



WEST VIRGINIA BLUEPRINT FOR
TECHNOLOGY-BASED ECONOMIC DEVELOPMENT

GENERAL REPORT

March 2009



A report from: **TechConnectWV**

West Virginia Coalition for Technology Based Economic Development

With consultation and assistance from:

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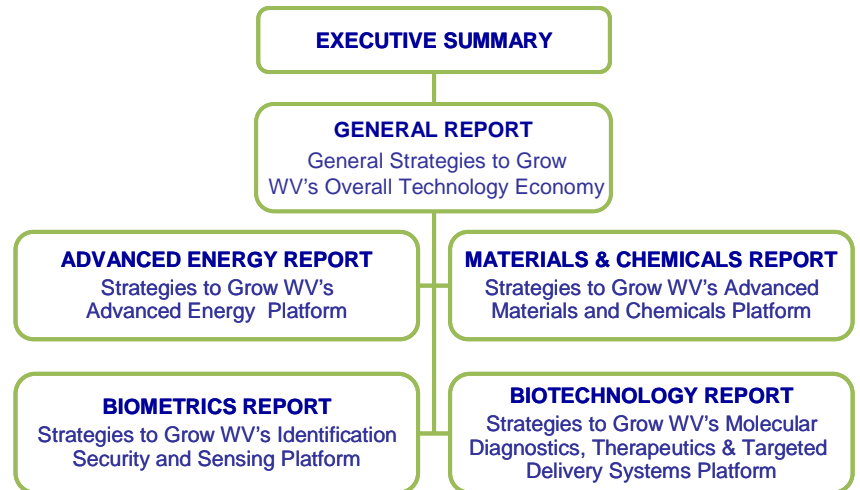
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HOW THIS REPORT IS ORGANIZED

This report represents Phase II of West Virginia's Technology-Based Economic Development (WV's TBED) Blueprint. In 2007, Battelle Technology Partnership Practice produced the Phase I report entitled *Gap Analysis and Identification of Strategic Technology Platforms*.

The Phase II study is organized into six distinct reports:

- Executive Summary** — Provides a synopsis of introductory and background material, general strategies and actions for growing West Virginia's technology economy, and specific strategies and actions for growing West Virginia's Advanced Energy and "Biometrics" (Identification, Security, and Sensing Technology) sectors
- General Report** — Includes the Executive Summary, but also provides detailed introductory and background material and detailed information on the general strategies and actions for growing West Virginia's technology economy
- Advanced Energy Report** — Provides detailed information on the specific strategies and actions for growing West Virginia's Advanced Energy sector
- "Biometrics" Report** — Provides detailed information on the specific strategies and actions for growing West Virginia's Identification, Security, and Sensing Technology sector
- Advanced Materials and Chemicals Report** — Provides detailed information on the specific strategies and actions for growing West Virginia's Advanced Materials and Chemicals sector
- "Biotechnology" Report** — Provides detailed information on the specific strategies and actions for growing West Virginia's Molecular Diagnostics, Therapeutics, and Targeted Delivery Systems sector



The general strategies and actions represent broad recommendations for West Virginia's overall technology economy. They are common activities and tasks that will boost TBED in West Virginia independent of and across all technology areas.

Conversely, the specific sector strategies and actions are recommendations explicitly targeted to four, pre-identified technology strength areas in West Virginia. They represent those activities and tasks that will enhance those particular technology platforms.

Thus, the general strategies and actions are common to all four technology sectors and to other technology areas as well.

While many of the specific sector strategies and actions are unique to particular technology areas, there are common or similar recommendations and thus overlap among the

technology platforms. Likewise, there are some common recommendations and overlap between the general and specific sector strategies and actions as well.

As of March 2009, the first four of the six reports have been completed. However, TechConnectWV plans to develop strategies and actions for the other two technology platforms — (1) Advanced Materials and Chemicals and (2) Molecular Diagnostics, Therapeutics, and Targeted Delivery Systems — over the coming months.

*This report is the **GENERAL REPORT** only.*

This report and all other reports can be found at:
www.TechConnectWV.com

EXECUTIVE SUMMARY

Battelle Technology Partnership Practice and TechConnectWV have identified **specific strategies and actions** to accelerate the growth of technology-based economic development (TBED) in West Virginia (WV). Successful implementation of the recommended strategies and actions will not only help grow West Virginia's innovation economy, but will **boost its overall economy** as well, fueling economic growth, increasing the standard of living across the state, and creating **more jobs and higher-paying jobs** for West Virginia's citizens.

TBED is an economic imperative. Multiple studies show that a state's economic success can be largely attributed to the growth of high-technology businesses, not only lifting the economy but diversifying it as well.

There can be no doubt that TBED is a critical component of West Virginia's economic future.

West Virginia has historically had an economy built on energy, chemicals, and natural resources.

More recently, the state has made strides in building a technology economy with, among others, significant federal labs, an emerging biometrics presence in north-central West Virginia, a strong information technology industry in the eastern panhandle, and a growing technology base in Charleston.

Importantly, the state's major research universities, Marshall University (MU) and West Virginia University (WVU), have increased their emphasis on technology transfer, commercialization, and entrepreneurial activities. New start-up firms are sprouting in West Virginia; and the state's recent investment in research, the Research Trust Fund, will support those efforts, helping both universities attract top-notch scientific talent with an entrepreneurial approach.

Still, although there is much to be proud of and much to build from in West Virginia, the state is admittedly far behind most of its counterparts both in the region and around the country. In fact, West Virginia ranked 49th in the 2008 *State Technology and Science Index* produced by the Milken Institute. **Although West Virginia is making strides, it continues to face challenges** in growing its technology industries and transitioning its economy to one based on innovation.

Implementation of this Blueprint will help ensure West Virginia becomes a leader in TBED, providing **solid, sustained economic growth** for the state and its citizens **well into the 21st century**.

"With over 18,000 technology jobs that pay, on average, **\$53,325 a year**, 9% of the jobs in [north-central West Virginia] are technology industry jobs. *Perhaps even more significant is that these jobs **account for 16% of all wages** paid in the region, a clear indication that **[the technology] industry offers higher wages than others do.***"

Anderson Economic Group LLC,
North-Central West Virginia's
Technology Industry: A Pathway Through the 21st Century, 2006.

Blueprint Phase I: West Virginia’s Gaps and Strengths

This report represents Phase II of WV’s TBED Blueprint. In 2007, **Battelle Technology Partnership Practice** produced for the WV Vision Shared TBED Team, the precursor to TechConnectWV, a report entitled *Gap Analysis and Identification of Strategic Technology Platforms*. That report was Phase I of the Blueprint. Using extensive qualitative and quantitative analyses, Battelle examined West Virginia’s innovation economy and determined its competitive position for TBED. Specifically, Battelle **uncovered key gaps** that need to be overcome and **uncovered key strengths** that can be exploited to enhance West Virginia’s position.

In the 2007 study, Battelle found four key gaps in West Virginia’s technology economy.

A fifth gap was uncovered while conducting focus groups for the present study.

Figure ES-1. Identified Gaps in WV’s TBED Structure

Those five gaps, illustrated in Figure ES-1, are as follows:

1) Talent – world-class technicians, skilled workers, scientists, engineers, executives, and other professionals at all levels

2) Early-Stage Seed Capital – risk capital that entrepreneurs, small businesses, and start-up firms must have to succeed and grow

3) Entrepreneurial Know-How – “serial entrepreneurs” who have successfully started and grown several technology companies and who can act as role models or mentors for aspiring entrepreneurs

4) Image – negative stereotypes of West Virginia that persist and impact the state’s ability to raise capital, recruit talent, and attract technology companies

5) Leadership – an organization to provide overall guidance, direction, facilitation, and broad leadership for the entire TBED effort across the state.

West Virginia’s strengths were categorized into two areas:

1) general competitive advantages (in text box at right)

2) specific technology strengths.

Based on an extensive analysis to determine those technology strengths, **Battelle recommended four technology platforms for West Virginia:**

- Advanced Energy and Energy-Related Technology
- Advanced Materials and Chemicals
- Identification, Security, and Sensing Technology (Biometrics)
- Molecular Diagnostics, Therapeutics, and Targeted Delivery Systems (Biotechnology).



West Virginia’s General Competitive Advantages

- ✓ Presence of a large number of nonprofit and federal research institutions
- ✓ Growing academic research base
- ✓ Increased focus on tech transfer and commercialization at MU and WVU
- ✓ Growing technology sector, particularly in North Central West Virginia
- ✓ Highly productive workforce
- ✓ Quality college graduates
- ✓ Growing entrepreneurial support infrastructure
- ✓ Quality of life that is attractive to many people

These represent the areas where West Virginia has the best chance of developing a robust technology economy. These are the areas where West Virginia — meaning the universities, federal labs, nonprofit groups, state and local government, economic development groups, and private companies in the state — can most likely collaborate to create new companies and new jobs and significantly expand and diversify the state's economy.

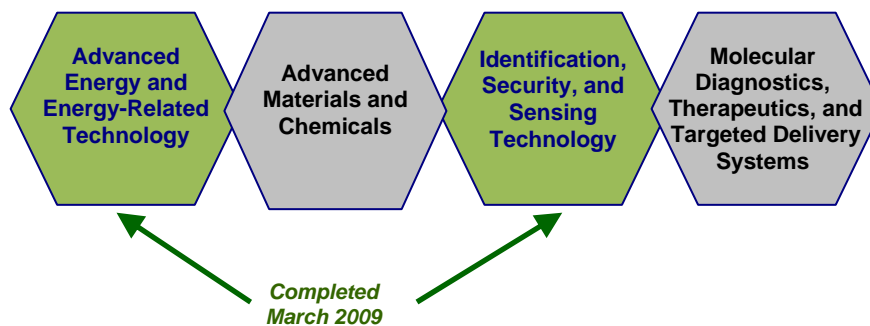
Although West Virginia should concentrate on these four technology areas where the state is already strong, it should still conduct and support research, development, and innovation in other technology areas. Significant economic and job growth could — and, with systemic improvements in WV's TBED structure, should — occur even in nonplatform areas.

As of March 2009, TechConnectWV has dedicated resources and **developed specific strategies and actions for two technology platforms** (Figure ES-2):

- ✓ **Advanced Energy** and Energy-Related Technology
- ✓ Identification, Security, and Sensing Technology (**Biometrics**).

These represent nearer-term opportunities based on West Virginia's capabilities and both state and national goals. However, TechConnectWV plans to develop strategies and actions for the other two platforms over the coming months.

Figure ES-2. West Virginia's Technology Platforms



Development of West Virginia's Strategies and Actions

As of March 2009, Battelle and TechConnectWV have developed three sets of strategies and actions to address the findings in the Phase I report:

1. Strategies and actions addressing **West Virginia's Gaps**
2. Strategies and actions capitalizing on West Virginia's strengths in **Advanced Energy** and Energy-Related Technologies
3. Strategies and actions capitalizing on West Virginia's strengths in Identification, Security, and Sensing Technology (**Biometrics**).

Working with TechConnectWV, Battelle crafted an initial set of strategies with specific actions using the following key sources of information:

- Findings from the Phase I Battelle report
- Various West Virginia–based research, planning, and strategy reports
- In-depth one-on-one interviews with key leaders
- In-depth conversations with TechConnectWV staff and Executive Committee
- Focus groups conducted around the state
- Focus groups conducted with technology platform leaders
- Battelle’s broad experience and expertise.

Battelle Technology Partnership Practice

- Includes **leading analysts and practitioners** in TBED.
- Helps clients **develop, implement, and evaluate technology strategies**, policies, and programs
- **Serves non-profit technology groups**, economic development groups, and universities across the U.S.
- **Builds collaboration** among business, higher education, and government groups **to stimulate economic growth**

TechConnectWV

- **Coalition of professionals** dedicated to growing and diversifying WV’s economy by advancing TBED
- A **501(c)3 non-profit** corporation with broad membership from the private and public sector
- Serves mainly as **facilitators**, enhancing awareness and increasing collaboration to **spur technology commercialization** in WV
- Partners with the WV Development Office to provide WV’s TBED strategy and to support initiatives
- The trade name for the **West Virginia Coalition for Technology-Based Economic Development, Inc.**

The **initial set** of strategies and actions was then **vetted** with a number of stakeholder and **leadership groups in West Virginia**.

Suggested changes were funneled back to Battelle for **further scrutiny**; and, after much interchange, a **final set** of strategies and actions was developed.

General Strategies and Actions for Boosting West Virginia’s Technology Economy

Four strategies and 18 actions are proposed to address the general or overall needs in West Virginia and its gaps in TBED. The strategies are shown in Figure ES-3 and described below.

Figure ES-3. Overview of General Strategies and Actions

Build a culture that supports innovation and entrepreneurship	Grow WV’s technology clusters around the targeted technology platforms	Ensure access to capital at all stages of firm development	Promote a proactive business climate
<ul style="list-style-type: none"> Support and expand TechConnect WV Support and expand a statewide network providing comprehensive commercialization services and support to technology entrepreneurs and early-stage start-up companies Encourage the state’s universities to continue to increase support for technology transfer and commercialization Create a university-industry matching grant program Publicize and celebrate TBED success 	<ul style="list-style-type: none"> Continue to provide support for the WV Research Trust Fund Establish an Innovation Institute Program focused on the technology platforms Form technical networks around each of the platform areas 	<ul style="list-style-type: none"> Provide funds to match SBIR and STTR Phase I awards received by WV companies Increase funding for INNOVA’s seed and early-stage investment fund Use tax credits to make capital available to early-stage technology companies Attract venture fund investments in WV technology companies 	<ul style="list-style-type: none"> Invest in technology infrastructure, including research parks, incubators, and laboratories Maintain the state’s refundable R&D tax credit and Economic Opportunity Tax Credit Develop a branding and marketing strategy that builds on the technology and location strengths of WV Identify and build awareness of 21st Century Skills Facilitate and expand talent recruitment efforts Undertake a communications campaign

STRATEGY ONE Build a culture that supports innovation and entrepreneurship and the creation and growth of technology-based companies

Innovation, in and of itself, will not necessarily translate into economic activity. Rather, it is the application of a technology and its introduction into the marketplace that result in economic growth. Facilitating TBED and supporting entrepreneurs and the growth of entrepreneurial companies is therefore a critical component of any state’s or region’s strategy to accelerate the growth of its technology-based economy.

STRATEGY TWO Grow West Virginia’s technology clusters by building R&D and commercialization capacity around the targeted technology platforms

To compete in today’s economy, a state must have both sources of technology and a way to bring that technology to the marketplace. A strong presence of research institutions — including universities, national laboratories, and nonprofit research institutions — is critical

for states seeking to grow technology-based economies. It is no less important to also have an infrastructure in place that supports the commercialization of research findings.

STRATEGY THREE

Ensure access to capital at all stages of firm development

Entrepreneurs, start-up firms, and small companies must have access to financing for each stage of development, from early-stage, proof-of-concept, and prototype development to venture financing. One characteristic shared by leading technology regions is that they are home to a venture capital community committed to early-stage local investment.

STRATEGY FOUR

Promote a pro-active business climate with incentives that will grow, attract and retain technology-based companies

Technology companies — with assets more intellectual than physical — are not well-suited to traditional economic incentive programs. Instead, key business climate factors for TBED include costs of doing business (tax structure, public sector policy), technology infrastructure (research parks and incubators), quality of life (low-cost housing, recreation, arts, and culture), and general business leadership (experienced and active leaders engaged in the innovation economy).

The strategies and actions are summarized in Table ES-1. Actions marked critical have the greatest priority, although some may take several years to accomplish. Immediate actions should be undertaken in the first year of implementation. Short-term actions should be undertaken in 1 to 3 years and mid-term actions in 3 to 5 years.

