From Insights to Impact

Fostering Innovation Through Texas Higher Education

Texas Higher Education
COORDINATING BOARD
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Letter from the Commissioner

Higher education institutions are essential engines for our state's economic growth and development. Colleges and universities educate, reskill, and upskill our workforce to produce the talent Texas businesses and economies rely on.

Texas higher education also drives our state's ability to compete through research, development, and innovation. Groundbreaking work across Texas campuses expands the frontiers of human knowledge and transforms our world.

Translating cutting-edge discoveries and innovations from our research laboratories and classrooms to the marketplace must be a top priority for Texas to compete into the future. Over the past two decades, policy decisions and state investments have laid the groundwork for extraordinary growth, and it is critical we strategically bolster and leverage our state's higher education research and development infrastructure.

Making Texas the best place for new startups to thrive, investments to flow, and talent to grow is crucial to our state's future in the innovation economy.

This is why our state strategic plan for higher education, *Building a Talent Strong Texas*, includes bold goals for increasing educational attainment, awarding credentials of value, and strengthening research and development. This year, the 88th Texas Legislature committed billions of dollars to help advance these goals and provide a path forward.

However, increased funding is only one piece of this equation. To sustain our state's global competitiveness, we must work together, fostering greater collaboration across higher education institutions, industry experts, investors, and community leaders. In particular, accelerating the translation of research discoveries from university laboratories to the marketplace is one of the most important ways we can generate more value and support our state's continued economic growth.

This report examines the current national landscape of higher education research and development to help gauge our state's current position and identify opportunities to drive further innovations into the future. I want to thank the hundreds of people across Texas who participated in this review and planning process. Their time, contributions, and insights were invaluable to this project.

Respectfully,
Harrison Keller, Ph.D.
Commissioner of Higher Education

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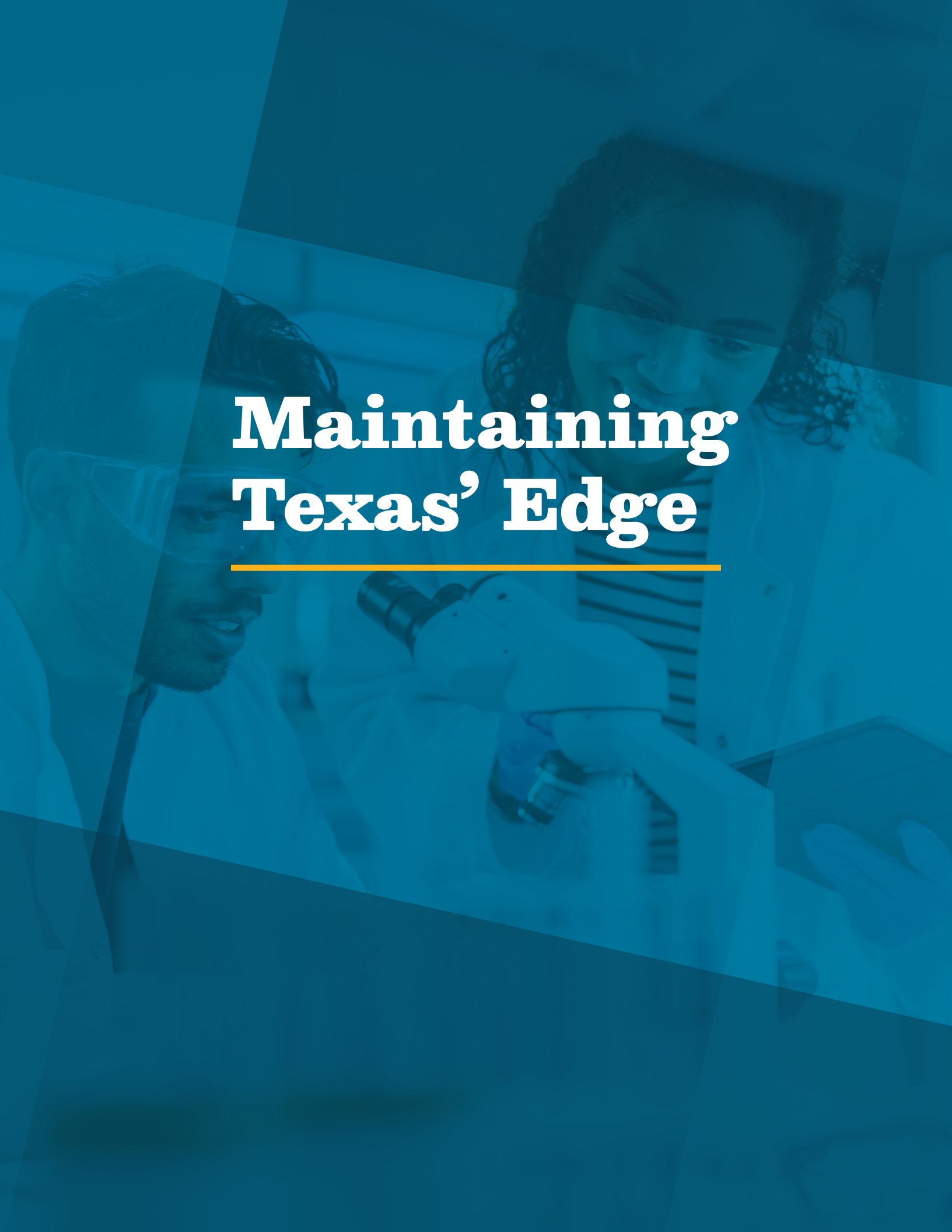


Maintaining Texas' Edge

MAXIMIZING THE BENEFITS OF ACADEMIC RESEARCH AND TECHNOLOGY

Higher education institutions play an essential role in Texas' global economic competitiveness. They provide the talent and innovation that gives the state its competitive edge. The COVID-19 vaccine, ethernet, plasma screens, and e-readers are just a few of the thousands of ideas that were born out of U.S. universities. These innovations have fundamentally changed the way people live. It is increasingly clear, however, that these breakthroughs cannot happen without robust supports designed to grow, advance, and translate ideas into successful commercial products.

...the Lone Star State is well positioned to become one of the nation's leading states for innovation and technology transfer.

Strong innovation ecosystems allow new ideas—and new companies—to flourish. Texas has the ingredients to compete with world-renowned innovation ecosystems like Silicon Valley and Boston's Route 128: top-tier research universities; science, technology, engineering, and math (STEM) talent; cutting-edge companies; and diversified funding streams relative to peer states. With these building blocks, the Lone Star State is well positioned to become one of the nation's leading states for innovation and technology transfer. But translating academic research into commercially viable products and companies is an ongoing challenge.

While Texas has the necessary elements, there is an opportunity to develop more robust, regionally focused innovation ecosystems that leverage higher education institutions to create economic benefit. A more consistent and coordinated approach to support commercialization across its many research institutions would enable Texas to better leverage the full potential of its higher education research and technology. Navigating the size of the state and its vast higher education institutions can be a challenge to investors, industry partners, and others seeking to support innovation in Texas. The scale of statewide infrastructure investments needed for these ecosystems to thrive—access to risk capital, highly skilled workers, and reliable broadband—is another.

A more strategic and coordinated approach will be needed to address these challenges. To ensure Texas' continued competitiveness, state leaders must continue to evolve their understanding of innovation ecosystems. Creative collaborations that foster successful commercialization are a means to that end. Doing so will require ongoing support for research and development (R&D) and commercialization efforts at Texas higher education institutions. Broader adoption of promising practices from leading institutions and economies across the world can also foster stronger innovation and commercialization efforts at Texas higher education institutions.

The Texas Higher Education Coordinating Board (the Coordinating Board) is committed to working with higher education institutions to advance the vision of Texas as a leader in translating basic and applied research into innovations that benefit individual Texans' lives and drive economic growth.

Generating knowledge and driving discovery are core tenets of *Building a Talent Strong Texas*, the state's strategic plan for higher education. In addition to bold goals for increasing educational attainment and awarding credentials of value, the plan recognizes that the state's future competitiveness requires a much stronger R&D infrastructure.

Building a Talent Strong Texas creates ambitious milestones for R&D and innovation. It aims to increase annual private and federal sponsored research by $1 billion by 2030 and to increase annual research doctorate awards to 7,500. Attracting major investments of private capital and federal grants to more colleges and universities will be essential. With that investment, Texas can be a stronger leader at the frontiers of knowledge, technology, and discovery.

Increased research funding and more doctorates are just the beginning. Strengthening higher education's role in creating a thriving ecosystem for research, development, and innovation requires a broader effort, one that makes an explicit link to economic competitiveness. With support from the Texas Higher Education Foundation and funding from the U.S. Economic Development Administration, the Coordinating Board engaged TIP Strategies, an economic development consulting firm, to assist with the preparation of a statewide plan focused on technology innovation and commercialization at Texas higher education institutions.

Identifying opportunities to improve the technology transfer process was a central aspect of this work: how university technology transfer offices (TTOs) can learn from each other and how they can better ensure that new ideas and new companies are anchored in the state. To make this possible, increased investment is also required to strengthen innovation ecosystem assets and put in place foundational supports that address corporate partnerships, capital access, and workforce development. *From Insights to Impact: Fostering Innovation Through Texas Higher Education* provides a roadmap for achieving those objectives, closing gaps in regional ecosystems across the state, and maximizing the return on investment in the state's academic research and technology development. The accompanying deliverable, *From Insights to Impact: The Technical Appendix*, provides further details about this work and how leaders across the state can collectively strengthen innovation and commercialization within Texas higher education.

Strengthening higher education's role in creating a thriving ecosystem for research, development, and innovation requires a broader effort, one that makes an explicit link to economic competitiveness.

What is technology transfer?

