Mayo Foundation Medical Education Research (100)	1
UNIVERSITIES (INDEX SCORE)	RANK
University of Minnesota (91)	10



MISSISSIPPI

Mississippi has three universities on our index, all of which support technology transfer with dedicated staff and are members of the Mississippi Research Consortium (MRC) alongside Jackson State University (not ranked on our index). In 2020, the three universities announced a partnership with the ERDCWERX innovation hub to help commercialize technologies invented at the Mississippi-headquartered U.S. Army Engineer Research and Development Center (ERDC). By leveraging the universities' expertise in tech transfer, the project will help evaluate the commercial potential of government-developed inventions.³⁵

UNIVERSITIES (INDEX SCORE)	RANK
Mississippi State University (42)	121
University of Southern Mississippi (36)	135
University of Mississippi (28)	150

MISSOURI

The University of Missouri System (No. 11) operates the Mizzou Lab 2 Market network to connect researchers with contacts and programs that can help them develop their inventions for commercial use. A number of biomedical accelerators support technologies at different points in the commercialization journey, positioning Mizzou researchers to successfully translate their research into inventions, as well as licenses and options. In St. Louis, the Cortex Innovation Community is building a neighborhood that houses the Washington University Office of Technology Management, along with more than 400 other companies and organizations.

SYSTEMS (INDEX SCORE)	RANK
University of Missouri System (60)	11

UNIVERSITIES (INDEX SCORE)	RANK
Washington University in St. Louis (72)	50

MONTANA

Montana State University (MSU), Montana Tech and the University of Montana all operate technology transfer offices, although only MSU reported enough data for us to include them in our analysis. Montana State (No. 124) in 2019 began offering gap funding to help develop and validate university technologies in preparation for commercialization.³⁶ The Montana Innovation Partnership also supports innovators in the state as they develop and commercialize their research.³⁷

UNIVERSITIES (INDEX SCORE)	RANK
Montana State University (41)	124

NEBRASKA

The University of Nebraska System (No. 18) ranks in the top 10 for normalized invention disclosures, indicating that faculty are using available research funding to create new technology. Technology commercialization at the Lincoln and Kearney campuses is led by NUtech Ventures. At the Omaha campus, the Nebraska Business Development Center offers commercialization services.

Life sciences and agriculture are particular strengths and are supported by public-private partnership organizations focused on leveraging research to grow the Nebraskan economy. The Biotech Connector, located on the Nebraska Innovation Campus in Lincoln, is an incubator with wet lab space where bioscience and research-based businesses can develop inventions. It is operated in partnership with the University of Nebraska-Lincoln. The Combine, an agriculture and food science incubator, also offers space for university researchers and entrepreneurs on the Nebraska Innovation Campus.

SYSTEMS (INDEX SCORE)	RANK
University of Nebraska System (48)	18

NEVADA

The Nevada System of Higher Education (No. 23 of 24) had limited success in technology transfer among systems we evaluated, performing outside the top tier on all measures considered. The University of Nevada, Reno (132) set out to improve its enterprise and innovation performance in its 2020-25 strategic objectives, including expanding technology transfer, along with contributing to economic development and growing the university's Innevation Center, a startup space with an incubator program.³⁸

Commercialization is handled through the Nevada Research & Innovation Corporation. Firms interested in collaborating with university researchers can work through the Nevada Center for Applied Research. The University of Nevada, Las Vegas (123) is investing in a new research park to facilitate tech transfer and collaboration in southern Nevada. Technology transfer is handled by the UNLV Research Foundation and the Office of Economic Development.

SYSTEMS (INDEX SCORE)	RANK
Nevada System of Higher Education (22)	23

UNIVERSITIES (INDEX SCORE)	RANK
University of Nevada, Las Vegas (41)	123
University of Nevada, Reno (37)	132

NEW HAMPSHIRE

At Dartmouth College (No. 67), the technology transfer office works with the Magnuson Center for Entrepreneurship to support emerging university entrepreneurs. One initiative to bolster healthcare research with translational potential is Dartmouth's Innovations Accelerator for Cancer (DIAC), founded in 2020.³⁹

The University of New Hampshire (107) manages tech transfer through UNHInnovation. The university is a National Science Foundation I-Corps site and offers entrepreneurial training for researchers interested in building teams to explore the commercial potential of their inventions. UNHInnovation also offers additional resources for students through its Entrepreneurship Center. Marine-related research presents an important economic opportunity.