Table ES-1. General Strategies and Actions Proposed for West Virginia

STRATEGY ONE	Build a culture that supports innovation and entrepreneurship and the creation and growth of technology-based companies			
ACTION	PRIORITY	TIMEFRAME	LEAD ORGANIZATION	RESOURCES
Action 1: Support and expand TechConnectWV	Critical	Immediate	TechConnect WV	\$250,000 annually
Action 2: Support and expand a statewide network providing comprehensive commercialization services and support to technology entrepreneurs and early-stage start-up companies	Critical	Immediate	INNOVA and WV Small Business Development Center (WVSBDC)	\$500,000 annually
Action 3: Encourage the state's universities to continue to increase support for technology transfer and commercialization	High	Immediate	TechConnect WV	Included in TechConnectWV budget
Action 4: Create a university-industry matching grant program	Medium	Mid-Term	WV Higher Education Policy Commission (WVHEPC) and WV Development Office (WVDO)	\$500,000 annually
Action 5: Publicize and celebrate TBED successes	Medium	Short-Term	TechConnectWV and WVDO	Included in TechConnectWV budget

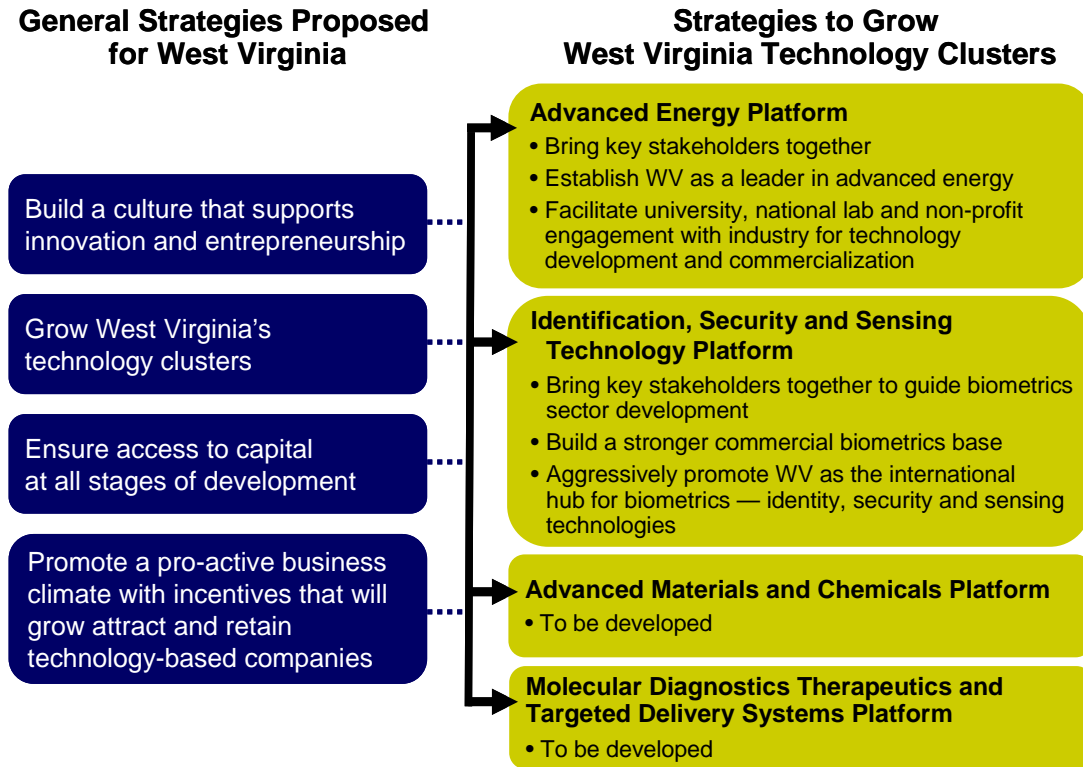
STRATEGY TWO		Grow West Virginia's technology clusters by building R&D and commercialization capacity around the targeted technology platforms			
ACTION	PRIORITY	TIME FRAME	LEAD ORGANIZATION	RESOURCES	
Action 6: Continue to provide support for the WV Research Trust Fund, which supports both faculty recruitment and development of research infrastructure	Critical	Immediate	WVHEPC	Annual investments to achieve \$180 million (cumulative) by 2015	
Action 7: Establish an Innovation Institute Program focused on the technology platforms that would fund people, equipment, and facilities and create proof-of-concept funds to support cluster development projects	High	Short-Term for plans Mid-Term for Institute Short-Term for Proof-of-Concept (PoC) Funds	WVHEPC, WVDO and TechConnectWV	Initial program grants of \$250,000 per Institute Approximately \$25 million per Institute over multiple years \$500,000 for PoC Funds scaled up to \$1 million to \$2 million over time based on demand	
Action 8: Form technical networks around each of the platform areas	High	Short- to Mid-Term	TechConnect WV	Staff support could be included in the TechConnectWV budget Alternatively, \$35,000 per year for part-time support	

STRATEGY THREE		Ensure access to capital at all stages of firm development			
ACTION	PRIORITY	TIME FRAME	LEAD ORGANIZATION	RESOURCES	
Action 9: Provide funds to match SBIR and STTR Phase I awards received by WV companies	Critical	Immediate	WVSBDC and INNOVA	\$700,000 in FY 2010 to be increased as the number of SBIR awardees increases	
Action 10: Increase funding for INNOVA's seed and early-stage investment fund	Critical	Immediate	INNOVA	\$5 million annually, with a minimum of \$5,000 and maximum of \$250,000 per award	
Action 11: Use tax credits to make capital available to early-stage technology companies	High	Immediate	WV Angel Network	Cap of \$2 million annually for the High Growth Business Investment Tax	
Action 12: Attract venture fund investments in West Virginia technology companies	Medium	Mid-Term	TechConnectWV	Included in TechConnectWV budget	

STRATEGY FOUR	Promote a proactive business climate with incentives that will grow, attract, and retain technology-based companies			
ACTION	PRIORITY	TIME FRAME	LEAD ORGANIZATION	RESOURCES
Action 13: Invest in technology infrastructure, including research parks, incubators, and laboratories	High	Short- to Mid-Term	WVDO, Universities, WV HEPC, TechConnectWV	To be determined
Action 14: Maintain the state's refundable R&D tax credit and Economic Opportunity Tax Credit for specified taxpayers	High	Immediate	TechconnectWV and WVDO	Existing resources
Action 15: Develop a branding and marketing strategy that builds on the technology and location strengths of WV	Medium	Short-Term	WVDO	\$250,000 to \$500,000 for outside firm Or existing resources
Action 16: Identify and build awareness of 21st century skills needed to support TBED and future workforce needs of the state's technology industries	Medium	Mid-Term	WORK-FORCE WV Department of Education, WVHEPC	Existing resources
Action 17: Facilitate and expand talent recruitment efforts	High	Immediate	WVDO with support from TechConnectWV, Create WV, and Generation WV	Existing resources
Action 18: Undertake a communications campaign to increase understanding of the technology economy and the opportunities it will provide to West Virginians	High	Short-Term	WVDO with support from TechConnectWV and Create WV	Included in budget for branding and marketing campaign

In addition to the overall strategies and actions, a set of proposed strategies and actions was developed for two of the four technology platforms (Figure ES-4). These sector specific strategies are outlined below.

Figure ES-4. Overview of Cluster Strategies and Relationship to Overall Strategies



Strategies and Actions for Advanced Energy Platform



Three strategies and 12 actions are proposed to grow West Virginia's energy economy. The strategies are briefly described below.

	ENERGY STRATEGY ONE	Bring key stakeholders together to guide advanced energy sector development
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West Virginia contains multiple organizations, groups, and businesses engaged in various aspects of energy R&D, energy resource development, energy production and distribution, and energy regulation. Several organizations have recently produced plans or strategies targeting energy-based development in the state. These organizations must work together, and the various strategies must be aligned — if not integrated — to drive West Virginia's energy economy well into the 21st century.

	ENERGY STRATEGY TWO	Establish West Virginia as a leader in advanced energy
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Energy has become a leading economic issue for the nation as well as a critical concern for domestic energy security, global climate change, and environmental protection. Although alternative energy sources and technologies are important and should be a key area of emphasis in West Virginia, fossil fuels are not going to be replaced any time soon. They are plentiful and comparatively inexpensive; but, new technologies for recovery, production, and use and environmental mitigation must be developed to sustain the fossil fuel industry and meet national goals. Clearly, with the state's energy strengths — its vast energy resources, strong energy industry, and robust energy research — **West Virginia is in a favorable position to become a global leader for advanced energy.**


	ENERGY STRATEGY THREE	Facilitate university, national lab, and non-profit engagement with industry for technology development and commercialization
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Although basic research is essential and often leads to significant commercial products, processes, and services, successful TBED usually occurs more readily from industry and market-driven initiatives. Thus, the Advanced Energy Platform will greatly benefit from proactive industry engagement, cooperation, and collaboration. In fact, it is Battelle's experience that the discovery and commercial implementation of solutions rapidly accelerate when such cooperation occurs.

The energy strategies and actions are summarized in Table ES-2. Actions marked critical have the greatest priority, although some may take several years to accomplish. Immediate actions should be undertaken in the first year of implementation. Short-term actions should be undertaken in 1 to 3 years and mid-term actions in 3 to 5 years.


Table ES-2. Energy Strategies and Actions Proposed for West Virginia

 ADVANCED ENERGY STRATEGY ONE		Bring key stakeholders together to guide advanced energy sector development		
ACTION	PRIORITY	TIME FRAME	LEAD ORGANIZATION	RESOURCES
Action E1.1: Form platform steering committee comprising representatives from industry, government, and R&D institutions	Critical	Immediate	TechConnect WV to form committee	Included in TechConnectWV budget Alternatively, \$35,000 per year for part-time support
Action E1.2: Develop opportunities and high-value technology areas with alignment to existing energy-related statewide strategic plans	High	Short-Term	Advanced Energy Platform Steering Committee	\$50,000 in consulting support and analytical services
Action E1.3: Develop key stake-holder groups or subcommittees that are chartered with developing and implementing plans, projects, or activities focused on specific high-priority theme areas (e.g., clean coal technology, carbon sequestration, combustion technology, etc.)	High	Short- to Mid-Term	Advanced Energy Platform Steering Committee	Variable depending on the needs of individual subcommittees

 ADVANCED ENERGY STRATEGY TWO		Establish West Virginia as a leader in advanced energy		
ACTION	PRIORITY	TIME FRAME	LEAD ORGANIZATION	RESOURCES
Action E2.1: Build an active and strong portfolio of advanced research projects funded by the federal government under its advanced energy program initiatives	High	Short-Term	Advanced Energy Platform Steering Committee, WVDO, WV Division of Energy, and Congressional Delegation	Research and public policy support service may be conducted by Advanced Energy Platform Committee members and related institutions
Action E2.2: Establish a significant level of nationally known technology programs funded by industry and venture capital firms	High	Mid- to Long-Term	Advanced Energy Platform Steering Committee	Included in TechConnectWV budget (and related organizations' budgets for support activities)
Action E2.3: Develop capability to write position papers on economic and / or policy issues related to energy across the spectrum of state government, universities, non-profits, and industry sectors	High	Short-Term	Advanced Energy Platform Steering Committee and WVU Energy Policy Leaders	Research and public policy support service may be conducted by Advanced Energy Platform Committee members and related institutions (especially WVU)

Continued on next page

Action E2.4: Take a leadership role in promoting interstate programs for energy research, demonstration, or deployment of advanced technologies				
Action E2.5: Implement advanced energy initiatives throughout governmental, government-related, industrial, and private sector sites to promote energy conservation and efficiency or deploy more environmentally friendly technologies	High	Mid-Term	Advanced Energy Platform Steering Committee, WVDO, WV Division of Energy	Could be significant, requiring state policy supports and financial incentives, but with value established, could far outweigh expenditures
Action E2.6: Increase West Virginia's non-fossil fuel and energy portfolio	High	Mid-Term	Platform Steering Committee, WVDO, WV Division of Energy	Initial support may be provided by Advanced Energy Platform Committee members and related organizations

 ADVANCED ENERGY STRATEGY THREE	Facilitate university, national lab, and nonprofit engagement with industry for technology development and commercialization				
	ACTION	PRIORITY	TIME FRAME	LEAD ORGANIZATION	RESOURCES
	Action E3.1: Hold a series of forums/events in which energy-sector industry representatives outline their needs to the university, national lab, and nonprofit research leaders	High	Short-Term	Advanced Energy Platform Steering Committee	\$10,000
	Action E3.2: Seek establishment of a nationally recognized (such as NSF) industry-university collaborative center in advanced energy technologies to be located at WVU and to focus on commercialization	High	Short- to Mid-Term	Advanced Energy Platform Steering Committee and WVU (possibly National Research Center for Coal and Energy)	Volunteer time plus a potential planning grant
Action E3.3: Encourage commercialization of intellectual property from the National Energy Technology Laboratory	Medium	Mid-Term	WVHEPC and WVDO (with support from Advanced Energy Platform Steering Committee)	\$250,000 annually (for related University-Industry Matching Grant Program)	

Strategies and Actions for the Biometrics Platform



Three strategies and eight actions are proposed to grow West Virginia's Identification, Security, and Sensing Technology (Biometrics) economy. The strategies are briefly described below.



BIOMETRICS STRATEGY ONE

Bring key stakeholders together to guide biometrics sector development

West Virginia contains multiple companies, R&D organizations, and major technology-user organizations engaged in various aspects of biometrics research, consulting, and services. The West Virginia Biometrics Initiative has a good start on bringing organizations and key leaders together and driving this sector in north-central West Virginia. However, the Initiative to date has restricted staffing and curbed activities because of limited financial resources. These organizations must increase their collaboration and joint activities to drive West Virginia's biometrics economy well into the 21st century.



BIOMETRICS STRATEGY TWO

Build a stronger commercial biometrics base

West Virginia has already developed a small but significant base of commercial biometrics support companies — firms providing integration, support services, and software development. Although this represents an important initial step, the state would benefit significantly if it could produce identification, security, and sensing hardware, software, intellectual property, or other products for export.




BIOMETRICS STRATEGY THREE


Aggressively promote WV as the international hub for biometrics, identity, security and sensing technologies


Because biometrics is an emerging industry without a current dominant hub globally, there is a small but significant window of **opportunity for West Virginia to aggressively position itself as a leading location for this important sector.**

The strategies and actions are summarized in Table ES-3. Actions marked critical have the greatest priority, although some may take several years to accomplish. Immediate actions should be undertaken in the first year of implementation. Short-term actions should be undertaken in 1 to 3 years and mid-term actions in 3 to 5 years.

Table ES-3. Biometrics Strategies and Actions Proposed for West Virginia

 BIOMETRICS STRATEGY ONE		Bring key stakeholders together to guide biometrics sector development			
ACTION	PRIORITY	TIMING	LEAD ORGANIZATION	RESOURCES	
Action B1.1: Fund the WV Biometrics Initiative to form the platform steering committee comprising representatives from industry, government, nonprofit, and R&D institutions	Critical	Immediate	WV Biometrics Initiative and WVDO	\$250,000 annually (see Action 8 in General Strategies)	
Action B1.2: Continue to identify and promote opportunities and high-value projects with alignment to existing capabilities in identification, security, and sensing technology areas	High	Immediate	WV Biometrics Initiative	WV Biometrics Initiative and key stakeholders	
Action B1.3: Continue to develop and implement plans, projects, or activities focused on high-priority theme areas	High	Short- to Mid-Term	WV Biometrics Initiative	WV Biometrics Initiative and key stakeholders	

 BIOMETRICS STRATEGY TWO		Build a stronger commercial biometrics base			
ACTION	PRIORITY	TIMING	LEAD ORGANIZATION	RESOURCES	
Action B2.1: Integrate biometric applications and technologies within state-controlled facilities to spur development of WV biometrics companies and industry	High	Mid-Term	WV Biometrics Initiative, WVDO	Could be significant, requiring state policy supports and financial incentives; but, with value established, could far outweigh expenditures	
Action B2.2: Encourage intellectual property development and technology transfer at WV universities and invest in technology commercialization of biometrics products from WV R&D institutions	High	Immediate	WV Biometrics Initiative Plus lead organizations noted in related actions in General Strategy section	WV Biometrics Initiative and key stakeholders (plus resources from related actions in General Strategy section) <i>This is not an independent action but instead links to several general recommendations under Strategies One and Two</i>	
Action B2.3: Provide funds to small WV biometrics companies to support joint R&D projects with area universities and user organizations specific to commercial product development	High	Short- to Mid-Term	WV Biometrics Initiative Plus lead organizations noted in related actions in General Strategy section	WV Biometrics Initiative and key stakeholders (plus resources from related actions in General Strategy section) <i>This is not an independent action but instead links to several general recommendations under Strategies One and Two</i>	
Action 2.4: Recruit a product-based company in the biometrics space	High	Mid-Term	WV Dept of of Commerce, WVDO, WV Biometrics Initiative	Significant — will likely require location incentives from the State of West Virginia and local government	

 BIOMETRICS STRATEGY THREE	Aggressively promote WV as the international hub for biometrics, identity, security and sensing technologies			
	ACTION	PRIORITY	TIMING	LEAD ORGANIZATION
Action B3.1: Provide funding through the WV Department of Commerce to support and expand the WV Biometrics Initiative’s sector-promotion activities	High	Immediate	WVDO and WV Biometrics Initiative	\$250,000+

Measures of Success

The ultimate measures of success — or outcomes — of the recommended strategies and actions will not come from one particular strategy or action. Instead, they will work together to produce the overall results — an overall boost inTBED in West Virginia. The following list includes specific measures of success for the overall Blueprint:

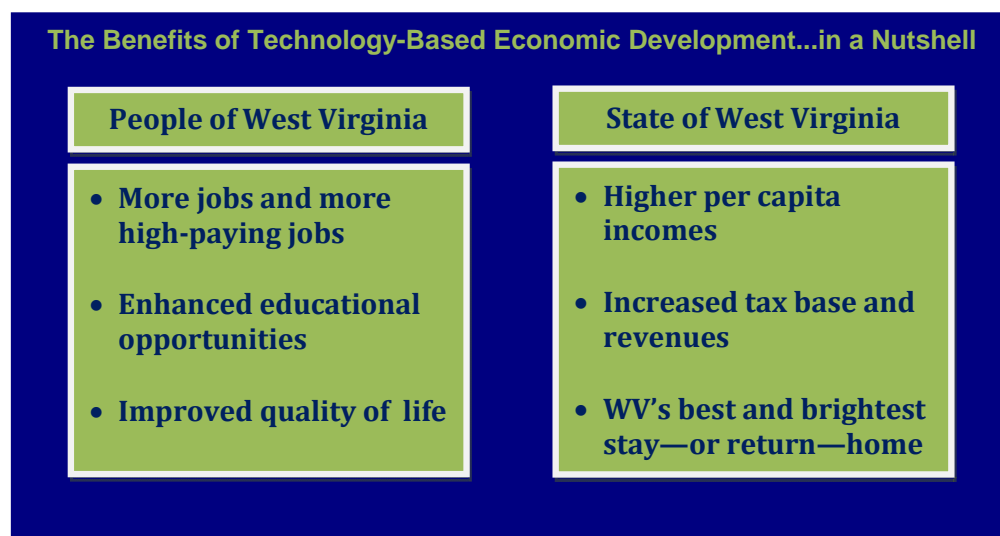
- Continue to **grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation, with a target of \$360 million by 2015
- **Increase R&D funding in platform areas** in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia’s universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia’s universities to achieve the national average by 2020.

