



# Advancing Pennsylvania's Entrepreneurial and Innovation Economy

A look at our past and roadmap  
for our future

---

August 2019

## About this Report and Recommendations

Pennsylvania's Department of Community and Economic Development, Office of Technology and Innovation commissioned the following analysis and stakeholder engagement process to review where Pennsylvania stands relative to other states in regards to common entrepreneurship and innovation measures. The analysis was reviewed with stakeholders from throughout the Commonwealth who then engaged in identifying opportunities for short-term to longer-term strategic actions.

The Office of Technology and Innovation contracted with Fourth Economy Consulting, Inc. and Econsult Solutions, Inc. to perform the analysis and develop recommendations for Pennsylvania to enhance its entrepreneurial and innovation performance.

The work contained within and recommendations are exclusively the findings and opinions of the consulting teams unless otherwise attributed. The recommendations were developed with the input of over forty stakeholders and reflect their collective ideas about ways that Pennsylvania can improve its support of entrepreneurship and innovation.

## Key Findings

Once recognized as a national leader in entrepreneurship and innovation, Pennsylvania has steadily fallen behind those states who have continually increased their support for entrepreneurship and technology-based economic development initiatives.

The global recession in 2007-2008 proved to be too much for Pennsylvania's once thriving ecosystem supporting entrepreneurs and innovators. State-supported initiatives such as the Ben Franklin Technology Development Authority (BFTDA), which has historically provided funding to programs such as Ben Franklin Technology Partners, the Keystone Innovation Zone, and programs that supported the commercialization of new technologies at our world-renowned colleges and universities, were severely impacted due to the lack of state funding and resulted in budget cuts.

The pages that follow provide ample detail about where Pennsylvania stands today. The information is organized into the areas of: Place, Investment, Ideas, and People.



## Place Key Findings

As a state, **we are starting to make strides** in creating commercializable innovations through R&D, patent activity, new business formations, risk capital deployment, and IPOs. However, **we lag in areas like human capital investment** as measured by advanced degrees, tech and science workforce at all skill levels, and concentration of job opportunities at growing tech and science based firms.

Pennsylvania's small **main street business** concentration and survival **is high**, while our share of scalable **high-tech startups** and **growth companies is lower**. Direct and indirect jobs, as well as output from the advanced industries sector, is also relatively low.

These factors all point to the need for **increased investment in talent** in terms of academic and career readiness, skills development, and talent attraction to the state, as well as **increased support for growing, scalable startups** and business attraction, retention, and expansion strategies for the **advanced industries sector** that will drive economic growth into the future.



## Investment Key Findings

R&D funding from universities, private companies, and federal sources have all **increased over recent years**, yet Pennsylvania is roughly **middle of the pack** compared to other states when it comes to R&D funding from all sources.

Pennsylvania has an **uncommonly high amount of university-led R&D spending**, ranked 5th in per capita spending among all states with over \$4 billion total spending in 2017. However, that is less than the \$10 billion spent in 2017 in Pennsylvania on R&D by the private sector. And in private R&D spending, Pennsylvania ranks **closer to the middle at 20th** among all states per capita.

Pennsylvania also is just about average among states in Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding, as well as venture capital deployment per capita. While Pennsylvania is doing better than some states on these measures, a **handful of leading states** are bringing in a disproportionate amount of these investment sources.

Taken together, these factors indicate a need for increased investment at the earliest stages of innovation.



## Ideas Key Findings

As an important precursor to innovative activity, **patent activity in the state is not keeping pace** relative to gains in other states and in the country as a whole. Universities are among the top 10 patent recipients in the state, indicating **academic innovation is strong**. However, corporate innovation is not as striking as it is in other states, and individuals hold patents at a lower rate than in the U.S. as a whole. Extra care should be taken to ensure that university-led innovation is being spun out as new startups, or licensed into larger companies that may not have in-house innovation capabilities.

Meanwhile, **business creation in Pennsylvania is below average**, with the state ranking 44th out of 50 in annual business births. When taken together with annual business deaths, net business creation jumps to 33rd, but that rate is still modest and in the bottom half of all states.

Although Pennsylvania has a higher-than-average business survival rate, **we are not turning innovative activity into economic output** at a rate comparable to high-performing states. The state should focus support of new business creation—utilizing resources including the [Pennsylvania Business One-Stop-Shop](#) and other entrepreneurial support work being advanced by the current administration of Governor Wolf.



## People Key Findings

The state is experiencing a **decline in workers employed in tech-related industries** beyond that which can be explained by Pennsylvania's stagnant population. This indicates that people moving into the state are disproportionately not working in advanced industries and occupations, such as advanced manufacturing or software development. (In recent data, Pennsylvania ranks 42nd among all states in employment change in high-tech sectors.)

Pennsylvania ranks **about average** among states when it comes to three key indicators: **college enrollment** (relative to resident population), pursuit of **STEM** fields (as measure by science and engineering higher-ed degrees as a percent of all degrees in the state), and pre-enrollment **achievement** of students.

These factors, taken together, may indicate that the decline in high-tech industry activity is related to a lack of workforce that is adequately trained in the requisite skills. Utilizing its many higher-ed institutions, Pennsylvania needs to **build the most critical piece of infrastructure** for its high-tech industries: **a skilled labor force**.

## Roadmap - Advancing Four Recommendations

In order to develop the following recommendations, two strategy sessions were held with a group of leaders in the Innovation and Entrepreneurship system from across the state. Through an interactive facilitation process, these stakeholders supported four areas of focus and assisted in the development of recommendations for each.

The four areas of focus are:

- Financing Innovation and Entrepreneurship
- Promoting the Message of Innovation and Entrepreneurship in Pennsylvania
- Supporting the Pipeline of Entrepreneurship and Innovation
- Reviewing the Existing Portfolio of Ecosystem Support Programs

What follows are recommendations to advance actions in each of these focus areas, with the expectation that **improvement is needed in each** to be successful in significantly improving the current trendline.

**Background** | State-related support for innovation and entrepreneurship decreased sharply during the 2009-2010 recession and has not been significantly increased since. Governor Wolf has been able to support innovation and entrepreneurship related programs with level appropriations funding over the past few years. While Innovate PA provided a much-needed pool of capital, it is now fully encumbered. Additional resources are needed to invest in a set of programs with a clearly demonstrated Return on Investment.

**Primary Goal** | Stem the short-term funding gaps for key innovation and entrepreneurship programs—e.g., BFTDA, Industrial Resource Centers (IRC), or Small Business Development Centers (SBDC). Mitigate the negative impacts of current funding levels and develop longer-term financing strategy.

The background of the slide is a blurred, high-angle photograph of a factory floor, showing various pieces of machinery and equipment in shades of green and grey.

## Recommendation 1

# Finance Innovation and Entrepreneurship

# Action Plan | **Financing Innovation and Entrepreneurship**

## **Short-term Actions**

- Identify and develop champions who will have credibility, influence, and moral authority with political leaders; use these champions to make the case for Innovation and Entrepreneurship program funding
- Engage key corporations and coalitions in development of a Public Private Partnership (PPP) to aggregate capital for a new innovation and entrepreneurship program
  - Follow Tech 21 model - Chambers, Tech Councils, Universities
- Create a model for linking corporate, foundation, and public funding for specific areas of innovation
- Conduct analysis of most appropriate funding model (e.g., tax credits, appropriations, dedicated revenue stream, etc.)

## **Long-term Actions**

- Develop a tax credit/rebate program for companies. (PA is willing to invest in a Public-Private Partnership to drive large-scale development, e.g., Amazon HQ2, with the promise of certain returns; the state should do the same for smaller-scale existing and potential job creators.)
- Develop long-term funding mechanism. Possible options include:
  - A fee on contracts from the state
  - A statewide Bond Referendum (Ohio's Third Frontier model)
  - Securitization from new tax/fee stream

## **Key Support and Resources**

- The state needs to fill the current funding gap for BFTDA, PREP, IRC, and other entrepreneurial programs
- Long-term planning and funding needs to be developed by a Public Private Partnership that has balanced representation from around the state

The background of the left side of the slide is a blurred image of a laptop screen. The screen displays the text 'Change: \$0.00' in a light color against a dark background. The overall color scheme is a gradient of reds and oranges.

## Recommendation 2

# Broadcast the Message of Innovation and Entrepreneurship in Pennsylvania

**Background** | The Commonwealth’s tourism slogan is “Pursue Your Happiness.” In 2017, DCED launched a related campaign with the slogan “[Work Smart. Live Happy](#)”. This campaign highlights the positive aspects of Pennsylvania’s economy and some of the exciting new opportunities that are emerging.

**Primary Goal** | Building upon DCED’S “Work Smart. Live Happy.” message, identify ways in which PA’s strengths in entrepreneurship and innovation can be incorporated and broadcast to interested parties within and outside of PA.

# Action Plan | **Broadcasting the Message of Innovation and Entrepreneurship in Pennsylvania**

## **Short-term Actions**

- Partners convene to develop a common messaging platform and tool-kit
- Editorial calendar and process for sharing fresh content
- Messaging should emphasize key positive aspects:
  - Low cost of living
  - Quality of life & natural resources
  - Strong existing businesses
- Diversity: messaging should be inclusive of the many different people and organizations that contribute to the innovative and entrepreneurial infrastructure of PA
- Messaging should incorporate the public's financial interest in innovation and entrepreneurship: e.g., with analyses of value of new or expanded businesses

## Long-term Actions

- Physical infrastructure (broadband, housing, etc.) must be developed to back up the message that PA is eager to host innovators and entrepreneurs
- Tourism and economic development messaging should work together with a cohesive brand
- Branding/Messaging should be used to develop sustainable and diversified funding

## **Key Support and Resources**

- The campaign needs a coordinator
- The initiative needs the support of both the legislature and private business
- Access to success stories is critical

## Recommendation 3

# Support the Entrepreneurship and Innovation Pipeline

**Background** | Organizations throughout the Commonwealth are working to foster awareness and provide support for entrepreneurs and innovators. These efforts range from legacy programs to newly launched initiatives.

**Primary Goal** | The objective of the pipeline is to provide all creative and innovative activities in the state a clear, sustainable, efficient path towards economic success. Making that a reality will require public and private engagement, a well-organized ecosystem of organizations, and common goals.

## Action Plan | **Support the Entrepreneurship and Innovation Pipeline**

### **Short-term Actions**

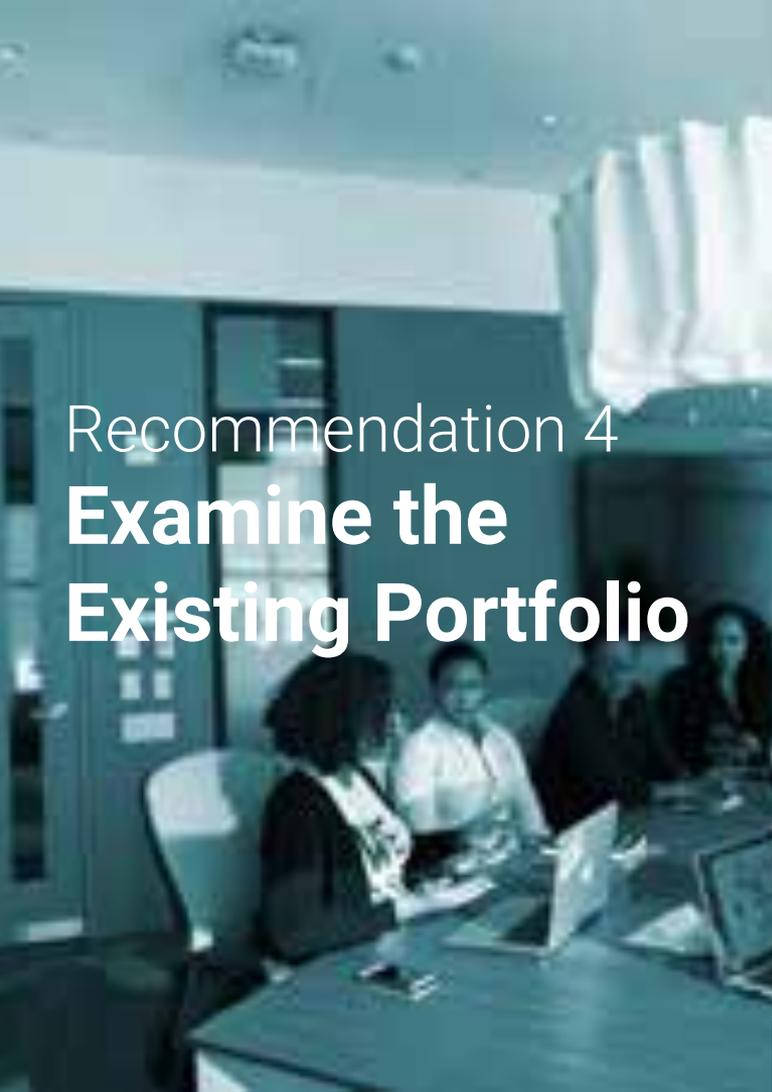
- Establish high-level, measurable economic development objectives for the state, and establish buy-in to these key objectives from the rest of the “economic development umbrella” (this ties into Recommendation 4)
- Bring key statewide players together through a public-private partnership
- Utilize the Partnerships for Regional Economic Performance (PREP) network to communicate and connect with local partners
- Assess current funding, find common threads, and identify opportunities for shared value

### **Long-term Actions**

- Solidify the role of the statewide PPP and intermediary hub with permanent capacity and long-term planning
- Build a case for long-term funding for PA innovation
- Attract and leverage additional support to the pipeline through private venture capital

### **Key Support and Resources**

- The PPP needs buy-in from different industries and regions
- A public campaign (Recommendation 2) will be vital to raising awareness and support

A teal-tinted photograph of a group of people sitting around a conference table in a meeting room, with laptops open and papers on the table.

## Recommendation 4 Examine the Existing Portfolio

**Background** | The diversity of knowledge, capacity and innovation within the Pennsylvania entrepreneurial and innovation ecosystem is what makes it strong and unique. The ecosystem can better leverage resources and learn through a more engaged partner network. In order to accomplish this, we need an evaluation of the existing portfolio of programs.

**Primary Goal** | Engage the legislature and administration to view economic development as investment for both short and long-term gain, and increase funding. Reduce competition for legislative support among economic development groups, and find common ground and common language to emphasize the importance of job creation to the Commonwealth. Clarify the differing and complementary roles that each component of the economic development ecosystem plays.