UNIVERSITIES (INDEX SCORE)	RANK
Dartmouth College (65)	67
University of New Hampshire (49)	107

NEW JERSEY

Princeton University (No. 22) offers several programs to facilitate tech transfer, including a new ventures fund to support entrepreneurial faculty and an IP accelerator fund that helps develop inventions until they are ready for investment. The Princeton Plasma Physics Laboratory (PPPL) is a U.S. Department of Energy laboratory focused on fusion energy research. It is operated by Princeton and collaborates with academics, companies and governments to conduct and commercialize research.

At Rutgers University-New Brunswick (35), Innovation Ventures supports researchers with tech transfer services and support. Work is underway on The Hub, a development in downtown New Brunswick that will host an incubator space, a medical school and the Rutgers Translational Research facility. The Hub will colocate entrepreneurs and researchers with the aim of bolstering innovation and tech transfer.⁴⁰

Hackensack University Medical Center (42) was the institution with the highest normalized number of papers cited in patents.

INSTITUTIONS (INDEX SCORE)	RANK
Hackensack University Medical Center (22)	42

UNIVERSITIES (INDEX SCORE)	RANK
Princeton University (86)	22
Rutgers University-New Brunswick (78)	35
Stevens Institute of Technology (57)	89
Rowan University (39)	127
New Jersey Institute of Technology (34)	139

NEW MEXICO

The University of New Mexico (No. 49) supports tech transfer through UNM Rainforest Innovations. The school ranked 16th for the normalized number of startups and operates the Joseph L. Cecchi VentureLab, an incubator for UNM projects with commercial potential. The VentureLab and Rainforest Innovations are co-located with the university's Innovation Academy, bringing together the entrepreneurial inventors on campus.⁴¹

Other tech transfer assets include the New Mexico Start-Up Factory, which helps scientists develop and commercialize their inventions. New Mexico Tech established its Office of Innovation Commercialization Business and Technology Management in 2017 to promote innovation and entrepreneurship on campus and facilitate technology transfer. They have added entrepreneurship to their STEM focus and offer programs to support the university community creating new firms.

UNIVERSITIES (INDEX SCORE)	RANK
University of New Mexico (72)	49



NEW YORK

New York's innovation assets include two large systems – the State University of New York (No. 14) and City University of New York (24). Both graduate large numbers of STEM students, with SUNY ranking second for share of undergraduates earning STEM degrees. Affiliated with SUNY, NY CREATES facilitates collaboration between industry and academic partners to commercialize and grow high-tech projects. Three universities rank in the top 25 for technology commercialization: Columbia University (3), Cornell University (14), and New York University (17). They are discussed in more detail in our May 2022 report.⁴²

New York is also home to top-tier medical research institutions that produce widely cited research. Cold Spring Harbor Laboratory (28), which focuses on biomedical research, ranked second for normalized gross licensing income generated by commercializing its inventions.

SYSTEMS (INDEX SCORE)	RANK
State University of New York System (54)	14
City University of New York System (12)	24

INSTITUTIONS (INDEX SCORE)	RANK
Memorial Sloan Kettering Cancer Center (83)	7
Mount Sinai School of Medicine (75)	12
Albert Einstein College of Medicine (62)	22
Cold Spring Harbor Laboratory (58)	28
Hospital for Special Surgery (40)	35

UNIVERSITIES (INDEX SCORE)	RANK
Columbia University (98)	3
Cornell University (90)	14
New York University (87)	17
University of Rochester (62)	75
Rochester Institute of Technology (61)	76

NORTH CAROLINA

The University of North Carolina System (No. 5) performs well across the metrics we assessed, including having the third-highest number of startups and second-highest normalized numbers of licenses and options issued.

North Carolina State University (7) produced the seventh-highest number of startups among universities included in our rankings. The N.C. State Chancellor's Innovation Fund (CIF), established in 2010, supports research projects that have a commercial focus.

Duke University (15) had the second-highest share of undergraduates earning STEM degrees, and the university's Office of Translation and Commercialization helps inventors bring their work to market.

