

# Assessment of Virginia's Research Assets:

*Presentation to House Appropriations Committee*

*Virginia Research Investment Committee's  
Strategic Directions to Advance Innovation-Led  
Growth across the Commonwealth*

January 22, 2018

## Project Purpose and Objectives

### Item 255.A.2 of Chapter 836 of the 2017 Acts of Assembly:

*"... the Virginia Research Investment Committee (VRIC) may use a portion of the funds appropriated to conduct a study that is to be an assessment of the Commonwealth of Virginia's research assets, including those located at or within its public and private universities, federal research facilities and private sector companies. The purpose of that study shall be, but not limited to ... :*

- (i) determine the strengths of Virginia's commercialization capabilities;*
- (ii) define research and commercialization clusters;*
- (iii) identify current public and private sector collaborations in research and commercialization;*
- (iv) identify current funding streams and where Virginia may best utilize its fiscal resources to leverage federal and private sector funds;*
- (v) [assess] competitive efforts in similar research and commercialization initiatives in other states; and*
- (vi) recommend areas where Virginia may wish to direct its resources to accomplish the mandate of the Virginia Research Investment Committee.*

*The State Council of Higher Education for Virginia shall serve as the coordinating body on behalf of the VRIC ... ."*

# Key Findings

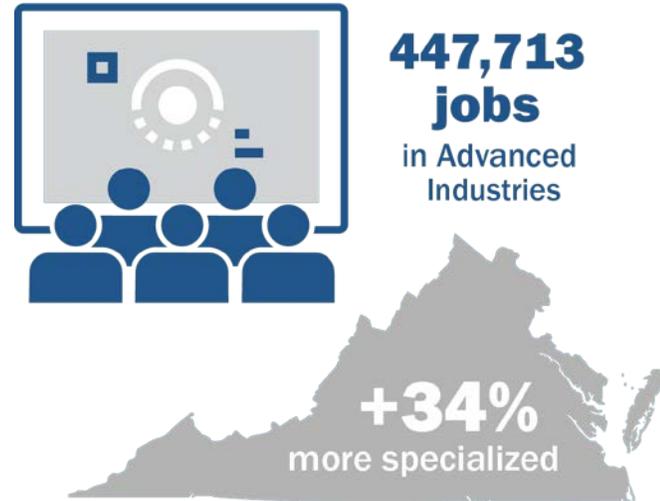
Virginia has a sizable base of innovation-led assets, with core technology competencies supporting strategic growth opportunity areas

But Virginia has not been performing well in innovation-led development through the recent period of economic growth

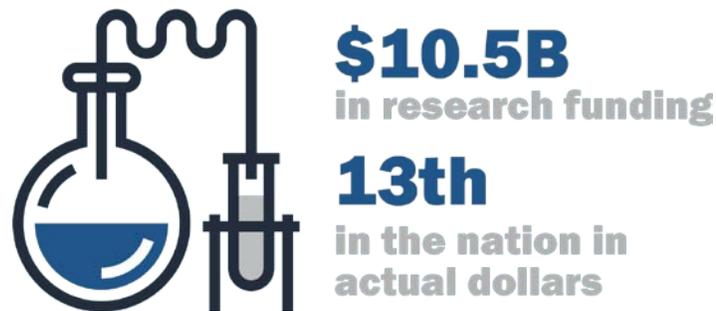
Business as usual will not work. Underlying challenges requires Virginia to find a new way forward.

# Virginia has a sizable base of innovation-led assets

- Advanced Industry Jobs in 2016:



- Total Research Funding From Industry, Universities and Federal Labs in 2015:



Virginia ranks 21<sup>st</sup> in research funding per state GDP

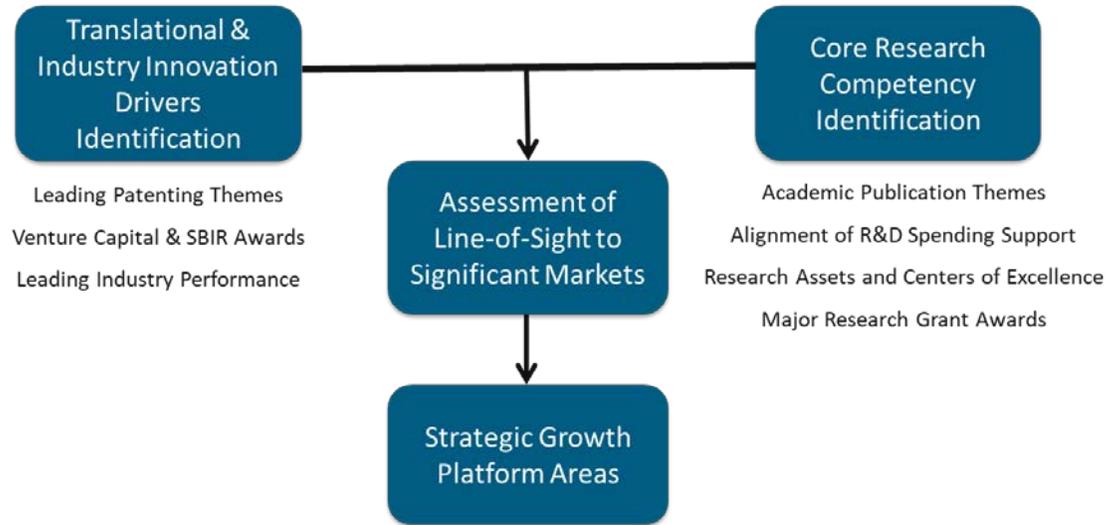
- Entrepreneurial Energy – 2106 Venture Capital Investments:



Virginia ranks 4<sup>th</sup> in venture capital per state GDP

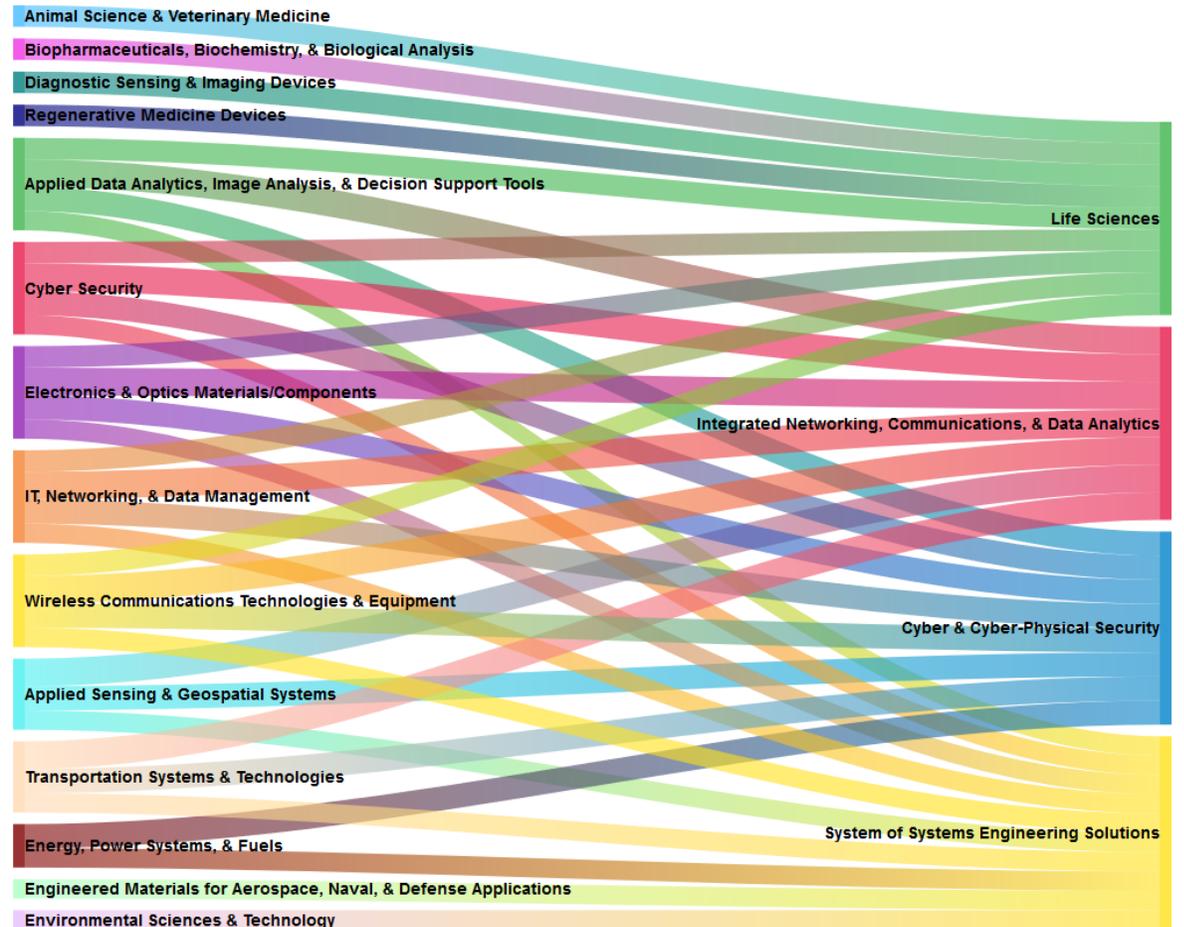
# Significant Strategic Growth Opportunities Identified from Virginia's Sizable Research Assets