## Action Plan | **Examine the Existing Portfolio**

### **Short-term Actions**

- Standardize data and outcome measurement
- Articulate impacts of current programs with clear and consistent messaging (this is closely related to Recommendation 2)
- Benchmark the existing portfolio (number, scale, and impact metrics) of existing programs in PA
- Develop a **joint budget request based on shared goals** from a coordinated delivery system of Economic Development programs
  - This combined budget ask would be broken into broad areas using a framework
  - Goal should be multi-year and related to statewide economic activity (this is closely related to Recommendation 3)

### **Long-term Actions**

- Create an Advisory Committee of economic development partners working with DCED on budget requests (ED's and board chairs of partners work collaboratively with DCED on goals, outcome measures, and funding levels)
- Build case for multi-year growth funding, attached to clear, measurable multi-year outcome goals

### **Key Support and Resources**

- This effort requires an early commitment from DCED and the administration to making the case for larger, more sustained economic development funding

A photograph of two people in a meeting. One person is seated at a wooden table with a laptop, and the other is standing and pointing at a document. A coffee cup is also on the table. The image has a warm, reddish tint.

# **PA's Entrepreneurship and Innovation Indicators**

## Baseline Data Indicators Summary

This section outlines the baseline data indicators that informed our assessment of Pennsylvania's Innovation and Tech Entrepreneurship Ecosystem today.

We examine: three industry reports that provide a summary of Pennsylvania's current standings as a state compared to our past and to others; investment into research and development levels as a proxy for entrepreneurial activity and an essential innovation driver; federal grant programs that encourage innovation; venture capital used to scale innovation; entrepreneurial activity as defined by patents and new business creation, and; the state of our residents employed in high tech sectors and college graduates ready to move into the workforce.

We see that despite some gains in entrepreneurial activity, our state is falling behind when compared to a handful of high-performing states. Growing but modest levels of R&D, risk capital deployment, patent filings, and new business formations are dwarfed by low levels of startup growth, advanced industry firm density, employment in high-tech fields, and workforce readiness.

This points to a need for increased human capital investments in both workforce development and talent attraction, increased business attraction, retention, and expansion services for companies in the high-tech and advanced industries, in addition to maintaining and increasing current levels of investment in early-stage entrepreneurship activities. These industries employ workers of all education and skill levels, and are our best shot at driving economic growth that is inclusive and encompassing now and into the future.

# Baseline Data Indicators Framework



## 1. PLACE - Overall State Performance

- a. Milken Index
- b. Kauffman Index
- c. Brookings Advanced Manufacturing



## 2. INVESTMENT - R&D, Federal Funding, State Funding, and Private Capital

- a. R&D Funding by Source
- b. R&D Spending by Sector
- c. SBIR & STTR Funding
- d. Venture Capital



## 3. IDEAS - Innovation Activity Level

- a. Patents Filed
- b. Business Creation



## 4. PEOPLE - Workforce

- a. Population Changes
- b. High Tech Jobs
- c. College Enrollment and Achievement



## PLACE - Overall State Performance

Strong entrepreneurship and innovation impacts all communities and makes them more vibrant. **How does PA stack up** regarding infrastructure for innovation? This section dives into three leading industry reports that provide a summary assessment of the overall health of Pennsylvania's Innovation Economy as compared to peer states and over time.

First is the Milken Institute's State Technology and Science Index, which measures each state's tech and science workforce **capabilities**, firm **concentration**, and **investment** in human capital, R&D, and risk capital, all of which help drive job creation and economic growth in a region.

Next, we looked at the Kauffman Index of Entrepreneurship series, comprised of three reports which measure **outputs of entrepreneurial activity**, namely rates of new company creation, business density, and growth rates, across the country and at state and city levels.

Finally, Brookings 2015 **Advanced Industries Report** identified 50 industries that rely on technology R&D and STEM workers. The report analyzed concentrations of these important industries by share of jobs and output in various regions of the United States.

Taken together, these reports show that **Pennsylvania is performing only modestly compared to several very high performing states** in measures critical to a high tech economy, like high tech employment, workforce readiness, and startup activity.

## **Milken Institute's State Technology and Science Index measures tech and science capabilities as it relates to economic growth**

This looks at factors such as facilities that are attracting R&D funding, venture capital activity, patents, business formations, IPOs, workforce investment by college degrees relative to a state's population, share of the workforce employed in STEM industries, the concentration of high-tech firms, employment, and payrolls, as well as birth and growth of high-performing tech companies.

How a state fares with this index does not directly correlate to current economic performance and job creation, but does **clearly indicate whether the state is likely to create high-paying and future-proof positions**, given the rising prominence of these fields in our economy.

Pennsylvania ranked **13th in 2018**, up from **14th in 2010**, improving in some categories while weakening in others, as demonstrated on the next few pages.

# Milken Index Indicator Rankings

## Research and Development Inputs

(facilities attracting funding and creating commercializable innovations)



## Risk Capital and Entrepreneurial Infrastructure

(venture capital activity, patents, business formations, IPOs)



## Human Capital Investment

(number of degrees relative to a state's population)



## Technology and Science Workforce

(share of employment in CIS, engineering, life and physical science)



## Technology Concentration and Dynamism

(% of establishments, employment, payrolls in high-tech, birth and growth of high-performing tech companies)



2018	2010
8	9
14	21
13	11
15	12
31	25

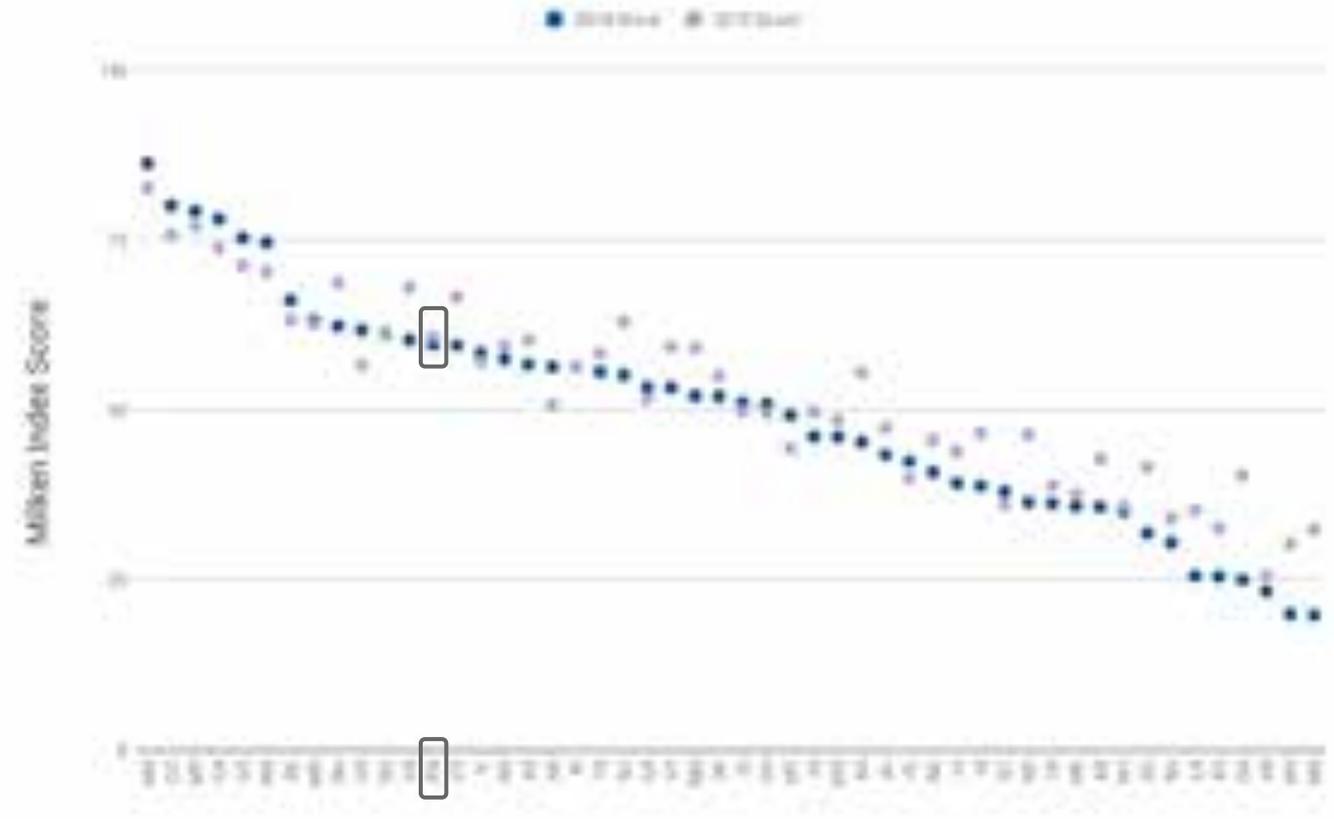
## Milken Index Implications

- 
 PA is **improving** in **R&D** funding amounts deployed to appropriate facilities
- 
 PA is also **improving** in terms of **startup activity** and **risk capital** deployment
- 
 PA is seeing a **decrease** in its workforce readiness as it relates to number of workers with **advanced degrees**, indicating a possible workforce mismatch
- 
 PA is **losing** its share of workers of all skill levels **employed in tech fields** like computer and information systems, life and physical science, and engineering
- 
 PA's **largest loss** is in the **concentration of companies**, payrolls, new business and growth of high performing high-tech companies

# Milken Index Score by State

Despite gaining one spot in the **rankings** between 2010 and 2018, in the same time period Pennsylvania's **score actually decreased, indicating that the gaps between states is widening** (high-performing states are better than ever and low-performing states are worse than ever).

We see large losses in the concentration of high-tech firms and employees in the state, which possibly **indicates the need for an attraction strategy.**

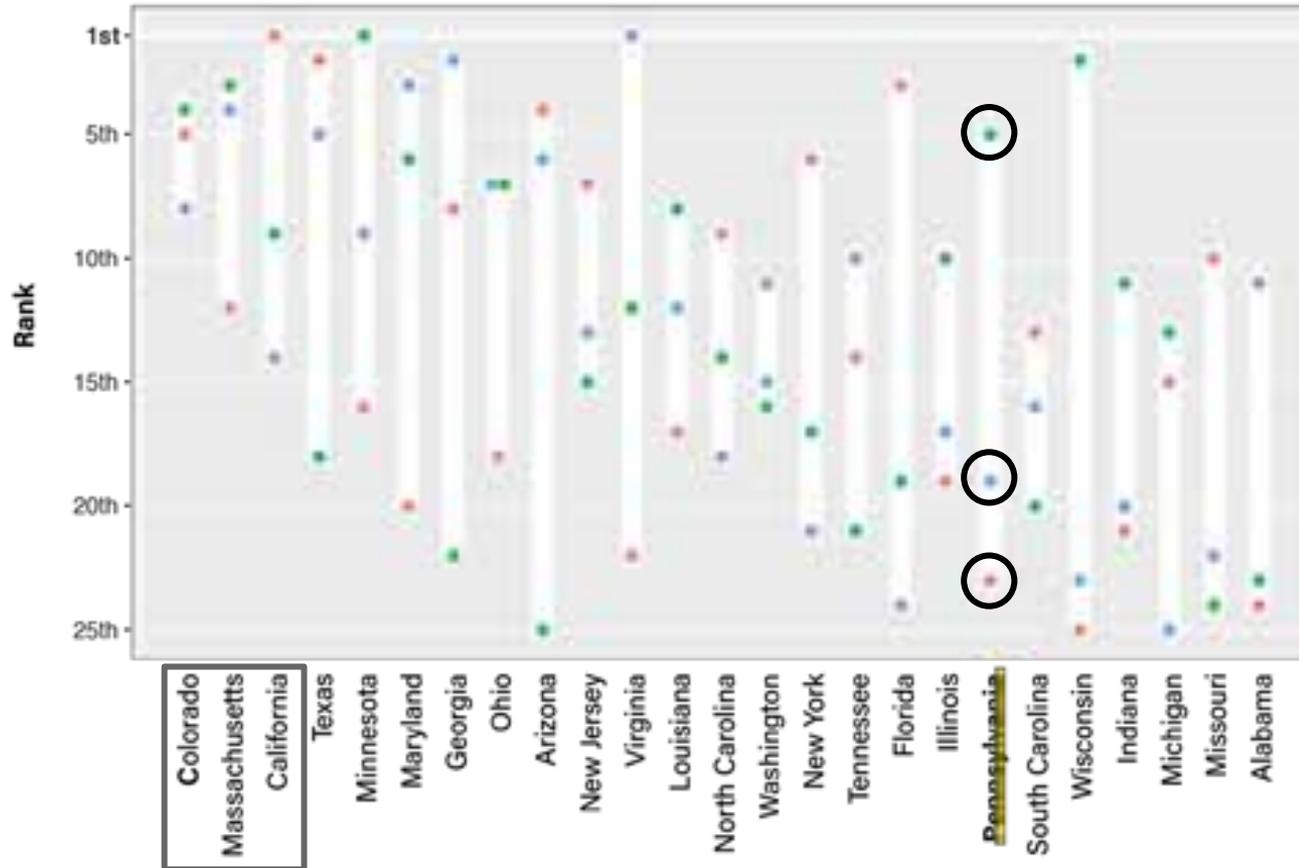


Source: Milken

# Kauffman 2017

The Kauffman Index of Entrepreneurship series is **comprised of three annual reports** - the Kauffman Index of Startup Activity, the Kauffman Index of Growth Entrepreneurship, and the Kauffman Index of Main Street Entrepreneurship. Together, the series assesses metropolitan, statewide, and national output trends across various types of entrepreneurship.

1. The **Startup Activity Index** captures business activity in all industries and focuses on the beginnings of entrepreneurship, specifically new business creation, market opportunity, and startup density. Startups, defined by Kauffman as firms that are less than one year old, are important to local economies because they create local jobs, and contribute to a culture of vibrancy and innovation.
2. The **Main Street Index** focuses on the prevalence of local, small business ownership in metros and states. Established small businesses make up almost 68 percent of all employer firms in the United States, making this segment an important driver of economic vitality.
3. The **Growth Entrepreneurship Index** focuses on growing and scaling companies in all industries as an important contributor to job creation, economic output, and productivity growth. It follows new startups and measures growth in their first five and ten years, as well as the prevalence of fast-growing, private companies in a given area.