SYSTEMS (INDEX SCORE)	RANK
University of North Carolina System (83)	5

UNIVERSITIES (INDEX SCORE)	RANK
North Carolina State University (93)	7
Duke University (88)	15
University of North Carolina at Chapel Hill (71)	51
University of North Carolina at Charlotte (63)	72
East Carolina University (51)	104
University of North Carolina at Wilmington (41)	122
North Carolina A&T State University (19)	160

NORTH DAKOTA

The NDSU Research Foundation manages commercialization at North Dakota State University (No. 117). The university has successfully transferred agriculture findings, as well as paint and coatings technology, to the private sector. NDSU ranked sixth on our normalized measure of licenses and options issued. NDSU Research and Technology Park offers incubator services, along with office space for new firms and connects the university to the regional economy. The University of North Dakota runs its tech transfer through its Corporate Engagement and Commercialization program.

UNIVERSITIES (INDEX SCORE)	RANK
North Dakota State University (45)	117

оню

The University System of Ohio (No. 4) ranks second for number of invention disclosures and awards degrees to a large number of graduate students in STEM fields. The Ohio IP Promise is an initiative across 14 public universities in the state to redesign the technology transfer process.⁴³ Having benchmarked best practices at top universities in the field, the schools are streamlining licensing processes to smooth commercialization of university inventions. Ohio's research hospitals, including the Cleveland Clinic (8), also contribute research of value to the private sector.

SYSTEMS (INDEX SCORE)	RANK
State University of New York System (54)	4
INSTITUTIONS (INDEX SCORE)	RANK
Cleveland Clinic (81)	8
Nationwide Children's Hospital (71)	14
Cincinnati Children's Hospital (57)	29
University Hospitals (51)	30

UNIVERSITIES (INDEX SCORE)	RANK
Ohio State University (78)	32
Case Western Reserve University (76)	39
University of Akron (63)	73
University of Toledo (61)	79
University of Cincinnati (60)	85
Ohio University (56)	93
Cleveland State University (36)	136
University of Dayton (35)	138
Wright State University (30)	144
Miami University (28)	147
Bowling Green State University (18)	161

OKLAHOMA

In the University of Oklahoma System (No. 22), the Office of Technology Commercialization assists researchers interested in protecting and transferring their work to the private sector. Key areas of focus include weather, medicine, and oil and gas. The OTC makes grants of up to \$75,000 through the Growth Fund to support the development of commercially focused research and prototyping, aiming to help faculty develop technology that has value in the market.

At Oklahoma State University (82), the National Science Foundation I-Corps program provides training for OSU researchers interested in developing and commercializing their discoveries. Brightest Orange Ventures helps OSU researchers through the process of building a startup around an invention, including mentorship and access to additional funding.

SYSTEMS (INDEX SCORE)	RANK
University of Oklahoma System (27)	22

UNIVERSITIES (INDEX SCORE)	RANK
Oklahoma State University (60)	82

OREGON

The University of Oregon (No. 48) took the top spot for both number of licenses and options executed and the number of licenses and options executed per invention disclosure. Researchers interested in commercialization can apply for grants to help develop their projects.

At Oregon State University (56), the OSU Advantage Accelerator is an option for those looking to create a new firm, and it is also connected to the NSF Innovation Corps program. To help disseminate information relating to tech transfer, faculty designated as Innovation Advocates are spread throughout the institution and can refer interested academics to relevant resources.

INSTITUTIONS (INDEX SCORE)	RANK
Oregon Health Science University (73)	13

UNIVERSITIES (INDEX SCORE)	RANK
University of Oregon (74)	48
Oregon State University (70)	56
Portland State University (46)	114

PENNSYLVANIA

Pennsylvania is home to three top 25 tech transfer universities: top performer Carnegie Mellon University (No. 1), University of Pennsylvania (6) and University of Pittsburgh (21). These are discussed in more detail in our May 2022 report.⁴⁴ These universities excel in conducting and commercializing research through formal tech transfer, and they contribute to local economic growth by attracting firms that want to collaborate with top-tier researchers as they develop their technologies.

At Drexel University (55), the long-standing, cooperative program focuses on informal tech transfer that happens through students bringing their freshly acquired skills and knowledge to the workplace. By having students complete a series of paid, six-month, full-time internships, students can find real-world applications for their class content and are better prepared for the workplace upon graduation.