Technology transfer, sometimes known as technology development, is the process of transferring innovations from academic research into commercial products. As an example, researchers at a university develop a new technology, which they then submit to the university through invention disclosures. From there, the university evaluates the disclosures and considers protecting the intellectual property (IP) it represents, typically through patents. Once the IP is protected, the university licenses the IP to companies through a licensing agreement with an existing business or with a newly formed startup. This licensing agreement may include one-time licensing fees or a provision for a portion of revenues to come to the university. The companies then develop and market products using the IP and, ideally, are successful in the market, generate revenue, and reinvest a portion of revenue back into research and education at the university.

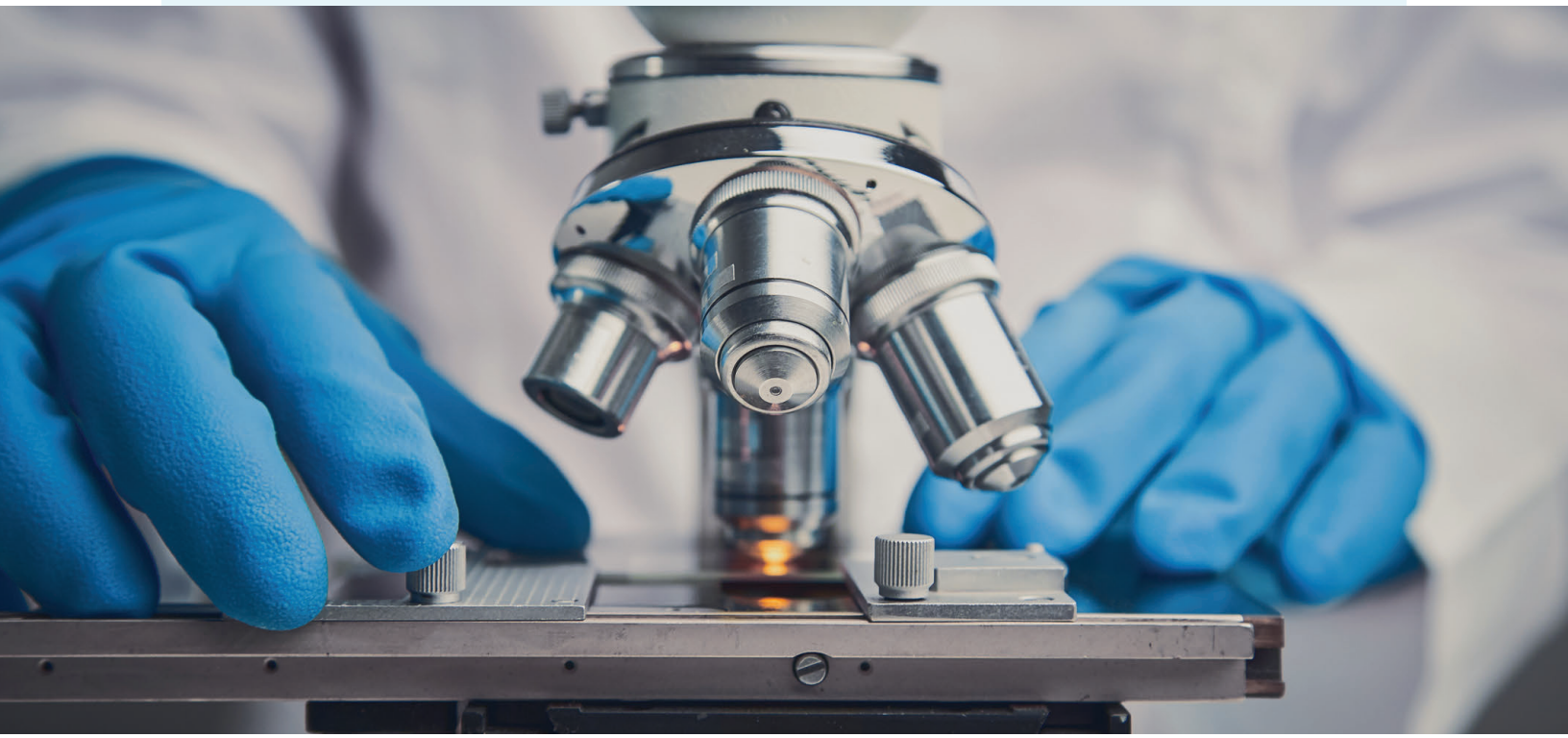
How Does Texas Compare?

BENCHMARKING TEXAS' PERFORMANCE

By several measures, Texas has seen tremendous growth in R&D activity, supported by significant investments by the Legislature. An in-depth data analysis benchmarked Texas' performance relative to peers in three areas: higher education research activity, technology transfer outputs, and innovation investment impacts (see Figure 1). These measures, however, are not perfect. R&D, technology transfer, and innovation are long-term processes, and the measures highlighted provide only a limited snapshot of Texas' performance. To truly bolster the state's economic competitiveness in these areas, state and institutional leaders will need to allocate resources and track the progress of these efforts for years to come.

Figure 1. Data Analysis Overview

Source: TIP Strategies, Inc.



SIGNIFICANT GAINS IN RESEARCH FUNDING AND TALENT

With thousands of colleges and universities in the U.S., the Carnegie Classification of Higher Education Institutions deemed only 146 as Research 1 (R1) institutions in 2022. This R1 designation, defined as an institution exhibiting "very high research activity," is based on measures like research spending, staff levels, and the number of doctorates awarded.[1] Achieving R1 status reinforces an institution's ability to attract top-tier faculty members and students in addition to strengthening its role as an economic driver.

A decade ago, Texas had only four R1 institutions. Today, Texas is home to 11 R1 universities and 11 Research 2 (R2) universities (categorized as having "high research activity"). That number ties Texas with California and New York for the highest number of R1 institutions. Nine of Texas' R1 designations are awarded to public institutions, the highest number among all 50 states. This report uses the Carnegie Classification to describe research universities because of its broader reach and applicability for national benchmarking. However, it is important to note that Texas has its own university grouping system, one commonly referenced by the Texas Legislature and the Coordinating Board (see Texas Public University Peer Groupings).

Texas Public University Peer Groupings

In 2004, Texas developed a system for grouping higher education institutions to support performance benchmarking among universities. The groups, along with criteria for the groupings, are revised on a periodic basis by the Coordinating Board. Texas' system has five groups – research, emerging research, doctoral, comprehensive, and master's. The focus of this report is on the three groups that include criteria on R&D expenditures:

- **Research universities** award 200 or more PhD degrees annually and generate at least $150 million in restricted research expenditures, adjusted for inflation. As of September 2020, the adjusted threshold was approximately $193 million.
- **Emerging research universities** award at least 30 PhD degrees annually and generate at least 20% of the research universities' criteria for restricted research expenditures, which was approximately $38 million in 2020.
- **Doctoral universities** are expected to reach three of the following four criteria: award at least 10 PhD degrees annually, offer at least five doctoral research programs, enroll at least 150 doctoral students, or generate at least $2 million annually in restricted research expenditures.

Along with an increase in R1 institutions, the number of research doctorates awarded by Texas institutions of higher education is also on the rise. With over 5,200 doctorates awarded in 2022, the state is on its way to reaching its goal of awarding 7,500 research doctorates annually. These doctorates are essential to developing and mentoring graduates who have learned to work at the frontiers of their disciplines and world-class future faculty for Texas institutions.

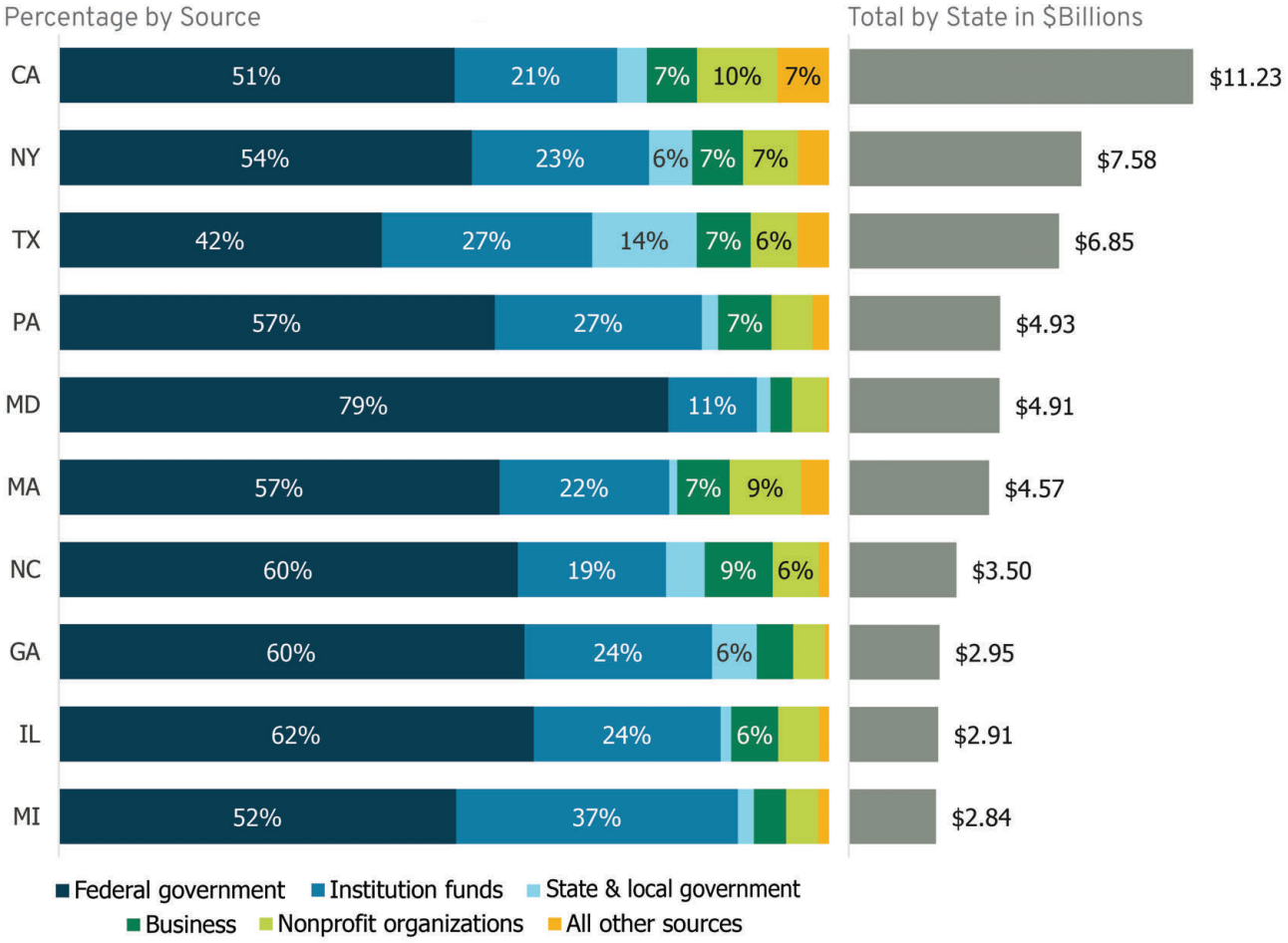
Texas' academic R&D expenditures (including both public and private institutions) have also increased at a steady rate. In 2021, Texas higher education institutions generated over $6.8 billion in academic R&D expenditures, with $5.8 billion of that at public institutions in Texas. Recent news of significant federal dollars available for research and innovation, coupled with the major investments made by the 88th Texas Legislature, suggests academic R&D funding is likely to see even more growth over the coming years.

