

COMMONWEALTH OF INNOVATION:

A POLICY AGENDA FOR
REVITALIZING PENNSYLVANIA'S
ECONOMIC DYNAMISM

MARK MURO, ROBERT MAXIM, AND YANG YOU



Executive Summary

Few states possess as many of the assets needed for innovation-driven growth as Pennsylvania. Powerhouse research universities are working on the most critical issues of the day in life sciences, artificial intelligence, robotics, transportation, and energy. Breakout companies are making headlines and garnering major investments. And the diversity of talent in the state's cities and rural areas is contributing to a rich capacity for community-based innovation at a time when creativity and inclusion matter more and more.

In short, Pennsylvania has much of what it takes to be a winner on a national economic map characterized by a short list of "superstars" and a longer one of "left-behind" places.

And yet, for all that, Pennsylvania has not been able

to convert its assets into abundant, high-quality economic growth. Specifically, leadership in some of the most prized factors for innovation-driven growth (e.g., research and development, patents, tech transfer) has failed to translate into the capstone indicator of innovation success: broad-based employment across an array of high-tech, high-pay advanced industries.

Given that, Pennsylvania needs to unlock its innovation potential, which will require catalytic steps on the part of state government. To assist with that, this report reviews the state's major innovation trends and challenges, and suggests a set of state-level policy recommendations with an eye toward helping the new governor energize the state's innovation sector. Overall, the report draws several key conclusions:

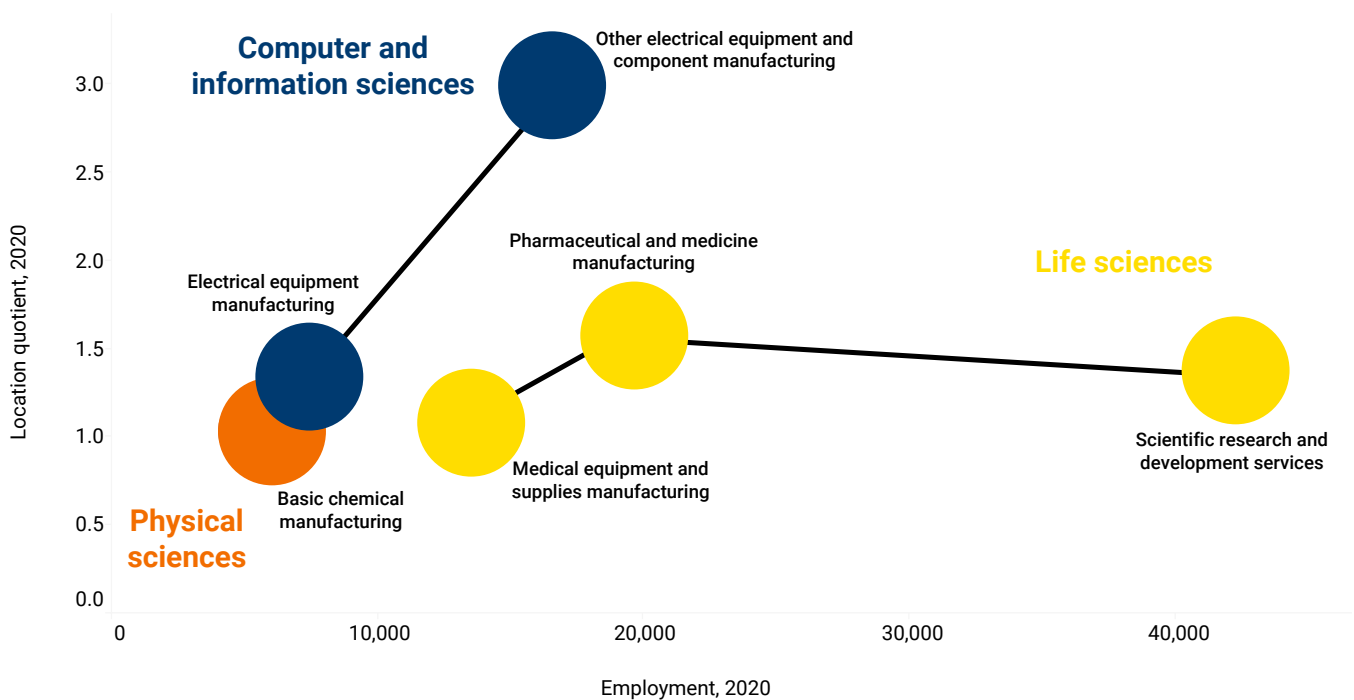
PENNSYLVANIA EXCELS AT UNIVERSITY-BASED R&D BUT LAGS IN HIGH-VALUE, HIGH-PAY JOB CREATION