INSTITUTIONS (INDEX SCORE)	RANK
Wistar Institute (91)	3
Fox Chase Cancer Center (44)	32
Children's Hospital of Philadelphia (35)	38

UNIVERSITIES (INDEX SCORE)	RANK
Carnegie Mellon University (100)	1
University of Pennsylvania (94)	6
University of Pittsburgh (86)	21
Drexel University (70)	55
Temple University (56)	94
Penn State University (51)	106
Duquesne University (26)	152

RHODE ISLAND

Brown University (No. 68) manages its formal tech transfer through Brown Technology Innovations. The office runs a paid internship program for graduate and medical students, as well as postdoctoral fellows, who want to learn more about research commercialization.⁴⁵ Brown also operates Brown Biomedical Innovations to Impact, an accelerator program focused on translational research in the Division of Biology and Medicine.

University of Rhode Island (No. 151) handles its tech transfer through the Division of Research and Economic Development (for faculty-facing services) and URI Ventures (for private sector-facing services and partnerships). The state has dedicated funding to establish three RI Innovation Campus projects to better connect university research to the private sector through colocation and collaboration.

UNIVERSITIES (INDEX SCORE)	RANK
Brown University (65)	68
University of Rhode Island (28)	151

SOUTH CAROLINA

The South Carolina Research Authority advises academic researchers and startups to help commercialize new technologies. It also offers financial support for promising projects, in part by drawing from the Industry Partnership Fund. Contributions to this fund earn companies matched South Carolina tax credits. The Scribble online innovation hub offers stories and advice from successful innovators in the state as a source of information and inspiration. At Clemson University (66), the Clemson University Research Foundation offers commercialization support. The Innovation Maturation Fund, focused on health sciences, funds projects conducted jointly by researchers at Clemson and funder Prisma Health.⁴⁶

INSTITUTIONS (INDEX SCORE)	RANK
Medical University South Carolina (61)	24

UNIVERSITIES (INDEX SCORE)	RANK
Clemson University (66)	66
University of South Carolina (31)	143

SOUTH DAKOTA

To help assess and demonstrate the viability of an invention, researchers in South Dakota can apply for a grant of up to \$25,000 from the Governor's Office of Economic Development Proof of Concept program. Tech transfer offices at both South Dakota State University (No. 101) and the University of South Dakota (147) participate in South Dakota Biotech, a statewide association promoting growth in the local biotech industry.

UNIVERSITIES (INDEX SCORE)	RANK
South Dakota State University (53)	101
University of South Dakota (28)	147



TENNESSEE

At Vanderbilt University (No. 53), The Wond'ry innovation center allows members of the university community and private firms to co-locate, use maker spaces and collaborate. In 2022, it added the Launch incubator to foster growth of promising startups. Vanderbilt researchers have produced licensable technology in a variety of health-related fields, including medical devices and imaging.

The University of Tennessee Research Foundation handles tech transfer for research conducted in the UT system, including at the flagship University of Tennessee campus in Knoxville (98). Researchers with a promising project related to a UT invention disclosure can apply for a UTRF Technology Maturation Grant of up to \$15,000 to help with the commercialization process.

INSTITUTIONS (INDEX SCORE)	RANK
St. Jude Children's Research Hospital (42)	134

UNIVERSITIES (INDEX SCORE)	RANK
Vanderbilt University (71)	53
University of Tennessee at Knoxville (54)	98
University of Memphis (15)	164

TEXAS

The University of Texas System (No. 3) performed in the top tier, with its scale and commercialization success putting it in the top three for all but one of the raw measures on our index. Each university campus and medical institution in the UT system operates its own technology transfer office.

The University of Texas at Austin (20) is part of a vibrant technology cluster, which it supports by graduating many students with STEM bachelor's degrees. The top Texas institution was the University of Texas Southwestern Medical Center (4), which produced the fourth-highest number of startup firms and offers a range of mentoring and training programs to help entrepreneurial researchers commercialize their inventions. The Texas A&M University System (15) had the highest proportion of master's students graduating with STEM degrees, and its large student body is a major contributor of talent to the region.