1 The Carnegie Classification of Higher Education Institutions is currently under review. The American Council on Education, which helps manage the classifications, is developing significant revisions that will be made effective in 2025.

Overall, Texas has a more diversified mix of R&D funding sources compared to other states (see Figure 2). While federal funds make up the largest share of Texas' research expenditures, just 42% of Texas' funding—roughly two out of every five dollars—came from the federal government in 2021. Unlike states such as Maryland (79%), Illinois (62%), North Carolina (60%), and Georgia (60%), Texas' share of funding from the federal government is the lowest share among the top 10 states by higher education R&D expenditures.

Institutional funds comprised the next largest source, representing 27% of total R&D funding in 2021, well above states such as Maryland (11%) and North Carolina (19%). One of the most striking differences among the peers is the share of R&D funding Texas institutions receive from state and local government, which at 14% was the highest among the peers. Funding from businesses (7%), nonprofits (6%), and other sources (4%) rounded out the total for Texas.

Figure 2. Top 10 States by Higher Education R&D Expenditures, 2021



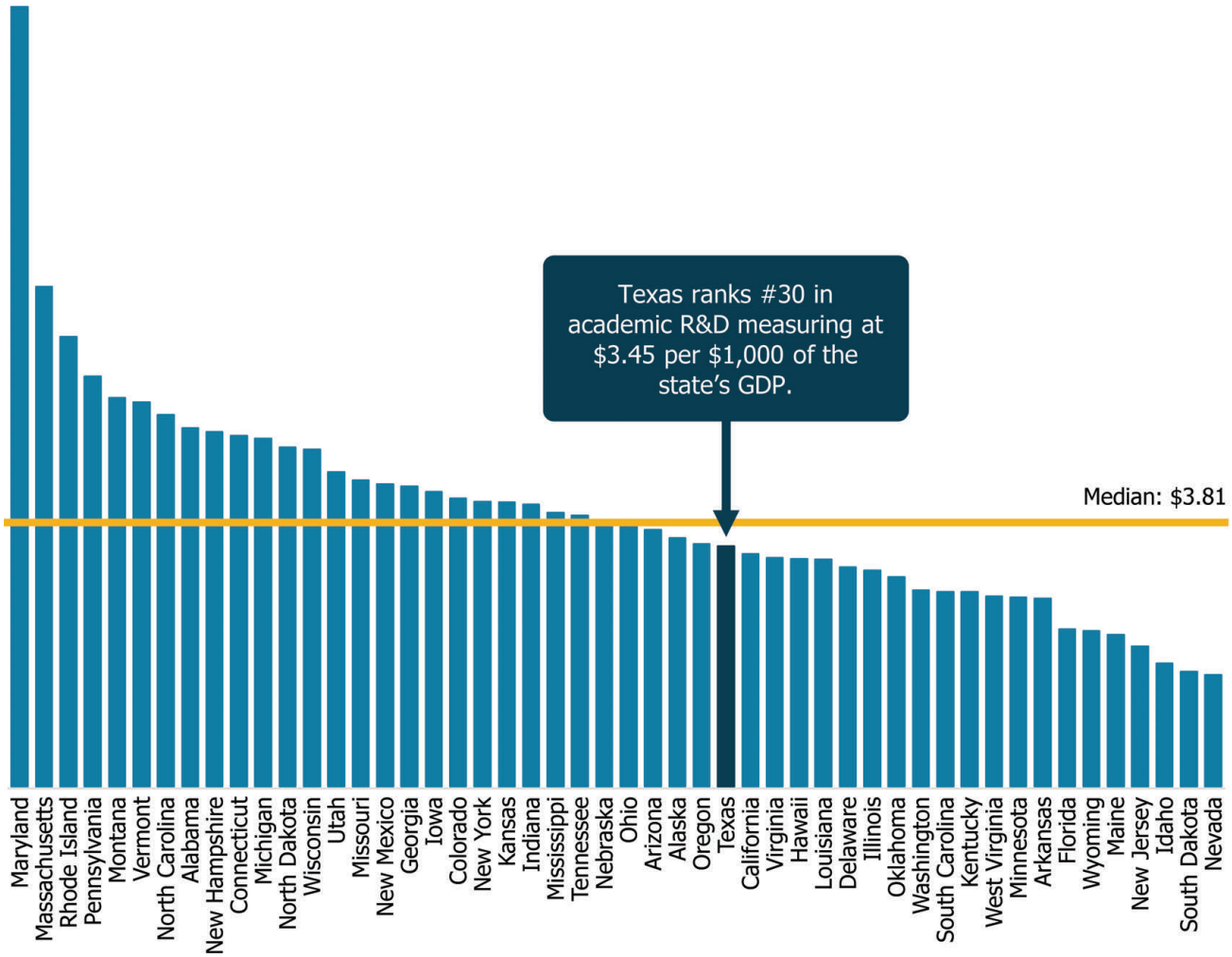
Sources: National Science Foundation, National Center for Science and Engineering Statics, Higher Education Research and Development Survey 2021; TIP Strategies, Inc.

Despite Texas' relatively diversified funding streams, the data suggest considerable untapped potential. This includes aligning institutional commercialization efforts with industry needs. The state's broad range of major industries can certainly make this easier. For example, states like North Carolina are focusing their academic R&D funding toward industries vital to their economy. In 2021, 72% of North Carolina's R&D funding was focused on life sciences. North Carolina remains a top competitor to Texas for business attraction and expansion in biosciences. To accelerate the state's economic growth and global competitiveness, academic research with commercialization potential can be linked more directly to regional industry needs and to the needs of the state's economy today and over the next decade.

ECONOMIC GROWTH OUTPACES INCREASES IN R&D FUNDING

For a holistic understanding of Texas' competitive position, context is key. As discussed in the prior section, Texas compares favorably to other states, ranking third in the nation for academic R&D expenditures generated in 2021, behind California and New York. Looking at academic R&D expenditures in the context of the state's overall economy, however, Texas is below the median. Even with Texas' gross domestic product (GDP) putting the state as one of the top 10 economies in the world, Texas ranks 30th in the nation for the amount of academic R&D generated relative to its GDP. Texas spent just $3.45 per $1,000 of the state's GDP in 2021 on academic R&D (see Figure 3). Given the seismic impact of the state's economy and the large number of research institutions in the state, a renewed focus on research, development, and innovation in Texas is warranted.

Figure 3. States by Academic R&D per State GDP, 2021



Sources: National Science Foundation, National Center for Science and Engineering Statics, Higher Education Research and Development Survey 2021; TIP Strategies, Inc.