• *Line-of-Sight Assessment*



Areas where Virginia **has real, differentiating potential**

• *Identified 4 Strategic Growth Opportunities that Leverage Multiple Core Competencies Found in Virginia*



# Overview of Growth Opportunities

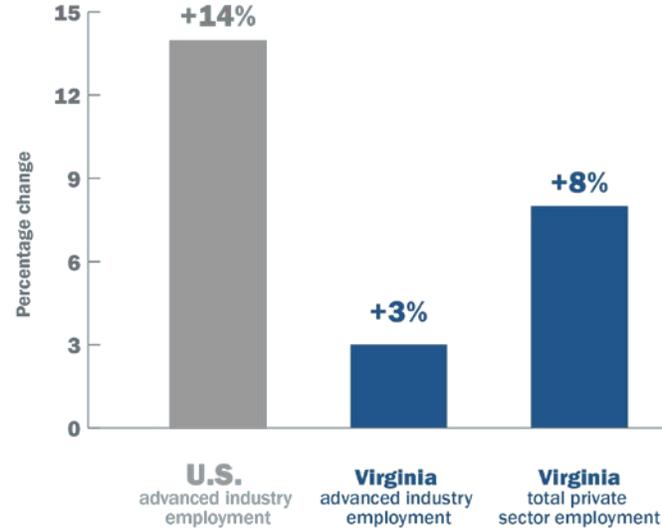
| Platform Area                                | Cyber & Cyber-Physical Security  | Integrated Networking, Communications and Data Analytics   |
|--|--|--|
| <b>Key Market and Technology Opportunity</b> | <ul style="list-style-type: none"> <li>• <b>Rapidly evolving area to counter threats proactively and in real-time as well as to assess damage and repair systems after attacks</b></li> <li>• <b>Rise of connected devices and infrastructure – Internet of Things – becoming major opportunity area</b></li> </ul>  | <ul style="list-style-type: none"> <li>• <b>Next generation integrated communications and data networks taking shape across mix of wired and wireless voice and data communications, broadband internet and data storage infrastructure</b></li> <li>• <b>Major market opportunities in more efficient routing, big data retrieval and processing, cloud-based services and integrated analytics applications</b></li> </ul>   |
| <b>Why Virginia?</b>                         | <ul style="list-style-type: none"> <li>• Highest concentration of cybersecurity jobs in the nation and 2<sup>nd</sup> in absolute number of jobs</li> <li>• Leading presence in patenting of encryption and security protocols</li> <li>• Lots of entrepreneurial energy – 36 companies on Cybersecurity 500 + over \$600 million in venture funding from 2009-16 + many SBIR funded companies</li> <li>• Presence of high profile cyber security centers and institutes across several universities               <ul style="list-style-type: none"> <li>• 10 universities and community colleges have some level of NSA academic excellence designation</li> <li>• VT and GMU recognized for academic excellence in research</li> </ul> </li> <li>• Growing focus on university research in cyber-physical systems security</li> </ul> | <ul style="list-style-type: none"> <li>• Large state employment base in wireless telecommunications carriers</li> <li>• Large base of data centers with access to 70 percent of world’s internet traffic</li> <li>• Presence of venture capital investment in emerging wireless and satellite communications companies</li> <li>• Major patenting cluster around wireless network operations and infrastructure</li> <li>• Large and specialized group of research publications in electrical engineering and telecommunications disciplines which support wireless innovation applications</li> <li>• Major centers focused around innovation in core wireless technologies of applied signal processing, IoT communications, and wireless security as well as applications areas in wireless health devices and command and control systems</li> <li>• Major centers across many aligned applications areas including modeling, visualization, image/video analysis, business analytics, and complex systems modeling</li> </ul> |