Conclusion

The State of West Virginia — including governmental agencies, economic development groups, universities, nonprofit organizations, and business and industry — **must act boldly and quickly** to grow its research, technology transfer, and commercialization activities.

Innovation and technology lead not only to **more jobs** but also to **higher-paying jobs**, fueling economic growth and increasing the standard of living across entire states and regions where TBED is prevalent (Figure ES-5).

Figure ES-5. Benefits of Technology-Based Economic Development for People and State of West Virginia



Although TBED is not widespread in West Virginia compared with other states and West Virginia is behind its neighbors, peers, and most of the nation in building a technology economy, **West Virginia does have significant strengths** with strong foundations in several technologies, including the following:

- Advanced Energy and Energy-Related Technology
- Advanced Materials and Chemicals
- Identification, Security, and Sensing Technology (Biometrics)
- Molecular Diagnostics, Therapeutics, and Targeted Delivery Systems (Biotechnology).

The **recommended strategies and actions** in this Blueprint will boost West Virginia's knowledge-based economy and thus **propel West Virginia's overall economy well into the 21st century — if successfully implemented**. These strategies and actions are indeed recommendations that can be used exactly as proposed or as guidelines for further refinement and development.

Successful implementation of the Blueprint will require the following:

- **Significant investments** in West Virginia's technology infrastructure
- **Strong leadership** from the recommended lead organizations — and other groups and individuals within the state
- **Long-term commitment** from all stakeholders, including West Virginia's citizens
- **Strong resolve** to make critical and sometimes difficult decisions
- **Genuine will to compete.**

No single organization will be able to carry out this Blueprint or boost West Virginia's innovation economy alone. But, with the right investments, a genuine long-term outlook, and true collaboration among all stakeholders in the state's public and private sectors, **West Virginia can and will become a leader in this vital economic sector.**

Importantly, **if the state succeeds in building its technology-based economy...**

...West Virginia will succeed in fueling its economic growth well into the future, providing current and future generations with abundant vocational, professional, and educational opportunities — and providing high-quality, high-paying jobs well into the 21st century.

INTRODUCTION

What IS Technology-Based Economic Development?

Technology-based economic development — usually shortened to **TBED** — is simply the **creation and attraction of technology-based companies and jobs**. It includes any and all activities that help make that happen, including the following:

- Educating and preparing a high-technology workforce
- Offering an attractive business climate
- Providing investment capital
- Promoting research and new technology development
- Supporting technology entrepreneurs and small businesses
- Turning research and technology into new products, processes, services, and businesses

“Synonyms” for Technology-Based Economy

- ✓ Innovation-Based Economy
- ✓ Knowledge-Based Economy
- ✓ New Economy

In a broad sense, TBED is the facilitation of technology transfer and technology commercialization...or the process of **turning technology-based ideas, knowledge, and expertise into new products and services** to benefit and grow the economy.

Why Emphasize Technology-Based Economic Development in West Virginia?

The answer to the above question is simple. Innovation and technology lead not only to **more jobs** but also to **higher-paying jobs**, fueling economic growth and increasing the standard of living across entire states and regions where TBED is prevalent.

In fact, an innovation-based economy is now seen by many as an **economic imperative**. Multiple studies show that a state’s economic success can be largely attributed to the growth of high-technology businesses. Thus, TBED is a **critical component of West Virginia’s economic future**. In addition to the high-paying jobs provided by a knowledge-based economy, most studies show that every high-technology job creates at least two indirect jobs in the broader economy — and some studies suggest that number is closer to five.

Moreover, West Virginia’s neighbors — and most of the states across the country — have emphasized TBED for many years, creating and attracting high-tech companies, providing highly skilled and highly paid educational and job opportunities for their citizens, diversifying their traditional economies, and boosting the overall wealth and economies of their regions. **West Virginia must be able to compete** with other states to offer its citizens the same high-value opportunities.

The Economic Impact of Pennsylvania’s Ben Franklin Technology Partners 2002–2006

- ✓ Boosted PA’s economy (Gross State Product) by **\$9.3 billion**
- ✓ Resulted in more than **\$517 million in state tax revenues**
- ✓ Provided a **3½-to-1 payback** to the state on its \$140 million investment
- ✓ Generated **10,165 job-years* in client firms**
- ✓ Generated **22,667 job-years in indirect jobs**

* Job-years are equivalent to the number of years of full-time work created by the program. For example, if a BFTP client firm employed three more workers for 5 years as a direct result of the program, which is expressed as 15 additional job-years.

“...we estimate that, in 2006, the north-central West Virginia technology industry will have a **total economic impact of \$5.2 billion** on the State of West Virginia.”

Anderson Economic Group LLC,
North-Central West Virginia's
Technology Industry: A Pathway
Through the 21st Century, 2006.

In a way, all economic development has a significant technology component. Developed **economies maintain their competitive edge through innovation** and the deployment of advanced technologies to increase productivity. Thus, understanding technology and its application is not just a function of the knowledge elite in the nation. Increasingly, skills in science, technology, engineering, and mathematics (STEM) are needed across the workforce and on the shop floor. Whether it is the production of technology for sale or the use of

technology to achieve higher levels of productivity, **technology is the driver of the U.S. economy**. For West Virginia to build its position in the American economy, it has to build its position in technology and innovation.

TBED generates multiple economic benefits for states as shown in Figure 1. Science and technology research and development (R&D) within universities, colleges, nonprofit organizations, and companies is a major economic sector by itself, benefiting from both in-state governmental and commercial funding and out-of-state federal and commercial funding. Academic, nonprofit, and commercial R&D generates direct, high-paying jobs and income for the economy.

Significantly, those **R&D investments are multiplied** when the results of that R&D move through the economy. On one level, research and technology advancements enhance the existing economic base as existing industry realizes productivity gains or new business opportunities. This helps maintain jobs but can also result in significant job growth.

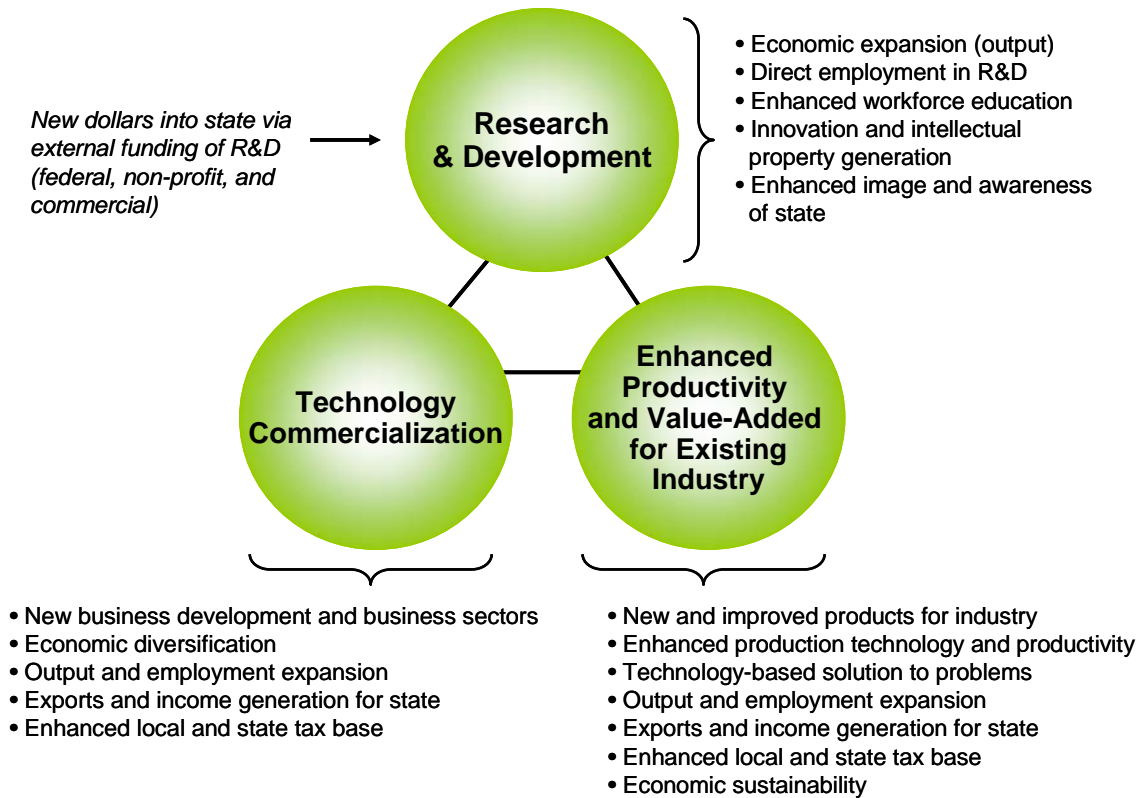
On another level, technology and innovation advancements expand and grow the economy beyond the existing base as new innovations and technologies are commercialized. This results in **new business creation** as new businesses (products or services) are created within existing industry or new businesses are created within new start-up companies.

The bottom line, though, remains. Innovation and technology lead not only to **more jobs** but also to **higher-paying jobs**, fueling economic growth and increasing the standard of living across entire states and regions where TBED is prevalent.

TBED Example: North Carolina's Biotechnology Industry

- North Carolina **invested \$1.2 billion** in bioscience over the past decade
 - ✓ \$857 million in research and facilities
 - ✓ \$135 million in workforce training
 - ✓ \$114 million for the North Carolina Biotechnology Center
 - ✓ \$102 million in direct company incentives
- NC's investment has helped build a **\$45 billion PER YEAR industry** in the state
- Bioscience **employment increased 18.5%** since 2001
- NC now has over **500 bioscience companies** employing over **54,000 people**
- Biotechnology companies are responsible for **\$1.44 billion in state and local taxes each year**
- Bioscience sector generates an estimated, **additional 127,000 jobs** and more than **\$9.4 billion in wages and salaries**

Figure 1. Technology-Based Economic Development Provides Multiple Benefits to State Economies



What is VISION 2015 and How Does it Relate to the Blueprint?

VISION 2015 is ***The West Virginia Science and Technology Strategic Plan***. It is a strategic framework of actions and initiatives that, similar to this Blueprint, are designed to bring measurable growth in TBED to West Virginia.

In fact, the vision for that plan is as follows:

By 2015, research and innovation will be the number one driver of West Virginia’s new, diverse, and prosperous economy.

The main elements of VISION 2015 are shown on the next page.

Although the ultimate goal of the plan is economic development, VISION 2015 is **focused more on the education and research piece of TBED, especially related to higher education**. That is appropriate, especially since VISION 2015 emanates from the Division of Science and Research of the West Virginia Higher Education Policy Commission (WVHEPC).

Although there is no doubt that both education and research are vital elements in developing West Virginia’s innovation economy, a broader plan is needed that addresses the commercialization piece of TBED for West Virginia.

This Blueprint works in conjunction with VISION 2015 to provide that broader plan and to address the commercialization and innovation aspects of TBED.

VISION 2015

The West Virginia Science and Technology Strategic Plan

HUMAN AND PHYSICAL INFRASTRUCTURE

- Increase the number of critical science, technology, engineering, and mathematics (STEM) researchers at West Virginia University (WVU) and Marshall University (MU) by 20%
- Build at least one new science and engineering facility at MU and WVU of up to 100,000 net assignable square feet each by 2010, and develop a long-term plan to continue creation of new research facilities
- Create four nationally competitive research thrusts/clusters by 2010
- Provide one-time \$1 million each to WVU and MU libraries to increase electronic journal subscriptions in critical STEM fields and \$0.5 million each on a continuing basis

RESEARCH AND INNOVATION

- Develop at least four new in-state emerging technology businesses
- Double competitive funding from federal agencies every 5 years

ECONOMIC DEVELOPMENT

- Create a Technology-Based Economic Development (TBED) Office within the Department of Commerce
- Create an early-stage, proof-of-concept gap fund of \$2.5 million for technology development and commercialization
- Increase by 10% per year the number of STEM job opportunities in the State of West Virginia for graduates with bachelor's/master's degrees

POLICY

- Develop policies and strategies to improve management of intellectual property (IP) on a statewide basis
- Each institution (WVU and MU) will revise promotion, tenure, and workload policies to be more research and entrepreneurial friendly
- Increase Research Challenge Fund (RCF) proportion of racetrack video lottery proceeds to 1% — thereafter, increase the proportion until at least 5% is achieved by 2015

EDUCATION AND OUTREACH

- Align with or create a regional alliance including research universities, the private sector, and government agencies
- Increase by 5% per year the retention and completion rates of STEM students (with emphasis on broadening participation)
- Increase by 10% per year the number of doctorates awarded in STEM fields through 2015
- Create a joint university-community and technical college (CTC)-business curriculum to train STEM technicians

What is the Status of Technology-Based Economic Development in West Virginia?

Historically, West Virginia has had an economy built on **energy, chemicals, and natural resources**. About a decade ago, public and private leaders began to take actions to build infrastructure that would support innovation and knowledge-based industries, diversify the state's economy, and provide high-wage jobs for its citizens. The state's Congressional delegation succeeded in attracting **federal technology projects and centers** to the state,

West Virginia's Federal and Nonprofit Technology Anchors

- U.S. Department of Defense (DoD) Biometrics Fusion Center (Clarksburg)
- Federal Bureau of Investigation (FBI) Criminal Justice Information Services Division (Bridgeport)
- FBI Biometric Center of Excellence (Clarksburg)
- Mid-Atlantic Technology Research and Innovation Center (MATRIC) (South Charleston)
- NASA Independent Verification and Validation Facility (Fairmont)
- National Biometric Security Project (Morgantown)
- National Energy Technology Laboratory (Morgantown)
- National Institute for Occupational Safety and Health (Morgantown)
- National Technology Transfer Center (Wheeling)
- Rahall Transportation Institute (Huntington)
- U.S. Army Corps of Engineers (Huntington)
- West Virginia High Technology Consortium Foundation (Fairmont)

joining existing national laboratories, including the National Energy Technology Laboratory (NETL), which has been located in Morgantown since 1954, and three divisions of the National Institute for Occupational Safety and Health (NIOSH), which has been located in Morgantown since 1970.