INCREASED R&D FUNDS AREN'T LEADING TO PROPORTIONAL TECH TRANSFER GAINS

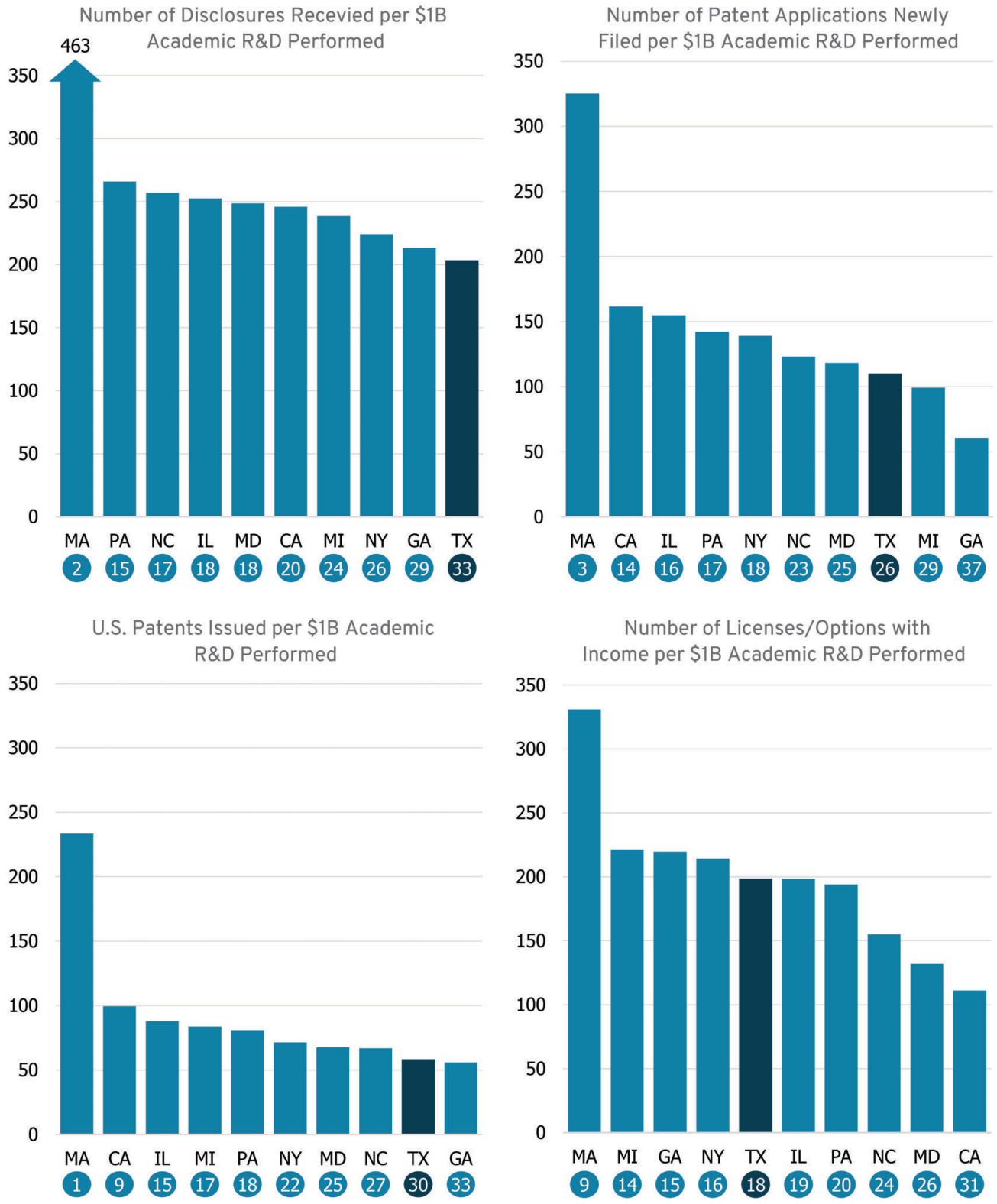
While boosting research doctorate completions and R&D funding enhances research activities, it does not guarantee a proportional increase in the successful commercialization of university-generated IP.

Over a 10-year period at Texas higher education institutions, invention disclosures increased 22%, patent applications increased 8%, and the number of U.S. patents issued increased 43%. In 2021, Texas ranked fourth in the nation for number of invention disclosures and patent applications filed from higher education institutions in the state, falling behind only California, Massachusetts, and New York. Texas tied with Pennsylvania in fifth place for the number of U.S. patents issued to higher education institutions in 2021. Texas ranked fourth for number of licenses (or other income-generating options) held by higher education institutions in 2021. While these basic output measures do not necessarily indicate the effectiveness of a university's research or the potential commercial success of its intellectual property, they do serve as helpful measures to gauge the health of the technology transfer process.

However, the data reveal that Texas has room for growth in technology transfer outputs in the context of academic R&D expenditures. For every billion dollars of academic R&D funding spent in 2021, Texas higher education institutions received 203 invention disclosures, filed 110 new patent applications, had 58 U.S. patents issued, and held 199 licenses (or other income-generating options). By those measures, Texas ranks 33rd for number of disclosures, 26th for number of patent applications filed, 30th for U.S. patents issued, and 18th for licenses (or other income-generating options) at higher education institutions relative to academic R&D funding (see Figure 4).

Technology transfer outputs like invention disclosures and patents are key components to the process of translating research into commercial products. Additional investments in and support for commercialization efforts will help improve Texas' rankings of technology transfer outputs relative to R&D funding.

Figure 4. Selected Technology Transfer Outputs at Higher Education Institutions, 2021



Sources: AUTM Statistics Access for Technology Transfer Database (STATT); National Science Foundation, National Science Board Science and Engineering Indicators; TIP Strategies, Inc.
Notes: AUTM data represent an aggregation of self-reporting by universities in those states. States included represent the top 10 by higher education R&D expenditures in 2021. Rankings among the 50 states appear in circles.

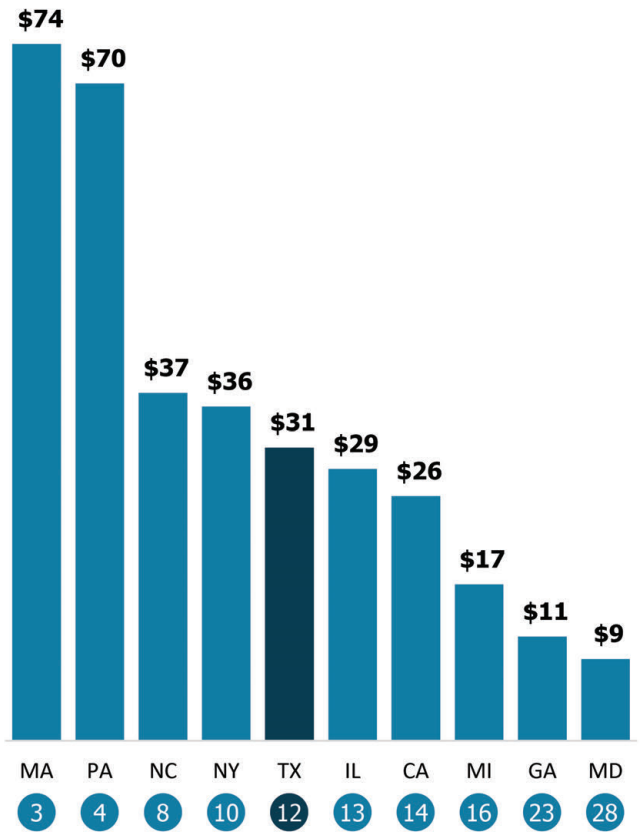
ECONOMIC BENEFITS FALL SHORT

Looking to broader outcomes of technology transfer, data from the Association of University Technology Managers (AUTM) rank Texas as twelfth in the nation for gross license income compared to academic R&D funding (see Figure 5).

Notably, Texas is the top state in the nation for creating associated startups using university IP, with 532 new companies formed in 2021. Yet in the same year, Texas universities indicated that only 27 of associated startup companies formed in prior years remained in the state. Instead, companies are being acquired by firms outside of Texas—which is considered a successful outcome for the startup—or the companies are relocating out of state. In other words, even though Texas may be creating many companies with IP from its higher education institutions, it is not retaining those companies in the state. As a result, the full economic benefits of those companies are not being returned to the local and state economies where they were formed.

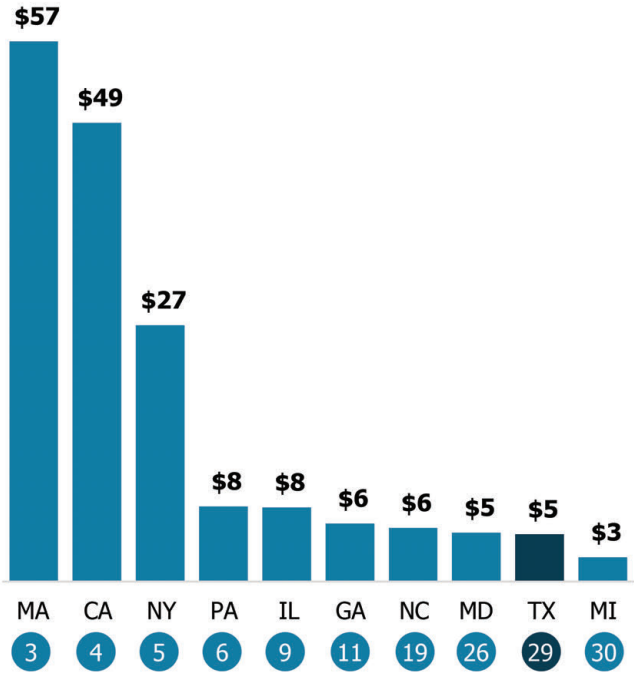
This situation may be in part due to the need for companies to relocate to regions with the access to capital, talent, networks, and other supports that major venture capital firms provide. For example, 90% of venture capital invested in Texas companies over the last five years originated outside of the state. That fact, coupled with Texas' 21st-place ranking in total venture capital disbursed relative to the state's GDP (see Figure 6), means that more can be done to ensure that university-generated IP stays in Texas. Increasing access to risk capital could boost retention of university-generated IP in Texas and maximize the state's return on investment (ROI).

Figure 5. Gross License Income per $1 Billion Academic R&D Funding, 2021



Sources: AUTM Statistics Access for Technology Transfer Database (STATT); National Science Foundation, National Science Board Science and Engineering Indicators; TIP Strategies, Inc.
Notes: States included represent the top 10 by higher education R&D expenditures in 2021. Rankings among the 50 states appear in circles.

Figure 6. Total Venture Capital Disbursed per $1B State GDP, 2021



Sources: National Science Foundation, National Science Board Science and Engineering Indicators; TIP Strategies, Inc.
Notes: States included represent the top 10 by higher education R&D expenditures in 2021. Rankings among the 50 states appear in circles.

COORDINATED EFFORTS ARE NEEDED FOR TEXAS TO REACH ITS FULL POTENTIAL

At first glance, Texas is performing well in basic measures of the technology transfer process at higher education institutions—R&D funding, research doctorates, invention disclosures, startups formed to license IP generated at Texas universities, and more. But when contextualizing the measures against the state's economy or academic R&D expenditures, a different picture emerges.

By signaling the importance of R&D and innovation, *Building a Talent Strong Texas* provided a renewed focus to this work. The Texas Legislature is actively investing to advance R&D and innovation with the Texas University Fund, a nearly $4 billion endowment for qualifying universities to expand their research activities, and nearly $700 million for university research and development of semiconductors. Continued investments of resources and partnerships can accelerate these efforts at Texas higher education institutions. The impact of this work will improve higher education institutions' innovation efforts and help the state maintain its economic competitiveness.