# Overview of Growth Opportunities

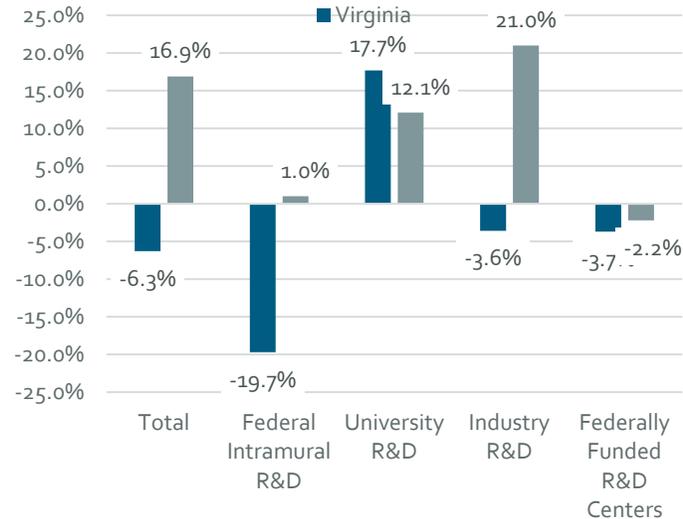
| Platform Area                                       | System of Systems Engineering  | Life Sciences   |
|---|--|---|
| <p><b>Key Market and Technology Opportunity</b></p> | <ul style="list-style-type: none"> <li>• Emerging approach to engineering and manufacturing “smart” devices and final products – from aerospace to unmanned systems to healthcare to power grid , etc. – as integrated platforms of specific components ranging from sensors, power electronics, communications, advanced materials and command and control interfaces.</li> <li>• Uses tools of digital design, simulation and modeling, advanced sensing and instrumentation and distributed computing.</li> </ul>   | <ul style="list-style-type: none"> <li>• Life sciences development in Virginia still very much being defined through commercialization of university research and collaborations unfolding between academic medical centers and Virginia’s major hospital systems.</li> <li>• Key markets aligning with Virginia strengths include: cancer therapeutics; addiction therapies; neuroscience diagnostics and sensing; personalized medicine diagnostics; healthcare technologies and medical devices; biomanufacturing.</li> </ul>  |
| <p><b>Why Virginia?</b></p>                         | <ul style="list-style-type: none"> <li>• Leading advanced industries in engineering services and ship building</li> <li>• University publication strengths in electric engineering, mechanical engineering and optics, plus significant research publications activity in materials science, applied physics, and nanoscience</li> <li>• Existing industry-university research centers in power electronics, self-powered systems, unmanned aerial systems and transportation systems testing</li> <li>• Signature shared use facilities include FAA unmanned aerial test site, Commonwealth Center for Advanced Manufacturing</li> <li>• Plus many other research centers across focused on modeling and simulation, embedded electronic systems, photonics, electrochemical science, nanoelectronics, bioelectric materials, manufacturing and testing of aerospace and naval materials, and space weather and atmospheric sensing</li> <li>• Strong alignment with federal labs from NASA Langley, Jefferson Labs, and Dahlgren, among others.</li> </ul> | <ul style="list-style-type: none"> <li>• Medical labs already a specialized life sciences industry with strong job growth</li> <li>• Large healthcare systems focusing on innovation and clinical excellence</li> <li>• Active area for university start-up companies</li> <li>• Presence in patents for surgical devices, biopharmaceuticals, biological analysis technologies, diagnostic sensing, medical prosthetics and biological testing and measuring</li> <li>• Venture capital funding for medical and health services stands out with over \$500 million from 2009-2016; also biotech research is active</li> <li>• Active publication areas in surgery, biochemistry and molecular biology, neurosciences, oncology, clinical neurology and pharmacology</li> <li>• Federally funded centers in cancer, molecular pathways, and substance abuse and tobacco</li> <li>• Broader efforts underway in immunology and infectious disease, neurosciences and biomanufacturing</li> </ul> |

But Virginia has not been performing well in innovation-led development since 2010 economic recovery

• Lagging Growth in Advanced Industry Jobs from 2010-2016:



• Declining Total Research Funding, 2010-2015:



• Venture Capital Growth Off Pace, 2010-2016

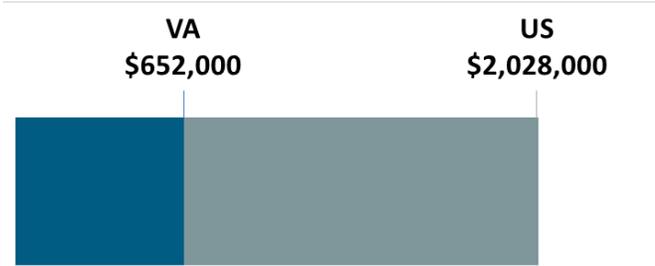


**Challenge:**  
Addressing low levels and lagging growth of industry research and development to focus on commercializing innovations, with focus on strategic growth opportunity areas

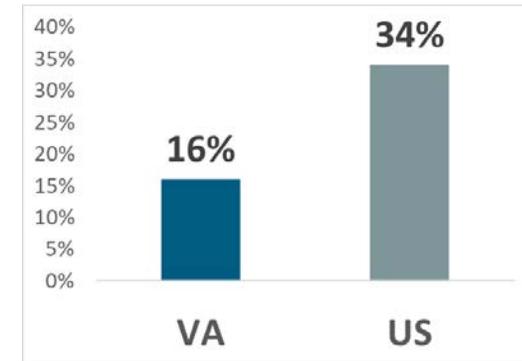
## Situational Assessment:

- Decline in industry research and development in Virginia not simply a reflection of strong dependency on federal R&D contracts, but weakness in company funding of R&D leading to the commercialization of new products and processes

Virginia stands at 1/3<sup>rd</sup> national level company-funded industry R&D in 2015 (per \$1 billion GDP):



Virginia lagging nation in growth of company-funded industry R&D, 2010-2015:



## Strategic Objectives:

- Raise industry R&D activities in commercializing technologies
- Target the four strategic growth opportunities identified through the line-of-sight assessment in Virginia
- Leverage and enhance translational research capacities of universities and federal laboratories to support company-funded research and development activities

# Challenge: Strengthening university capacities in technology transfer, commercialization and industry partnerships

## Situational Assessment: Active Efforts Underway

- Policies at Virginia universities appear fairly consistent with national best practices in terms of how to handle intellectual property, conflict of interest and faculty incentives
- Active technology transfer efforts found across universities, generally measuring up to national averages in key measures for major research universities but some areas lagging
- Plus, recent years have shown continued improvements in many measures of technology transfer activity.

Technology Transfer Metrics for Virginia's Three Largest Research Universities Reporting to AUTM Compared to National Average of All Universities Reporting, Average 2010-2016, Per \$10 million of University Research

| Metric<br>(Per \$10 million of university research) | Virginia Three<br>Largest Research<br>Universities | Average for All U.S.<br>Universities<br>Reporting to AUTM |
|---|--|---|
| Disclosures   | 4.41<br>(3,401 total)                              | 3.72  |
| Patents Issued                                      | 0.66<br>(508)                                      | 0.92  |
| Licenses Issued                                     | 1.11<br>(854)                                      | 1.04  |
| Gross License Income                                | \$91,557.<br>(\$70.6 m)                            | \$351,546   |
| Start-ups   | 0.13<br>(101 total)                                | 0.14  |

### Industry interest from interviews:

- Creating more effective and business-friendly approaches shared across all universities in Virginia to reduce barriers
- Prioritize value creation for Virginia's economic development over revenue maximization

**Challenge:  
Strengthening  
university  
capacities in  
technology  
transfer,  
commercialization  
and industry  
partnerships**

**Situational Assessment: Room for Improvement**

**Assessment of Technology Transfer and Commercialization Policies and Practices:**

- 34 recommendations for improving technology transfer and commercialization, with its main areas of focus on advancing translational research and commercialization practices.
  - Providing more technical and market expertise input into how inventions are assessed before patent decisions are made,
  - Undertaking more invention lead prospecting with proven entrepreneurs walking the halls
  - Increasing the access to proof-of-concept projects for de-risking university technologies
  - Creating more streamlined templates and transparency in deal-terms
  - Better connecting with entrepreneurs, venture investors and other stakeholders as the commercialization process unfolds and new startups are formed.