SYSTEMS (INDEX SCORE)	RANK
University of Texas System (88)	3
Texas A&M University System (53)	15
Texas Tech University System (39)	20
University of North Texas System (35)	21

INSTITUTIONS (INDEX SCORE)	RANK
University of Texas Southwestern Medical Center	4
(87)	
University of Texas Health Science Center at	16
Houston (70)	
Baylor College of Medicine (69)	17
M.D. Anderson Cancer Center (66)	19
University of Texas Medical Branch (63)	21
University of Texas Health Science Center at San	26
Antonio (58)	
University of North Texas Health Science Center	36
(39)	

UNIVERSITIES (INDEX SCORE)	RANK
University of Texas at Austin (86)	20
University of Houston (77)	36
Rice University (71)	52
University of Texas at Dallas (69)	57
University of North Texas at Denton (58)	87
University of Texas at San Antonio (57)	90
University of Texas at Arlington (52)	102
University of Texas at El Paso (33)	141
University of Texas at Tyler (22)	158
University of Texas Rio Grande Valley (17)	162
University of Texas Permian Basin (7)	166

UTAH

Utah universities have been an essential part of the state's vibrant Silicon Slopes. When scaled for research expenditures, Brigham Young University (No. 23) in Provo ranks first for both number of startups launched and invention disclosures received. BYU sends clear signals to faculty that it values research commercialization—e.g., by including a technology transfer award among its annual faculty awards. In Salt Lake City, the University of Utah (37) handles tech transfer through the Partners for Innovation, Ventures, Outreach & Technology (PIVOT) Center, and frames its activities in the context of stimulating economic development and contributing to the state's innovation ecosystem.

UNIVERSITIES (INDEX SCORE)	RANK
Brigham Young University (84)	23
University of Utah (77)	37
Utah State University (42)	120

VERMONT

The University of Vermont (No. 118) offers grants for early-stage development of university technology with a potential for positive economic impact in Vermont. The annual Invention 2 Venture (I2V) Conference assembles experts on different aspects of research commercialization to help build tech transfer expertise within UV.

UNIVERSITIES (INDEX SCORE)	RANK
University of Vermont (44)	118

VIRGINIA

The University of Virginia (No. 54) offers support to inventors through the UVA Licensing and Ventures Group. With a strong track record in the life sciences, the university implemented specific funding streams for COVID-19 research, aiming to deliver solutions with commercialization potential. The UVA Licensing & Ventures Group seed fund invests in UVA startups. Virginia Commonwealth University (No. 64) hosts the Innovation Gateway, which awards commercialization funds to projects that have the potential to advance more quickly to market with additional financial support.

Virginia Tech (not ranked on our index) is investing in a new Innovation Campus in North Potomac Yards, where it is partnering with the private sector and focusing research on specific big questions that could impact the economy in a major way. By emphasizing innovation as a core focus and partnering with school districts, VTU hopes to attract more students to STEM fields.

UNIVERSITIES (INDEX SCORE)	RANK
University of Virginia (71)	54
Virginia Commonwealth University (67)	64
James Madison University (49)	108

WASHINGTON

The University of Washington (No. 18) has strong connections to the technology conglomeration in Seattle. It ranks fifth for academic articles cited in industry patents and second for licenses and options issued. Its large cohort of STEM bachelor's degree graduates (eighth overall) helps fuel Seattle's privatesector firms' innovation in technology and engineering.

Washington State (30) offers support to researchers through the Office of Commercialization, including grants of up to \$40,000 from the Commercialization Gap Fund. WSU also offers the National Science Foundation I-Corps program to help teams develop their ideas.

INSTITUTIONS (INDEX SCORE)	RANK
Fred Hutchinson Cancer Research Center (58)	27
Seattle Children's Research Institute (28)	41

UNIVERSITIES (INDEX SCORE)	RANK
University of Washington (87)	18
Washington State University (79)	30

WEST VIRGINIA

West Virginia University (No. 110) connects inventors to resources via the Office of Technology Transfer. Through the TransTech Energy program and the associated TransTech Business Development program, university researchers with innovative energy technology have developed and obtained funding for their projects. WVU's LaunchLab helps build entrepreneurial skills in members of the school community, and it offers services through the Applied Innovation Centers at the Morgantown and Beckley campuses. Vantage Ventures is connected to the WVU John Chambers College of Business and Economics, and it supports and funds entrepreneurs across the state.