While these federal programs and centers were growing, various efforts were underway to help West Virginia companies as well. The **West Virginia High Technology Consortium (WVHTC) Foundation** was created in 1990 to encourage the growth of technology companies in West Virginia. The **Mid-Atlantic Technology, Research, and Innovation Center (MATRIC)** was created in Charleston in 2004 to conduct research and commercialize new products and services, taking advantage of the technical talent leaving a downsizing Dow Chemical.

In addition, the State of West Virginia enacted the Capital Company Act designed to encourage venture capital companies to invest in West Virginia-based firms, and numerous regional and local economic development groups worked to create a climate conducive to technology firms.

Importantly, the state's major research universities, **Marshall University (MU)** and **West Virginia University (WVU)**, have gradually increased their emphasis on technology transfer, commercialization and entrepreneurial activities. These investments and activities are starting to bear fruit. **New start-up firms** are sprouting in West Virginia, poised to create jobs and expand opportunities in the state. Many of the start-up companies have resulted from work being done at the state's research universities. The state's recent investment in research, the **Research Trust Fund**, will support those efforts, helping both universities attract top-notch scientific talent with an entrepreneurial approach.

Technology-Based Start-Up Firms in West Virginia

From Marshall University

- Vandalia Research
- Progenesis Technologies, LLC
- Ecer Technologies, LLC
- Medical Information Systems Technologies, LLC

From West Virginia University

- Protea Biosciences, Inc.
- EyeMarker Systems, Inc.
- NexID Biometrics, LLC
- Oculus Development, LLC

Like WVU and MU, other state colleges and universities have started entrepreneurial or business incubation programs to help entrepreneurs and others commercialize their ideas and products as well, including **Shepherd University**, **Concord University**, and **WVU Institute of Technology**. And other nonprofit groups in the state provide support and facilities for tech-based entrepreneurs, including the **Chemical Alliance Zone** and the **Polymer Alliance Zone**.

Technology-Based Firms in West Virginia

Biometrics and Information Technology Firms in North-Central West Virginia

- Northrop Grumman Corporation
- Lockheed Martin's Biometric Experimentation and Advanced Concepts (BEACON) Center
- Azimuth Inc.
- Computer Sciences Corporation
- Global Science and Technology, Inc.
- ManTech International Corporation
- Plethora Technology
- SecurLinX Corporation
- Tygart Technology, Inc.
- vIdentity Systems, Inc.

Information Technology Firms in West Virginia's Eastern Panhandle

- HMS Technologies, Inc.
- Information Manufacturing, LLC
- Information Resource Corporation
- MILVETS Systems Technology, Inc.
- The Library Corporation

Although the state's universities are vital in supporting TBED, other companies and initiatives have attracted or established small and start-up companies in West Virginia in recent years. For example, a **growing biometrics and information technology industry** has sprouted in north-central West Virginia. This growth has been aided by federal agencies, WVU, and others, but also by the **Biometrics Initiative**, a project of the **I-79 Development Council**.

Similarly, there is a small but strong information technology industry in the **eastern panhandle** of West Virginia.

As another example, **MATRIC** has spawned a number of start-up companies through the commercialization of technologies developed at MATRIC.

Companies Started by MATRIC

- Transparent Armor, LLC
- NG Innovations, LLC
- Mountaineer Biofuels, LLC
- Certus Scientific, LLC

Still, although there is much to be proud of and **much to build from** in West Virginia, the state is admittedly far **behind most of its counterparts** both in the region and around the country.

In fact, **West Virginia ranked 49th in the 2008 State Technology and Science Index** produced by the Milken Institute, moving down from a ranking of 46th in 2004. Although a number of reputable rankings could be used, the *State Technology and Science Index* provides a good overall measure of TBED in each state. It takes inventory of all the technology and science assets that can be leveraged to boost economic development. The study factors in 77 indicators in five categories in each state: (1) Research and Development, (2) Risk Capital and Entrepreneurial Infrastructure, (3) Human Capital, (4) Technology and Science Work Force, and (5) Technology Concentration and Dynamism. **Although West Virginia is making strides, it continues to face challenges** in growing its technology industries and transitioning its economy to one based on innovation.

UNIVERSITY SPIN-OFFS STAY HOME: At least 494 new companies based on an academic discovery were formed in FY 2001 — 84% in the university's home state



Four companies started from Marshall University technologies are still in West Virginia and active



West Virginia University lists 27 firms started within the university...and NONE have left the state

BLUEPRINT PHASE I: WEST VIRGINIA'S GAPS AND STRENGTHS

In March 2007, **Battelle Technology Partnership Practice** produced for the WV Vision Shared TBED Team, the precursor to TechConnectWV, a report entitled *Gap Analysis and Identification of Strategic Technology Platforms*. That report was **Phase I** of the Blueprint, with the present report representing Phase II. Using extensive qualitative and quantitative analyses, Battelle examined West Virginia's innovation economy and determined its competitive position for TBED. Specifically, Battelle **uncovered key gaps** or barriers that need to be overcome and **uncovered key strengths** that can be exploited to enhance West Virginia's position.

What Are West Virginia's Specific Gaps?

In the 2007 study, Battelle found four key gaps to building West Virginia's technology economy. A fifth gap was uncovered while conducting focus groups for the present study. Those five gaps, illustrated in Figure 2, are as follows:

(1) Talent. To accelerate growth of its technology sectors, West Virginia must be able to (1) attract world-class scientists, engineers, technicians, executives, and other professionals at all levels; (2) educate and train its citizens and workforce; and (3) retain its talented graduates.

(2) Early-Stage Seed Capital. Entrepreneurs, small businesses, and start-up firms must have access to risk capital to succeed and grow. West Virginia has three capital gaps: (1) translational and proof-of-concept (PoC) funding in the range of \$50,000 to \$250,000; (2) early-stage, pre-seed and seed capital funding from \$200,000 to \$1 million; and (3) risk capital for companies that are not appropriate targets for traditional venture capital financing. West Virginia must be able to attract risk capital to grow its technology economy.

(3) Entrepreneurial Know-How. West Virginia historically has not had a technology-based entrepreneurial culture. Thus, the state lacks a supply of "serial entrepreneurs" — entrepreneurs who have successfully started and grown several technology companies and who can act as role models or mentors for aspiring entrepreneurs. The state must find ways to attract, nurture, and support entrepreneurial and management talent.

(4) Image. Unfortunately, negative stereotypes of West Virginia persist and impact the state's ability to raise capital, recruit talent, and attract technology companies. The lack of awareness of the technology assets in West Virginia exists not only in people unfamiliar with the state, but with many West Virginians as well. Efforts will be needed to change this image, both internally and externally, and to better educate both policymakers and the general citizenry on the technology economy and its importance in West Virginia's economic future.

(5) Leadership. Although several state government, university, economic development, and business and industry groups have been

Figure 2. Identified Gaps in WV's TBED Infrastructure



Key Success Factors for Building a Technology-Based Economy

- Engaged universities with active leadership and strong ties to industry
- Intensive networking across sectors and with industry
- Available risk capital covering all stages of the business cycle
- Discretionary federal or other R&D funding support
- Workforce and talent pool upon which to sustain efforts
- Stable and supportive business environment
- Patience and a long-term perspective

involved in various facets of TBED in West Virginia over the years, no organization has provided overall guidance, direction, and organization of efforts. That gap was recognized by focus group participants during sessions to obtain input on this Phase II of the Blueprint and was thus identified as an additional gap. West Virginia clearly needs broad leadership for the entire TBED effort across the state.

What Are West Virginia's Specific Strengths?

As mentioned above, in the March 2007 report, Battelle Technology Partnership Practice, using extensive qualitative and quantitative analyses, determined West Virginia's competitive position for TBED. Thus, along with key gaps, Battelle also uncovered key strengths that can be exploited to enhance the state's position.

West Virginia's strengths were categorized into two areas: (1) **general competitive advantages** and (2) **specific technology strengths or technology platforms**. Although the competitive advantages are vital and given in a sidebar below, the technology strengths are more relevant for this report and are thus discussed in more detail below.

To determine West Virginia's technology strengths, Battelle asked three core questions:

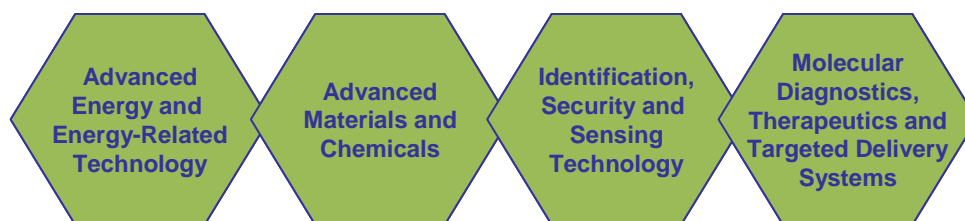
1. What are the established and emerging science and technology R&D **core competencies** in West Virginia?
2. Which of these core competencies coincide with significant **market opportunity** — thereby constituting key technology niches or "**technology platforms**" that may drive technology-based economic development for West Virginia?
3. What is West Virginia's **current competitive position** for technology-based economic development?

After answering these questions and conducting an extensive analysis, Battelle recommended four technology platforms for West Virginia (Figure 3):

- Advanced Energy and Energy-Related Technology
- Advanced Materials and Chemicals
- Identification, Security, and Sensing Technology (Biometrics)
- Molecular Diagnostics, Therapeutics, and Targeted Delivery Systems (Biotechnology).

West Virginia's General Competitive Advantages

- ✓ Presence of a large number of nonprofit and federal research institutions
- ✓ Growing academic research base
- ✓ Increased focus on tech transfer and commercialization at MU and WVU
- ✓ Growing technology sector, particularly in North Central West Virginia
- ✓ Highly productive workforce
- ✓ Quality college graduates
- ✓ Growing entrepreneurial support infrastructure
- ✓ Quality of life that is attractive to many people

Figure 3. West Virginia's Technology Platforms

What is the Significance of West Virginia's Technology Platforms?

The four technology platforms represent the areas where West Virginia has the **best chance of developing a robust technology economy**, according to Battelle's analysis. In these areas, West Virginia — meaning its universities, federal labs, nonprofit groups, and private companies — can most likely collaborate to create new companies and new jobs and significantly expand and diversify the economy.

A base of research alone is not sufficient for ensuring technology development. Instead, TBED is most likely to occur in areas where research intersects with a state's industry base, competitive advantages, and market opportunities. Those niche or strength areas — technology platforms — serve as a bridge between the research core competencies and their use in commercial applications and products. Ideally, identified technology platforms are as follows:

- **Applications oriented**, merging early-stage laboratory-scale science and technology into systems and devices (a process called “fusion” or “convergence”)
- **Robust and self-renewing**, able to address current as well as new, emerging market opportunities
- **Prolific**, able to produce a regular stream of innovative, perhaps disruptive, products (providing a product pipeline)
- **Multidisciplined**, requiring collaborations across scientific and technology disciplines as well as across organizations (universities, federal labs, nonprofits)
- **Commercially oriented**, requiring partnerships with industry to provide customer perspective and capacity to develop new products.

Thus, the four technology platforms represent West Virginia's strengths — the areas where the state's resources should be most concentrated. However, West Virginia should still conduct and support research and innovation in other technology areas. Significant economic and job growth could — and, with systemic improvements in WV's TBED structure, should — occur even in nonplatform areas.

Although all four technology platforms are important, as of March 2009, TechconnectWV has dedicated resources and **developed specific strategies and actions for two technology platforms:**

- ✓ **Advanced Energy** and Energy-Related Technology
- ✓ Identification, Security, and Sensing Technology (**Biometrics**).

These represent nearer-term opportunities based on West Virginia's capabilities and both state and national goals. TechConnectWV plans to develop strategies and actions for the other two platforms over the coming months.

TechConnectWV: West Virginia Coalition for Technology-Based Economic Development

Who is TechConnectWV?

TechConnectWV is a **coalition of professionals** dedicated to growing and diversifying West Virginia's economy by advancing TBED. The organization is a **501(c)(3) nonprofit** corporation with broad membership from the private and public sectors. TechConnectWV serves mainly as **facilitators**, enhancing awareness, increasing collaboration, and raising the discussion of important issues to spur technology development and commercialization in West Virginia.

TechConnectWV is the trade name for the West Virginia Coalition for Technology-Based Economic Development, Inc.

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What is the History of TechConnectWV?

Recognizing the need to build a high-technology economy in West Virginia, a group of economic developers, researchers, technologists, service providers, and others came together

in **2004** for a series of three meetings to examine TBED in West Virginia. These meetings were initiated and funded by the **Claude Worthington Benedum Foundation**.

Independently, **A Vision Shared** developed an economic development strategy and implementation plan for West Virginia that identified four key themes, including “**New Economy: New Challenges and New Solutions**.” That area was divided into four smaller subcategories, including TBED.

In **2005**, the group that originally formed for a series of three meetings aligned with A Vision Shared, becoming the **Vision Shared TBED Working Group**. This alignment led to the commissioning of three studies

West Virginia: A Vision Shared... began in the spring of 2000. The product of both a grassroots initiative and the leadership of the West Virginia Council for Community and Economic Development, A Vision Shared grew rapidly to include over 750 active volunteers from the public and private sectors working in many diverse but interrelated areas of economic development.

concerning TBED in West Virginia that were funded by the Claude Worthington Benedum Foundation.

In **2006**, the group was **incorporated** as the West Virginia Coalition for Technology-Based Economic Development, Inc.

In **2007**, the Coalition released **Phase I** of the **WV TBED Blueprint**, which identified specific gaps and recommended specific technology platforms for building West Virginia’s technology economy.

Also in 2007, WV TBED received a grant from the Benedum Foundation to promote TBED in West Virginia and develop the organization. In **2008** WV TBED obtained a new trade name, **TechConnectWV**, and received formal designation as a **501(c)(3)** nonprofit corporation.

TechConnectWV was formed to...

- ✓ **Facilitate** TBED in West Virginia
- ✓ **Promote collaboration** among all resource groups in West Virginia, including technology, capital, workforce, business, and support services
- ✓ **Raise awareness** of the importance of diversifying West Virginia's economy
- ✓ **Increase innovation** and commercialization, leading to high-paying jobs and wealth creation across West Virginia
- ✓ **Provide the strategy** to grow and diversify West Virginia's economy
- ✓ **Partner with the West Virginia Development Office** to support initiatives

Studies Commissioned by TechConnectWV

Technology Transfer & Commercialization Mapping Project, Presented to Vision Shared Working Group on Technology Transfer & Commercialization, Mark A. Scott (Acacia Business Solutions LLC), February 2006

Resource Inventory and Assessment: Vision Shared Focus Team on Technology-Based Economic Development, Randall W. Jackson, Walter R. Schwarm, and Russ Lorince, WVU, December 2006

Technology Blueprint: Gap Analysis and Identification of Strategic Technology Platforms, Prepared for WV Vision Shared TBED Team, Battelle Technology Partnership Practice, March 2007

Key TechConnectWV Accomplishments 2004–2008

- **Developed inventory of organizations** involved in technology transfer and commercialization in West Virginia
 - **Developed resource inventory** and assessment, identifying broad gaps in West Virginia's technology-based economy
 - Working with Battelle, **identified specific gaps** that must be addressed to enhance technology transfer and commercialization in West Virginia
 - Working with Battelle, **identified and recommended specific technology platforms**, based on current strengths, to build West Virginia's technology economy (formed basis of technology areas in **Research Trust Fund**)
 - **Supported** the need and development of a **West Virginia Small Business Innovation Research (SBIR)** Program
 - **Increased awareness** of the need to grow West Virginia's economy through technology transfer and commercialization
 - **Promoted TBED** and West Virginia organizations and companies involved in TBED at conferences, through articles, and with discussions with various stakeholders within and outside the state
 - **Supported legislation** for the Research Trust Fund and seed/capital investments
 - **Supported technology firms** such as MATRIC, SecurLinx, Progenesis, Protea, and others
 - **Supported** statewide science and technology and economic development **conferences**
 - **Formed Advanced Energy Working Group**, a group of leaders, researchers, and innovators in West Virginia who will focus on the Advanced Energy and Energy-Related Technology Platform
 - **Formed Biometrics Working Group** (using Biometrics Initiative as foundation), a group of leaders, researchers, and innovators in West Virginia who will focus on the Identification, Security, and Sensing Technology Platform
 - **Helped** raise the need for **early-stage and seed funding** and helped form the **West Virginia Angel Network**
 - **Facilitated increased collaboration** and interaction among leaders, researchers, companies, venture capitalists, and others interested in and involved in TBED throughout the state
 - **Published three reports** to provide assessments of TBED activities in West Virginia
-

Battelle Technology Partnership Practice

Who is Battelle?