Pennsylvania is emerging from the COVID-19 pandemic with a set of middling trend lines that include a relatively slow employment recovery and fairly solid income growth. At the same time, the state’s innovation metrics are polarized.

On the one hand, Pennsylvania has a rich innovation history, with strong research universities and several groundbreaking innovation programs. The state’s \$4.8 billion higher education R&D enterprise ranked fourth-

largest in the nation in 2020, with a top 10 R&D growth rate and strong patenting. At the same time, the state has begun to develop a set of nationally competitive innovation clusters, mostly centered in Philadelphia and Pittsburgh but extending into other regions as well. These clusters encompass above-average concentrations of research and industry activity in multiple areas, including the life sciences, computer and information services, robotics, chemicals, and plastics and rubber products.

EMPLOYMENT AND LOCATION QUOTIENTS FOR SELECTED ADVANCED INDUSTRIES IN PENNSYLVANIA, 2020



NOTE: Figure 12 in the full report

SOURCE: Brookings analysis of Lightcast data

On the other hand, the state’s accumulation of advanced industry jobs has been lagging. From 2010 to 2019, Pennsylvania saw its advanced industry jobs grow by an aggregate 10.9%, trailing the national sector by 8 percentage points. Overall, Pennsylvania ranked sixth out of nine peer states in terms of advanced industry job growth, lagging

Indiana and Massachusetts by 9 percentage points and Michigan by 23. From 2015 to 2021, employment the Pennsylvania advanced industry sector grew by just 3%. Scientific research, software, and pharmaceuticals/medicine activities surged, but dozens of advanced manufacturing categories went sideways or shed jobs.

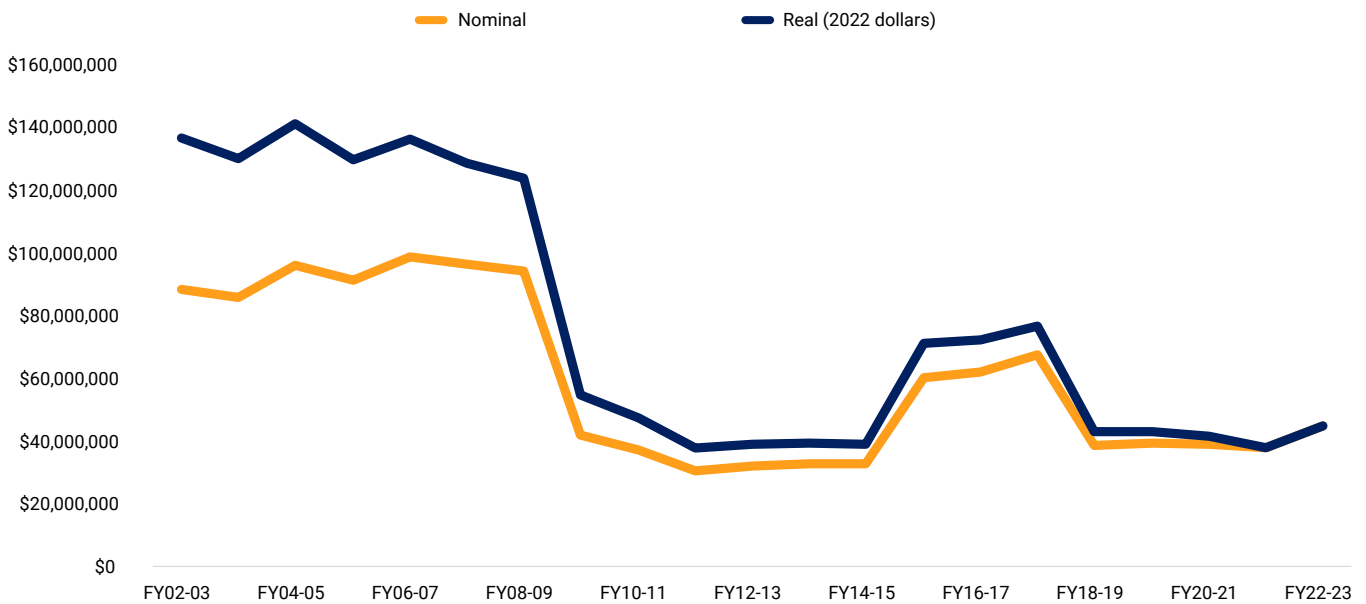
UNDERLYING PENNSYLVANIA'S INNOVATION DRIFT LIE FOUR CHALLENGES THAT ARE HOLDING THE STATE BACK