Insights Learned

LESSONS FROM THE FIELD

While data tell part of the innovation story in Texas, the individuals responsible for R&D initiatives and innovation provide invaluable insights and additional context. To support this work, the Coordinating Board engaged over 400 individuals ranging from investors, industry representatives, institutional technology transfer office (TTO) staff, and higher education leadership, in the development of this plan. Their experience-based insights highlighted challenges and opportunities to strengthen R&D and innovation in the state. The stories shared during this process, along with key findings from data analysis, informed and guided the direction of the recommendations in *From Insights to Impact: Fostering Innovation Through Texas Higher Education*. Here are some of the insights:

1 Demand-driven innovation can lead to greater commercial success.

Not all R&D is viable for commercialization, nor does it need to be. For IP where market entry is the goal, Texas higher education's approach to R&D for successful commercialization can be reframed. Instead of looking for end users of a technology after the technology has been developed, researchers would achieve better commercialization outcomes through a more demand-driven approach. This shift from a "push" model to a "market pull" mindset requires supporting faculty interested in commercialization with more engagement with industry, investors, and other business partners earlier in the R&D process. Starting with an industry problem or a specific market demand can lead to more practical pathways for successful commercialization.

2 Higher education needs resources and support to strengthen its capacity to respond to industry needs.

To find a stronger balance between the "push" model and "market pull" mindset, it is crucial to test ideas for technological feasibility and alignment with market needs. Higher education institutions need support to build their capacity for commercial validation. This requires additional resources, like proof of concept funding to test and evaluate IP. Additional support could include tapping into industry expert panels for due diligence. Institutions can also work to expedite licensing, adopt business-friendly contract terms, and maintain transparent procedures to help investors better navigate their technology transfer processes.

3 Successful technology transfer can benefit from regional flexibility and additional statewide supports.

Texas is home to a large number of higher education institutions and systems. The diversity of institutions in the state is a major advantage, and each institution has a unique role to play in supporting their local innovation ecosystems. Technology transfer can balance the need to adapt processes to address different situations with the larger need to provide campus and industry constituencies with clear, transparent, and efficient technology transfer processes. In addition, broader support and coordination across multiple institutions, within regions and across the state, can improve Texas' competitive position.

4 The pipeline for STEM and entrepreneurial talent needs reinforcement.

Developing and retaining a robust pipeline of STEM and entrepreneurial talent is foundational to commercializing university IP. In addition to increasing the number of research doctorates, Texas also needs talent to test and evaluate IP, pitch ideas to investors, and run startups. Faculty and researchers at Texas universities would benefit from stronger connections with serial entrepreneurs and executive talent who can help turn their innovative ideas into successful business operations.

5 Research commercialization can be better aligned with the needs of the state's major industries.

Finally, an overarching theme of this work was the universal need for stronger alignment between research commercialization efforts and the needs of the state's major industries. The Texas Legislature recently made significant investments to support R&D in the semiconductor and aerospace industries. By strengthening the links between academic research and the industries fueling the state's economy, Texas can encourage research, talent, and companies to stay and create more opportunities for economic growth within the state. Connecting research commercialization activities with industry needs helps ensure Texas is the best place for higher education ideas and inventions to grow and thrive.

OPERATING PRINCIPLES FROM LEADING INSTITUTIONS

While technology transfer differs across higher education institutions, colleges and universities with a track record of success have a common set of enabling conditions and cultures. These leading institutions set the standard for effective technology development by prioritizing entrepreneurship, deep connections with industry, and responsiveness to the needs of their local innovation ecosystems. Broader adoption of these principles across Texas higher education institutions would foster more substantial innovation and commercialization outcomes across the state. The following operating principles enable technology transfer practices at leading institutions to be more effective. More details about these themes are available in *From Insights to Impact: The Technical Appendix*.

Prioritization of Technology Transfer. A strong culture is reflected by institutional leaders prioritizing innovation and research commercialization. These leaders believe that entrepreneurship and commercialization are avenues for their institution to have greater impact on their communities, society, and the world. Where the technology transfer team is housed in an institution signals the importance of commercialization. Leading institutions that prioritize commercialization tend to locate technology transfer in parts of the institution with high visibility, access to institutional leadership, reach across schools and departments, and proximity to external industry and investor networks.

A Broader View of ROI. Technology transfer professionals across the country and around the world recognize that successful technology transfer is a long-term process with varying levels of risk and reward. Higher education leaders often make tradeoffs between generating revenue for their institutions, making strategic bets for future success, and serving the needs of a broad range of internal and external stakeholders. There are times when the best course of action is to take a less risky approach, such as licensing IP to existing businesses, while other opportunities call for a long-term investment in creating spin-outs, supporting entrepreneurs, or developing time-intensive technologies. Leaders of top institutions adopt the long view, understanding that success can be rare and is seldom immediate. They also recognize that return on investment can come in many forms, including revenue returned to their institutions, career development for faculty and students, increased alumni engagement, bolstering institutional reputation, and broader contribution to the economy and society.

Entrepreneurship Pathways. Leading institutions encourage entrepreneurial endeavors among faculty, students, and staff. These institutions create opportunities for more researchers to consider commercialization as a pathway for success, allowing researchers to continue using university labs to launch commercial products or faculty to serve in advisory roles in a company licensing university-generated IP. Entrepreneurship is also fostered among undergraduate and graduate students by creating pathways for cross-discipline collaboration and opportunities to develop business plans and practice pitches. Leading institutions also view entrepreneurship as a central tenet of higher education's contribution to the world alongside teaching, research, and service.

Internal and External "Customers." Institutions effective in technology transfer take a collaborative approach to developing technologies with researchers and businesses. While technology transfer at higher education institutions historically focused on serving internal stakeholders (e.g., faculty and students), a shift among leading institutions elevates external stakeholders like investors and industry partners as key customers of technology transfer. Top institutions strike a balance between providing services and value to both internal and external stakeholders, recognizing successful technology transfer requires collaboration within and beyond their college or university.

PROMISING PRACTICES FROM LEADING INSTITUTIONS

In addition to enabling conditions for success, promising practices from leading institutions in technology transfer shed light on common, scalable, and tactical approaches that can lead to success. Strengthening adoption of these promising practices across Texas higher education institutions can facilitate more efficient and effective technology transfer. The following takeaways are based on research of leading institutions with demonstrated success in technology transfer. Additional details on case studies are available in *From Insights to Impact: The Technical Appendix*.

SUPPORTING RESEARCHERS AND ENTREPRENEURS

Inventor Awareness. Leading institutions offer programs and tools that help faculty understand how to commercialize their research along with intensive support throughout the process. Inventors' guides succinctly introduce inventors to the common topics, paths, and policies they may encounter through the technology transfer process. Faculty at leading institutions can access this information at any time to learn more about resources and preferred internal processes within a specific institution. Beyond information guides, facilitating internal peer-to-peer relationships between faculty who have commercialized IP and faculty who are new to the commercialization process helps, as well.

Vetted Business Services. Researchers often need access to business providers that can supply technical and legal guidance about IP protection, company formation, and business operations. Leading institutions often provide researchers with a trusted repository of startup friendly service providers. For example, a list of attorneys to complete company formation filings or accountants to outsource financials can help when forming university spin-outs that are focused on commercializing IP from the institution.

Talent Development. Successful technology transfer practices include developing opportunities to engage a broader pool of talent, including undergraduate and graduate students, to participate in technology transfer and commercialization processes. Some technology transfer offices offer internships and other programs for students to not only participate in research but also in commercialization and startup formation. This engages students from many disciplines and fields of study to develop research, conduct market due diligence, or create physical prototypes of discoveries.

COLLABORATING ON TECHNOLOGY DEVELOPMENT

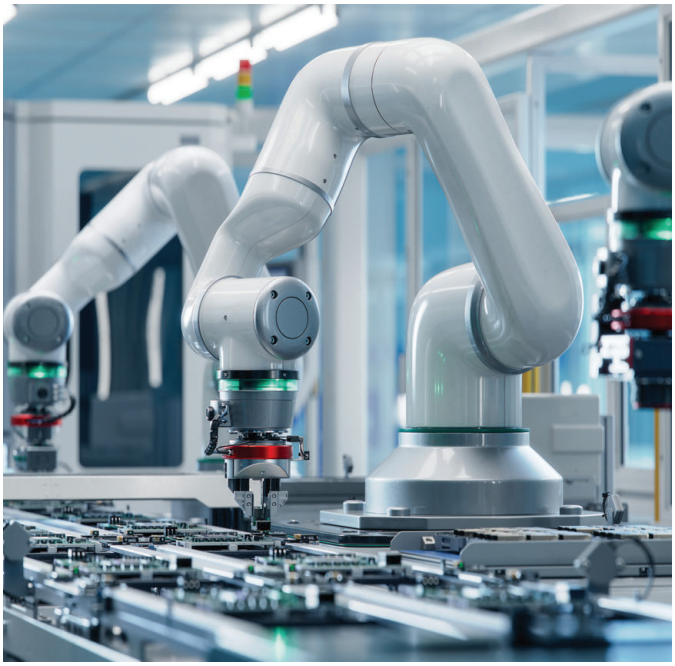
Relationship Building. Successful technology transfer requires active relationship building. It is important to maintain strong relationships early in the research process with principal investigators and the companies that may eventually license university-generated IP or support commercialization in other ways. Leading institutions actively engage researchers by going to their labs and maintain relationships with the companies that license the IP. Both of which may lead to follow-on industry-sponsored research as the companies continue to develop the IP.

Advisory Boards. A widespread practice among leading institutions is to explore the commercial viability of inventions and engage external stakeholders early, even before invention disclosures are filed. To help, some institutions convene advisory boards with industry executives, venture capitalists, and other faculty with expertise in the field of study to identify the most commercially competitive technologies. Advisory boards help explore the patentability of the invention, determine the size and growth potential of the relevant market, and make connections needed to further develop IP.