Battelle is the **world's largest nonprofit, independent R&D organization**, with 20,400 employees in more than 120 locations worldwide, including seven national laboratories that Battelle manages or co-manages for the U.S. Department of Energy and the U.S. Department of Homeland Security. Battelle is a **global leader in TBED**, management, and commercialization. It is also a global leader in the development of partnerships among industry, government, and academia.

Who is Battelle Technology Partnership Practice?

Battelle Technology Partnership Practice includes **leading analysts and practitioners** in TBED. The organization helps clients develop, implement, and evaluate technology strategies, policies, and programs.

Battelle created Technology Partnership Practice in 1991 to focus its broad experience to **serve nonprofit technology groups**, economic development organizations, and universities across the United States. Battelle Technology Partnership Practice works across industries and technologies, building collaboration among business, higher education, and government and providing common ground for building agreements, setting a vision, and assisting implementation. Battelle Technology Partnership Practice provides a link between public and private sectors to **stimulate economic growth for its clients**.

A Sampling of Battelle Technology Partnership Practice's Clients

- Arizona Department of Commerce
- Colorado BioScience Association
- University of California, Davis Campus
- Connecticut Center for Advanced Technology
- Connecticut Governor's Office of Workplace Competitiveness
- Georgia Research Alliance
- The State of Iowa Department of Economic Development
- Kentucky Science and Technology Corporation
- Maryland Technology Development Corporation
- Maryland Department of Business and Economic Development
- Ohio State University
- Ben Franklin Technology Centers
- Carnegie Mellon University
- University of Pittsburgh
- Memphis Tomorrow, Inc.
- Virginia's Center for Innovative Technology (CIT)
- Biotechnology Industry Organization
- Economic Development Administration, U.S. Department of Commerce
- Finland Technology Center (VTT) – Finland

Blueprint Phase II Background

In **late 2007**, TechConnectWV contracted with Battelle Technology Partnership Practice to assist in developing the second phase of WV's TBED Blueprint — the **strategies and actions** needed to capitalize on West Virginia's technology strengths, close critical gaps, and grow its innovation economy. This effort would become a series of **recommendations** for both the **public and private sectors** in the state, forming the state's strategic plan for TBED.

Two sets of strategies and actions were developed:

- Strategies and actions **addressing West Virginia’s Gaps**
- Strategies and actions capitalizing on West Virginia’s strengths (technology platforms) in two platform areas: **Advanced Energy** and Energy-Related Technologies and in Identification, Security, and Sensing Technology (**Biometrics**).

As of March 2009, TechConnectWV has dedicated resources to these two platforms since they represent nearer-term opportunities. However, TechConnectWV plans to develop strategies and actions for the other two platforms over the coming months.

How Were the Strategies and Actions Developed?

Working with TechConnectWV, Battelle crafted an **initial set** of overall strategies with specific actions related to each strategy, using research and input from key stakeholder groups around the state. Key sources of information included the following:

- Findings from the **Phase I Battelle report**
- Research, planning, and strategy **reports produced by West Virginia’s** government agencies, nonprofit groups, economic development groups, and universities
- In-depth one-on-one **interviews with key stakeholders** in many of the above organizational categories
- In-depth **conversations with TechConnectWV staff and Executive Committee**
- **Focus groups conducted around the state** with representatives from local universities, economic development groups, technology companies, businesses, nonprofit groups, government agencies, and others
- **Focus groups** conducted with stakeholders in each of two **platform areas**
- **Battelle’s broad experience and expertise** in providing guidance, assistance, and consultation with organizations across the United States.

Focus Group Sessions to Address West Virginia’s Gaps

- ✓ **Eastern Panhandle** (Martinsburg)
- ✓ **Mid State** (South Charleston)
- ✓ **Northern Counties** (Morgantown)
- ✓ **Southern Counties** (Beckley)

The **initial set of general strategies and actions**

— addressing West Virginia’s gaps — was then **vetted with a number of groups**, including the TechConnectWV staff and Executive Committee, the TechConnectWV Board of Directors, the Vision Shared Board of Directors, the West Virginia Development Office (WVDO), and others from the university, economic development, and business communities in West Virginia. Suggested changes were then funneled back to Battelle for further scrutiny; and, after much interchange, a final set of strategies and actions was developed.

The **initial set of platform strategies and actions** — capitalizing on West Virginia’s technology strengths — was developed similarly. This set was **vetted** with a smaller group, relying mostly on the TechConnectWV staff and Executive Committee along with the **state’s leaders and experts in the platform areas** to provide guidance and feedback.

These stakeholders were formed into Working Groups that, as planned, will continue to evaluate and prioritize platform initiatives and promote projects and activities in the platform areas, becoming the Platform Steering Committees.

Advanced Energy Working Group

Richard Bajura, Ph.D.

Director
National Research Center for Coal and Energy
West Virginia University

Gene Cilento, Ph.D.

Dean
College of Engineering and Mineral Resources
West Virginia University

Anthony Cugini, Ph.D.

Director, Office of Research and Development
National Energy Technology Laboratory

Mark Dempsey

VP External Affairs in WV
AEP's Appalachian Power Company

Betsy Dulin, J.D.

Dean
College of Information Technology and Engineering
Marshall University

Mridul Gautam, Ph.D.

Associate VP for Research and Economic Development
West Virginia University

Andrew Gellman, Ph.D.

Head of Chemical Engineering Development
Carnegie Mellon University
Research Director, CWP Inc.

Larry Headley, Ph.D.

Senior Associate
Technology & Management Services, Inc.

Jeff Herholdt

Director
WV Division of Energy

Kenneth Kirk

Executive VP, Production
Equitable Resources

Diane Newlon

Technology Transfer Manager
National Energy Technology Laboratory

Keith Pauley

President and CEO
MATRIC

Ray Prudnick

VP Operations
Triana Energy

Rick Remish

Executive Director
Imagine WV

Scott Rotruck

Vice President, Corporate Development
Chesapeake Energy Corporation
Research Director, CWP Inc.

Dick Winschel

Director, Research Services
CONSOL Energy Inc.

Biometrics Working Group

Ralph Bean, J.D.

Member
Steptoe & Johnson PLLC

Brian Bell

Vice President and General Manager
Global Science and Technology

Thomas Bush

Assistant Director
Criminal Justice Information Services, FBI

Valerie Evanoff

Chief Executive Officer
Biometric Services International, LLC

Patrick Farrell

Deputy Program Manager
Biometrics Task Force Services
Computer Science Corporation

Terry Fenger, Ph.D.

Director, Forensics Science Center
Marshall University

Craig Hartzell

President
Azimuth Inc.

Barry Hodge

President and CEO
SecurLinX Corporation

Todd Hooker

Manager
Business and Industrial Development
West Virginia Development Office

Steve Hooks

Program Manager
DoD Biometrics Fusion Center
Computer Sciences Corporation

Kris Hopkins

Manager
Business and Industrial Development
West Virginia Development Office

Larry Hornak, Ph.D.

Co-Director
NSF Center for Identification Technology Research
West Virginia University

Mike Kirkpatrick

Executive Director
West Virginia Biometrics Initiative

Jason Lis

Account Executive
TEK Systems

John Maher, Ph.D.

Vice President for Research
Marshall University

Bob McLaughlin

President
I-79 Development Council

Chirag Patel

President & CEO
Innovation Management & Technology

Curt Peterson, Ph.D.

VP for Research and Economic Development
West Virginia University

Charles Schliebs, J.D.

Co-Founder and Managing Director
iNetworks

Steve Spence

Director, International Division
West Virginia Development Office

Linda Wellings

President
MPL Corporation

Bob Wentz

President
Information Research Corporation

LaRue Williams

Associate Director, Biometric Knowledge Center
NSF Center for Identification Technology Research, West Virginia University

Michael Yura, Ph.D.

President
Yura Consulting LLC

Measures of Success

The ultimate measures of success — or outcomes — of the recommended strategies and actions will reflect the work of many groups, organizations, companies and individuals. No one person or organization will be solely responsible for the overall results — increased investment in technology-based research, development, and commercialization and increased numbers of jobs and new companies in the technology sector in West Virginia. However, **to promote accountability, lead organizations have been recommended** for all actions identified in the strategy.

Likewise, these **outcomes will not come from one particular strategy or action**. Instead, the various strategies and actions will work together to produce the overall results — an overall boost in TBED in the state.

Still, **some actions will impact some outcomes more directly than others**. Thus, those measures of success that will likely be most influenced by a particular action item are also listed as outcomes of that particular action. Consequently, each outcome is listed multiple times under both the general strategy below and the platform strategies that follow.

Specific measures of success are listed below for the overall Blueprint (and again, are also listed under specific actions where appropriate).

- Continue to **grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation with a target of \$360 million by 2015
 - *Between 2006 and 2007, R&D at West Virginia's universities and colleges increased by 11.1% while total U.S. academic R&D increased by 3.5%*
 - *Between 2002 and 2007, R&D at West Virginia's universities and colleges increased an average of 10.9% per year while total U.S. academic R&D increased an average of 6.3% per year*
 - *The \$360 million target represents an increase of just over 10% per year, roughly equivalent to the 10.9% average from 2002 to 2007*
 - *Recent West Virginia academic R&D:*
 - 2002: \$100,830,000
 - 2003: \$125,417,000
 - 2004: \$134,961,000
 - 2005: \$146,489,000
 - 2006: \$150,420,000
 - 2007: \$167,208,000
 - *The past growth in West Virginia R&D occurred at a time of increasing federal R&D budgets, including the doubling of NIH funding; future funding will be highly dependent on the growth of future federal R&D funding*

- **Increase R&D funding in platform areas** in all sectors (academia, nonprofits, and industry)
 - *Because no current baseline data exist, there is a need to track over time and form more specific goals as data are gathered*

- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
 - *In 2007, 3.3% of total R&D expenditures at West Virginia colleges and universities came from industry, compared with 5.4% in the United States*
 - *From 2002 to 2007, an average of 3.4% of total R&D expenditures at West Virginia colleges and universities came from industry, compared with 5.3% in the United States.*

- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
 - *Because no current baseline data exist, there is a need to track over time and form more specific goals as data are gathered*

- **Increase employment** in private-sector, technology-based companies in West Virginia to reach national average by 2020
 - *In 2005, 8.1% of West Virginia's total employment was in the high-tech sector, compared with the national average of 10.9%*
 - *It may be helpful to consider other measures, such as employment in platform areas or particular industry sectors related to the platforms*

- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020
 - *Current national average is one spin-off company created for every \$88 million of academic R&D*
 - *The measure would correspond to about two new start-ups created per year at current academic R&D funding levels*
 - *The measure would correspond to about four new start-ups created per year if academic funding reaches \$360 million in 2015*

General Strategies and Actions for Boosting Technology-Based Economic Development in West Virginia

Four strategies and 18 actions are proposed to grow West Virginia's technology economy. These strategies and actions were developed to address the **general or overall needs** for increasing technology transfer and commercialization in West Virginia. They specifically address **West Virginia's gaps** in TBED.

The strategies and actions are summarized in Table ES-1 and are detailed below. Actions marked critical are those that have the greatest priority, although some may take several years to accomplish. Immediate actions are those that should be undertaken in the first year of implementation. Short-term actions should be undertaken in 1 to 3 years, and mid-term actions should be undertaken in 3 to 5 years.

STRATEGY ONE

Build a culture that supports innovation and entrepreneurship and the creation and growth of technology-based companies

Rationale: Innovation, in and of itself, will not necessarily translate into economic activity. Rather, it is the application of a technology and its introduction into the marketplace that result in economic growth. **Supporting entrepreneurs and the growth of entrepreneurial companies** is therefore a **critical component** of any state's or region's strategy to accelerate the growth of its technology-based economy.

The National Governors Association puts forth this definition of entrepreneurship and entrepreneurs:

Entrepreneurship is the ability to amass the necessary resources to capitalize on new business opportunities; and an entrepreneur is one who combines smart business practices with innovation, without regard for resources under his or her control.¹

Entrepreneurs and **entrepreneurial firms need many resources**, including management talent, technology, capital, and professional expertise. They often need assistance in determining economic feasibility and identifying markets and distribution channels. They may also need access to specialized equipment and laboratories and to expertise to solve technical issues that arise during product development. They must be able to recruit key personnel and have access to small amounts of pre-seed capital.

West Virginia does not have a history of having a strong technology-based entrepreneurial economy. For many years, the state's economy has been dependent largely on exporting its natural resources — its coal, oil, and gas in particular. Its industry base is composed of major corporations that are most often headquartered out of state. As a result, **the state has an extremely limited cadre of successful entrepreneurs** who can serve as role models and mentors to West Virginia start-up and emerging companies. West Virginia's entrepreneurial infrastructure is expanding; but, most of the organizations

Entrepreneurs...

- **Commercialize innovative products** and services that improve quality of life
- **Create dynamic and flexible new industries and firms** to replace those that are no longer viable in a rapidly changing global economy
- **Provide most new employment opportunities**
- **Create wealth** that is reinvested in new enterprises and, through demonstrated philanthropic activity, in communities

¹ A Governor's Guide to Strengthening State Entrepreneurship Policy, National Governors Association, 1999.

have limited resources and lack the critical mass to adequately serve the state's start-up and emerging technology companies.

Action One: Support and expand TechConnectWV

Over the years, a number of agendas have been advanced for growing WV's TBED and various organizations have pursued TBED initiatives. But, **West Virginia has lacked a focal point for TBED**, a single organization that could bring together the various public and private entities in support of a common agenda. **Development of this Blueprint is a first step** in pursuing a focused, coordinated, and comprehensive statewide plan for TBED in West Virginia. **An organization is needed to bring together key stakeholders and guide implementation** of this Blueprint.

Recognizing this, West Virginia's public and private TBED leaders came together to form the West Virginia Coalition for Technology-Based Economic Development, Inc., now doing business as **TechConnectWV**. The mission of TechConnectWV is to advance TBED in West Virginia, from research to commercialization, by primarily serving as facilitators to increase activity and support for program initiatives and policies that grow the West Virginia economy through new technology-based industry, businesses, and jobs.

Specifically, TechConnectWV will be responsible for the following:

- **Analyzing and disseminating information** on technology-based research, development, education, and commercialization capabilities found within West Virginia
- **Proposing policies, practices, and programs** that will support creation and growth of technology-based businesses in the state
- **Facilitating collaborations** among the federal, state, and private R&D and technology organizations in the state to promote commercialization
- **Providing a forum to foster dialogue** between educational institutions and the private sector to ensure that West Virginia has the talent to support the growth of TBED
- **Fostering a culture** that support innovation and entrepreneurship
- **Communicating** both the importance of TBED to the state's economy and the benefits that will accrue to its citizens
- **Creating a one-stop shop** for technology entrepreneurs seeking assistance with capital, talent, and other resources
- **Supporting the West Virginia Development Office** in the TBED arena

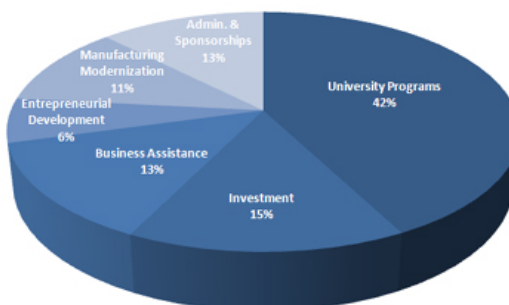
Resources Required: Propose State of West Virginia provides annual funding of \$250,000. It is anticipated that additional funds will be obtained from private industry and foundations.

Kansas Technology Enterprise Corporation

The Kansas Technology Enterprise Corporation (KTEC) is a private-public partnership established by the State of Kansas to promote TBED.

Kansas state law assigns KTEC the responsibility to lead TBED initiatives for the state. The state funds KTEC's efforts annually and distributed \$12.7 million to KTEC for FY 2008.

KTEC FY2008 Expenditures



Priority: Critical

Time Frame: Immediate

Recommended Lead Organization: TechConnectWV

Intended Outcomes:

- Continue to **grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation, with a target of \$360 million by 2015
- **Increase R&D funding in platform areas** in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Action Two: Support and expand a statewide network providing comprehensive commercialization services and support to technology entrepreneurs and early-stage start-up companies

West Virginia has few organizations that provide support to entrepreneurs and early-stage companies, some of which target technology entrepreneurs and others that provide support to all entrepreneurs. Most of West Virginia's entrepreneurial support organizations, however, are small, have limited resources, and have limited capacity to assist technology entrepreneurs.