Brookings' 2019 Pennsylvania innovation report, "Ideas for Pennsylvania's innovation policy: Examining efforts by competitor states and national leaders," underscored just how much effort peer states are investing in fostering innovation-based growth. This report, conversely, reveals numerous innovation-system gaps in Pennsylvania that are depressing innovation-based growth and require attention.

Four issues in particular warrant notice, beginning with a question of commitment:

1. **State government has seemed to lack a clear commitment to innovation and has let its core innovation programs languish.** Pennsylvania lacks a high-profile innovation vision and messaging framework that a growing number of competitor states have. No well-researched strategy document appears regularly, nor does the state invest much in promoting its innovation economy. Since 2010, governors have kept a low profile on the topic of innovation, and years of disinvestment have eroded the size and relevance of the state's innovation efforts. Most starkly, Pennsylvania reduced its investments in innovation programs by nearly two-thirds during the Great Recession, and has failed to rebuild in subsequent years.

CORE INNOVATION FUNDING IN PENNSYLVANIA, FY 2003 – FY 2023



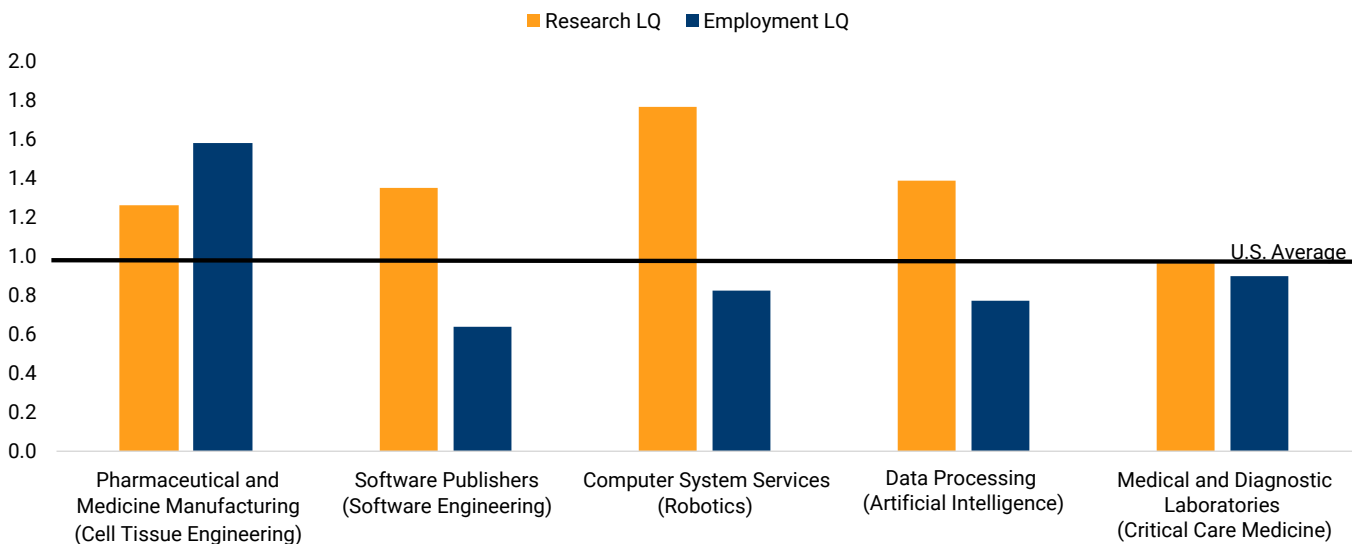
NOTE: Figure 15 in the full report

SOURCE: Brookings analysis of Pennsylvania Department of Community and Economic Development data

2. The state lags on converting top-quality research into growth firms and broader employment growth. The growth of commercial clusters depends on the presence of supportive tech “ecosystems” built out of local intermediaries, investor groups, and entrepreneurship networks. However, shortcomings