**Kauffman Rankings (Large States)**

- Growth Entrepreneurship **19th**
- Start Up Activity **23rd**
- Main Street Entrepreneurship **5th**

Source: Kauffman Foundation, Kauffman Index of Entrepreneurial Activity, 2017

## Kauffman 2017

1. **Startup Activity** - Startup activity measures rates of new entrepreneurs per 100,000 adults, the share of entrepreneurs starting new businesses out of market opportunity rather than necessity, and the number of startups per 1,000 employer businesses. Pennsylvania has **one of the lowest rates of new entrepreneurship** among the 25 large states - 180 new entrepreneurs per 100,000 adults in a given month.
2. **Main Street Vitality** - This index measures the percentage of adults owning businesses as their main jobs, the percentage of firms that remain in operation throughout their first five years, and the number of established small employer businesses compared to number of firms. Pennsylvania has a very high **Established Small Business Density Rate**, as well as a **higher than average Small Business Survival Rate**.
3. **Growth Entrepreneurship** - This index captures how much, on average, startups grew in their first five years, the number of businesses starting small and growing to medium-sized or larger (employing fifty or more people) by their tenth year of operation as a percentage of all employer firms, and the prevalence of fast-growing, private companies in a region, defined as at least 20 percent annualized growth over three years and \$2 million dollars in annual revenue. **Pennsylvania has a low Share of Scaleups and a low High-Growth Company Density.**

Pennsylvania's high Main Street score and relatively low Startup and Growth scores indicate a high level of small businesses success **as opposed to new business creation or high growth scaleups, indicating a need for more support for startups and growing companies.**

# Brookings, Advanced Industries

This 2015 Brookings Report looked at 50 Industries characterized by a high concentration of STEM workforce and tech-focused R&D that invest heavily in technology innovation and employ skilled technical workers to develop, diffuse, and apply new productivity-enhancing technologies.

These advanced industries provide high quality economic opportunities for workers **at all education levels** and play an important role in overall economic activity for the country.

Pennsylvania's low score indicates a **lack of readiness for the coming economic future** arising from innovation and featuring family-sustaining jobs as well as inclusive workforce/employment needs.

## The Rankings:

1. Michigan
2. Washington
3. Massachusetts
4. Indiana
5. Virginia
6. Utah
7. California
8. Connecticut
9. Alabama
10. Colorado
11. Maryland
12. Texas
13. Kansas
14. New Hampshire
- ...
- 24. Pennsylvania**

“ Ranging from **manufacturing** (automaking, aerospace) to **energy** (oil and gas extraction), to **high-tech services** (computer software and computer system design, including for **health** applications), these industries encompass the nation’s “tech” sector at its broadest and most consequential. ”

“ Their dynamism is going to be a **central component of any future revitalized U.S. economy**. As such, these industries encompass the country’s **best shot at supporting innovative, inclusive, and sustainable growth**. ”



## INVESTMENT - R&D, Federal, Private Capital

Investment is critical for transforming ideas into economic output. This section examines amounts of R&D funding as an essential input of entrepreneurship and innovation, R&D spending as a proxy for innovation-based entrepreneurial activity, federal innovation grants (SBIR/STTR) which allow businesses to explore new technologies through research and development and academic partnerships, and venture capital deployed in Pennsylvania to help scale companies to the next level.

First, when we observe funding from state, federal, university, and private sources, now and in the past, and compared to other states, we see that R&D funding in Pennsylvania overall **has increased**. However it has not grown at the rate of several states that have become outliers, rising to the top and surpassing others. These states are winners in a “winner-take-most” environment, while Pennsylvania resides in the middle.

Next, by looking at R&D spending as compared to other states and the rest of the country, we see that Pennsylvania has the **5th highest level** of university R&D spending per capita. However, most of the state’s R&D spending occurs in the private sector, largely at large businesses with 250 or more employees. This places the state’s private sector spending at **20th among all states**.

As far as Federal Innovation Grants, the state is **just at or just below average** for both SBIR and STTR. And Pennsylvania is right in the **middle of the pack** regarding venture capital, receiving about 33% of the national average.

Let's start by looking at four sources of funding:



**State**  
Funding



**Federal**  
Funding



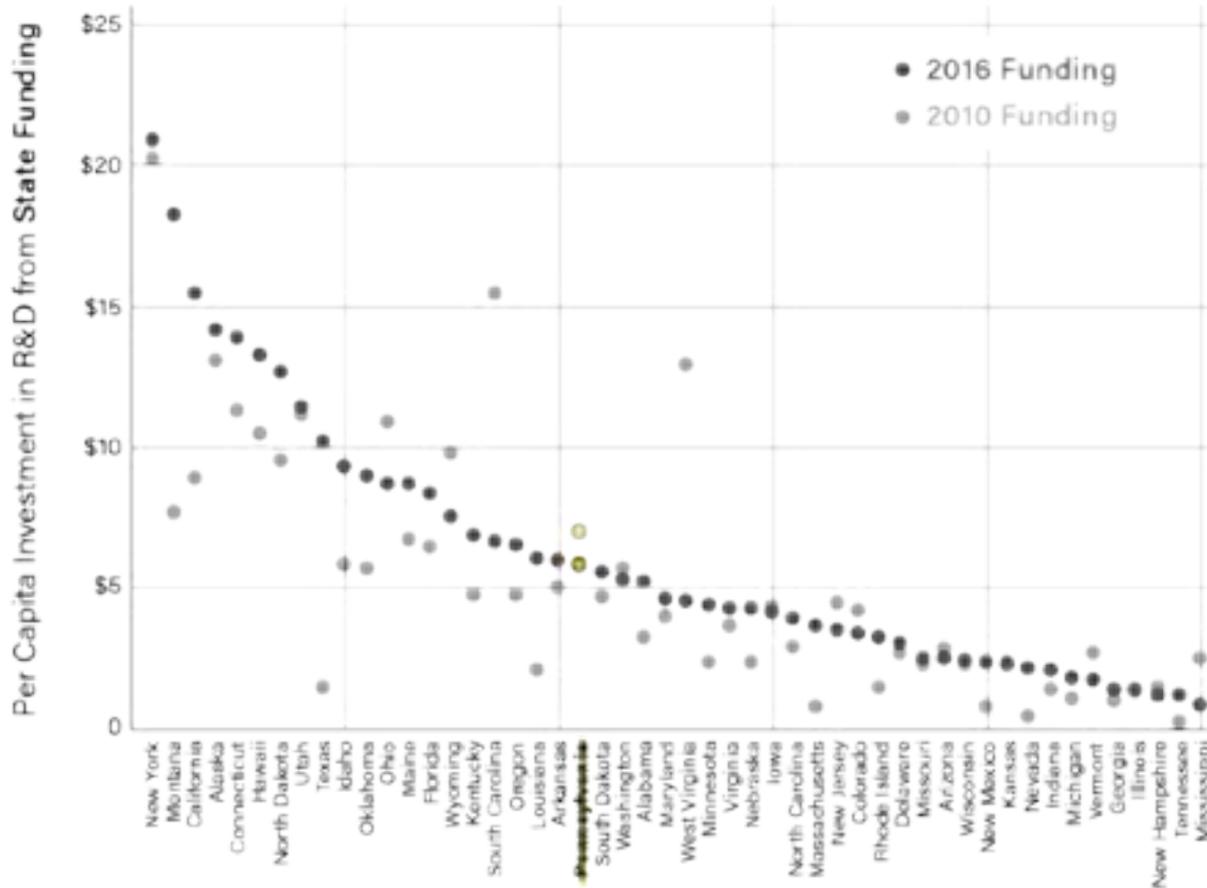
**University**  
Funding



**Private Business**  
Funding



## STATE R&D Funding

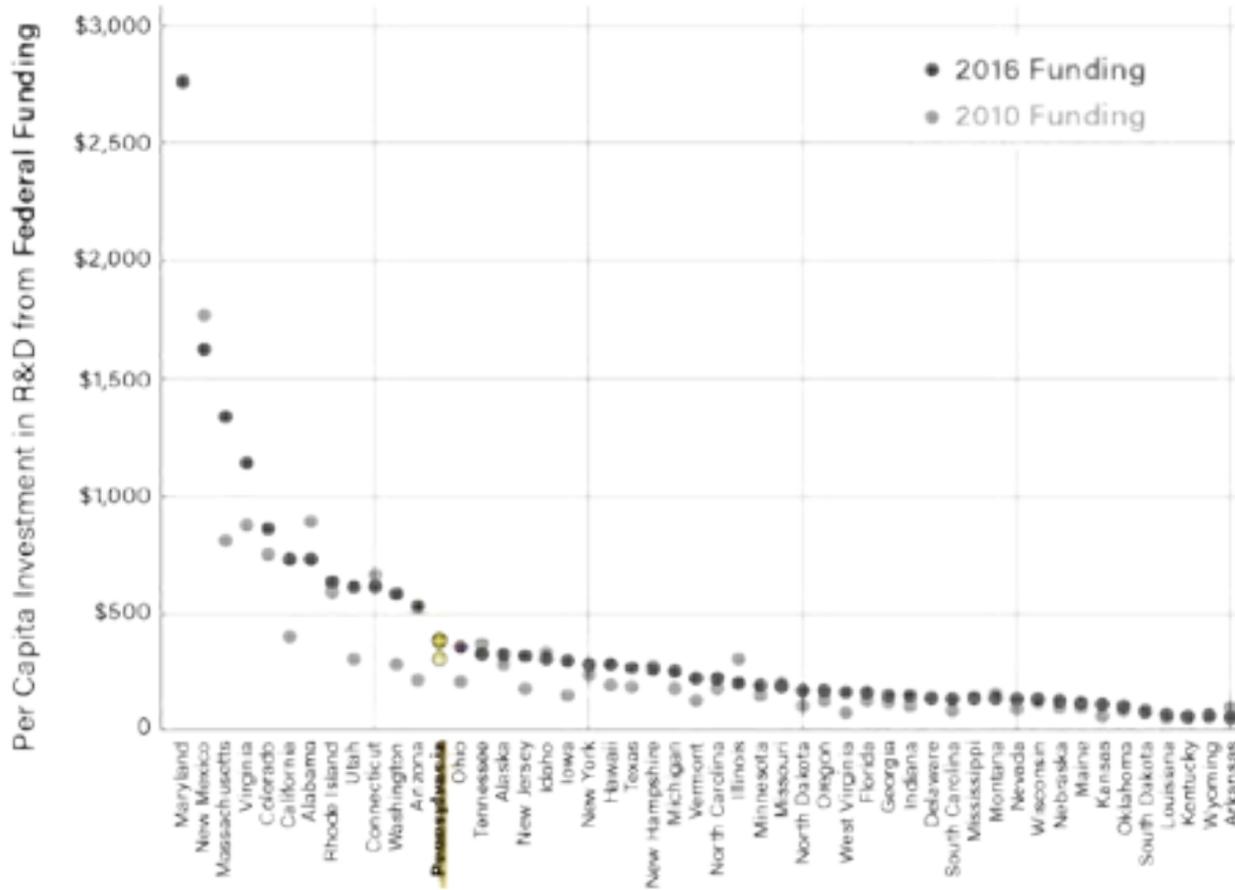


- PA is **one of 10 states** allocating **fewer** state funds 2010 - 2016
- PA is still roughly in the **middle** compared to peers
- State R&D funding impacts university **commercialization** levels
- However, state funding is a **minority** of R&D funding from all sources

Data:  
NSF, Survey of State Government  
Research and Development



# Federal R&D Funding

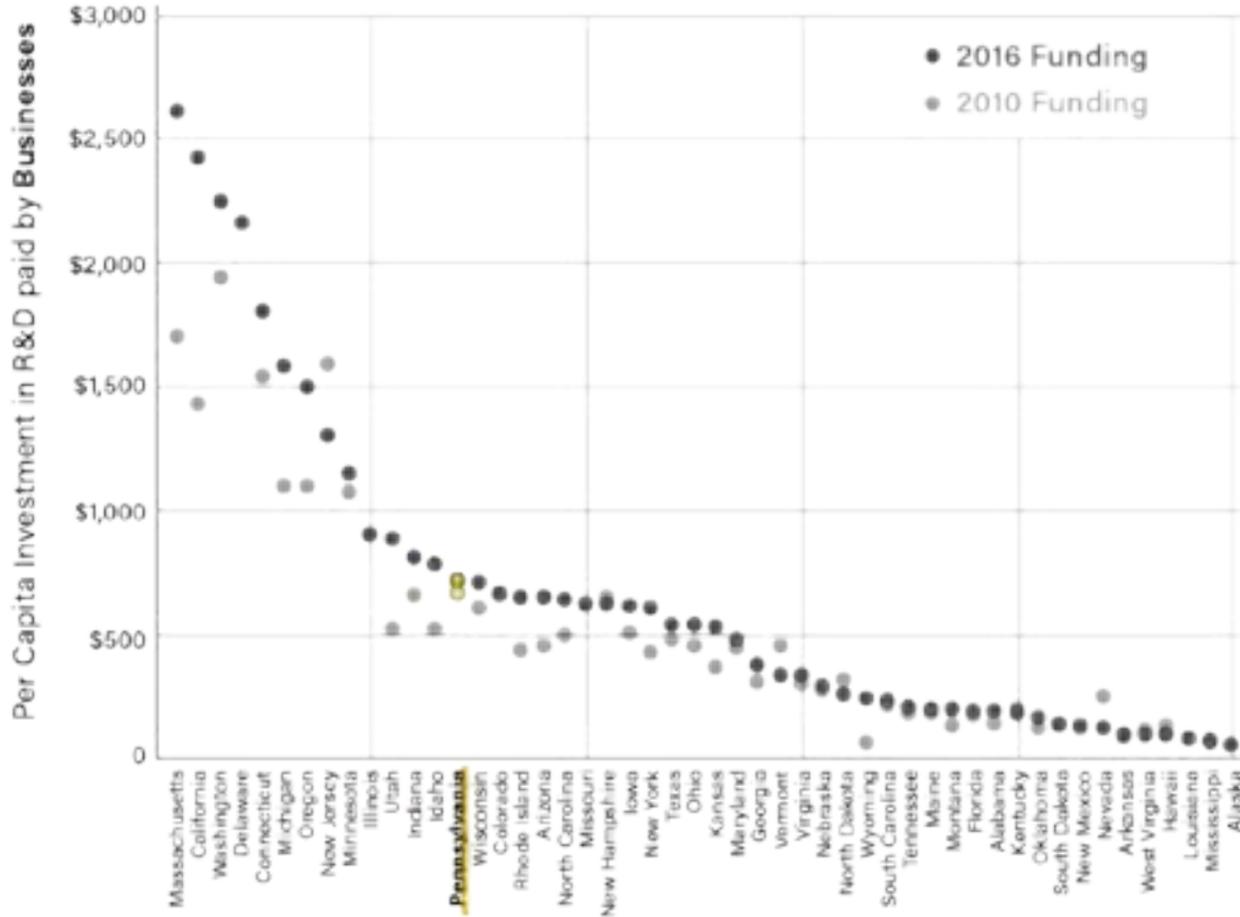


- PA received **increased** federal funding from **2010 - 2016**
- PA is still roughly in the middle, around average and **above median**
- However, there are outliers with much higher rates of investment, such as: MD, MA, CT, CA