Corporate Partnerships. Another way leading institutions foster collaborative technology development is by forming corporate partnerships that explore innovation beyond one-time research projects. For example, some institutions offer corporate membership models that allow industry to access institutional research without entering a formal research contract and allow the institution to understand industry demand signals. Others may use a simple master collaboration agreement with confidentiality clauses that can later be customized for more specific industry-sponsored research under the agreement.

REMOVING FRICTIONS

Business Development. A common challenge for external stakeholders, such as investors, is understanding the breadth of research and technologies available from higher education institutions. A frequent practice among leading institutions is to develop tools and relationships that provide greater line of sight into their IP portfolio. This may include sending abstracts to industry contacts segmented by market space; posting technologies on an online, searchable database; or facilitating collaboration meetings between researchers and companies.



License Agreements. Navigating differences in terms and agreements across higher education institutions is a common obstacle for investors, industry collaborators, and other external stakeholders. Where applicable, leading institutions increase transparency by posting standard license agreements or pre-prepared license agreements online, which can simplify internal processes for staff and create greater predictability for investors. For example, some licenses for software technologies rarely change, so a "ready to sign" agreement can facilitate expedited licensing processes. For deals requiring custom terms, a brief summary sheet allows both parties to quickly review all key negotiated terms. The summary sheet can then be used to generate the full agreement.

Term Negotiation. Taking research at higher education institutions from the lab to the marketplace is just the start for viable technologies and spin-outs. The inventions created, companies launched, and entrepreneurs developed still have a long road ahead to realize commercial success. Leading institutions recognize that they can set their inventors and spin-outs up for favorable outcomes by negotiating terms to facilitate the future commercial success of the IP. For example, institutions can take a certain level of equity early in the life of a spin-out and then dilute their stake after a spin-out reaches certain milestones. This allows opportunities for further growth and investment from other sources, which can help take the spin-out to the next stage of growth.

From Roadmap to Reality

RAISING THE BAR: STRATEGIC FOCUS ON INNOVATION AND COMMERCIALIZATION

Strengthening technology transfer support structures and processes at higher education institutions, bolstering regional innovation ecosystems across the state, and addressing the foundational supports needed for success cannot be achieved by any one entity alone. A wide range of stakeholders have a role in implementing this plan, from leaders at institutions of higher education to leaders in the Texas business community. With more than 400 individuals engaged in the planning process, Texas has the champions needed to bring *From Insights to Impact: Fostering Innovation Through Texas Higher Education* from roadmap to reality.

Extensive stakeholder engagement across the state and the country informed the development of this plan.

400+

Stakeholders

Engaged individuals across the state and the nation in the planning process

120+

Survey Responses

Surveyed stakeholders to prioritize and refine strategies

50+

Interviews

Facilitated one-on-one interviews with experts in technology transfer, higher education, venture capital, and industry

18

Council Members

Convened a Technology Transfer Advisory Council quarterly with leaders from higher education, state government, research organizations, the private sector, and philanthropic organizations

10

Roundtables

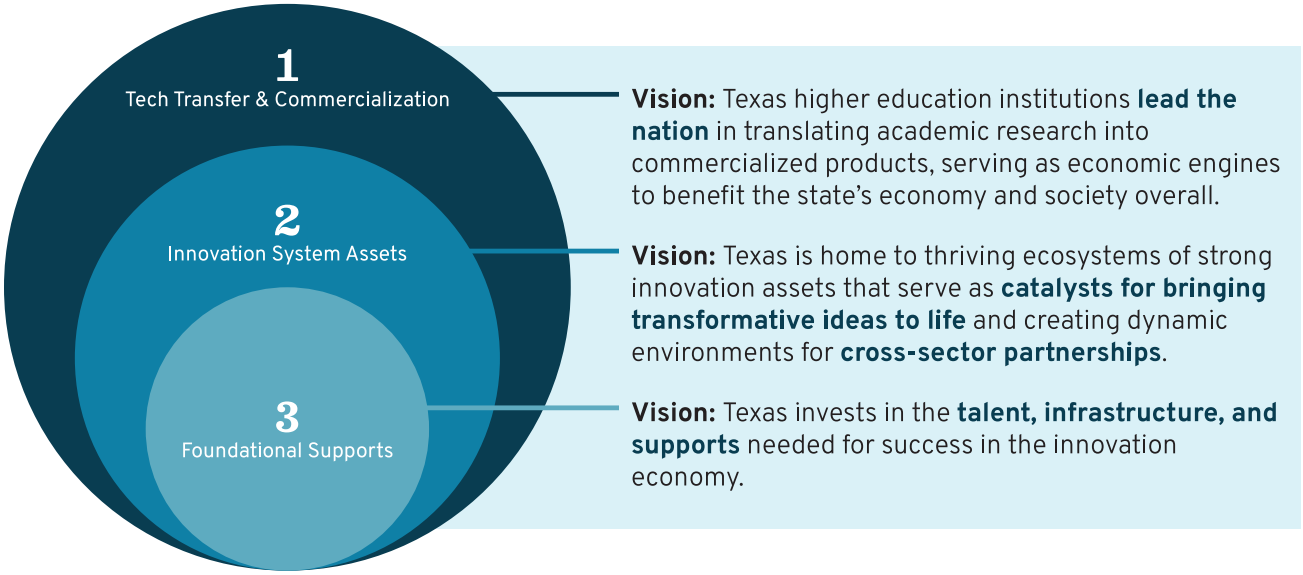
Co-hosted roundtables with regional partners and economic development organizations statewide

7

Committee Members

Established a steering committee made up of leaders from higher education, investment firms, and businesses to guide the project planning process

Figure 7. Three-Tiered Framework to Foster Innovation Through Texas Higher Education



Source: TIP Strategies, Inc.

In addition to the extensive stakeholder engagement, the project team also analyzed data to understand Texas' performance across a variety of innovation measures and reviewed promising practices from technology transfer offices and statewide innovation networks. Altogether, *From Insights to Impact: Fostering Innovation Through Texas Higher Education* provides targeted strategies aimed at easing the translation between academic research and commercial products, strengthening regional innovation ecosystems, and building a strong talent base for the innovation economy. Figure 7 displays the plan's framework with three goals: technology transfer and commercialization, innovation ecosystem assets, and foundational supports. These overarching goals represent spheres of influence for higher education institutions to affect change in R&D and innovation. Each goal lays out a clear vision for generating knowledge through basic and applied research and for translating discoveries into commercially viable products that benefit Texans and drive economic development for decades to come. In *From Insights to Impact: The Technical Appendix*, additional details are provided about the actions required for successful strategy implementation.

GOAL 1. TECH TRANSFER AND COMMERCIALIZATION

Vision: Texas higher education institutions lead the nation in translating academic research into commercialized products, serving as economic engines to benefit the state's economy and society overall.

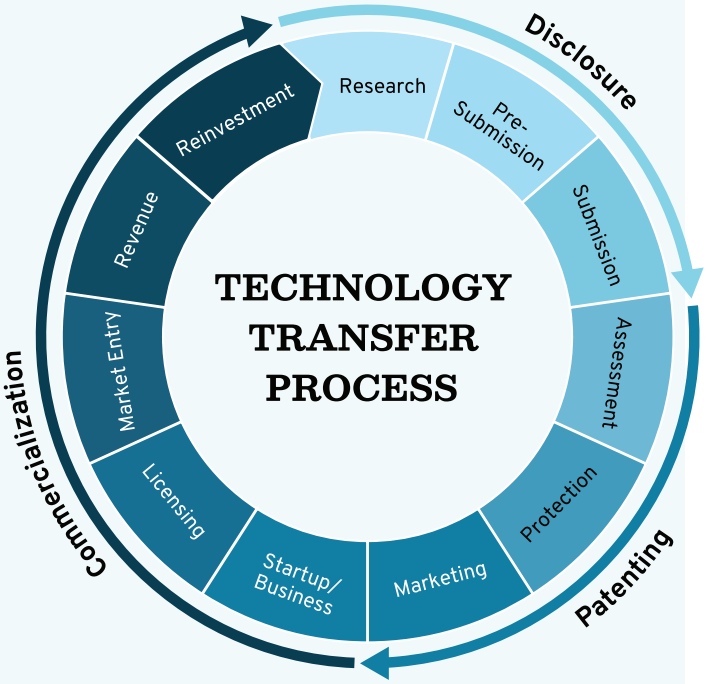
To maintain and advance Texas's economic competitiveness, the state must continue to invest in the infrastructure, capacities, and resources needed to translate academic research into commercialized products.

Institutions of higher education are engines for economic growth and development. In addition to strengthening the talent pipeline, higher education is a major driver of research, development, and innovation, largely through the technology transfer process (see Figure 8). Researchers generate knowledge through basic and applied research, develop cutting-edge innovations, and work with industry to translate discoveries into new inventions or treatments that change lives. The role of higher education in fostering innovation is critical for Texas' long-term economic prosperity and the opportunities it offers to Texans.

However, a significant portion of research conducted at higher education institutions never reaches the market. Research universities across the state prioritize commercialization outcomes to different degrees and quantify success in different ways. This means Texas is not fully leveraging the potential of academic research for the state's economic benefit. The research and development function of higher education can often be overlooked; however, it is imperative to our society and economy.

To maintain and advance Texas's economic competitiveness, the state must continue to invest in the infrastructure, capacities, and resources needed to translate academic research into commercialized products. This goes beyond R&D funding alone. There must be intentional focus and resources devoted to support technology transfer and commercialization. All institutions have a role to play in driving research and innovation in Texas—accelerating the process between idea and market entry, creating new businesses, and promoting technological development in leading fields and sectors. This will ensure that Texas shares cutting-edge technologies developed within its universities with the world, growing the state's competitive advantage that generates high-skill, high-value jobs and supports the state's major industries in upstream operations.