in Pennsylvania’s entrepreneurial ecosystems are likely impeding new-firm creation and scale-up in advanced industries. Specifically, the state’s above-average concentrations of academic research in fields such as IT are so far failing to translate into above-average employment concentrations in pertinent advanced industries. Only in the pharmaceutical and life sciences realm has Pennsylvania’s above-average research concentration and strong tech transfer generated above-average employment commensurate with the state’s scientific leadership. Also depressing innovation-related employment growth is thin startup formation and hiring.

Contributing to the problem is reduced state investment, which has weakened efforts to bolster entrepreneurial ecosystems, support new-firm formation, and help companies scale. State policy is important in ecosystem-building, yet Pennsylvania drastically reduced its investments in innovation inputs and ecosystem-building during the 2008-2009 budget cycle amid the Great Recession, and never restored those investments to pre-recession levels. The results are severe budget reductions for key ecosystem supports such as the Pennsylvania Life Sciences Greenhouse initiative and the Ben Franklin Technology Development Authority. Other innovation-oriented programs were zeroed out. Increases for innovation programs requested by Governor Tom Wolf in the FY 2023 budget have only modestly restored some of the reductions.

PENNSYLVANIA’S RESEARCH ACTIVITY AND INDUSTRY EMPLOYMENT; LOCATION QUOTIENTS IN SELECT FIELDS, 2020



NOTE: Figure 18 in the full report

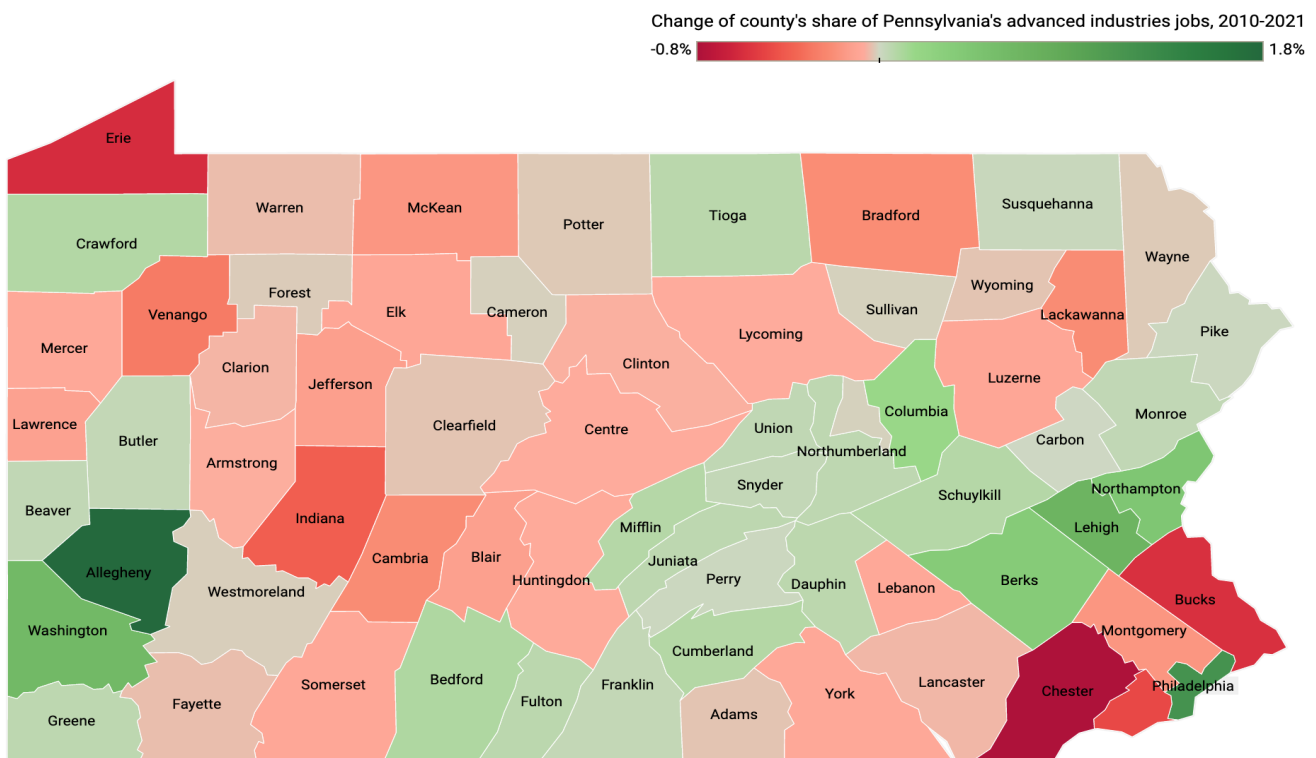
SOURCE: Brookings analysis of data from Lightcast, TEconomy Partners, and World of Science