**Strategic Objectives:**

- Promote goal of “value creation” that maximizes efforts to start-up companies, supports growth of existing companies, and attracts outside companies
- Increase funding for de-risking university technologies linked with industry mentored processes
- Maximize the wide-ranging and significant opportunities for increased collaborations in technology transfer practices and resources across Virginia’s universities

# Challenge: Bridging the disconnect between university research and Virginia-based company innovation

## Situational Assessment:

- Lower level of industry funding for university research, but recent growth shows promise:



- A closer examination finds lack of close relationships with Virginia industry in technology transfer and commercialization
  - In university patents developed with industry funding in FY 2017, 35 out of 40 patents involved companies from out-of-state.
  - In citations of university patents, 303 out of 327 industry citations of Virginia university patents were by industry inventors located outside of Virginia.
  - Similarly, for Virginia-based federal laboratories/agencies, 417 industry citations out of 466 were by industry inventors located outside of Virginia.
  - In licensing of university patents, 108 out of 137 licenses issued in FY 2017 going to out-of-state companies.

## Strategic Objectives:

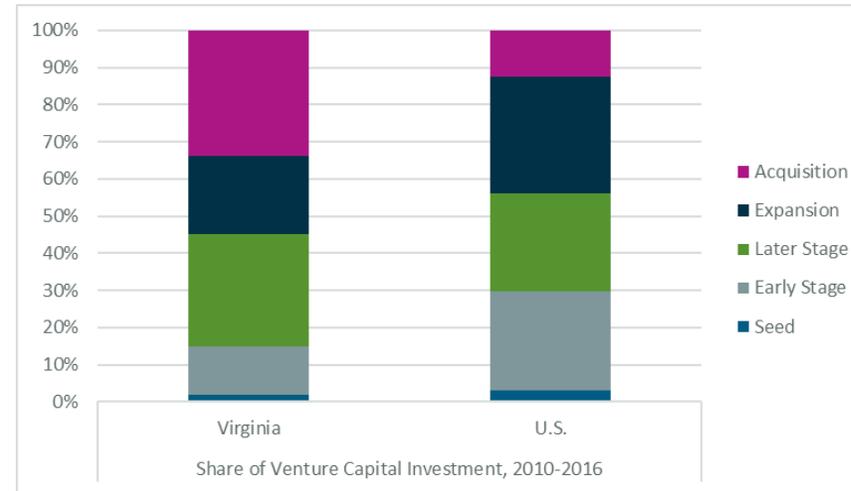
- Facilitate pro-active outreach and high touch, customer service to Virginia companies of university research capacities and technologies
- Incentivize industry-university applied research projects

# Challenge: Shoring up Virginia's entrepreneurial development system to generate more shots on goal and high-growth companies

## Situational Assessment:

- The number of companies funded in Virginia receiving formal venture capital has remained relatively flat.
  - The 2010-2016 average of 76 companies had a range from a high of 87 in 2012 and a low of 70 in 2013.
- One of the biggest differences in Virginia from the nation is the low share of venture investment going into early stage rounds of funding

Venture Capital Investments by Investment Stage, Virginia and U.S., over 2010-2016 period



## Strategic Objectives:

- Recognize entrepreneurial development is a very localized phenomenon, where *local* research and development (R&D) know-how and entrepreneurial culture needs to come together for success.
- Enable regions to have access to key tools – entrepreneurial support services and locally-based seed capital funds – but allow local stakeholders to have key role in governance and oversight

**Business as usual  
will not work.**

**Underlying  
challenges  
requires Virginia  
to find a new way  
forward.**

- Addressing low levels and lagging growth of industry research and development to focus on commercializing innovations, with focus on strategic growth opportunity areas
- Strengthening university capacities in technology transfer, commercialization and industry partnerships
- Bridging the disconnect between university research and Virginia-based company innovation
- Shoring up Virginia's entrepreneurial development system to generate more shots on goal and high-growth companies

# Recommended Action Plan Being Considered by VRIC

## Strategic Priorities

Strategy 1: Pursue strategic growth opportunity areas to catalyze stronger advanced industry growth

Strategy 2: Strengthen university technology transfer and commercialization capacity

Strategy 3: Bridge the disconnect between university research and Virginia-based company innovation

Strategy 4: Strengthen Virginia's regionally-based innovation capacities



## Proposed Actions

- **8 Baseline actions** for VRIC to consider in use of current and proposed VRIF resources in 2019-2020 biennium
- **4 Enhanced actions** for the Commonwealth to consider in advancing innovation-led development

**What distinguishes VRIF efforts from other statewide innovation efforts is its focus on:**

- *Raising university translational research and commercialization capacities, connecting it more systematically with market-driven processes and focusing it on value creation for economic development in the Commonwealth.*
- *Focusing on industry and university research collaborations across translational research, applied research, and technology transfer and commercialization.*



## **Innovating Tomorrow's Economic Landscape**

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