Data:  
NSF, Survey of Federal Funds for Research and Development



# Private Business R&D Funding



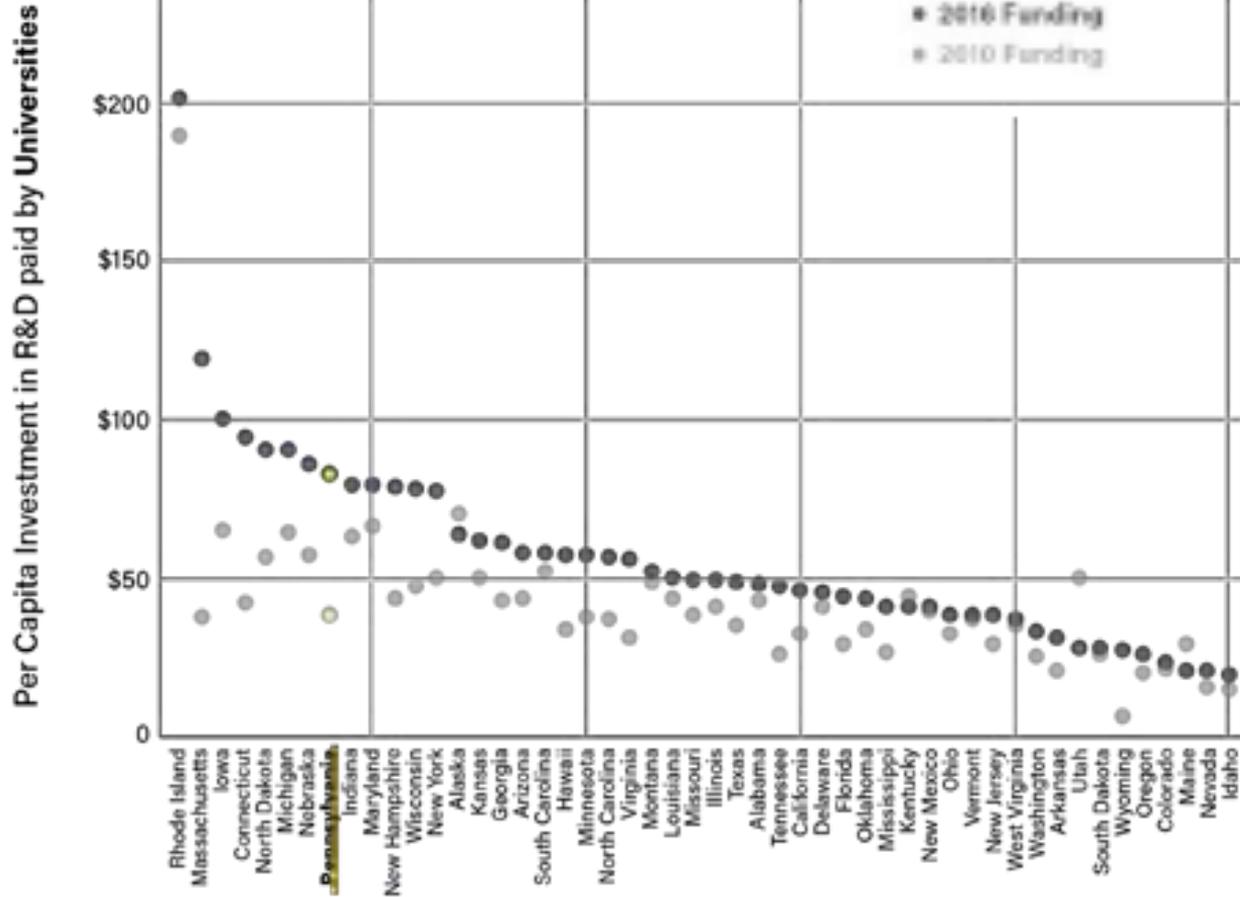
- Private funding is PA's **largest source** of R&D money
- PA's share of private funding is **above average** and above median

\* 2010 data for Delaware, Missouri and Alaska is not available.

Data: NSF, Survey of Federal Funds for Research and Development



# University R&D Funding



- PA is in the top percentile of university R&D funding
- University R&D funding still makes up a **minority** of PA's overall R&D money

Data:  
NSF, Survey of Federal Funds for Research and Development

## Where is the R&D Funding Spent in PA?



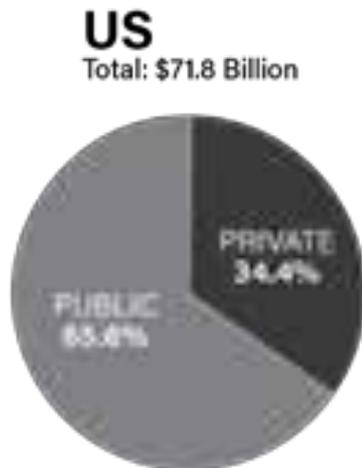
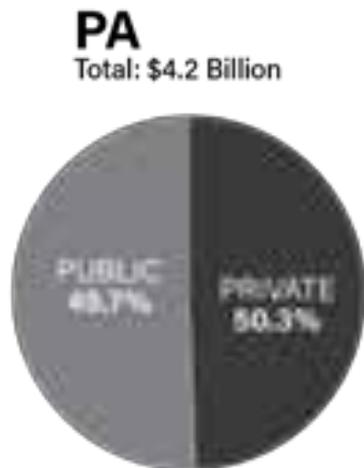
**Universities**  
\$4 Billion  
In 2016



**Private Businesses**  
\$10 Billion  
In 2015



## University R&D Spending in PA, 2017



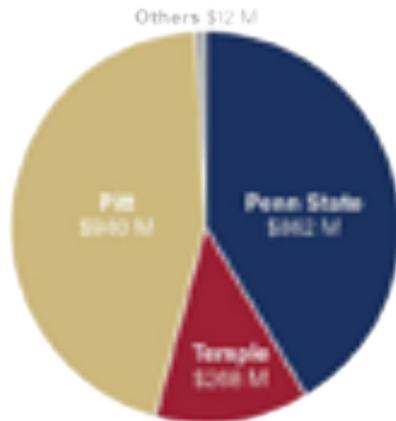
Compared to the United States as a whole, Pennsylvania's R&D dollars are spent at **private universities** at a much higher level.

Data:  
NSF, Survey of Federal  
Funds for Research and  
Development

## University R&D Spending in PA, 2017

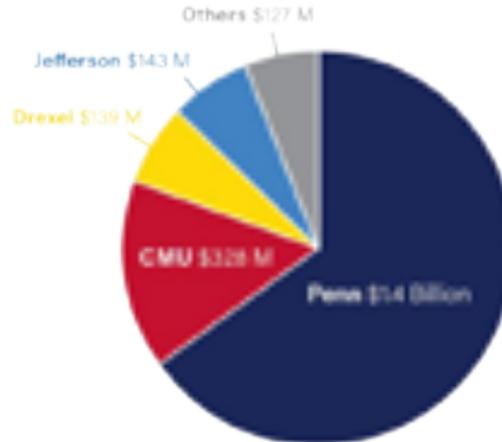
### Public

Total: \$2.08 Billion



### Private

Total: \$2.11 Billion



Pennsylvania's university R&D dollars are dispersed among institutions across the state.

Data:  
NSF, Survey of Federal  
Funds for Research and  
Development

# Where is the R&D Funding Spent in PA?



**Universities**  
\$4 Billion  
In 2016

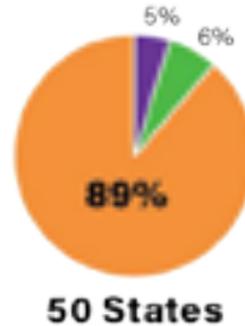
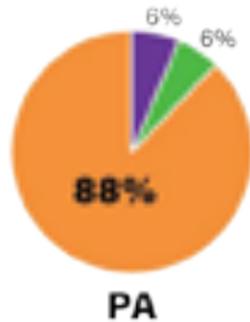


**Private Businesses**  
\$10 Billion  
In 2015



## Business R&D Spending in PA, 2017

- Small Businesses (<50 employees)
- Medium Businesses (50 - 249 employees)
- Large Businesses (250+ employees)



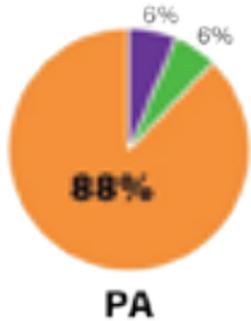
Nearly **90 percent** of private sector R&D is spent by **large companies**, both in PA and nationally.

PA is very similar in its distribution to the US at large.

Data:  
NSF, Survey of Federal  
Funds for Research and  
Development

## Business R&D Spending in PA, 2017

- Small Businesses (<50 employees)
- Medium Businesses (50 - 249 employees)
- Large Businesses (250+ employees)



### NH

- 8%
- 21%
- 71%



### AL

- 47%
- 28%
- 22%



### NM

- 28%
- 20%
- 51%



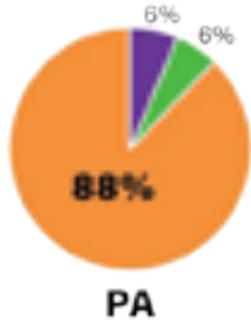
A few states are outliers, with a much higher than average concentration of R&D spending among small and medium sized businesses.

For example, companies with **less than 250 employees spend over 25% of NH's**, nearly **50% of NM's**, and over **75% of AL's** private sector R&D.

Data:  
NSF, Survey of Federal  
Funds for Research and  
Development

# Business R&D Spending in PA, 2017

- Small Businesses (<50 employees)
- Medium Businesses (50 - 249 employees)
- Large Businesses (250+ employees)



## NH

- 8%
- 21%
- 71%



## AL

- 47%
- 28%
- 22%



## NM

- 28%
- 20%
- 51%



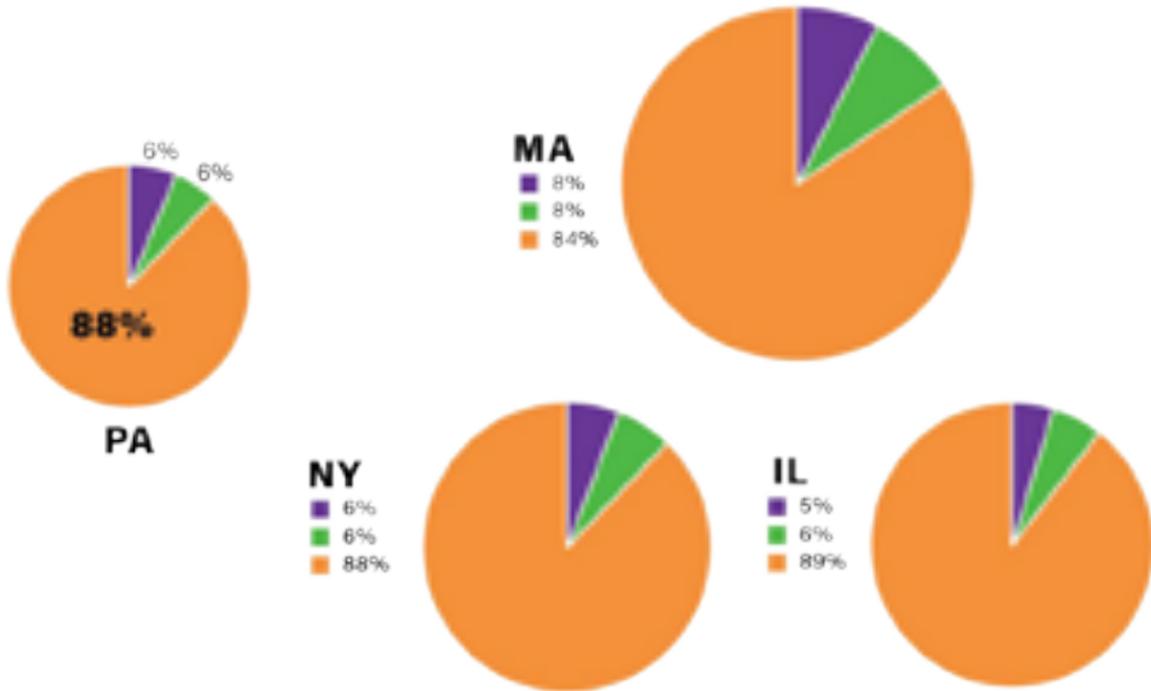
But those states are very small!

*(Size here by population.)*

Data:  
NSF, Survey of Federal Funds for Research and Development

# Business R&D Spending in PA, 2017

- Small Businesses (<50 employees)
- Medium Businesses (50 - 249 employees)
- Large Businesses (250+ employees)

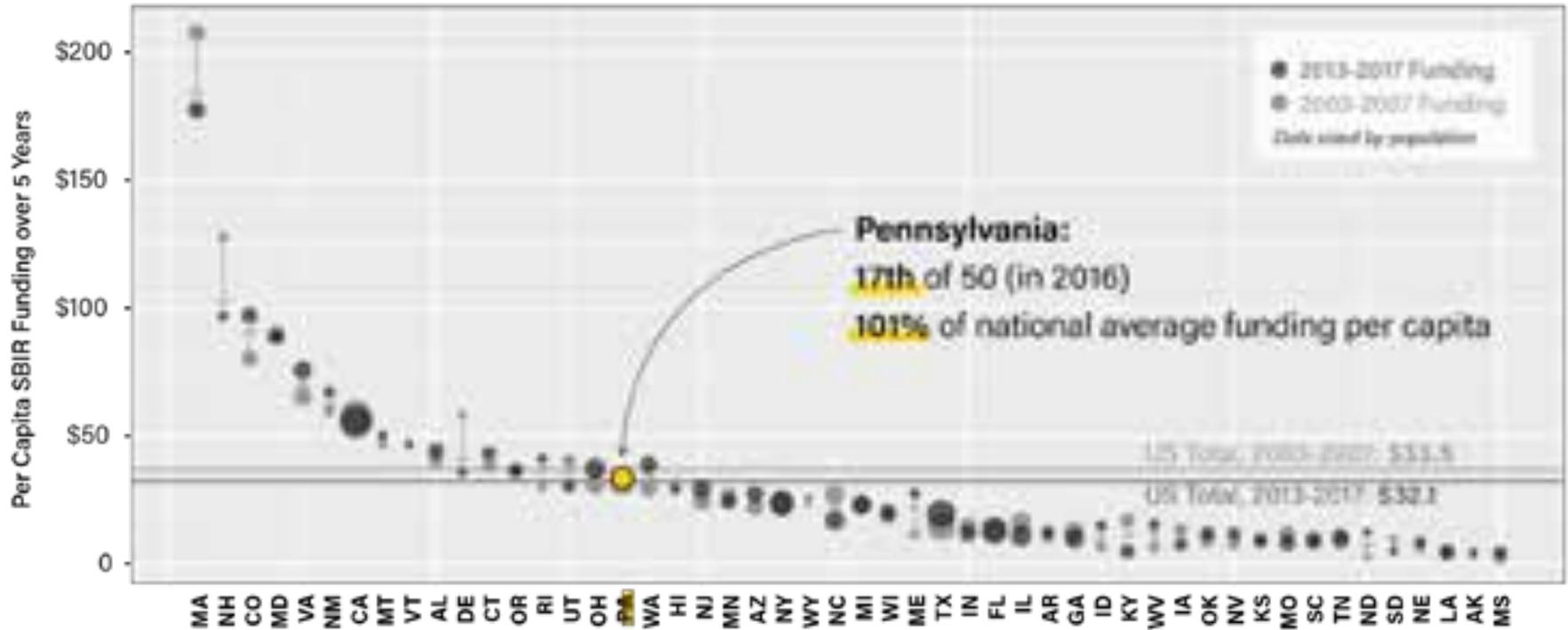


Most states similar to PA in size are also similar in their concentration of R&D spending among **large businesses**.