3. Meanwhile, innovation is struggling outside of the state's largest cities. Crucial university innovation activity remains sparse outside the state's major academic metro areas of Philadelphia, Pittsburgh, and State College. Specifically, only about 1% of Pennsylvania's university-based R&D activity takes place beyond the confines of the major university hubs.

Advanced industry employment and vibrancy also lag outside these hubs. Advanced sector employment—though present in every county—is thinly distributed across most of the state, with

local clusters remaining sparse outside the major metro areas. In fact, regions outside the three major metro areas have seen their share of the state's advanced industry employment decline through the last decade to 42% of the state total. Data from Crunchbase shows that just 27% of the state's advanced sector new-firm starts were formed outside of the major university metro areas. Overall, the past decade of Pennsylvania's advanced industry growth reflects a broader pattern seen nationwide, with the largest cities pulling away from the rest of the state, and many of the most rural counties lagging.

CHANGE OF COUNTY'S SHARE OF PENNSYLVANIA'S ADVANCED INDUSTRIES JOBS, 2010-2021



NOTE: Map 2 in the full report. This graph includes employment in actual counties only and excludes jobs whose specific location within Pennsylvania is unknown or undefined

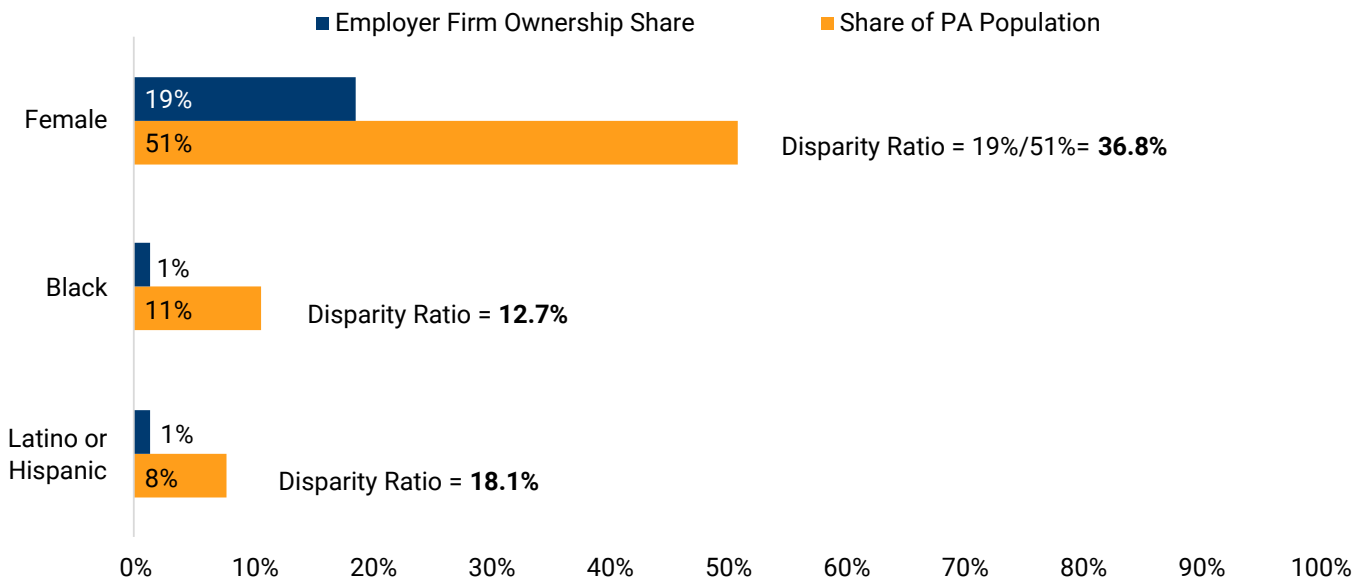
SOURCE: Brookings analysis of Lightcast data

4. Throughout the state, access to the innovation economy is unequal by race and gender. To start, K-12 STEM education remains significantly unequal by race in Pennsylvania. Underserved Pennsylvania students attend schools with fewer resources for STEM learning. This feeds into higher education, with female, Black, Latino or Hispanic, and Indigenous Pennsylvanians underrepresented among STEM degree graduates in the state. Black, Latino or Hispanic, and Indigenous people account for nearly 19% of Pennsylvania’s population, but less than 10% of STEM degrees, and just 5% of STEM Ph.Ds. Women account for less than 40% of STEM degrees in Pennsylvania, and just one-third of STEM Ph.Ds.