UNIVERSITIES (INDEX SCORE)	RANK
West Virginia University (48)	110

WISCONSIN

The University of Wisconsin System (No. 13) Center for Technology Commercialization helps university researchers apply for funding, including federal SBIR and STTR grants, and offers training and mentoring around commercialization. The Ideadvance Seed Fund invests in ideas from startups across Wisconsin, pairing them with UW System researchers to help assess and develop technologies. UW-Madison (38) manages its intellectual property through the Wisconsin Alumni Research Foundation (WARF), while a partnership between the foundation and UW-Madison—the Discovery to Product program—offers advice, funding and services to help the UWM research community commercialize their inventions.⁴⁷

SYSTEMS (INDEX SCORE)	RANK
University of Wisconsin System (55)	13

INSTITUTIONS (INDEX SCORE)	RANK
Medical College of Wisconsin (31)	40

UNIVERSITIES (INDEX SCORE)	RANK
University of Wisconsin-Madison (77)	38
University of Wisconsin-Milwaukee (48)	109
Marquette University (47)	111

WYOMING

None of the systems, institutions, or universities in Wyoming reported sufficient data for us to include them in our analysis.

The University of Wyoming, a four-year research institution, operates the Wyoming Technology Transfer and Products Center, which helps faculty, students and other Wyoming residents protect and commercialize their intellectual property.

The state has made changes to foster innovation since the data analyzed in our report, forming new organizations and initiatives. The Health & BioScience Innovation Hub for the State of Wyoming is a publicprivate partnership set up to facilitate the biosciences and includes SPARK Wyoming, which made its first grants of up to \$50,000 to support and fund promising translational research.⁴⁸

In 2021, the governor used federal funds to launch the Wyoming Innovation Partnership, which provides funding for universities and community colleges. Among a number of educational programs and initiatives are efforts to support technology transfer and to foster research partnerships between universities and the private sector.⁴⁹

WASHINGTON D.C.

At George Washington University (No. 96), the Technology Commercialization Office offers virtual networking to the GWU community through the GW Commercialization Advising Network (GW CAN). It holds an innovation competition and collaborates with Georgetown University (97) on the DC Startup Showcase, where entrepreneurs can seek funding to help commercialize their high-impact research.⁵⁰ Catholic University of America (156) claimed the most academic articles cited in industry patents per dollar of research expenditures. This reflects an impressive number of academic articles cited in industry patents (ranking 84th in raw terms) despite having the 15thlowest research expenditures of all the universities considered.

UNIVERSITIES (INDEX SCORE)	RANK
George Washington University (55)	96
Georgetown University (55)	97
Catholic University of America (23)	156



ENDNOTES

¹ Feldman, M., Gates, M., Ratnatunga, M., DeVol, R., & Shideler, D., (2022, May 6). "Research to Renewal: Advancing University Tech Transfer." Heartland Forward, <u>https://heartlandforward.org/case-</u> study/research-to-renewal-advancing-university-tech-transfer/

² Well-funded private universities and those publics that have benefited from a home-run invention have the highest rankings in our prior report.

³ Feldman, M.M. & Stewart, I.I. (2007), Well-springs of Modern Economic Growth: Higher Education, Innovation and Local Economic Development. Annual World Bank Conference on Development Economics, edited by Justin Yifu Lin & Boris Pleskovic. Washington, D.C., World Bank Press.

⁴ The University of Georgia was chartered in 1785 and admitted its first students in 1801. The University of North Carolina at Chapel Hill was chartered in 1793 and admitted students in 1795. Each has a distinct basis for the claim of being the oldest American university: North Carolina was the first to hold classes and graduate students, while Georgia was the first to charter a public university. Thus began the competition among states for institutions of higher learning. The idea of sponsoring public higher education quickly spread. See Roger L. Geiger, The History of American Higher Education (2014)

⁵ The Morrill Act (1862) provided federal land to states to sell for the purpose of raising funds to establish colleges. The 1890 Amendment provided for the establishment of 19 universities designated as historically Black colleges and universities (HBCUs).

⁶ The Servicemen's Readjustment Act of 1944 was created to help veterans of World War II. The impacts are documented in Suzanne Mettler, Soldiers to Citizens: The G.I. Bill and the Making of the Greatest Generation (Oxford University Press, 2005). The Readjustment Benefits Act of 1966 permanently extended educational benefits to all veterans of the armed forces.

⁷ We elected not to use the 2020 AUTM data, which was released as this report was being prepared. Due to the pandemic, 2020 is an atypical year, with fewer institutions reporting and many universities forgoing formal tech transfer to get COVID testing, vaccines and treatments into use.

⁸ Feldman, M., Gates, M., Ratnatunga, M., DeVol, R., & Shideler, D., (2022, May 6). "Research to Renewal: Advancing University Tech Transfer." Heartland Forward, <u>https://heartlandforward.org/case-</u> study/research-to-renewal-advancing-university-tech-transfer/.