Data: NSF, Survey of Federal Funds for Research and Development

# SBIR Funding by State per capita, five-year total

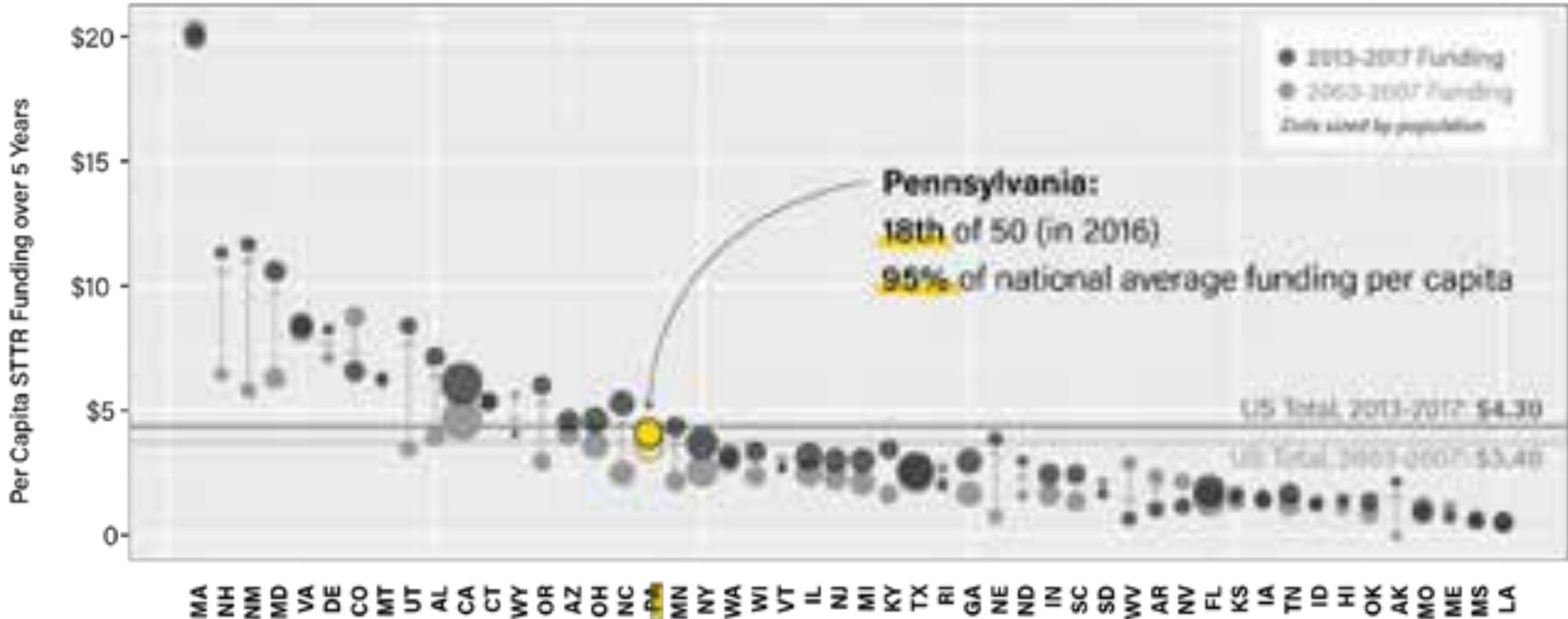
Small Business Innovation Research grants allow businesses to explore technology and incentivizes research and development with the goal of commercialization.



Data: Small Business Administration

# STTR Funding by State per capita, five-year total

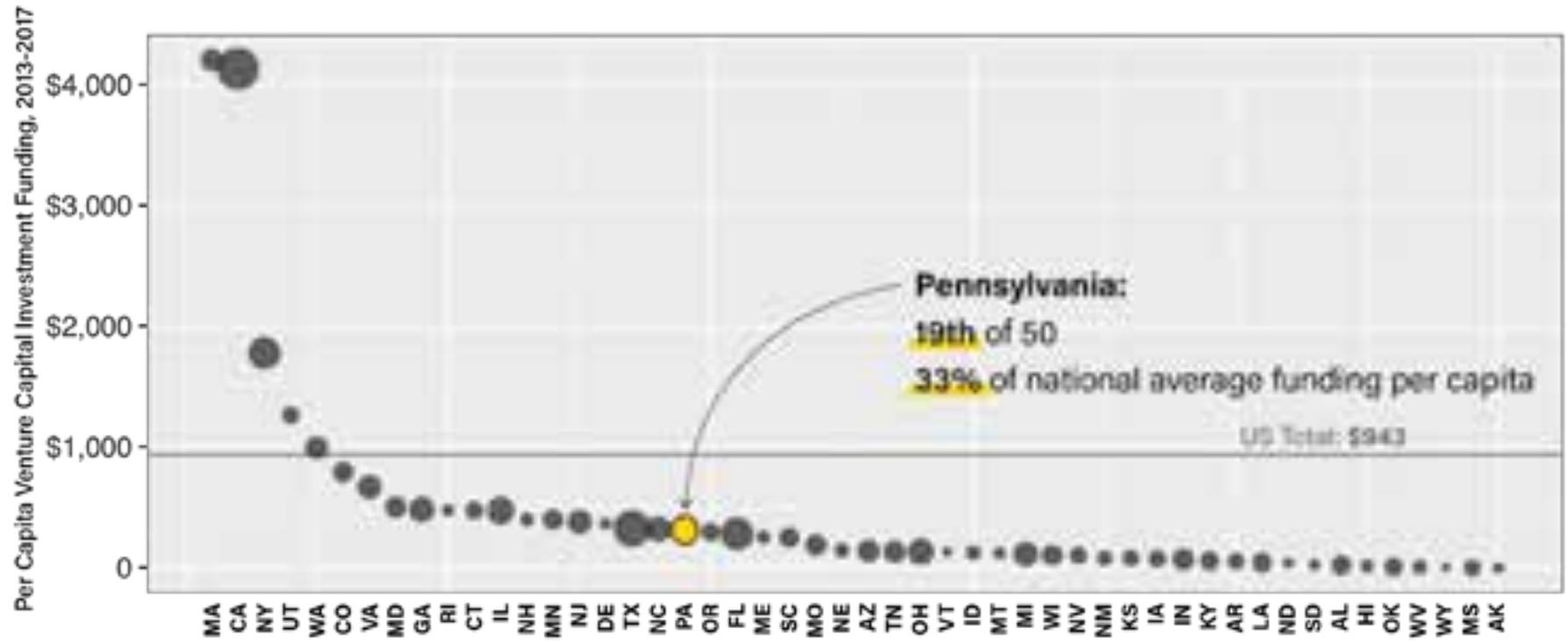
**Small Business Technology Transfer** funding facilitates the transfer of technology from a research institution to a partnering business.



Data: Small Business Administration

# Venture Capital Investment by State

per capita, five-year total



Data: PWC, MoneyTree



## IDEAS - Patents, New Business Creation

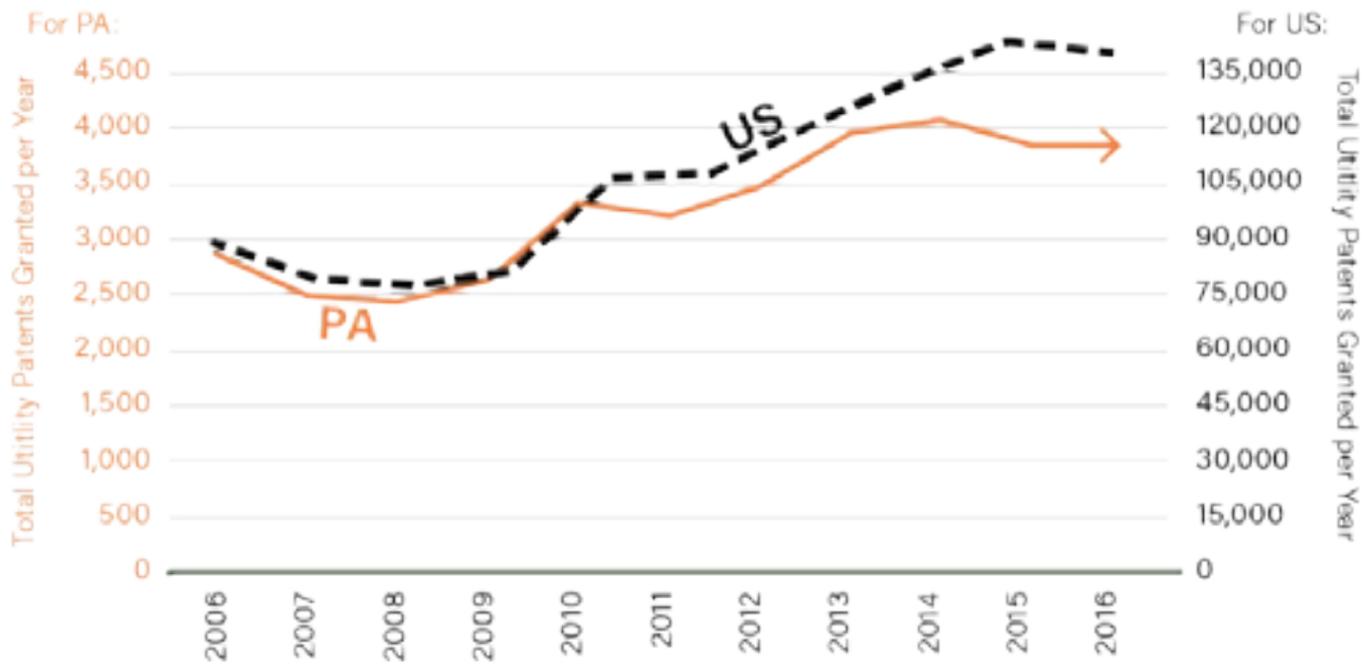
New ideas create the foundation for entrepreneurial endeavors and innovation. Has the state's R&D activity led to ideation activity? This section looks at: rate of patent filings as an indicator of ideation and innovative activity; patent origins to understand where innovation is coming from and happening, and; new business creation as an output of new idea generation.

We see that though the number of patents granted in Pennsylvania is rising, it is actually **not keeping pace with increases across the rest of the country**. In addition, individuals make up the largest source of patent activity in the state, but at a lower rate than in the country as a whole. Individual patent owners are an important factor in driving new company creation.

Of Pennsylvania's top 10 patent recipients, **individuals and universities combined, are receiving the largest share of patents**, indicating that corporate intrapreneurship is modest. Compared to other states, Pennsylvania does not have large, corporate drivers of patent activity and innovation, like Amazon in Washington, for instance.

Finally, we look at business births and deaths to calculate net business creation. Pennsylvania is in the bottom quartile for business births, but has a relatively high business survival rates. Still, the state ranks **33rd among all other states for business creation**.

## Patents Granted, 2006-2016



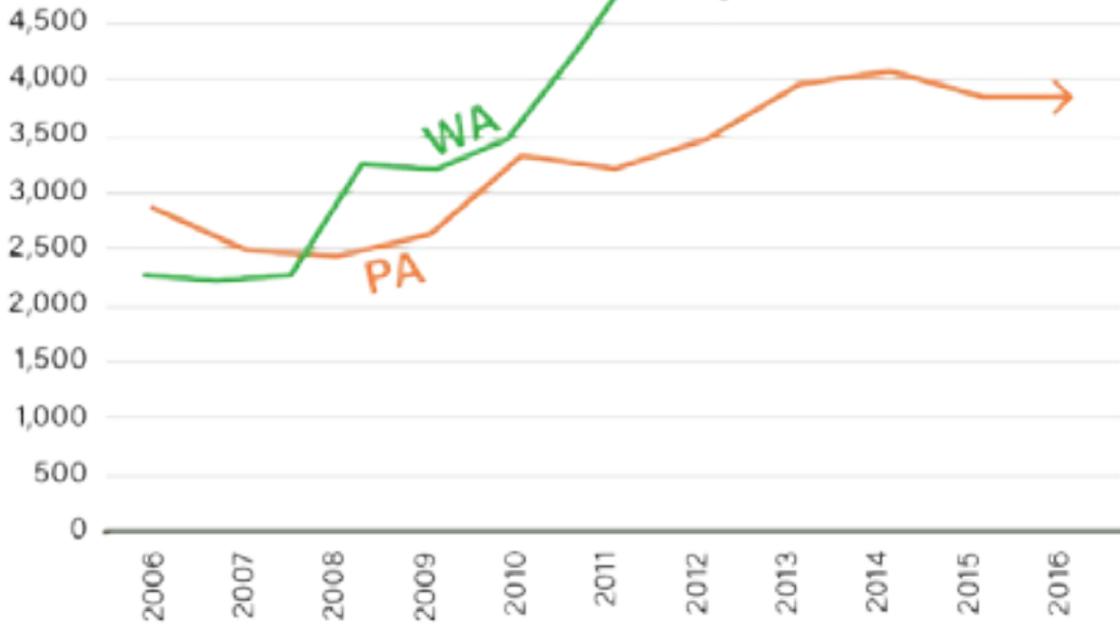
Pennsylvania's number of utility patents (a patent that covers the creation of a new or improved and useful product, process, or machine, as opposed to a design patent that protects the way something looks) granted per capita is rising, but at a rate that is **below the national rate**. Utility patents are a proxy for entrepreneurial activity.

Data:  
USPTO

## Patents Granted, 2006-2016

For PA and WA:

Total Utility Patents Granted per Year



Data:  
USPTO

Many states' patent filings have been rising much faster. For example, at roughly half of Pennsylvania's population, Washington's per capita patent rate is much higher and is growing more sharply.

That's largely been driven by a few companies (36% of all Washington's patents filed are from just three companies - Microsoft, Amazon, and Boeing), indicating a high rate of corporate innovation activity.

# Largest Patent Recipients in PA, 2010-2015

PATENT ASSIGNEE	PATENTS	% OF PA TOTAL
<b>INDIVIDUALLY OWNED PATENTS</b>	<b>2319</b>	<b>12.4%*</b>
TYCO ELECTRONICS (TE)	620	3.3%
DU PONT	529	2.8%
UNIVERSITY OF PENNSYLVANIA	421	2.2%
PPG	347	1.8%
GENERAL ELECTRIC	324	1.7%
AIR PRODUCTS AND CHEMICALS, INC.	290	1.5%
AGERE SYSTEMS, INC.	272	1.4%
UNIVERSITY OF PITTSBURGH	258	1.4%
ROHM AND HAAS CO.	248	1.3%

Individuals own 12.4% of PA's patents, which is **lower than in the U.S.** at 14% over the same period.