WVHTC Foundation's **INNOVA** program, for example, is a **commercialization assistance program** launched in 2002 that **targets technology-based companies**. INNOVA provides entrepreneurial training, provides start-up and business support services, and makes seed and early-stage investments (Figures 4 and 5).

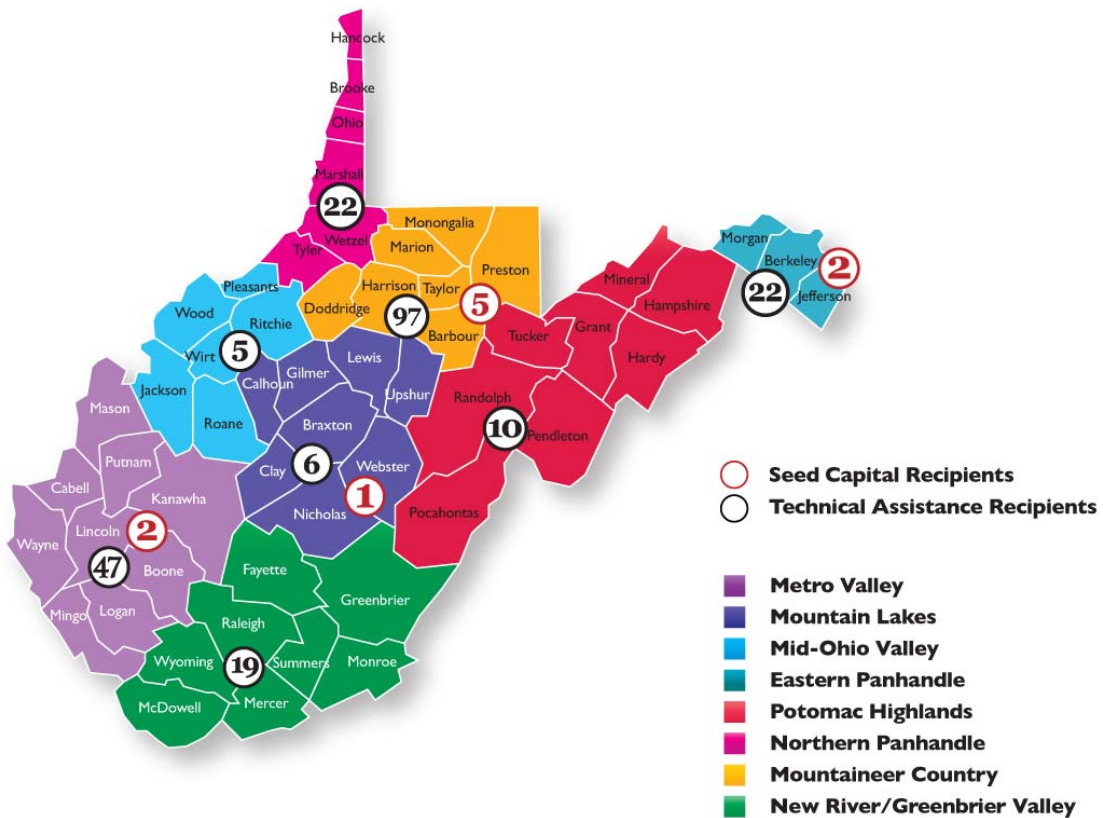
A Few INNOVA Highlights to Date

- **Contacted by more than 300 companies** and entrepreneurs seeking assistance
- **Placed direct investments into 10 West Virginia companies** (some have raised significant additional capital since this "seed" funding)
- **Established as a primary source** of seed capital in West Virginia
- **Raised approximately \$1.5 million** in its seed-stage capital fund
- **Implemented a proven process** for evaluating and assisting West Virginia companies
- **Created deal flow** for the West Virginia venture capital community

Figure 4. Efforts of the INNOVA Commercialization Group



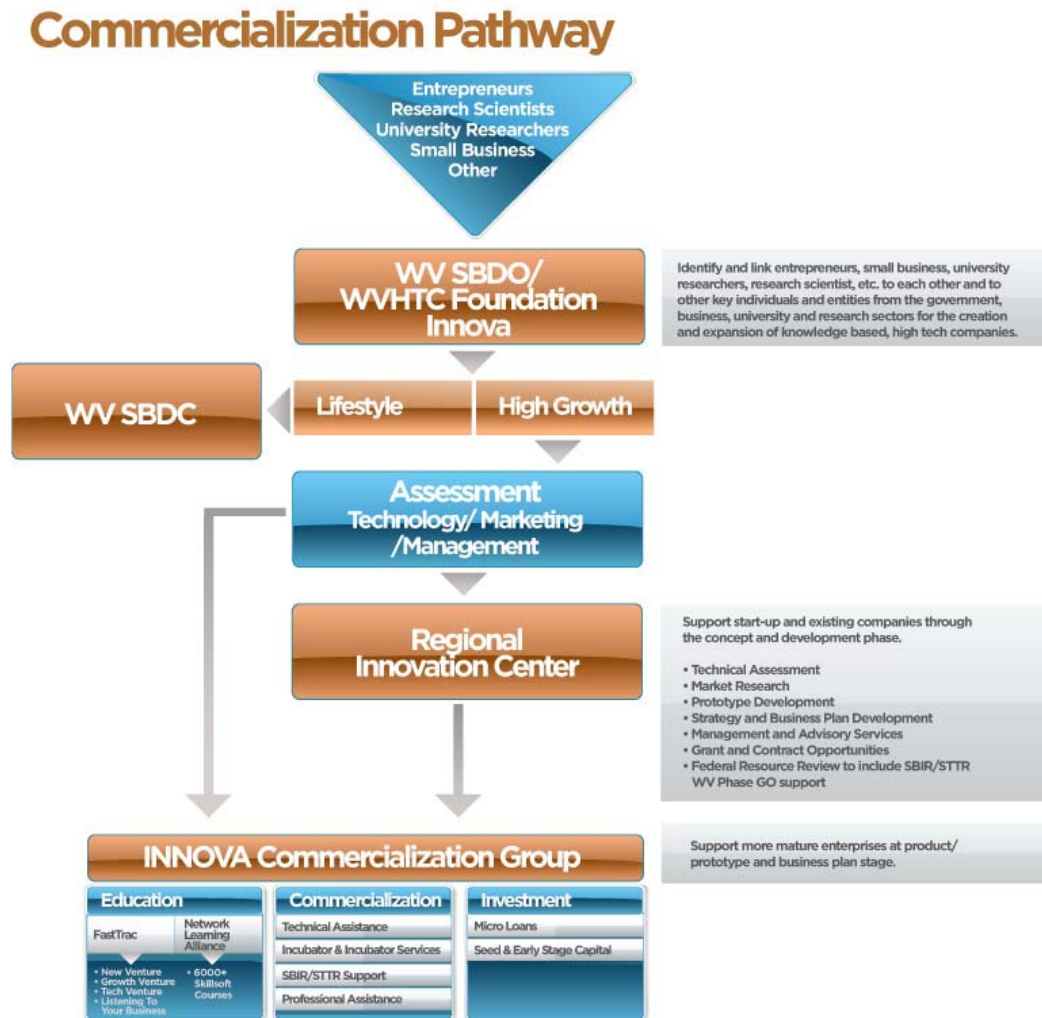
Figure 5. INNOVA Clients by Region, April 2003 to December 2007



The **West Virginia Small Business Development Center (WVSBDC)**, a division of WVDO, provides assistance to small businesses and emerging entrepreneurs.

Recently, **INNOVA and WVSBDC developed a model and process**, shown in Figure 6, that will allow them to act as a portal for entrepreneurial and small business commercialization activity within the state. They would provide comprehensive, in-depth support to technology entrepreneurs.

Figure 6. INNOVA and WWSBDC Process for Entrepreneurial and Small Business Commercialization Assistance and Activity



As envisioned, the network would do the following:

- Provide organizational documentation, preliminary technology and market assessments, and start-up strategic planning
- Provide management and in-depth business planning support to technology entrepreneurs and start-up companies
- Link companies to mentors
- Conduct due diligence
- Provide consultation and ongoing entrepreneurial education
- Prepare companies to seek venture financing
- Link companies to sources of capital
- Support development of angel networks.

Future endeavors will include extending this pathway to include regional entrepreneurial organizations, rural development agencies, and underserved colleges and universities in the state (for example, Glenville State College and Concord University). **It is proposed**

that West Virginia support and expand this effort to form a statewide technology commercialization network.

Resources Required: It is estimated that \$500,000 would be required on an annual basis to support the network.

Priority: Critical

Time Frame: Immediate

Recommended Lead Organizations: INNOVA and WWSBDC

Intended Outcomes:

- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Action Three: Encourage the state's universities to continue to increase support for technology transfer and commercialization

Commercialization of R&D has not traditionally been a high priority among universities. However, during the past decade, many of the **nation's leading research universities** have restructured and **placed increased emphasis on commercialization** activities — connecting their R&D capabilities to the commercialization strengths and opportunities of industry. This remains more an art than a validated scientific approach; but, as the universities have gained more experience, knowledge, and results, it has become clear that **R&D will not “magically” pass over the transom from university to business.**

Both WVU and MU have increased support for technology transfer in recent years, and Shepherd University recently created a Research Corporation. However, resources dedicated to technology transfer and commercialization remain extremely limited at West Virginia's colleges and universities. The leadership of **West Virginia's research universities should be encouraged to commit to** promoting an entrepreneurial environment for faculty and providing the resources that will allow greater **technology transfer and commercialization** to occur.

Resources Required: Included in the budget of TechConnectWV

Priority: High

Time Frame: Immediate

Recommended Lead Organization: TechConnectWV

Intended Outcomes:

- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Action Four: Create a university-industry matching grant program

The most common and, in Battelle's experience, **one of the most effective means of fostering greater university and industry interaction is to provide matching grants for research partnerships.** Such programs help build relationships between academic researchers and companies and provide support for activities that may lead to investments of private capital and commercialization of new technologies.

As of 2008, **28 states have matching grant programs** that provide an incentive for firms to support research projects at local research institutions.² Most of these programs solicit applications on a competitive basis and make awards to projects that are both technically sound and likely to have a positive economic development impact. All of the programs require that the **company shares the cost** of the research project, which is conducted by faculty and students on behalf of the company. The level of cost share can vary. Some programs vary the matching requirement based on the size of the company.

It is proposed that West Virginia provide grants of up to \$100,000 that would be matched with an equal contribution from West Virginia companies to fund research conducted by faculty at West Virginia colleges and universities. The program would be available to all universities in West Virginia, which would allow the state's less research-intensive schools, such as Shepherd, Wheeling Jesuit, West Virginia State, Concord, and others to participate.

Resources Required: It is proposed that this program be initiated with \$500,000 in annual funding.

Priority: Medium

Time Frame: Mid-term

Recommended Lead Organizations: WVHEPC and WVDO

Intended Outcomes:

- **Increase R&D funding** in platform areas in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Maryland Industrial Partnerships Program

The Maryland Industrial Partnerships Program (MIPS) has a proven track record of working with industry to accelerate the commercialization of technology by **funding collaborative university-industry product R&D projects.** Originally started as an outreach effort by the University of Maryland College Park Engineering School, MIPS has grown to encompass all campuses of the University of Maryland System across all fields. MIPS projects are **conducted by university faculty and graduate students** in conjunction with company researchers. With **more than 800 project awards worth more than \$140 million since 1987,** MIPS projects have generated solid results. MIPS-supported products have **generated more than \$14.4 billion in sales,** added jobs to Maryland, and exported state-of-the-art Maryland-originated technology into the global marketplace.

² *Technology, Talent and Capital: State Bioscience Initiatives 2008*, www.bio.org/local.

Action Five: Publicize and celebrate TBED successes

As discussed previously, West Virginia does not have a large base of technology companies or a strong tradition of entrepreneurship. The state needs to **change the culture** to encourage West Virginians to at least support and at most pursue technological and entrepreneurial endeavors. The state needs to provide and **showcase its role models**. One key ingredient will be to get the region's citizens to understand the importance of technology and entrepreneurship and the opportunities it offers for developing the state's economy. Successful technology entrepreneurs, who can become important role models, need to be rewarded and encouraged. It is proposed that a **Technology Entrepreneur of the Year Award** be established and that entrepreneurial successes be publicized. Coverage by television stations and newspapers of human interest stories about technology entrepreneurs in the region should be promoted.

West Virginia already has a successful **Statewide Student Business Plan** competition, which seeks to identify student businesses that have the potential to be viable West Virginia start-up companies. The competition makes awards in two categories, one of which is high technology. This program **should be maintained and expanded** to include a business plan competition among West Virginia entrepreneurs who are not students.

It is also important to recognize the accomplishments of the state's technology industry and its contributions to the state economy. One way to do this is by holding an **annual meeting** of legislators, other government and economic development officials, and technology business leaders to discuss issues of concern to the region's technology industry clusters and how such concerns could be addressed. Such an annual event also will provide the opportunity for CEOs of successful technology companies to share information on how they were able to launch, finance, and grow their companies. The summit would allow technology company executives to interact with the region's political leadership, thereby building understanding among the leadership of both the technology assets of the region and the needs of technology companies. At the meeting, an update should be presented on the **progress made in implementing this TBED Blueprint**.

It is recommended that TechConnectWV work with WVDO to hold an **annual Governor's Technology Summit**. Recipients of the Technology Entrepreneur of the Year award and the statewide business plan competition could be recognized at the summit.

Resources Required: Included in the budget of TechConnectWV

Priority: Medium

Time Frame: Short-term

Recommended Lead Organizations: TechConnectWV and WVDO

Intended Outcomes:

- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020

STRATEGY
TWO

Grow West Virginia's technology clusters by building R&D and commercialization capacity around the targeted technology platforms

Rationale: To compete in today's economy, a state must have sources of innovation and technology. **A strong presence of research institutions**, including universities, academic medical centers, national laboratories, and nonprofit research institutions, with recognized areas of research excellence, **is critical for states seeking to grow technology-based economies.**

West Virginia has a small but fortunately growing academic R&D base. **West Virginia R&D spending ranks 45th among the 50 states** in academic R&D expenditures. To capitalize on its strengths and build its technology economy, **West Virginia must become nationally competitive** in building its higher education infrastructure.

As identified in Phase I of this study, West Virginia has significant research strengths in selected areas of energy, advanced materials, chemicals, biomedical and identification, security, and sensing technology research. But, even where West Virginia has strengths, the number of faculty and centers is small.

West Virginia will need to do more to build world-class centers, recruit star faculty and researchers, support emerging future stars, and provide facilities and equipment they need to compete successfully for public and private R&D support. At the same time that West Virginia is establishing its research credentials, the state should also further develop its infrastructure to support the commercialization of research findings.

State Research Institutions...

- ✓ Generate new knowledge and technology, forming the basis for creating new firms and introducing new products in the marketplace
- ✓ Both attract and produce highly trained personnel who provide the skilled workforce needed by technology companies
- ✓ Together with a technically trained workforce, attract technology companies to locate near centers of excellence

Action Six: Continue to provide support for the West Virginia Research Trust Fund, which supports both faculty recruitment and development of research infrastructure

West Virginia needs to continue to build its academic R&D base to grow its technology economy. Universities should continue to be encouraged to **recruit eminent scholars who are also entrepreneurs** and have experience in commercializing research.

The base of faculty in key strategic platform areas needs to be both broader and deeper, and platform steering committees should be involved in recommending areas of focus in need of faculty reinforcement and support. Final decisions on faculty hiring must, of course, remain within the universities themselves; but, Battelle highly advises key stakeholder engagement in scoping the areas of science and technology focus for potential new faculty recruits and their associated research teams.

The State of West Virginia created a **Research Trust Fund** with an initial appropriation of **\$50 million** in March 2008 (Senate Bill No. 287). The funds are available to WVU and MU to **recruit research faculty and build research infrastructure** to support the development of specific technology areas. The universities must raise 1:1 matching funds to access the fund. The West Virginia School of Osteopathic Medicine and other West Virginia colleges and universities can receive matching grants that are financed with the interest on the Research Trust Fund.

It is proposed that West Virginia **grow the West Virginia Research Trust Fund to \$180 million by 2015**, enabling the Trust to support 40 to 50 faculty positions focused on the state's strategic technology platforms.