Figure 8. Technology Transfer Process



Source: TIP Strategies, Inc.
Note: Graphic adapted from MIT's Technology Licensing Office.

Strategies

With so many higher education institutions and systems across the state, additional strategic coordination and dedicated resources are needed for Texas to lead the nation in technology transfer and commercialization. The following strategies outline how the state can raise the bar in applied research, technology development, and commercialization to foster innovation through Texas colleges and universities.

1.1. COMMERCIAL VALIDATION

Support institutions with dedicated resources like proof of concept funding to build capacity for market validation of commercially viable inventions and technologies.

1.2. PROCESS IMPROVEMENT

Remove friction within the technology transfer process, especially to help applied research efforts respond to market needs in an efficient and effective manner.

1.3. R&D RESOURCES

Bolster higher education institutions by securing additional resources like R&D funding and specialized research talent to support technology transfer.

1.4. STATEWIDE RESOURCE CENTER

Establish a statewide resource center that provides information about grant funding and state programs to support research, development, and innovation; supports institutional training about technology transfer; and fosters opportunities for collaborative partnerships among multiple institutions.

1.5. DATA INFRASTRUCTURE

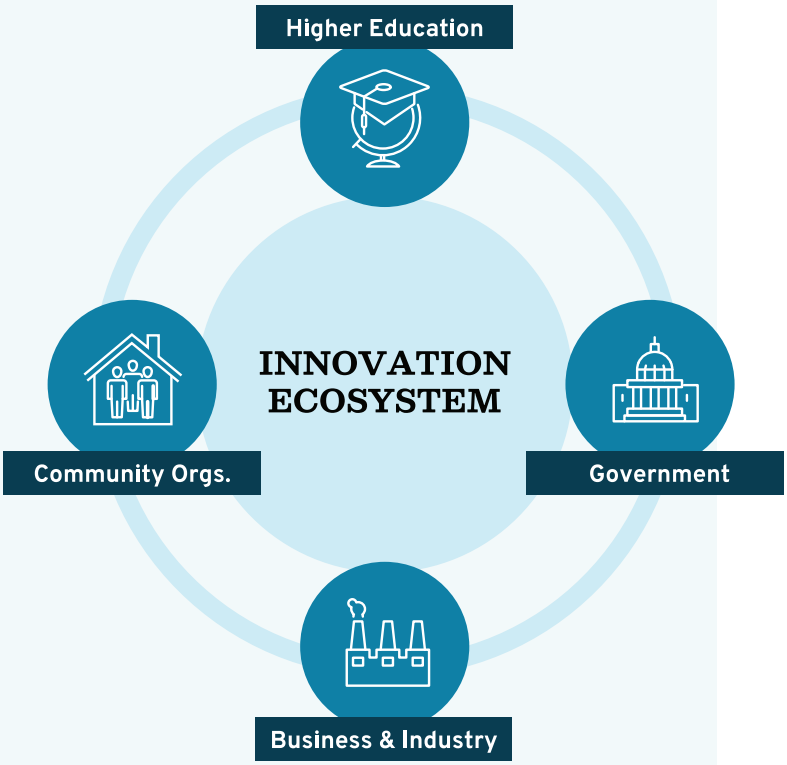
Expand statewide data infrastructure to collect R&D and technology transfer information from institutions of higher education and pinpoint opportunities for accelerated commercialization.

GOAL 2. INNOVATION ECOSYSTEM ASSETS

Vision: Texas is home to thriving ecosystems with strong innovation assets that serve as catalysts for bringing transformative ideas to life and creating dynamic environments for cross-sector partnerships.

Successful translation of academic research into commercialized products does not happen in a vacuum. While improving processes and practices is important, commercialization requires strong partnerships and robust, regionally focused innovation ecosystems that go beyond the boundaries of higher education. A strong innovation ecosystem is comprised of collaborations among higher education, government, business and industry, and community organizations (see Figure 9).

Figure 9. Innovation Ecosystem



Source: TIP Strategies, Inc.

Beyond that, successful ecosystems rely on proximity and accessibility of various innovation assets—including risk capital, incubation spaces, accelerator programs, entrepreneurial support programs, and more. Texas is home to strong innovation assets, and more can be done to strengthen the collaboration between higher education and their regional innovation ecosystems. By bridging geographic disparities and improving partnerships, different areas within Texas can contribute to the broader innovation efforts in the state and make Texas more competitive for funding and industry innovation hubs.

The path between academic research and commercial products involves more than the efforts of the higher education institutions alone.

The path between academic research and commercial products involves more than the efforts of the higher education institutions alone. It requires creative, cross-sector collaboration to capitalize on the strengths of Texas' innovation ecosystem assets. By strengthening the links between higher education institutions and their regional ecosystems, Texas can improve the pipeline from academic research to licensing deals, startup formation, and industry innovation.

Strategies

More can be done to strengthen the innovation ecosystem assets in Texas—from facilitating strong partnerships between corporations and academia to increasing access to risk capital. By implementing these strategies, Texas can reinforce collaboration between higher education and broader innovation ecosystem partners.

2.1. RISK CAPITAL

Increase access to risk capital for Texas companies by matching existing federal grant programs and private investments to make Texas the most attractive environment to grow new businesses.

2.2. CORPORATE AND ACADEMIC PARTNERSHIPS

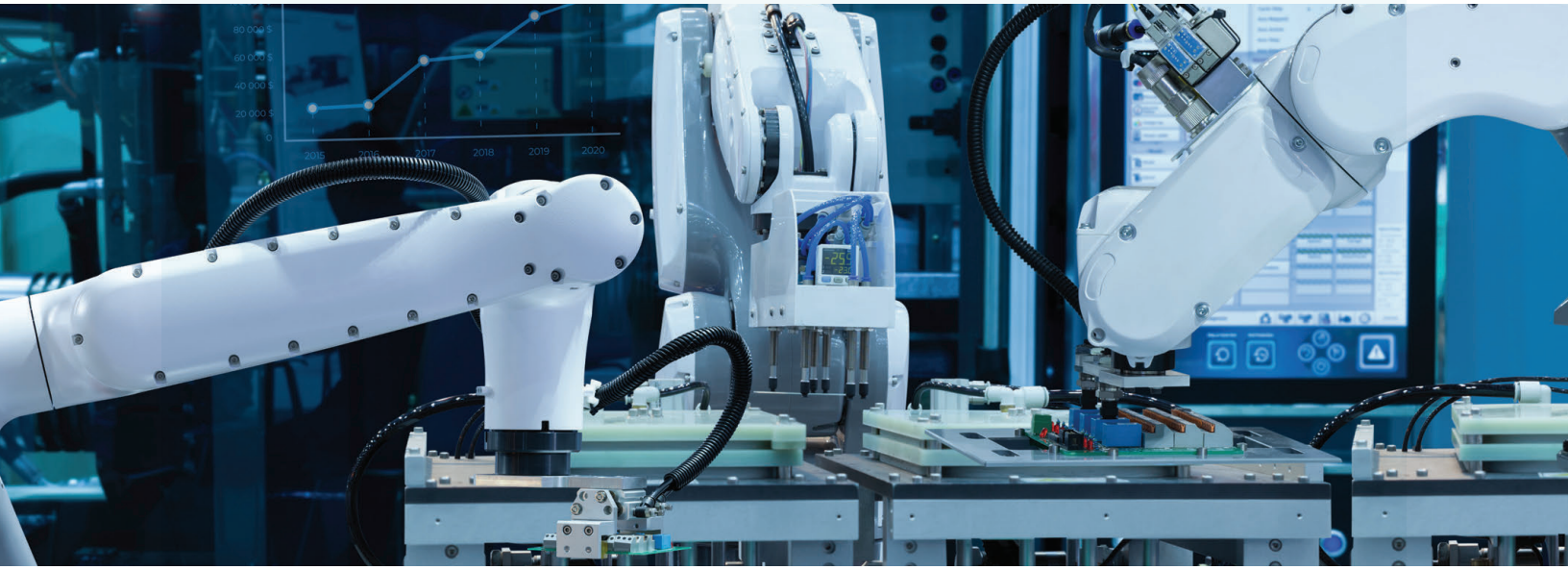
Encourage more robust partnerships between businesses and higher education institutions by increasing industry-sponsored research and strengthening their roles as anchors in regional economies across Texas.

2.3. INNOVATION SUPPORT SYSTEMS

Leverage the ongoing work of existing entrepreneurial support organizations and physical spaces like research parks and innovation districts to increase collaboration and facilitate cutting-edge innovation.

2.4. STORYTELLING

Strengthen Texas' brand as a leader for innovation by sharing success stories about R&D conducted at Texas higher education institutions and university spin-outs.



GOAL 3. FOUNDATIONAL SUPPORTS

Vision: Texas invests in the talent, infrastructure, and supports needed for success in the innovation economy.

With Texas' recent move toward funding community colleges for outcomes focusing on credentials of value in high-demand fields, every institution, colleges and universities alike, has a role to play in fostering a dynamic talent pool capable of supporting and driving innovation in the state's core industries.