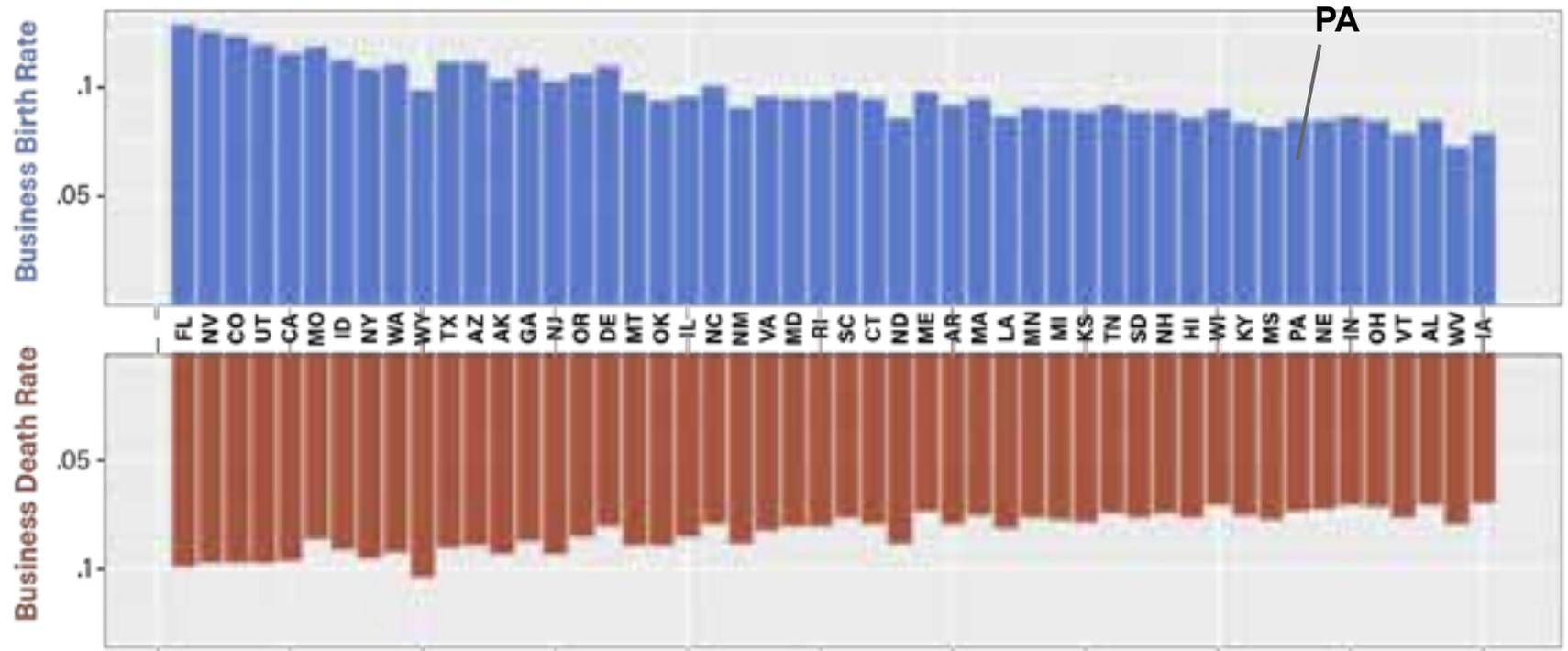
Together, individuals and universities are two of PA's top patent winners.

The significance of patents among universities indicates **academic innovation**, but that doesn't necessarily translate into corporate innovation.

# Business Births and Deaths by State

2016 rate

Are we creating businesses with our patent and R&D investment?

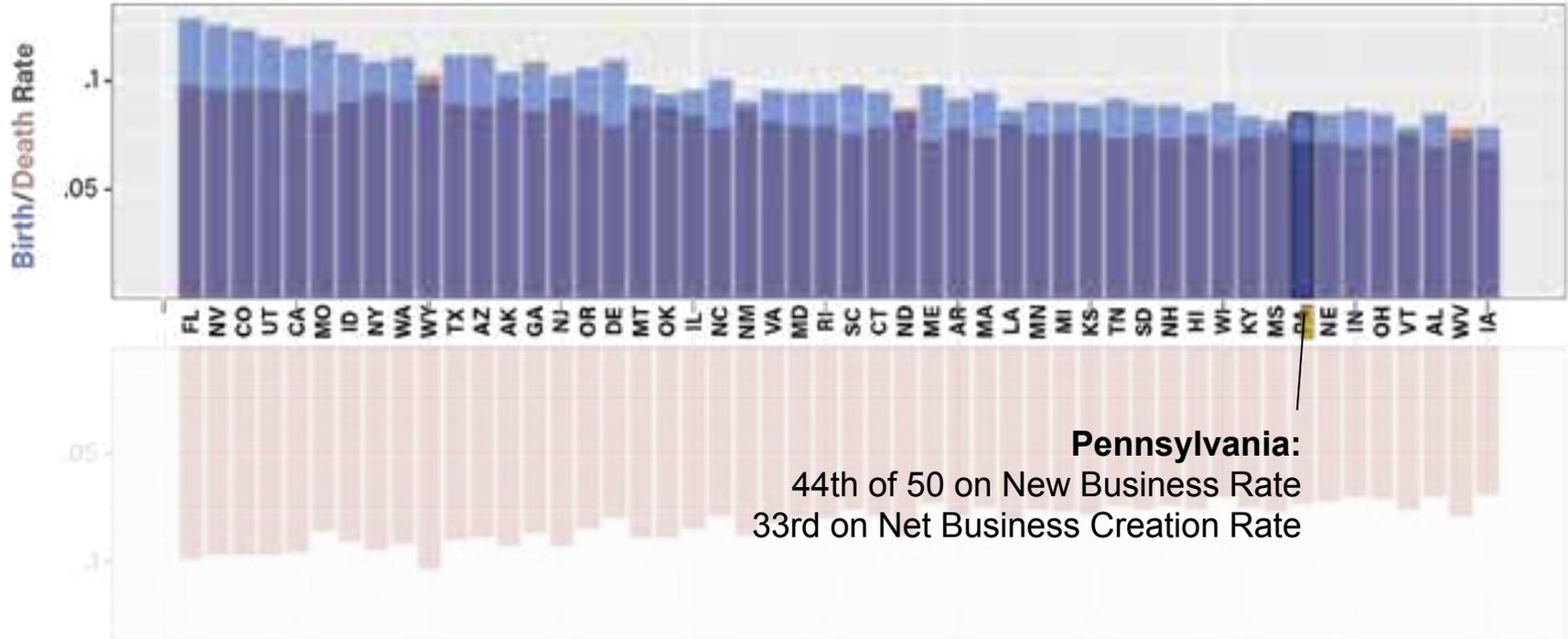


Data: US Census Bureau

# Business Births and Deaths by State

2016 rate

By looking at new business creation rate combined with rate of business death, we see that at 33rd net business creation, Pennsylvania is in the **lower half of all states**.



Data: US Census Bureau



## PEOPLE - Population, Employment, Education

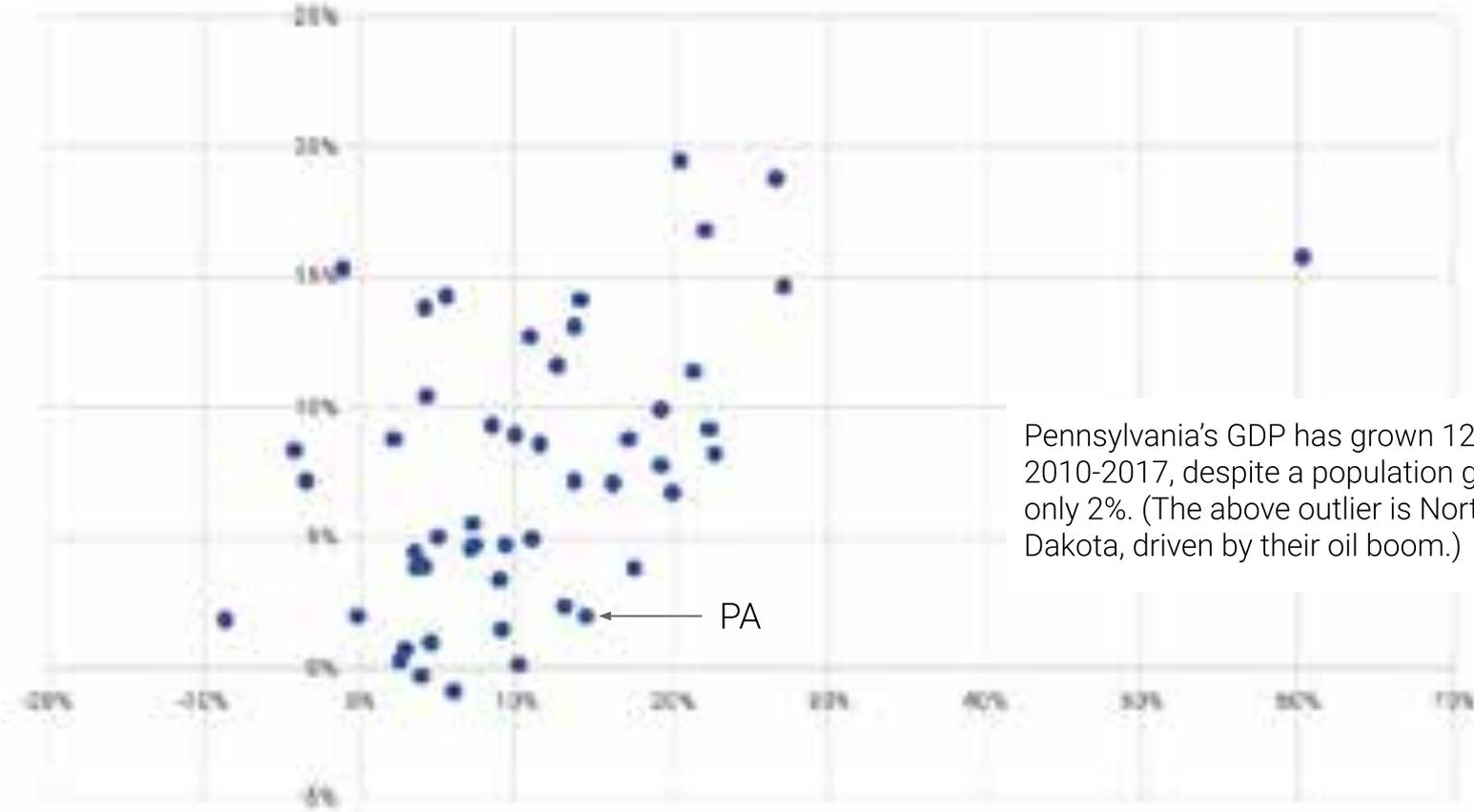
People are the most vital ingredient in any economy. How is Pennsylvania doing in terms of human capital? This section looks at population trends and economic growth, **rising industries and high tech employment levels**, and human capital investment as it relates to college enrollment and achievement.

Pennsylvania's GDP has grown 12% from 2010-2017, despite a population gain of only 2%. However, employment in the high growth advanced industries is **low and has been decreasing**, indicating a potential coming shortage.

University enrollment in the state is about **average**, with close to 5% of the population attending graduate or undergraduate programs. Pennsylvania students also land around the **middle of the pack** when it comes to pre-college test scores. However, when combined with college enrollment levels, we see that higher-ed students perform at a higher level comparative to their peers, indicating the presence of a **bright young talent pool** that must be groomed for the workforce.

# Population Growth and Economic Growth by State, 2007 - 2017

Population Growth, 2007-2017



Pennsylvania's GDP has grown 12% from 2010-2017, despite a population gain of only 2%. (The above outlier is North Dakota, driven by their oil boom.)

GDP Growth, 2007-2017 (Real Dollars)

Data: BEA

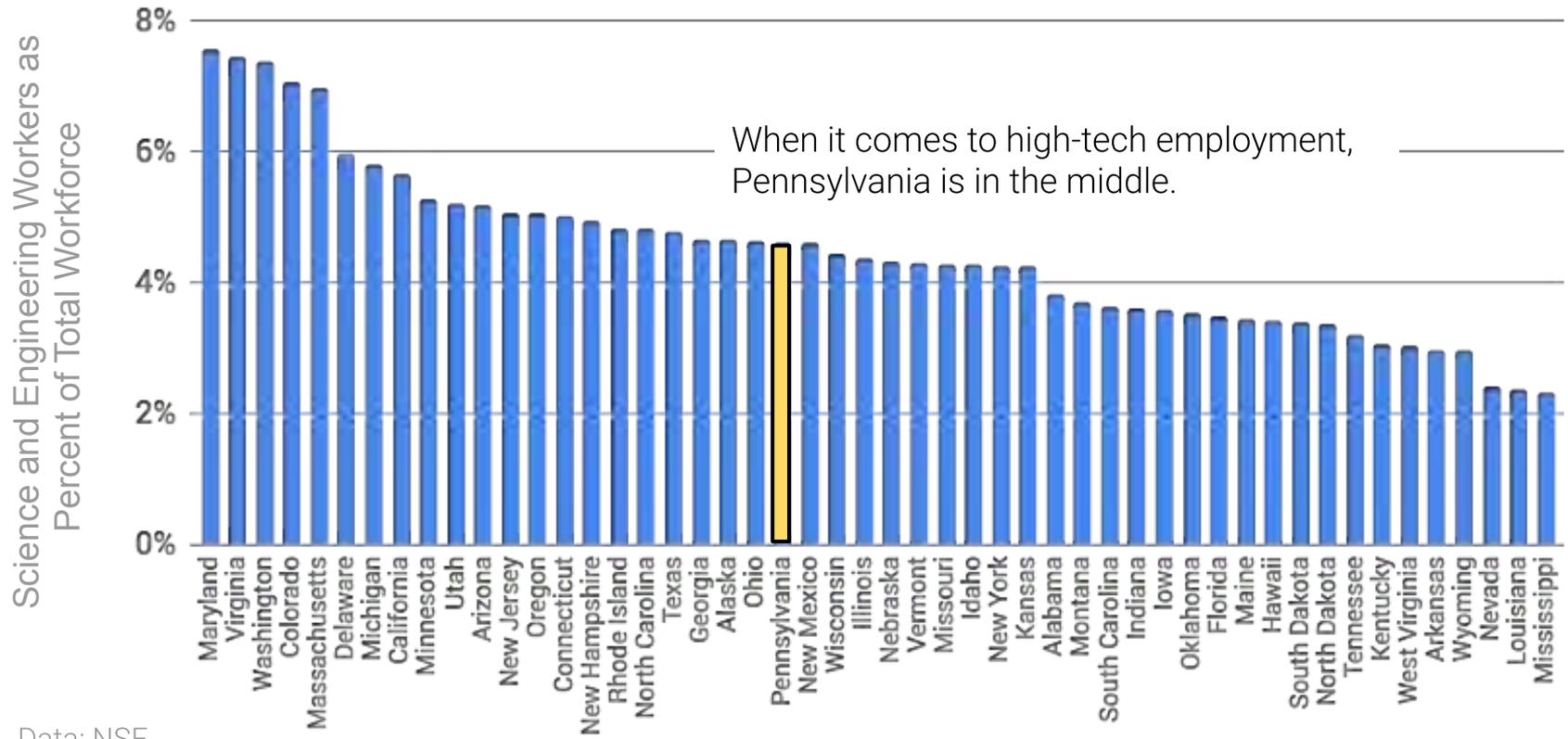
## **Are we creating *high-tech jobs*?**

We investigated by looking at employment in 46 NAICS codes that NSF identified as “high-technology industries.” This includes occupations that typically require an advanced degree, but also those that require associate degrees and vocational training, to account for more of the working population that will need to engage in a vibrant science and technology-driven economy.