With less access to STEM education, female, Black, and Latino or Hispanic Pennsylvanians are also underrepresented in the state’s advanced industry jobs. Women hold just one-third of all advanced industry jobs, while Black workers hold advanced industry jobs at a rate half their share of the state population.

Finally, significant inequalities exist across race and gender when it comes to entrepreneurship and firm ownership. Just 1% of firms with employees in Pennsylvania have majority-Black ownership, and just 1% have majority-Latino or -Hispanic ownership. Meanwhile, only 19% of firms with employees in the state have majority female ownership.

WOMEN, LATINO OR HISPANIC, AND BLACK PENNSYLVANIANS ARE OWNERS OF FIRMS WITH EMPLOYEES AT DISPROPORTIONATELY LOW RATES



NOTE: Figure 32 in the full report. Business ownership is defined as having 51% or more of the stock or equity in the business; only businesses classifiable by owner or demographic group are included in the calculations. Calculations based on unrounded numbers; ownership share may not sum to 100% due to co-ownership. Data on American Indian, Alaska Native, and Native Hawaiian and Other Pacific Islander firm owners suppressed due to small sample size

SOURCE: Brookings analysis of Bureau of Labor Statistics and Census Bureau data

THE COMMONWEALTH NEEDS TO RENEW ITS COMMITMENT TO INNOVATION AS A FUNDAMENTAL DRIVER OF HIGH-QUALITY, BROAD-BASED PROSPERITY

Having lost its focus on innovation in the last 15 years, the commonwealth needs to refocus on innovation as the best way to unlock its economic possibilities. Given its world-class anchor institutions, promising urban ecosystems, and diverse talent, the state possesses vast potential to invent, grow, and participate in the next crucial technology platforms. However, if it is to meet that potential, Pennsylvania must reclaim its history of supportive policy innovation. Such assistance remains a crucial aspect of the kind of ecosystem-building critical for the state's innovation enterprise.