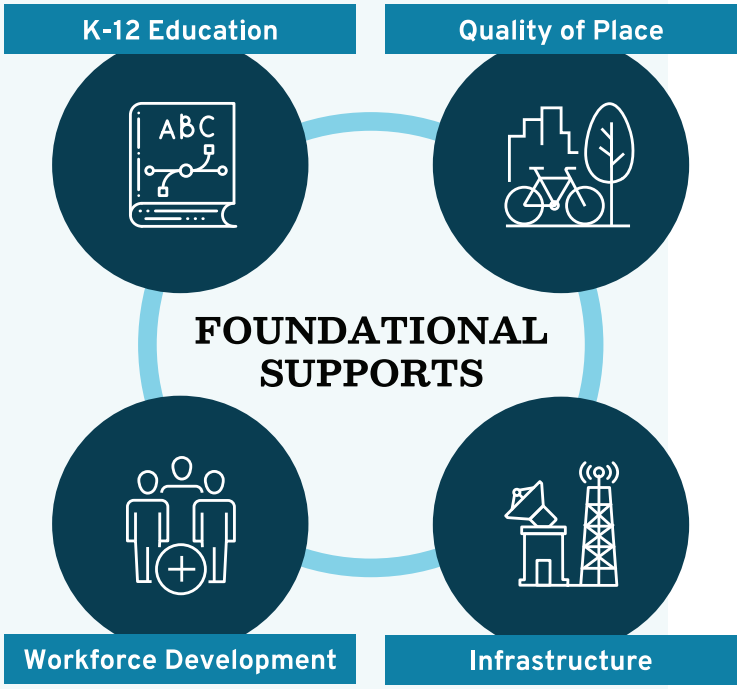
A thriving innovation ecosystem requires foundational supports, including a strong talent pipeline and reliable infrastructure. Texas' competitiveness and prosperity increasingly depend on an educated workforce, which the goals of *Building a Talent Strong Texas* elevate as priorities for the state. While the strategies outlined in this section focus on talent recommendations, other factors like broadband, housing, and placemaking are also necessary components for successful innovation (see Figure 10).

Higher education institutions are well known for the role they play in strengthening talent pipelines. Education and training programs—from short-term trainings at community colleges to multiyear doctorate programs at universities—have a pivotal role to play in preparing the future workforce. With Texas' recent move toward funding community colleges for outcomes focusing on credentials of value in high-demand fields, every institution, colleges and universities alike, has a role to play in fostering a dynamic talent pool capable of supporting and driving innovation in the state's core industries.

The state needs a wide range of talent, from faculty and principal investigators to conduct research, to entrepreneurs to run businesses that license university-generated IP, to skilled workers to manufacture the products.

The state's long-term competitiveness depends not only on its ability to create jobs but also on its ability to develop, attract, and retain skilled workers. Attracting and retaining top-tier talent, including faculty and principal investigators, depends on both the education and training landscape as well as the attractiveness of Texas communities as places to live, work, and thrive. Increased alignment between the state's higher education goals and its economic growth is vital to ensuring a prosperous future for all Texans.

Figure 10. Foundational Supports



Source: TIP Strategies, Inc.

Strategies

By focusing on these necessary building blocks, Texas can reinforce regional innovation ecosystems to support thriving environments for research, technology development, and commercialization.

3.1. WORKFORCE DEVELOPMENT

Strengthen workforce education programs at higher education institutions that train students to meet the skilled talent needs of target industries, particularly for STEM careers.

3.2. WORK-BASED LEARNING

Expand efforts to provide students with high-quality experiential learning opportunities that equip them with knowledge and skills in demand by employers in core industries.

3.3. TEXAS TALENT RETENTION

Add incentives and benefits to programs for Texas higher education students to support graduate retention.

Amplifying the Impact

THE FUTURE OF HIGHER EDUCATION IN TEXAS' INNOVATION ECONOMY

The path forward is clear. The strategies in *From Insights to Impact: Fostering Innovation Through Texas Higher Education* will strengthen higher education's role in shaping the future of Texas' innovation economy.

To realize the state's full potential, leaders at both the state and institutional levels will need to accelerate progress and commitment to strengthening Texas' innovation ecosystem.

State leaders have made significant commitments to accelerate research and innovation opportunities across Texas. During the 88th Texas Legislature, lawmakers made sizable investments: $400 million to increase community college financing with a focus on credentials of value in high-demand fields, a nearly $4 billion endowment to expand research activities at qualifying universities, and nearly $700 million to invest in university facilities for semiconductor research. State funding will also be essential to ensure all colleges and universities have resources for commercialization efforts, strengthening the link between academic research and economic impact.

Coupled with the state's steady investments, a renewed focus on Texas higher education's contribution to the state's global competitiveness sets the stage for a bright future. There are many opportunities ahead for the Texas innovation economy. With additional details on implementation steps in *From Insights to Impact: The Technical Appendix*, Texas higher education can strengthen its role as a global leader in innovation and commercialization of research. To realize the state's full potential, leaders at both the state and institutional levels will need to accelerate progress and commitment to strengthening Texas' innovation ecosystem.

State leaders can amplify the importance of supporting technology transfer and its benefits to the future of Texas' innovation economy. In addition, increased resources for commercialization efforts within higher education will be required to take the state's research and development infrastructure into the future. The Coordinating Board is dedicated to serving as a resource, advocate, and partner to higher education institutions, working together to collectively realize the vision of Texas as a leader in translating research into innovations that enhance the lives of Texans and drive economic growth.

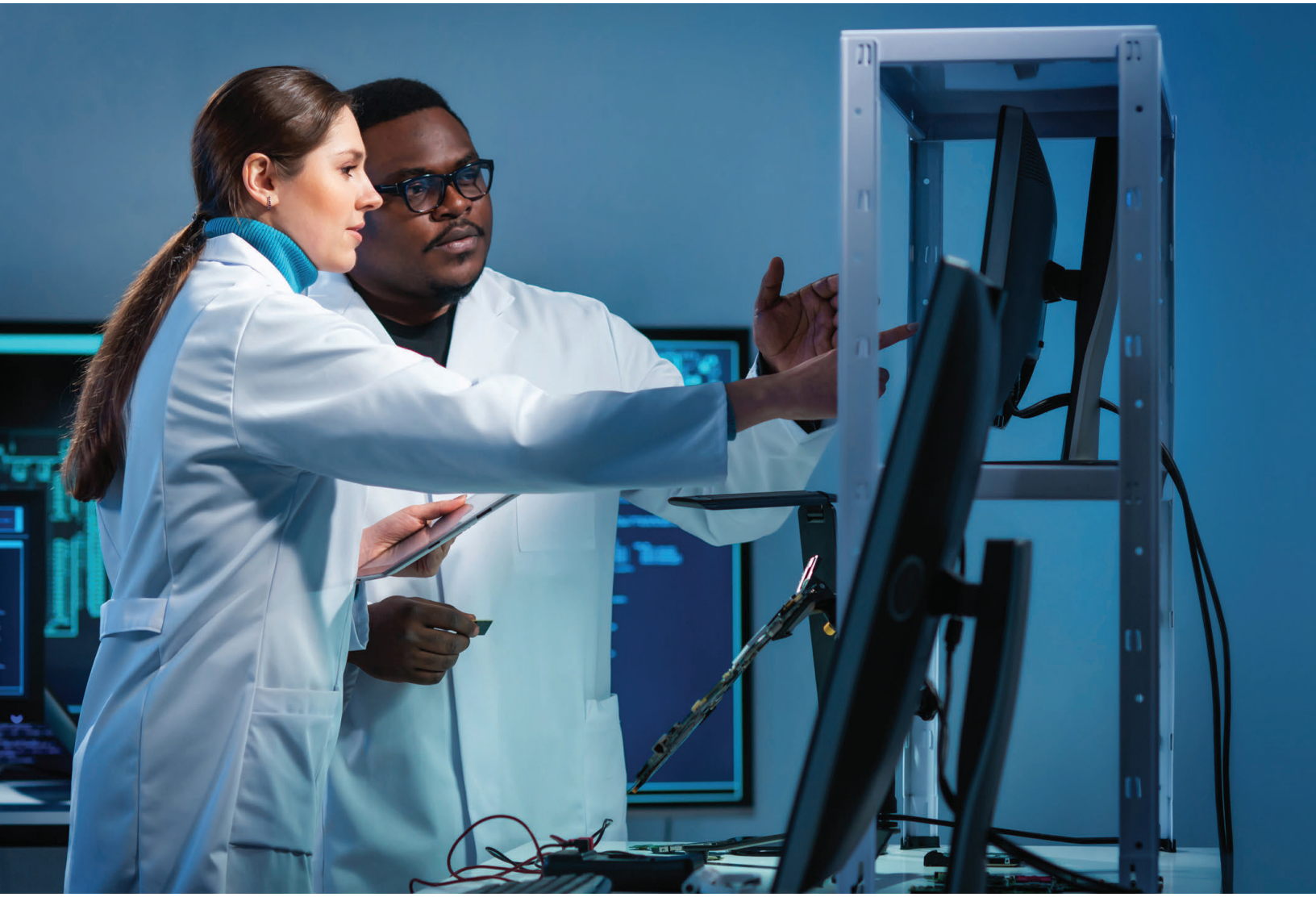
Higher education systems and institutions can optimize use of transformational investments from the Texas Legislature to continue advancing research and development while also increasing efforts targeted towards innovation and commercialization. Looking to promising practices from leading institutions with demonstrated success in technology

As key sources of invention, colleges and universities generate knowledge, innovation, technology, and entrepreneurship, making them engines of the economy.

transfer can help Texas higher education institutions strengthen their role in powering Texas' innovation economy.

Almost every notable innovation hub in the U.S. is anchored by one or more institutions of higher education. As key sources of invention, colleges and universities generate knowledge, innovation, technology, and entrepreneurship, making them engines of the economy. The strategies within this plan are designed to better support higher education institutions in serving their researchers, regional innovation leaders, and commercial partners.

Higher education's role in fostering a thriving ecosystem for research, development, and innovation is crucial. It requires a comprehensive effort that explicitly links to economic competitiveness. Strategic investments, collaboration among higher education institutions, and statewide coordination will secure Texas' performance and improve commercialization outcomes. With these factors in place, leaders across the state can help Texas compete at the forefront of knowledge, technology, and discovery. Texas has the talent and assets to create the innovation economy of tomorrow. The state's long-term prosperity and global competitiveness depend on it.



Texas Higher Education
COORDINATING BOARD
www.highered.texas.gov