Resources Required: Annual investments to achieve \$180 million by 2015

Priority: Critical

Time Frame: Immediate

Recommended Lead Organization: WVHEPC

Intended Outcomes:

- Continue to **grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation, with a target of \$360 million by 2015
- **Increase R&D funding** in platform areas in all sectors (academia, nonprofits, and industry)
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Economic Impact of Kentucky's Research Challenge Trust Fund

- Between 1997 and 2006, **endowments** at Kentucky's research universities **grew** from \$454 million to \$1.466 billion, or by **223%**
- **Federal R&D** investments at the research universities **increased** from \$76 million to \$210 million annually, or by **178%**
- **Corporate R&D** investments **increased** from \$105 million to \$310 million, or by **194%**
- **The University of Kentucky** alone has created a research park, business incubators, and **44 start-up companies** with more than 870 employees and **average salaries of \$61,000**
- **University of Louisville** research has been responsible for **18 start-up companies**
- Each \$100,000 research grant has had a **regional economic impact** estimated at \$180,000 to \$230,000, or **1.8 to 2.3 times** the grant amount

Action Seven: Establish an Innovation Institute Program focused on the technology platforms that would fund people, equipment, and facilities and create proof-of-concept funds to support cluster development projects

Traditionally, university research was conducted by individual investigators in discipline-focused departments. However, over the past 20 years **an increasing share of university research has been channeled through research centers or institutes.**³

An institute generally includes a number of affiliated faculty members; a director and management; graduate students; dedicated laboratory facilities; allied educational programs; and, in the case of university-industry institutes, industrial partners. **More and more, such institutes also include commercialization activities.**

³ Friedman, R.S., and Friedman, R.C. (1985). Organized research units in academe revisited. In B.W. Mar, W.T. Newell, and B.O. Saxberg (eds.), *Managing high technology*. New York: Elsevier Science Publishers.

Industry-university research institutes can be organized in several ways. At the most basic level, they can be as follows:

- Part of the university
- Independent but closely affiliated with a university
- Completely independent (nonprofit organization).

There are advantages and disadvantages to each approach. Institutes that are part of a university have to make sure that they understand and are responsive to industry needs. Likewise, independent nonprofits must understand and appreciate the academic climate in which university researchers must operate.

A successful institute will be able to bridge the gap between the two very different cultures — academia and business.

It is proposed that West Virginia create a program that would fund Innovation Institutes focused on the identified core technology platforms.

These Institutes would be **multi-institutional and multidisciplinary and would involve industry**. The Institutes would be a compilation of resources, talent, and facilities that, as much as possible, already exist within the state. They would not necessarily be created from a blank page and would not necessarily include new facilities unless required. The Institutes would be given initial seed funding by the state, which could be used for both capital and operating expenses. The funding should be used to support graduate students and technicians, to provide matches for federal grants, and to provide funds for facilities and equipment. **Initial state funding would be used to position the Institutes to leverage additional federal and private-sector support.**

Similar approaches have proven to be **highly successful in other states** (for example, the Wright Centers in Ohio and Signature Research Centers in Oregon).

Each Institute would be different, depending on the maturity of the sector and current needs. Each would be required to have a commercialization component.

Funding could be awarded by means of a Request for Proposal, or RFP; alternatively, a decision could be made to establish an institute in each of the four technology platform areas (with proposals crafted by key members of each platform committee). The Institutes need not be limited to being based at a

Oregon's Signature Research Centers

- Developed and funded by the **State of Oregon**
- Meant to **foster collaborations** among multiple universities, Oregon companies, and the Pacific Northwest National Laboratory
- The first, the **Oregon Nanosciences and Microtechnologies Institute**, created in 2003, received **\$8 million in operating funds and \$20 million in capital** from the Legislature
- Participating research institutions have performed the following:
 - ✓ Achieved a **tenfold leverage of federal and private funding** by the state investment
 - ✓ Attracted **renowned faculty**
 - ✓ Built a **national reputation**
 - ✓ Developed **new market-focused technologies** that are becoming the seeds of new Oregon investments

Nanotechnology Institute in Philadelphia

- **Collaboration** led by Ben Franklin Technology Partners of Southeastern Pennsylvania, Drexel University, and the University of Pennsylvania
- Focused on the **transfer of nanotechnology** from universities to industry partners
- Focused on **rapid application and commercialization** of nanotechnology to stimulate economic growth
- Some **highlights** to date:
 - ✓ Helped produce over **80 intellectual property assets**
 - ✓ Facilitated **seven technology licenses**
 - ✓ Created or assisted **13 young companies**
 - ✓ Attracted more than **\$172 million in public and private investment** to the region

university, although **university involvement would be required**. The involvement of the state's nonresearch universities should also be encouraged.

University of Colorado Bioscience Discovery Evaluation Grant Program

- Essentially a state bioscience **proof-of-concept program** for development-oriented research to accelerate commercialization
- Provides **\$50,000 to \$200,000 per award** from the State of Colorado to be matched 1:1 by the University of Colorado
- In **2006** program, **13 projects** funded for **\$2.13 million**
- **2006** program **results** as of August 2008:
 - ✓ **Three equity investments** in Colorado start-up companies **totaling over \$23 million**
 - ✓ **Another term sheet** for venture deal pending
 - ✓ Start-up companies have secured **SBIR/STTR** grants totaling **over \$1 million**
 - ✓ **Advanced stage commercialization discussions** (term sheet) are underway with **six other groups** interested in forming Colorado start-up companies

Major consideration should also be given to creating PoC funds within each Institute to support the activities necessary to determine the commercial potential of entrepreneurial ventures and research findings. Activities that could be funded would include **prototype development, testing and validation, market assessments, and IP protection**. These are all activities that must be undertaken prior to the formation of a business. Without active programs in this area to prove the initial technological and commercial viability of a concept, it is virtually impossible to raise funding from the private risk capital and investment community.

As recommended here, this would be an Institute-specific and thus platform-specific program. However, since the Innovation Institutes may not be funded for some time, **consideration should be given to financing PoC funds independent of the Institutes**.

Most PoC programs provide grants in the range of \$50,000 to \$100,000;

grants of at least \$25,000 to \$50,000 are recommended here. Such an effort could be started with an initial budget of \$500,000 (\$250,000 in each Institute) that could be increased over time.

Alternatively, a more general statewide PoC fund could be created, although this should still be tied to the state's technology strengths.

It is proposed that the WVHEPC and WVDO, with input from TechConnectWV and the platform steering committees, define the parameters of the institutes program and develop criteria and a process for selecting institutes. Consideration should be given to awarding program grants for organizational development and implementation for the initial two institutes.

Resources Required: Initial program grants of \$250,000 per Institute are proposed for organizational development and implementation. Approximately \$25 million will be required over a multiyear period for each Institute.

The PoC Fund could be started with \$500,000 (\$250,000 for each Institute) and then scaled up to \$1 million to \$2 million over time based on demand.

Priority: High

Time Frame: Organizational development

University of Louisville Proof of Concept Grant Program

- **Provides pre-seed, proof of concept funding** for developed technologies that show commercial potential
- Special consideration given to projects in **disciplines** in which there is a **greater opportunity for later funding**
- Special consideration given to **platform technologies** that could form the solid basis of a start-up company

For **FY 2009**, a total of **\$50,000** will be awarded for either a single application or shared application **per quarter**

and planning grants should be initiated in the short-term; Institute awards would occur in the mid-term time frame; PoC funds should be created in the short-term.

Recommended Lead Organizations: WVHEPC, WVDO, and TechConnectWV

Intended Outcomes:

- Continue to **grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation, with a target of \$360 million by 2015
- **Increase R&D funding** in platform areas in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Action Eight: Form technical networks around each of the platform areas

This action is also described under each set of platform strategies and actions (see Actions E1.1 and B1.1 in those reports).

West Virginia has identified four strategic technology areas that appear to offer the greatest potential for growing the state's technology-based economy. To realize the economic development potential of these platform areas, **the university and industry players should get to know one another and begin to find ways to collaborate.** One mechanism that can be used to foster such relationships is the development of technical networks composed of industry, academia, and resource providers.

Networks are not simply a means for linking higher education and industry; they are also a means to link business-to-business and faculty-to-faculty. **Collaboration is a key element** for ensuring world-class research and world-class industry. Networks can play many roles, from simply helping inform and educate, to providing technical and problem-solving assistance, to providing product innovation and process improvement opportunities.

West Virginia already has organizations in place that could, and in some ways already do, fulfill this function, such as the Chemical Alliance Zone and the Biometrics Initiative. In fact, **platform steering committees have already been formed in two of the technology areas**, with the Biometrics Initiative taking the lead in the biometrics area.

Additional alliances should be formed to address the other platform technology areas, with staff support provided by TechConnectWV. As done with the existing committees, these

Common Activities for Networks

- **Transferring resources and knowledge** among intellectual property and capabilities members
- **Developing inventories of capabilities**
- **Conducting seminars or workshops** sponsored by partners
- **Creating Web sites** to facilitate sharing of information
- **Developing joint opportunities**
- **Developing joint contributions** to new

would bring together academic and industry players to provide input on the actions that should be undertaken to grow each platform area.

Resources Required: Funding to provide staff support could be included in the overall TechConnectWV budget. Alternatively, \$35,000 per year is recommended for a part-time position in support of committee administrative and organizational functions and for meeting support.

Priority: High

Time Frame: Short- to mid-term

Recommended Lead Organization: TechConnectWV

Intended Outcomes:

- Continue to **grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation, with a target of \$360 million by 2015
- **Increase R&D funding** in platform areas in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

STRATEGY THREE

Ensure access to capital at all stages of firm development

Rationale: Access to early-stage risk capital is a critical factor in building a technology-driven economy. One characteristic shared by leading technology regions is that they are home to a venture capital community committed to early-stage local investment. These regions also have networks of successful entrepreneurs who act as angel investors, willing to invest in very early-stage start-up companies. Building a base of angel investors and venture capital funds able and willing to invest in emerging companies is a challenge for many regions.

It is also **critical to have financing available for each stage of development** from early-stage, PoC, and prototype development to venture financing. Leading technology regions typically have access to commercialization funding, pre-seed and seed funding, and venture financing.

West Virginia lacks a fully developed risk capital market able to meet the needs of technology firms at various stages of their product life cycle, particularly at the very early commercialization and pre-seed/seed stages. Although the state has helped increase the availability of venture capital in recent years, West Virginia companies received only \$14 million in venture capital investments between 1999 and 2006. By comparison, venture capitalists invested \$29.4 billion in 3,813 deals in the United States in 2007 alone. In fact, in the 2008 State Technology and Science Index produced by the Milken Institute, **West Virginia ranks 48th in the Risk Capital and Entrepreneurial Infrastructure Composite Index.**

However, the issue is **not only capital availability.** Investors have indicated that, to date, West Virginia has not had a rich pipeline of companies that have reached the investment-

grade stage. The proposed statewide entrepreneurial support network will increase deal flow by helping more entrepreneurs and start-ups reach the point at which they are investment grade. West Virginia's technology entrepreneurs and **start-ups will not succeed if early-stage pre-seed and seed capital is not available**. And even successful start-up companies will not grow in West Virginia if they cannot access venture and debt financing.

Action Nine: Provide funds to match SBIR and STTR Phase I awards received by West Virginia companies

The **federal Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) program** is an excellent source of very early-stage capital for start-up companies. Through this program, 11 federal agencies award more than \$2 billion to small businesses to develop new products and services based on new technologies.

The program is very competitive, so firms that receive SBIR awards have been through a rigorous review project and the technologies they are developing have been judged to have merit and commercial potential. The **WVSBDC provides SBIR application assistance** to companies, including \$5,000 grants that can be used to offset the cost. In addition, thanks to support generously provided by the Claude Worthington Benedum Foundation, **INNOVA provides additional funding for technical and professional assistance** in preparing the strongest application possible.

It is recommended that West Virginia provide matching funds (\$100,000) to those companies that have successfully won SBIR awards **for Phase I SBIR activities** and that total funding be increased to \$700,000 in FY 2010 to match the amount awarded in 2008. These funds will provide an incentive for more small businesses and universities to compete for and win SBIR/STTR awards. They will also help increase the number of Phase I awards won by small businesses in West Virginia and the number of small businesses and universities competing for and winning Phase II awards.

Resources Required: \$700,000 in FY 2010, to be increased as the number of SBIR awardees increases

Priority: Critical

Time Frame: Immediate

Recommended Lead Organizations: WVSBDC and INNOVA

Intended Outcomes:

- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Action Ten: Increase funding for INNOVA's seed and early-stage investment fund

The WVHTF Consortium created INNOVA in 2002 to provide support to technology entrepreneurs and start-up companies. As part of its mission, **INNOVA can make equity or near-equity investments of \$50,000 to \$150,000** in early-stage technology companies.

Since 2003, INNOVA has invested \$1.2 million in 10 companies. INNOVA now has an additional approximately \$500,000 available for investment.

Currently, seed-stage investments are dictated by available capital, with the number of market-ready companies outstripping the funding available for successful introduction.

As West Virginia expands the capacity of its entrepreneurial support networks, demand for pre-seed funding will continue to increase. **It is proposed that INNOVA's fund be recapitalized by the State of West Virginia.** This will help increase the number of seed-stage investments in the State of West Virginia and thus the number of start-up companies engaged in technology commercialization.

Resources Required: \$5 million annually, with a minimum of \$5,000 and maximum of \$250,000 per award

Priority: Critical

Time Frame: Immediate

Recommended Lead Organization: INNOVA

Intended Outcomes:

- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Maryland Technology Transfer Fund

- ✓ Administered by the **Maryland Technology Development Corporation**
- ✓ **87 companies** have received funding and completed their projects
- ✓ Total investment slightly over **\$5 million**
- ✓ These companies have received **downstream funding exceeding \$168 million** from angel and venture investors, federal awards, and other sources

Action Eleven: Use tax credits to make capital available to early-stage technology companies

States are increasingly using tax incentives to encourage private investment in early-stage companies. **Nineteen states now offer tax credits to angel investors** who invest in technology companies. **In 2005, West Virginia created the high-growth business investment tax credit** that provided a tax credit to taxpayers who made an investment in a qualified R&D company headquartered in West Virginia. The credit was equal to 50% of the total investment with a maximum of \$50,000 in any year. The credit was capped at \$1 million annually. This tax credit ended in June 2008.

West Virginia should encourage angel investment in technology companies by organizing angel capital networks and continuing the high-growth business investment tax credit. In fact, this has begun with the **formation of the West Virginia Angel Network.**

To help the network and further encourage investment, **it is proposed that the tax credit be reauthorized and increased to \$2 million annually.** To ensure that the tax credit is used most effectively, efforts should be undertaken to more formally align all facets of the funding chain, from seed stage through angel to venture capital. In addition, best practices of angel networks, as practiced across the country, should be studied and instituted as processes in West Virginia.

Resources Required: Cap of \$2 million annually for the High-Growth Business Investment Tax

Priority: High

Time Frame: Immediate

Recommended Lead Organization: West Virginia Angel Network

R&D Tax Credits Boost Technology Start-Ups in Arkansas

- About **\$3 million** in tax credits given to **20 start-ups** over past few years
- Tax credit up to **33% of R&D expenditures**
- BioBased Technologies has received about \$200,000 in credits and claims a **doubling of its R&D staff** as a result
- At the 20 companies that have received the credits, about **190 employees** earn an average of **\$30 per hour**

Intended Outcomes:

- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Action Twelve: Attract venture fund investments in West Virginia technology companies

As West Virginia generates more successful technology-based start-up companies, it will become increasingly important to provide **venture capital financing for start-up company growth**. It will be important for the state to have access to both locally based venture-capital firms and out-of-state venture investments.

West Virginia has taken steps previously to provide incentives to attract venture capital to the state. **The West Virginia Jobs Investment Trust (JIT)**, a public venture-capital fund, was created in 1992. In addition to investing directly in companies, **JIT invested \$4 million in each of the following private venture funds** that agreed to have locations in West Virginia and to make a good faith effort to invest in West Virginia companies:

- Adena Ventures
- Anthem Capital
- Mountaineer Capital LP
- PA Early Stage Partners
- Toucan Capital
- Walker Ventures.

Of these, **only Mountaineer Capital is headquartered in West Virginia**. To date, only Mountaineer Capital and Adena Ventures have invested in West Virginia companies.

In some ways, **West Virginia may have been ahead of its time**. When these investments were made, the state's technology economy may not have been well developed enough to generate deals that were ready for venture investments. But, the concept of creating a fund that could invest in other venture funds — a **“fund of funds”** — is one that has **gained traction in recent years** in a number of states. These funds of funds invest in other privately managed venture funds that meet certain criteria, including a willingness to invest in the state. They can also require that a certain percentage of the fund be invested in venture capital funds that target a particular technology area or a particular stage of investment, such as seed and early stage.