What follows, then, is a finite set of priority themes and recommendations through which state government can catalyze Pennsylvania's vast innovation potential and reinvigorate its entrepreneurial dynamism. Specifically, the state now has a critical opportunity to:

- 1. Commit to innovation.** Today, Pennsylvania's main innovation programs are mostly adrift, without either adequate funding or high-level advocates in government. The next administration's top leaders should move urgently to elevate the importance of innovation. Along these lines, the next administration should:
 - **Embrace the cause of innovation** and articulate a strong vision.
 - **Center innovation in economic development** activities.
 - **Rebuild the innovation budget.**
- 2. Accelerate commercialization and growth in the state's major innovation metro areas.** Pennsylvania lags in translating its top-quality R&D into growth firms and advanced industry employment. At the same time, reduced state investment has undercut efforts to bolster the vital tech ecosystems that help companies grow, particularly near research universities. The state therefore needs to enact a bold initiative aimed at assisting its major innovation regions scale up transformative strategies to convert startups into growth. Accordingly, the next administration in Harrisburg should:

- Design and **support a Pennsylvania Innovation Hubs program** as a sizable challenge grant to help regional innovation clusters in key university-based innovation hubs promote tech-based economic growth and job creation.
 - Aggressively **leverage parallel federal cluster programs** such as the Advanced Research Projects Agency for Health (ARPA-H) and the regional technology hubs programs in the CHIPS and Science Act for further impact.
 - **Expand the state matching fund for federal Small Business Innovation Research (SBIR)/ Small Business Tech Transfer (STTR) awards**—programs that provide funding to small businesses engaged in federal-agency-relevant R&D that has potential for commercialization—with an emphasis on support for underrepresented groups.
- 3. Foster innovation and entrepreneurship outside of major metro areas.** Pennsylvania's stark regional divides divorce hundreds of thousands of Pennsylvanians from opportunities in big-city innovation centers. Today, whole portions of the state threaten to become traps of underdevelopment that undercut economic connection and may fuel "backlash" political dynamics. To help more of the state's smaller cities, towns, and rural areas tap into the benefits of the innovation economy, the next administration should:
 - Design and **fund a competitive challenge grant** to catalyze innovation and entrepreneurship in 20 regions outside Pennsylvania's major metro areas.
 - **Establish an advanced industries innovation voucher** program to help firms across the state access cutting-edge research from Pennsylvania universities.
 - Continue to **strengthen the Penn State LaunchBox and Innovation Network** and expand university engagement in local regions more broadly.

4. **Insist on inclusion.** Investing in Pennsylvania communities of all sizes will be critical for bolstering Pennsylvania’s innovation economy. However, without a specific effort to build a more inclusive innovation economy, Pennsylvania risks perpetuating the same inequalities that it has faced for years. Given that, the state should focus on enhancing inclusion in its innovation economy across three themes:

- **Grow a more inclusive entrepreneurial ecosystem** through steps such as providing additional, state-level funding for the SSBCI Diverse Leaders Venture Program; establishing a state CDFI fund; and better leveraging public procurement to support entrepreneurship and business development among underrepresented groups.
- **Expand access to advanced industry careers** through efforts such as developing a set of state-supported communities of practice for organizations focused on connecting workers to advanced industry jobs; providing competitive funding to programs that aim to bolster engagement of underrepresented groups in the advanced industry workforce; and leveraging funding from recent federal legislation to connect underrepresented workers to innovation jobs.

- **Make STEM education more equitable** through policy actions such as creating a new program to attract diverse STEM professors and Ph.D. candidates to Pennsylvania higher education institutions; bolstering the Pennsylvania Department of Education’s PAsmart grants program for schools; and providing competitive funding to programs that aim to bolster racial, gender, and other types of inclusion in STEM education.

Reenergizing Pennsylvania’s stagnant innovation economy will take more than a one-off investment. To generate sustained and consistent investment over time, the state can explore a variety of revenue options. One would be to channel a portion of the growth in personal income tax receipts received by the state from advanced industry workers into a new “Keystone Advanced Industries Growth Fund,” to be used to finance future investments in innovation and advanced industry growth without raising taxes. Other options could include tapping the state’s sizeable budget surplus or taxing transactions tied to legal marijuana to fund an inclusive innovation agenda.