This is an important thing to note because the tech economy will and should include a broad variety of occupations that cover more of the working population, ensuring that the benefits of increasing tech/innovation activity in the state benefit more workers/constituents.

# Science and Engineering Workers

Percent of Workforce, 2017



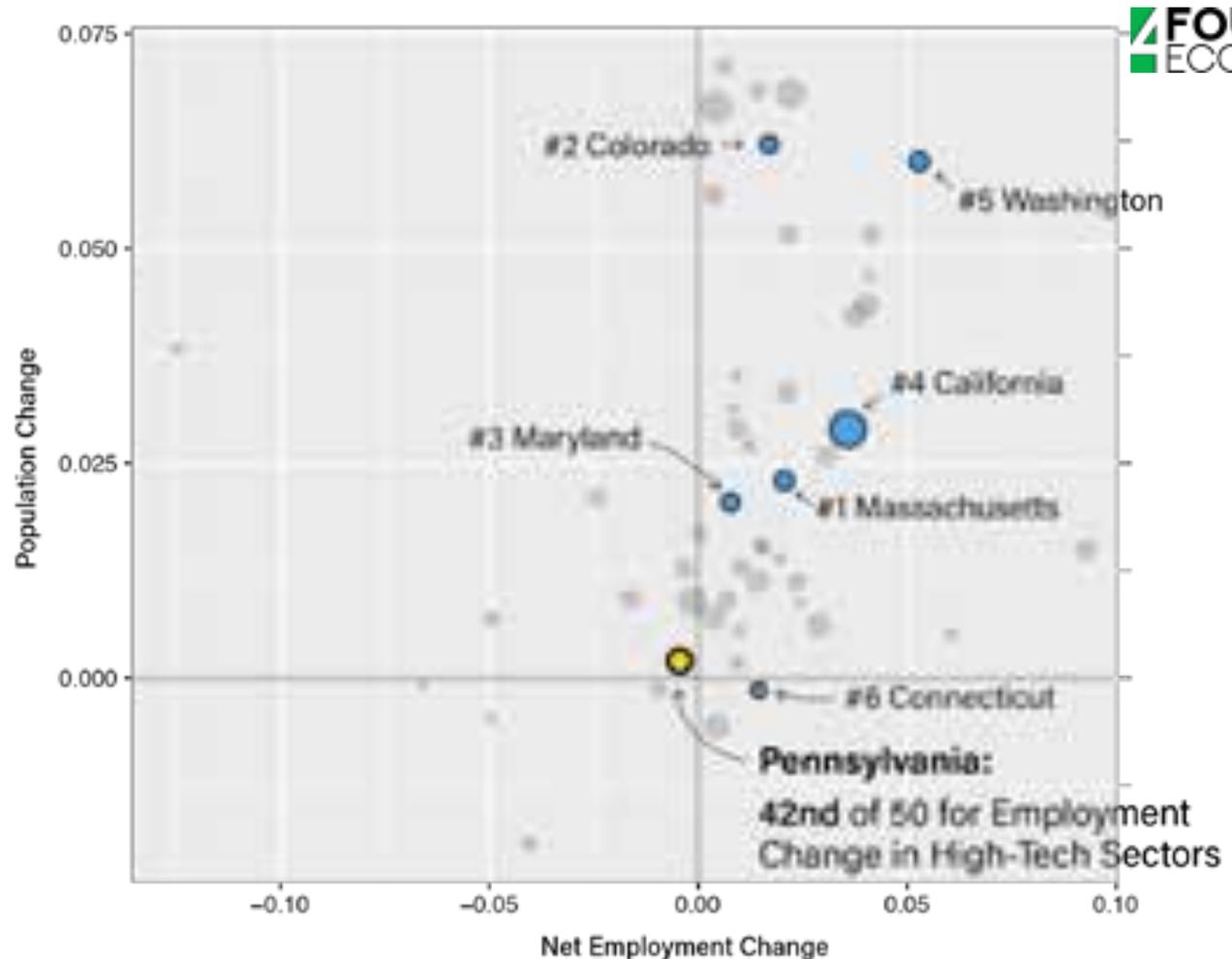
Data: NSF

# Population Change & Key Industry Employment Change

2015-2016

**Growth is a critical issue**, especially when compared with States with highest Milken Index scores (shown in blue).

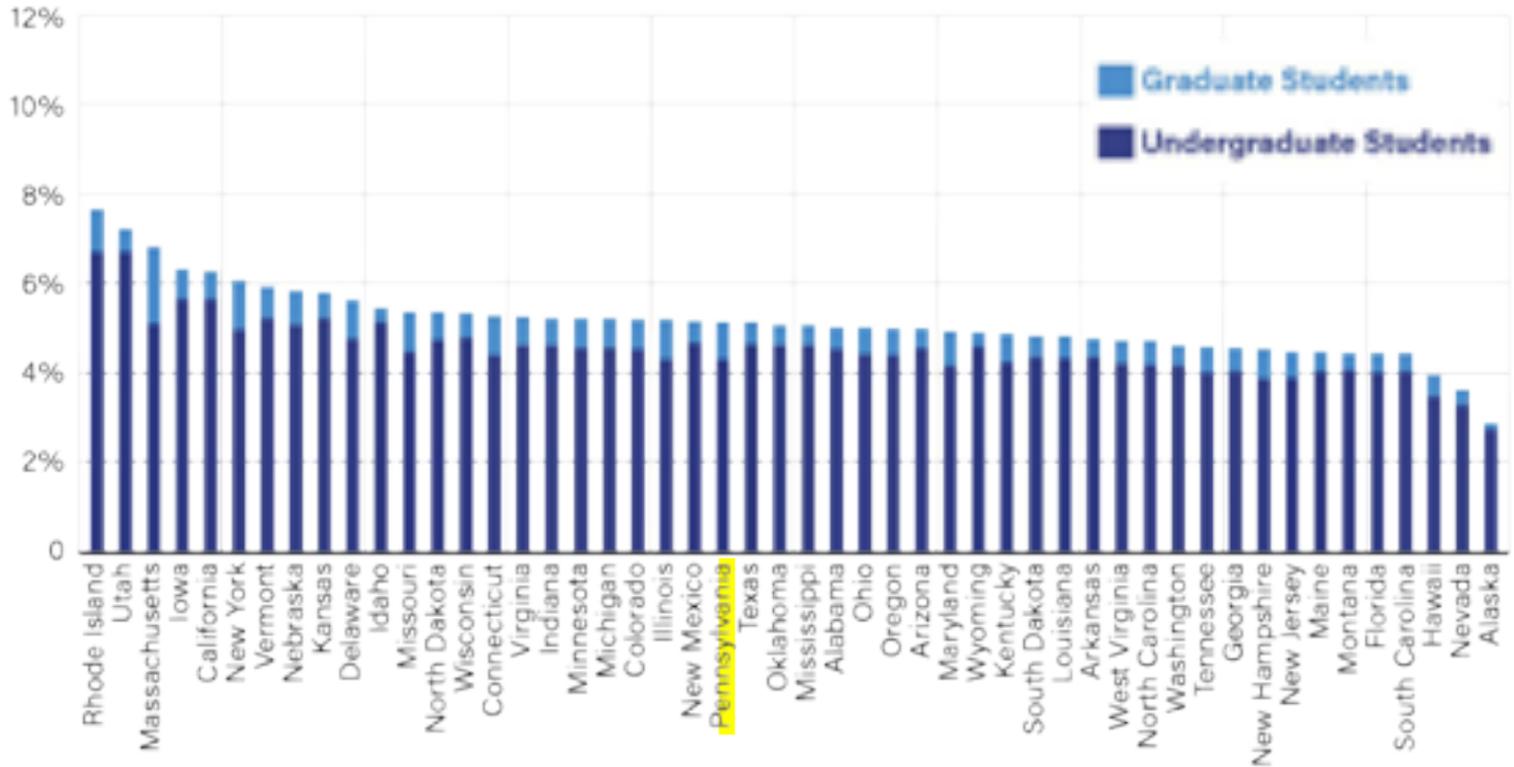
Data: US Census Bureau



# College Enrollment as a Percent of Population by State

Excluding Students Enrolled only in Distance Learning

Despite being home to some large universities, PA does not have a particularly high concentration of college students; instead, it falls in the middle for its ratio of college students to population.



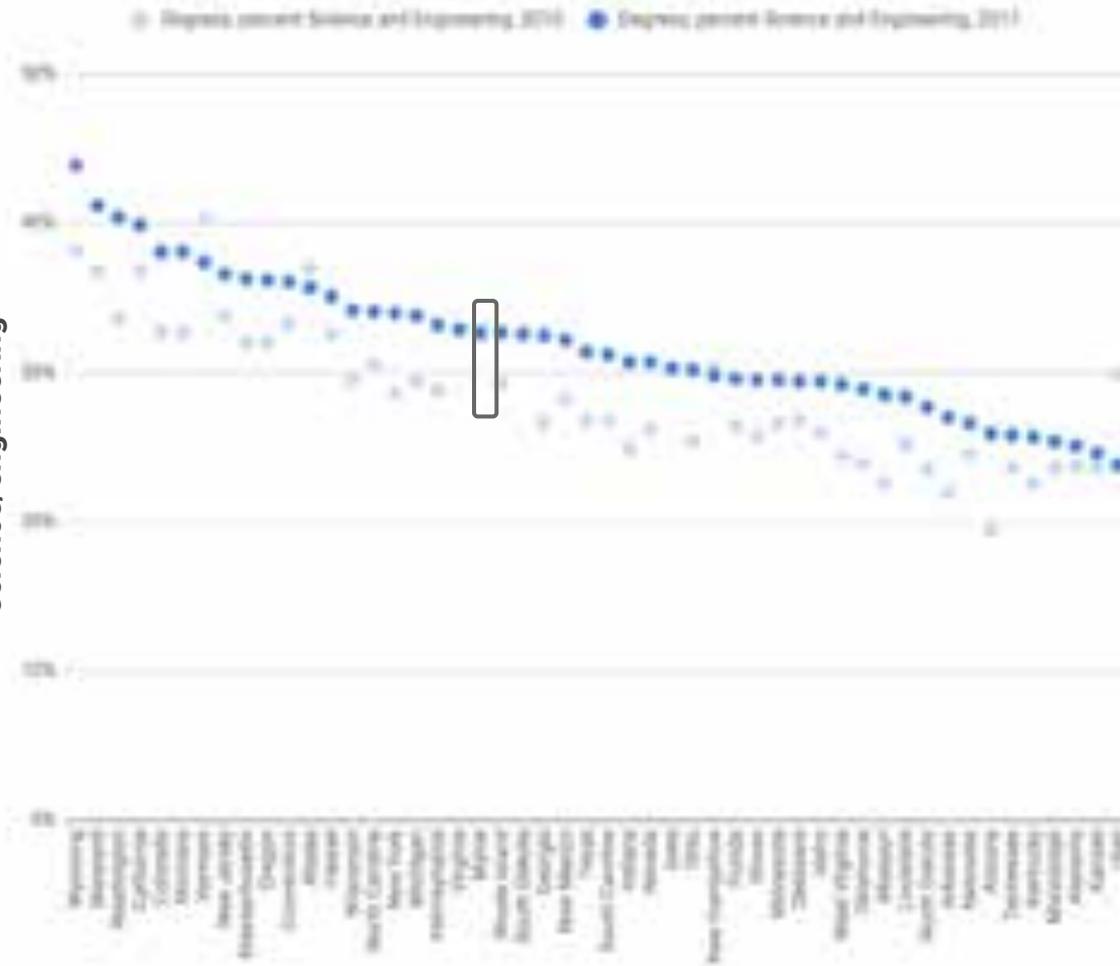
Data: IPEDS

# Science and Engineering Higher-ed Degrees

(as a percent of all degrees) by state

Pennsylvania is about **average in Science and Engineering Higher-ed Degrees** as a percent of all degrees in the state. That percentage has grown since 2010 in PA, but it has also grown similarly in many other states.