A fund of funds should be created in West Virginia. Several approaches could be pursued. A fund of funds could be created along the lines of the Indiana Future Fund described in the text box. Another approach, which has been used in Oklahoma and Utah, is to use contingent tax credits to encourage investment in a fund of funds. Over the long term, West Virginia will need to ensure the availability of venture capital.

Indiana Future Fund

- **\$73 million fund** created in 2003
- **Capitalized with investments** by state pension fund, state teachers' retirement fund, Eli Lilly, Anthem Blue Cross/Blue Shield, and endowments of four universities
- Required that:
 - ✓ 60% of investments to **Indiana-focused** or -based venture funds
 - ✓ 70% of funds that invest at **early stage**
 - ✓ 60% of investments in **Indiana companies**
 - ✓ 60% of investments targeted to **specific technology platforms**
- Invested in six local and national funds

It is proposed that a working group be formed to review the experience of the JIT, to assess the demand for venture capital, and to explore options including the creation of a fund of funds to meet West Virginia's venture capital needs.

Resources Required: Included in budget of TechConnectWV

Priority: Medium

Time Frame: Mid-term

Recommended Lead Organization: TechconnectWV

Intended Outcomes:

- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

STRATEGY FOUR

Promote a pro-active business climate with incentives that will grow, attract and retain technology-based companies

Rationale: To encourage companies to relocate or grow within their borders, states and regions have traditionally used tax and economic incentives to overcome perceived quality-of-life disadvantages and/or the negative impacts of tax codes. However, **many traditional economic incentive programs are not well adapted to technology companies.** Until fairly recently, most such programs were aimed at subsidizing capital-intensive, high-employment manufacturers — the recruitment targets of a half-century ago. Technology companies whose assets are more intellectual than physical rarely qualified for loan programs that required hard collateral or for job-creation credits that favored large manufacturing workforces.

Key business climate factors for building a technology-driven state economy include the following:

- **Costs of doing business**, including tax structure, regulatory climate, predictability and stability of public sector policy, and access to and responsiveness of economic development incentives
- **Technology infrastructure**, including computing and communications infrastructure, physical infrastructure (such as research parks, incubators and accelerators, wet labs, multitenant space, and pilot plants), and access to specialized research facilities
- **High quality of life**, including low-cost housing, recreation, arts and culture, outdoor activities, and downtown amenities (this area is becoming increasingly more important for attracting and retaining managerial and technical talent)
- **General business leadership**, including experienced, dynamic, and active leaders across all sectors who at least support and at best are engaged in the innovation economy.

West Virginia has made progress in amending some of the state's tax incentive programs to make them more useful to technology-related companies. The **state will need to continue to examine ways in which its policies and programs impact technology-based companies** and invest in its technology infrastructure.

Action Thirteen: Invest in technology infrastructure, including research parks, incubators, and laboratories

Increasingly, **states and regions are focusing on the physical environment in which research and technology-based industries grow.** Technology-related firms tend to cluster — and thrive — close to each other and to other research institutions, including university and academic medical centers. Research parks, in particular, are an important component of the innovation infrastructure needed to support today's knowledge economy, much as roads, bridges, and rail were critical to yesterday's industrial economy. Research parks are real-estate developments in which land and buildings are used to house public and private R&D facilities, high-technology and science-based companies, and support services. By providing a location where researchers and companies operate in close

University Research Parks...

- Employ more than **300,000 employees** in North America
- **Generate 2.57 indirect jobs** in the economy on average
- Provide a total impact of more than **750,000 jobs**
- **Spur homegrown business start-ups**, retention, and expansion
- Exhibit a strong ability to **attract and retain talent**

proximity, **research parks create an environment that fosters collaboration and innovation** and promotes the development, transfer, and commercialization of technology.

Battelle Technology Partnership Practice and the Association of University Research Parks, in a survey of 134 parks in the United States and Canada, found that **university research parks are strong sources of entrepreneurship, talent, and economic competitiveness⁴** (see text box at left).

Important success factors included the commitment of university leadership and the local economic development community.

Chicago-based Grant Thornton in a study released to the U.S. Department of Commerce Economic Development Administration found that **backing business incubators that support entrepreneurs and start-up companies is a more effective strategy in creating jobs** than investing in public works and projects⁵ (see text box at right).

West Virginia has begun to invest in technology infrastructure; but, these investments have been limited largely to university buildings. WVU recently opened the Blanchette Rockefeller Neurosciences Institute building and an addition to the WVU Engineering Building. MU recently constructed the Robert C. Byrd Biotechnology Science Center, which houses the University's multidisciplinary research programs, and is building a Biotech Incubator with the Huntington Area Development Council.

The Chemical Alliance Zone maintains the **Biotechnology and Allied Sciences Incubation**

Incubators Create More Jobs for Less Investment

- Incubators...
 - **Create 46.3 to 69.4 local jobs** per every \$10,000 invested
 - **Cost \$144 to \$216 per job**
- In comparison, **roads and transportation** projects...
 - **Create 4.4 to 7.8 jobs** for every \$10,000 invested
 - **Cost more than \$1,200 per job**
- In comparison, **commercial structures**...
 - **Create 9.6 to 13.4 jobs** for every \$10,000 invested
 - **Cost \$744 to \$1,008 per job**

⁴ *Characteristics and Trends in North American Research Parks: 21st Century Directions*, prepared by Battelle Technology Partnership Practice in cooperation with the Association of University Research Parks, October 2007.

⁵ *Construction Grants Program Impact Assessment Report*, prepared by Grant Thornton for the U.S. Department of Commerce, Economic Development Administration, September 30, 2008.

Center at the South Charleston Technology Park, where Progenesis Technologies LLC, a biotech start-up from MU, has its main laboratories.

However, **additional laboratory facilities, incubators, and research parks** that can house industry and university researchers as well as entrepreneurs and start-up firms **will be needed to advance the state's core technology platforms.**

WVU has established the **WVU Research Park**; but, efforts to finance the first building that would provide both incubator space and space for technology companies have stalled. The **South Charleston Technology Park** owned by The Dow Chemical Company has great potential for development into a multitenant technology park; but, significant investments will be required to fully develop the site.

It is proposed that a long-term strategic plan be developed that would assess, identify, and prioritize West Virginia's technology infrastructure requirements. Part of this effort would involve identifying resource needs and proposing revenue sources that could be tapped. A possible outcome from this analysis would be a proposal to create some type of technology infrastructure fund that could be tapped to finance infrastructure improvement projects.

Resources Required: To be determined

Priority: High

Time Frame: Short- to mid-term

Recommended Lead Organizations: WVDO, Universities, WVHEPC, TechConnectWV

Intended Outcomes:

- **Continue to grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation, with a target of \$360 million by 2015
- **Increase R&D funding in platform areas** in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Action Fourteen: Maintain the state's refundable R&D tax credit and Economic Opportunity Tax Credit for specified taxpayers

In 2009, West Virginia enacted an **Economic Opportunity Tax Credit** that is available to taxpayers engaged in manufacturing, information processing, qualified R&D, and several other categories. Previously, the tax credit was available only to companies that created a threshold number of jobs; but, changes made the credit **more available to small technology companies**. With those changes, the new credit is available to firms that do not meet the job threshold but do provide the following:

- Jobs that pay at least \$32,000 annually
- Health insurance
- A full-time permanent position.

West Virginia also has a **Strategic Research and Development Tax Credit** that can be refunded up to \$100,000 if the taxpayer has no tax liability (as is often the case with start-up companies). The refundability provision makes this credit **particularly useful to technology-based start-ups**.

These credits should be maintained and the annual cap raised based on demand.

Resources Required: Existing resources

Priority: High

Time Frame: Immediate

Recommended Lead Organizations: TechConnectWV and WVDO

Intended Outcomes:

- **Increase R&D funding in platform areas** in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Action Fifteen: Develop a branding and marketing strategy that builds on the technology and location strengths of West Virginia

One of the most powerful approaches to marketing a state or region in emerging technology areas is to establish a brand name. **Silicon Valley and Route 128 stand out as clear brands** for translating research and technology strengths into viable businesses and now carry over from information technology to the biosciences and other emerging technology areas. **So does Research Triangle in North Carolina**, but more as a place to locate research centers and high-tech manufacturing.

The Best Practice Objectives of a Brand Are...

- **Aspirational but realistic...**An effective branding campaign must reflect the realistic opportunities for West Virginia in TBED, but must also convey the vision of West Virginia in TBED
- **Distinguishable...**A branding campaign should reveal and celebrate the unique technology strengths of West Virginia's various regions
- **Able to leverage existing strengths...**West Virginia's technology branding should be linked with other strengths of the state, such as its location and quality of life
- **Inclusive...**The brand should reflect a consensus and involve a broad range of organizations across the state
- **Memorable and easy to communicate...**Otherwise, it simply won't be very effective

On its face, a brand may seem to be only a catchy logo, name, or tagline for the region. For too many states and regions, that is the case. But, for the best practice states and regions, branding goes much deeper.

West Virginia does not currently have an image — internally or externally — as a state that has significant technology resources and offers attractive opportunities for technology-based companies. **West Virginia needs to develop a technology brand and market itself.**

To implement the branding campaign, it is essential to turn to an experienced **professional marketing or public relations firm** to develop the brand name and to identify the best way to implement and gain acceptance of the brand by key stakeholders. Developing a brand requires a

strategy that will differentiate West Virginia and its various regions from other locations. Its technology platforms are one way to differentiate West Virginia.

The implementation should include an active earned-media campaign that works to place key stories about West Virginia technology-based companies in newspapers. It should also include a focused targeting of trade shows, developing “signature conferences” in its targeted technology areas and other public awareness efforts.

In the end, the state needs to **create an awareness and a call to action** for increased involvement and collaboration among and between the state’s universities, research institutions, economic development and regional entities, industries and businesses, and West Virginia governmental offices to support and advance the TBED initiatives vital to the future of West Virginia.

The state also needs to **create an awareness among the general population** of West Virginia for the need to change the economic landscape and develop new initiatives necessary to grow the economy, create new businesses, and provide opportunities for the current workforce and future graduates across the state.

Resources Required: May require as much as \$250,000 initially to develop the brand and \$500,000 for marketing and the internal communications campaign described in Action 17, but may also use existing resources at WVDO and TechConnectWV (perhaps with some funds provided for additional consulting support)

Priority: Medium

Time Frame: Short-term

Recommended Lead Organization: WVDO

Intended Outcomes:

- Continue to **grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation, with a target of \$360 million by 2015
- **Increase R&D funding in platform areas** in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia’s universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia’s universities to achieve the national average by 2020

Action Sixteen: Identify and build awareness of 21st century skills needed to support TBED and future workforce needs of the state’s technology industries

A highly skilled and educated workforce is an absolute prerequisite for building West Virginia’s technology economy.

However, the **educational level of the state’s workforce lags much of the nation**. Many of its university graduates leave the state to seek employment elsewhere. Further, existing technology-based companies often face difficulties in finding senior personnel with experience in technology firms. Likewise, it is often hard to recruit senior managers to West Virginia.

West Virginia must turn this situation around for the innovation economy to flourish. The state must feed the pipeline by encouraging its middle and high school students to study science, technology, engineering, and mathematics (STEM) and to complete the rigorous courses to **prepare students to pursue STEM degrees at the college and graduate levels**. West Virginia must also undertake initiatives to retain its STEM graduates and link them to opportunities in technology companies. This action **will require leadership and action from many organizations, entities, and individuals**.

The state's education organizations, including the **Department of Education and WVHEPC, will need to lead efforts to fill the pipeline** of STEM students and graduates. However, other groups, including economic development organizations, business, and industry, should play major support roles.

For example, **WORKFORCE West Virginia will need to lead workforce development efforts**. WORKFORCE West Virginia serves as the lead state agency for workforce development matters and is a key partner in the state's workforce development system.

Resources Required: Existing resources

Priority: Medium

Time Frame: Mid-term

Recommended Lead Organizations: WORKFORCE West Virginia, Department of Education, WVHEPC

Intended Outcomes:

- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
- **Increase the number of technology-based companies** in West Virginia at a rate higher than the national average
- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020
- **Increase the number of spin-off companies** developed from technology created at West Virginia's universities to achieve the national average by 2020

Georgia Intellectual Capital Partnership Program

- **Connects the intellectual resources** of Georgia's colleges and universities to the state's business community
- **Meets company hiring needs** through accelerated curricula designed for knowledge workers
- Since 1997, has helped secure **more than 7,000 jobs** in Georgia

Action Seventeen: Facilitate and expand talent recruitment efforts

West Virginia must create an environment that will attract talent to the state. The Come Home to West Virginia Web site, launched by the WVDO, provides a mechanism to make individuals with ties to West Virginia aware of employment opportunities in the state. This effort was initiated because employers reported that they had great success in recruiting talent who had family in West Virginia, had attended school in West Virginia, or had other ties to the state. **The Come Home to West Virginia effort — or similar outreach efforts — should be continued and expanded** to reach out to people who currently live in West Virginia but commute out of state to work. Many of these workers are skilled technical workers employed in the Washington DC area. They are a potential source of talent for the state's technology companies. The possibility of creating a **technology-specific segment** of the Web site should be explored.

Resources Required: Existing resources

Priority: High

Time Frame: Immediate

Recommended Lead Organizations: WVDO, with support from TechConnectWV and possibly Create WV and Generation WV

Intended Outcomes:

- **Increase employment** in private-sector, technology-based companies in West Virginia to reach the national average by 2020

Action Eighteen: Undertake a communications campaign to increase understanding of the technology economy and the opportunities it will provide to West Virginians

Both policymakers and the general citizenry must be better educated and informed about the importance of the technology economy and West Virginia's role in it. It will be particularly important to communicate to the general public the **opportunities that technology-based development can offer them and their children**. This public communications campaign should be undertaken as part of the branding and marketing effort.

It will be particularly important to brief legislators so that they understand the impact that state investments in education, research, and technology-based development can have on their constituents and the state in general. The internal education campaign should be aligned with the branding and marketing campaign; but, it will require a distinct set of activities. These activities could include, for instance, public service announcements and an ambassador program to reach schools and local civic organizations.

Resources Required: Included in budget for branding and marketing campaign

Priority: High

Time Frame: Short-term

Recommended Lead Organizations: WVDO, with support from TechConnectWV and Create WV

Intended Outcomes:

- Continue to **grow the West Virginia academic R&D base** at a pace that significantly exceeds that of the nation, with a target of \$360 million by 2015
- **Increase R&D funding in platform areas** in all sectors (academia, nonprofits, and industry)
- **Increase industry-supported R&D** at West Virginia's universities and colleges to match the national average by 2020
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CONCLUSION

The State of West Virginia — including governmental agencies, economic development groups, universities, nonprofit organizations, and business and industry — **must act boldly and quickly** to grow its research, technology transfer, and commercialization activities. TBED is an economic imperative, with multiple studies showing that a state's economic success can be largely attributed to the growth of high-technology businesses.

Innovation and technology lead not only to more jobs but also to higher-paying jobs, fueling economic growth and increasing the standard of living across entire states and regions where TBED. Thus, **TBED is a critical component of West Virginia's economic future.**

Unfortunately, TBED is not widespread in West Virginia compared with other states. Its innovation economy is young and must be cultivated. West Virginia is behind its neighbors, behind its peers, and behind most of the nation in building a technology economy.

However, **West Virginia does have significant strengths** with strong foundations in several technologies.

This Blueprint lays out **recommended strategies and actions** — which can be used exactly as proposed or as guidelines for further refinement and development — **to boost West Virginia's knowledge-based economy.**

Successful implementation of the Blueprint will require the following:

- **Significant investments** in West Virginia's technology infrastructure
- **Strong leadership** from the recommended lead organizations — and other groups within the state
- **Long-term commitment** from all stakeholders, including West Virginia's citizens
- **Strong resolve** to make critical and sometimes difficult decisions
- **Genuine will to compete.**

No single organization will be able to carry out this Blueprint or boost West Virginia's innovation economy alone. But, with the right investment, true collaboration among all stakeholders in the state's public and private sectors, **West Virginia can and will become a leader** in this vital economic sector.

"We have a local saying that biotechnology in North Carolina has been a 30-year overnight success."

Barry Teater, North Carolina Biotechnology Center, in *Research Ripple: States attracted to job multiplier effect of biotech firms*, The Council of State Governments, May 2006.

This report and all other related reports — as well as
other information about West Virginia's
technology economy — can be found at...

www.TechConnectWV.com



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