In order to build a more competitive and inclusive economy in the coming years, the commonwealth must act now to reclaim its former position as an innovation leader.



ACKNOWLEDGEMENTS

Funding for this report was provided by the Henry L. Hillman Foundation. The report and recommendations are the result of a statewide, stakeholder-based process and do not necessarily reflect the views or priorities of the Henry L. Hillman Foundation.

Brookings Metro would like to thank the Henry L. Hillman Foundation for its support of this research. Special thanks go to David K. Roger, D. Tyler Gourley, and Pamela D. Lewis there. Brookings is also grateful to the Metropolitan Council, a network of business, civic, and philanthropic leaders that provides financial and intellectual support for the program.

In addition, Brookings Metro is grateful to the Chamber of Commerce for Greater Philadelphia for its continued engagement, and also to the York County Economic Alliance and the Schuylkill Chamber of Commerce for two helpful regional focus groups.

During the work numerous Pennsylvanians provided valuable insights, including: Theodore Alter, Scott Andes, Saul Behar, Phil Brooks, Amy Bridger, Quintin Bullock, Katie Campbell, Robert Carl, Feona Castro, Samantha Chivinski, John Clapham, Della Clark, Steve D’Ettorre, Dennis Davin, James Delattre, Lee Erickson, Evan Facher, Liz Ferry, Ralph Ford, Juan Garrett, Karianne Gelinas, Presley Gillespie, Ryan Glenn, Anthony Green, Claire Greenwood, Jason Greiss, Herman Herman, Kelly Hoffman, Art Howe, Annie Hughes, Stephen Hunter, Ian Kanski, Kari King, Kurt Imhof, Kelauni Jasmyrn, Patrick Jones, Shintaro Kaido, Tim Kelsey, Kevin Kinross, Grace Klein, Andrew Kleiner, Kurt Knaus, Kyle Kopko, Majestic Lane, Brad Lashinsky, Lance Lindauer, Rich Lunak, Sean Luther, Becki Lynch, James Martin, Dave Mawhinney, Rachael Miller, Steve McKnight, Timothy McNulty, Christopher Molineaux, Katie Nash, Heath Naquin, Scott Nissenbaum, Nadyli Nuñez, Rich Overmoyer, Kimberly Palladino, Gabby Payne, Sully Pinos, Lindsey Powell, Eliza Prendzov, Sam Reiman, Tina Richardson, Michael Rinsem, David Robusto, Kevin Schreiber, Tom Sharbaugh, Maura Shenker, John Sider, Jaishree Singh, Don Smith, Matt Smith, Kevin Snider, Ben Speggen, Tobias Sytsma, Mark Thomas, Simon Tripp, Roger Vanhoy, Howard Wial, Tiffany Wilson, Sam Woods Thomas, Rob Wonderling, Steven Wray, Dennis Yablonsky, Skyler Yost, and Melanie Zaber.

Special additional help came from Scott Andes, Ross DeVol, Lauren Lanahan, and John Miner.

The report’s authors would also like to thank Phil Brooks, Steve D’Ettorre, Evan Facher, Ryan Glenn, Ty Gourley, Claire Greenwood, Art Howe, Pamela Lewis, Becki Lynch, Tim McNulty, Katie Nash, Kimberly Palladino, and Skyler Yost for providing invaluable comments on early versions of the analysis.

At Brookings, Aleida Baumgartner provided crucial research support for this report. Lavea Brachman, Joseph Parilla, and Rodney Sampson provided further comments. Thank you also to our colleagues Annelies Goger, Joe Kane, and Carlos Martin for providing input into early drafts of this report.

The authors would also like to thank the following Brookings colleagues for invaluable support in producing the report and contributing to outreach efforts: Dalia Beshir, Michael Gaynor, David Lanham, Carie Muscatello, and Erin Raftery.



B | Brookings Metro

1775 Massachusetts Ave NW,
Washington, DC 20036
(202) 797-6000
www.brookings.edu