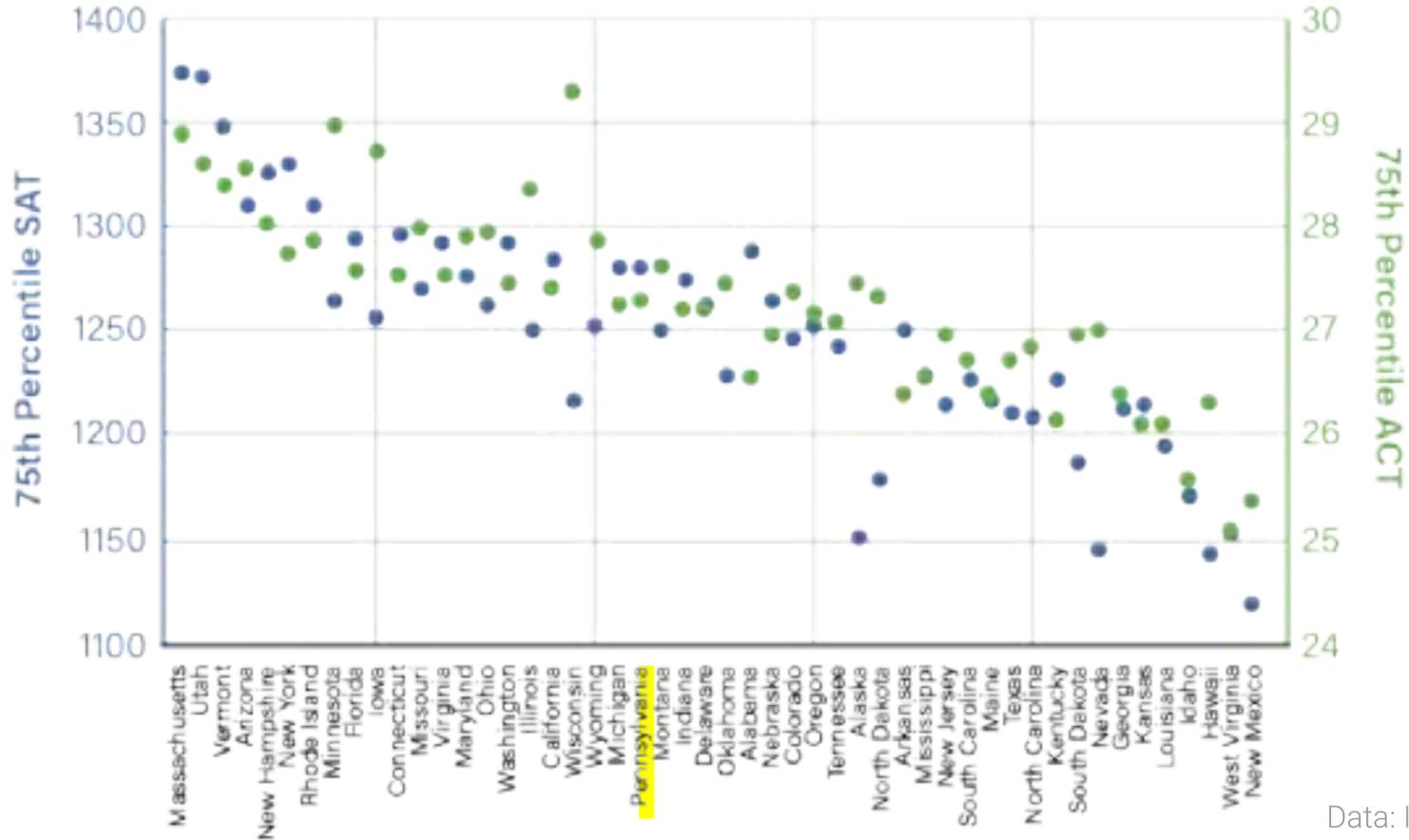
Percent of degree conferred that were science/engineering



Data: NSF

# Test Scores, 2016-2017

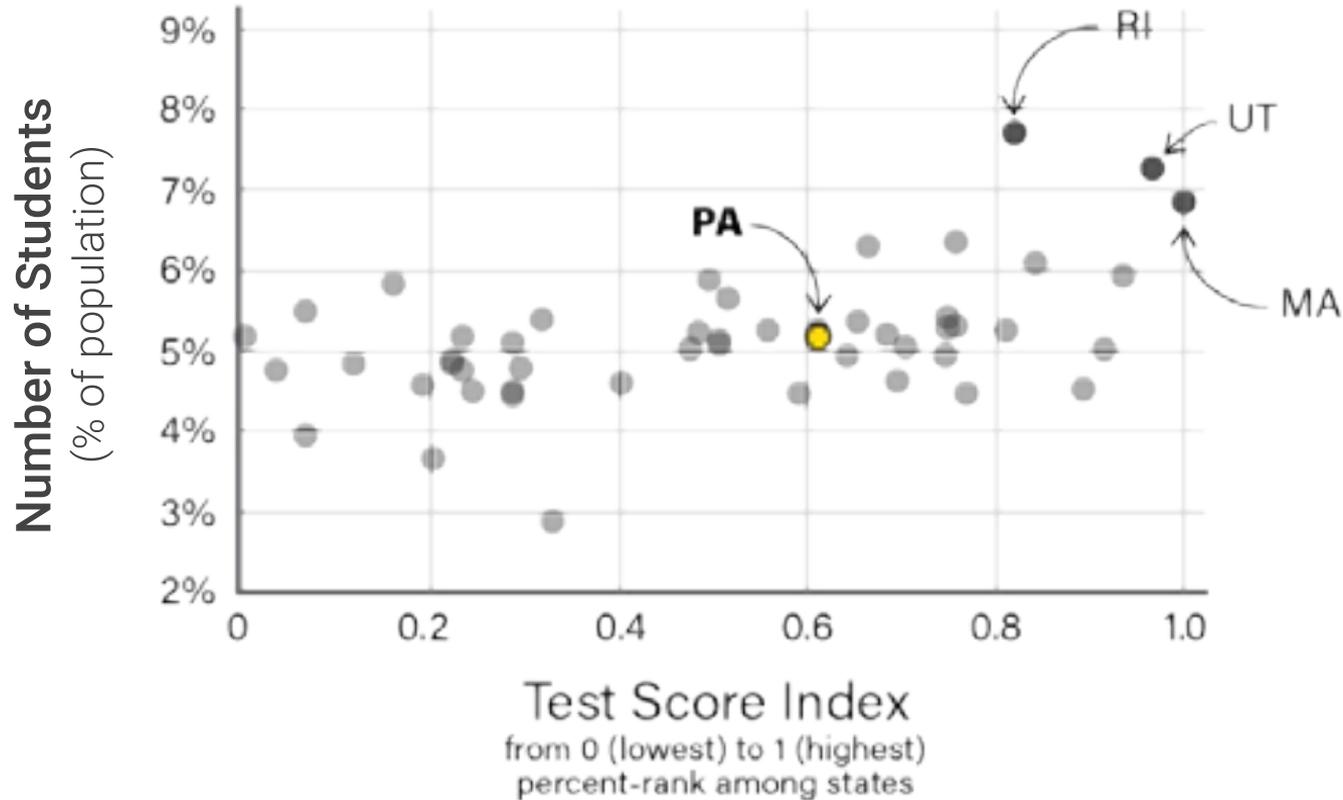
Refers to the average 75th percentile test score for first-year undergraduates, weighted by non-distance student attendance



Which states are getting the highest-achieving students?

Pennsylvania is in the middle.

# Enrollment Per Capita and Undergraduate Test Scores by State



When enrollment and achievement are considered together, Pennsylvania appears to be **about average**, but other states—especially Rhode Island, Massachusetts, and Utah—are much stronger on both enrollment and achievement.

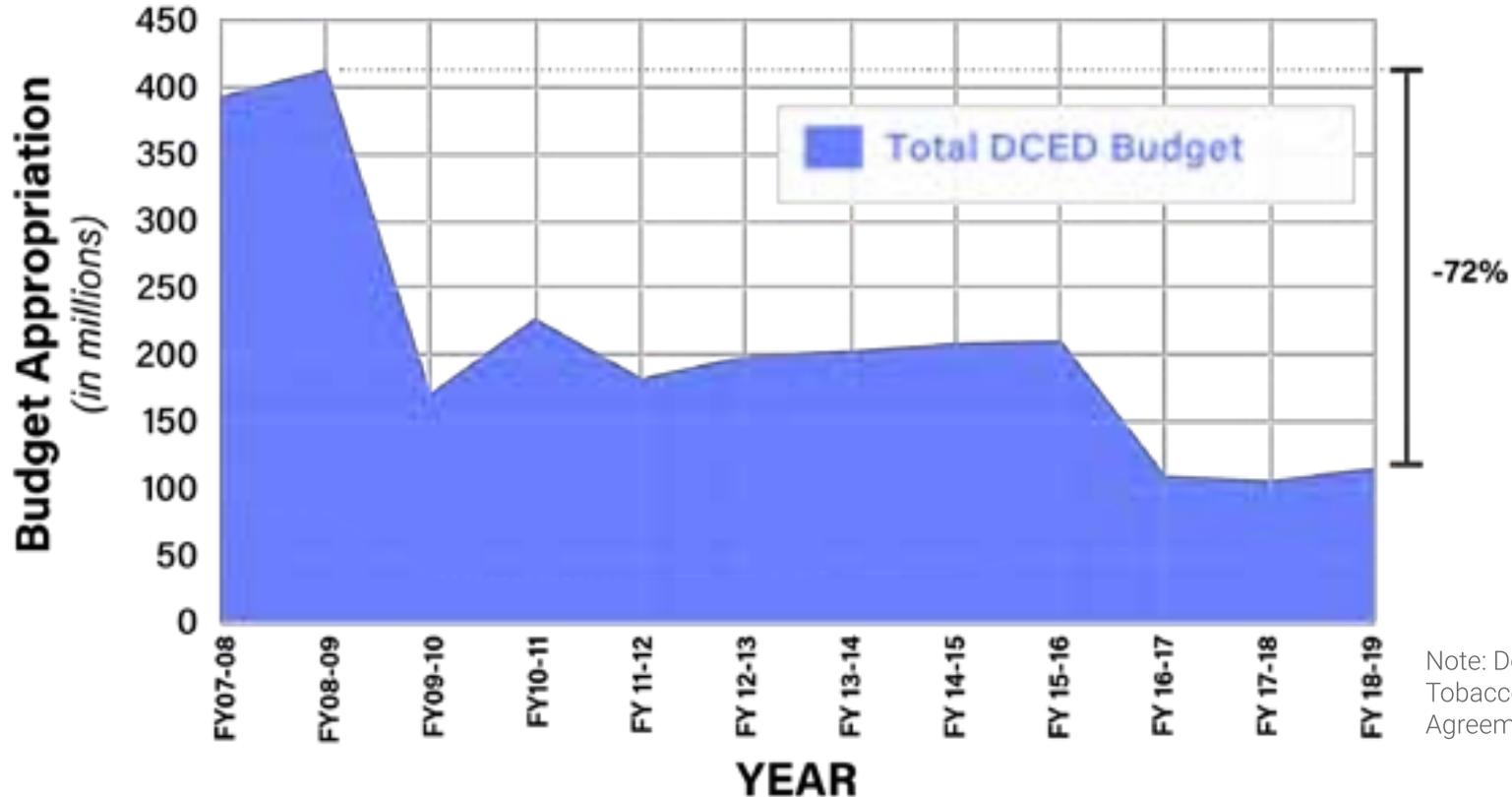
Data: IPEDS; Test Score Index calculated by Fourth Economy.



# **Pennsylvania Department of Community and Economic Development Appropriations**

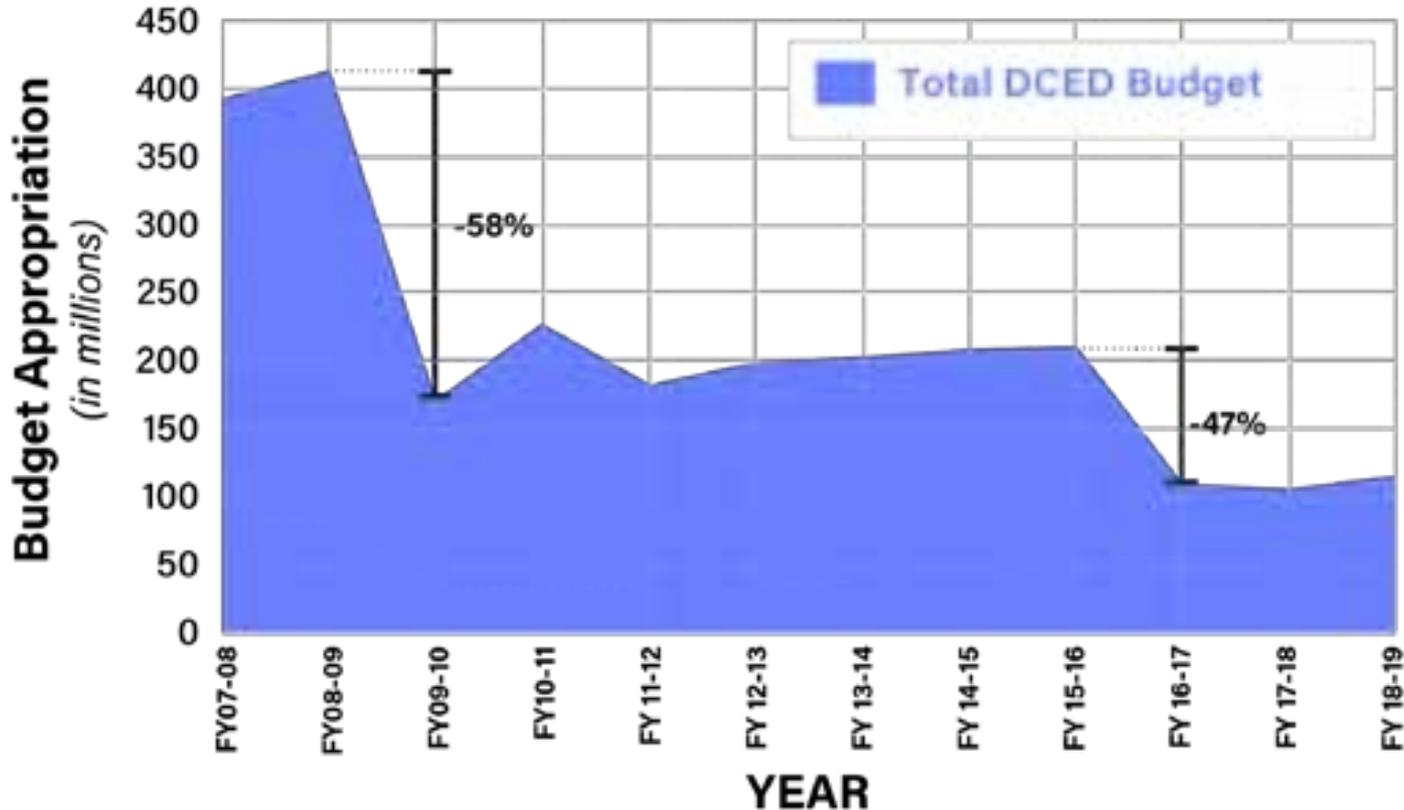
# DCED Funding

2007-2018



Note: Does not include CFA, Tobacco Master Settlement Agreement, or AEDP funding.

# DCED Funding 2007-2018



In addition to a **72% reduction** between 2008 - 2019, DCED saw a **58% drop** in its budget between 2009 - 2010, and a nearly as drastic **47% reduction** between 2016 - 2017.

Note: Does not include CFA, Tobacco Master Settlement Agreement, or AEDP funding.

# DCED Funding

2007-2019



DCED's specific Innovation and Entrepreneurship program line items (including Innovate PA) saw a **51% budget drop** between 2007 - 2019.

Note: Does not include CFA, investments, Tobacco Settlement Investment Board, or AEDP funding.

## Innovation and Entrepreneurship Line Items:

- Ben Franklin Technology Development Authority
- Manufacturing PA:
  - Industrial Resource Centers
  - Manufacturing Innovation Program
  - Training-to-Career Grant Program
- Pittsburgh SuperComputer Center
- Digital & Robotic Technology
- Discovered in PA
- PREP :
  - Small Business Development Centers
  - Local Development Districts
  - Industrial Development Authorities/EDCs
- Innovate PA
- Life Sciences Greenhouses
- Powdered Metals

**End**