⁹ Feldman, M., Gates, M., Ratnatunga, M., DeVol, R., & Shideler, D., (2022, May 6). "Research to Renewal: Advancing University Tech Transfer." Heartland Forward, <u>https://heartlandforward.org/case-</u> study/research-to-renewal-advancing-university-tech-transfer/

¹⁰ Ibid.

¹¹ Price, S.E. & Siegel, D.S. (2019). "Assessing the Role of the Federal Government in the Development of New Products, Industries, and Companies: Case Study Evidence since World War II." Annals of Science and Technology Policy: 3(4): 348-437. ¹² AUTM allows educational institutions to report either as a system or by campus. Our previous report, "Research to Renewal: Advancing University Tech Transfer," focused exclusively on educational institutions that reported by campus. In this report, we share rankings across university systems and other research institutions, and we include the previously reported campus rankings to provide a comprehensive profile of research activity in a given state.

¹³ Bryant, B. (October 21, 2022). New life sciences fund announced to spur UAB innovation commercialization. University of Alabama Birmingham. Retrieved May 18, 2022, from <u>https://</u> www.uab.edu/news/research/item/12385-new-life-sciences-fundannounced-to-spur-uab-innovation-commercialization

¹⁴ Alabama Innovation Commission. (October 2021). "Innovate Alabama: Alabama Innovation Commission Report." Alabama Innovation Commission. Retrieved May 18, 2022, from <u>https://</u> innovatealabama.org/wp-content/uploads/2021/12/commission report.pdf

¹⁵ Arizona Board of Regents. (n.d.). Technology Transfer. Retrieved May 18, 2022 from <u>https://www.azregents.edu/</u> technology-transfer

¹⁶ University of Arkansas Office of Entrepreneurship and Innovation. (n.d.). Commercialization Retreat. Retrieved May 18, 2022, from https://entrepreneurship.uark.edu/programs/ commercialization-retreat.php

¹⁷ Arkansas Research Alliance. (n.d.). About ARA. Retrieved May 18, 2022, from <u>https://aralliance.org/about/#about</u>

¹⁸ Venture Partners at CU Bolder. (n.d.). Ascent Deep Tech Accelerator. University of Colorado Boulder. Retrieved May 18 2022, from <u>https://www.colorado.edu/venturepartners/what-we-</u> do/entrepreneurial-training/ascent-deep-tech-accelerator

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²¹ Aldrich, A.Z. (2020, September 1). "UConn Receives \$8 Million to Continue Air Force Research Lab Project in Advanced Manufacturing." UConn Today. Retrieved May 16, 2022, from https://today.uconn.edu/2020/09/uconn-receives-8million-continue-air-force-research-lab-project-advancedmanufacturing/

²² Delaware Biotechnology Institute. (n.d.). ARC. Delaware Bioscience CAT. Retrieved May 19, 2022, from <u>https://cat.dbi.udel.</u> edu/grants.php

²³ University of Hawaii. (n.d.) Hawaii Innovation Initiative (HII). Retrieved May 19, 2022, from <u>http://blog.hawaii.edu/</u> strategicdirections/hawaii-innovation-initiative/ ²⁴ Feldman, M. et al. (2022, May 13). "Research to Renewal: Advancing University Tech Transfer." Heartland Forward.

²⁵ Indiana University. (n.d.). "IU's pharmaceutical pipeline features innovative technologies for disease treatment." Retrieved May 19, 2022 from <u>https://research.impact.iu.edu/more-iu-research/</u> stories/ico-pipeline.html

²⁶ Kansas Department of Commerce. (February 2021). "Kansas Framework for Growth." Retrieved May 19, 2022 from <u>https://</u> www.kansascommerce.gov/kansas-framework-for-growth/

²⁷ University of Kentucky Office of Technology Commercialization. (n.d.). "Advancing Innovation that Makes a Difference." Annual report, 2020. Retrieved May 19, 2022, from https://www.research.uky.edu/office-technologycommercialization

²⁸ Schwartz, J. (2022, March 16). "Kentucky program will help students and faculty in the tech commercialization process." Tech Transfer Central, Retrieved May 19, 2022, from <u>https://</u> techtransfercentral.com/2022/03/16/kentucky-program-willhelp-students-and-faculty-in-the-tech-commercializationprocess/

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