

MEMORANDUM

TO: Legislative Oversight Commission on Education Accountability

FROM: Dr. Juliana Serafin, Senior Director Division of Science and Research

DATE: July 1, 2023

RE: Vision 2025: Science & Technology Strategic Plan Annual Report

West Virginia Code §18B-18B-2 requires the West Virginia Science and Research Council to report to the Legislative Oversight Commission on Education Accountability annually on progress in implementing the state science & technology strategic plan, as well as any updates to the plan. In 2021, a completely revised strategic plan, **Vision 2025: West Virginia Science and Technology Plan**, was created with input from more than 60 stakeholders from industry, higher education, and state government.

The strategic plan was developed with an eye toward attracting federal research funding and new high-tech industries to West Virginia. Through the plan, we have an incredible opportunity to attract more external investments over the next five years that will allow new sectors to take root right here at home.

In Fiscal Year (FY) 2023, the plan moved forward significantly with the procurement of a RII Track-1 EPSCoR Research Infrastructure Improvement grant which is funded for \$20 million over the next five years. This grant, which is for the "West Virginia Network for Functional Neuroscience and Transcriptomics" is a strategic fit with the four science and technology platforms identified in the plan: **Life Sciences, Computer and Data Science, Advanced Manufacturing and Advanced Energy**. In addition to this funding, a conference award to identify ways to support the applications for and administration of STEM research grants in the state, GRANTED Conference: Increasing STEM Grant Capacity Across West Virginia, for \$99,000, has been awarded by the National Science Foundation.

Funding from the state's Research Challenge Fund continues to support the growth of new research in the four platforms. In FY23, three new Research Challenge Grants began in the areas of 1) Data Driven Autonomous Experiments for Energy Sciences Principles of Machine Learning, 2) Metal-Embedded Carbon-based Catalytic Membranes for Co-production of Ammonia and Ethylene, and 3) Synergistic Conversion of Captured CO₂ and Green H₂ to Value-Added Products for a Decarbonized Economy. These projects will create research that is eligible for federal-agency funding and further the goals of the Science & Technology Plan. The three previous Research Challenge Grants (see attachment), ending in 2023, produced a total of \$89 million in follow-on funding.

The Science & Technology Plan has specific goals in five focus areas: **STEM Talent Pipeline, Research Enterprise, Innovation & Entrepreneurship, High-Tech Companies and Stakeholder Alignment**. The plan sets Vision, Goals, Actions and Metrics for each focus area. It also analyzes trends that affect technology and workforce in the state and includes a SWOT analysis for the four science and technology platforms.

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Focus Area One: STEM Talent Pipeline

Vision: The vision is for West Virginia students to become interested in high-tech career pathways and actively pursue STEM degrees. Ultimately, companies will locate in West Virginia because of the availability of STEM talent in the state.

The goals are to increase two- and four-year STEM degree enrollment and degree conferral, and to increase research opportunities and internships for students with the support of federal grants and the state-funded Research Challenge Fund.

Actions include expanding K-12 STEM opportunities, partnering with organizations in the state to help prepare and retain STEM students, and partnering with companies and federal labs to increase the number of available internships.

FY 23 Results and Recommendations for Focus Area One:

The successful RII Track-1 EPSCoR grant awarded in May 2023, and extending through 2028, will have a significant impact on the STEM pipeline by creating a STEM internship portal for college students, implementing an extensive program in data science and neuroscience for K-12 students and teachers, and partnering with CodeWV <https://codewv.wvu.edu/> on K-12 computer science instruction.

A partnership between the STaR Division and the Division of Student Affairs led to co-sponsorship of an event for over 1,000 middle school students participating in the federal Department of Education's GEAR UP (Gaining Early Awareness and Readiness for Undergraduate Programs) program in 11 counties. The event included a popular STEM speaker and a career fair for students.

The state's NSF INCLUDES Eddie Bernice Johnson First2 Success Network award has been extended a sixth year through August 2024. The First2 program helps retain first-generation college and other under-represented groups in STEM majors during the first two years of college. West Virginia University, Marshall University, Glenville State University, University of Charleston, Fairmont State University, BlueRidge Community and Technical College, and WVU Institute of Technology are all partner institutions in this program.

Focus Area Two: Research Enterprise

Vision: The vision for the research enterprise is that West Virginia will be recognized for its academic research in the four target platforms (Life Sciences, Computer and Data Science, Advanced Manufacturing and Advanced Energy), and that industry will seek technical expertise and collaborations with academic researchers.

Goals are to increase the number of STEM doctoral degrees conferred at West Virginia's universities, and to increase research expenditures in the four target platforms. Actions include increasing funding for the Research Challenge Fund, securing federal research capacity-building grants, increasing federal grants and contracts in the four target platforms, and identifying critical lab and facility needs and assessing funding mechanisms to fulfill those needs.

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FY 23 Results and Recommendations for Focus Area Two:

The Research Challenge Fund continues to fund STEM doctoral students at WVU and Marshall through the STEM Fellows program. This award was renewed in 2021 and will be in place from 2022 to 2026.

We expect that the new NSF EPSCoR RII Track-1 grant in Neuroscience will significantly assist research growth at the higher education institutions in the state.

The National Science Foundation (NSF) has identified the critical need for support of STEM research grant proposal preparation process and post award administration for grants. The STaR office applied for and will receive a conference grant to visit regions of the state and assess the barriers to grant application and administration, as well as collect input on barriers at a state conference in 2024.

Focus Area Three: Innovation and Entrepreneurship

Vision: The vision for Focus Area Three is for successful startups in West Virginia to attract more Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding and venture capital to increase operations.

Goals include increasing industry-university research and development activity, including patents and invention disclosures, and SBIR/STTR awards. Actions include piloting an R&D voucher program, supporting the FAST program (Federal and State Technology Partnership Program to help West Virginia companies apply for SBIR/STTR funding and providing the SBIR/STTR match) and increasing the Entrepreneurship and Innovation Investment Fund. This Department of Economic Development-managed Fund supports entrepreneurship, creation of business startups, improvements in workforce participation, and attracting individuals to relocate to West Virginia.

FY 23 Results and Recommendations for Focus Area Three:

In 2021 and 2022, the following SBIR/STTR awards were made with assistance from TechConnect WV's FAST project and the state Entrepreneurship and Innovation Investment Fund (EIIF):

- 7 received Phase I matching awards in 2021, and 4 in 2022.
- 2 received Phase II matching awards in 2021, and 4 in 2022.

The number of companies participating could be increased by adding more state matching funding in the EIIF and the creation of a R&D Voucher program, which are recommendations made in Vision 2025 that have not been implemented.

Focus Area Four: High-Tech Companies

Vision: The vision is to make West Virginia home to high-tech companies and industries and to grow business R&D and innovation activities.

Goals include attracting R&D-oriented federal operations; ensuring that infrastructure, facilities, and specialized equipment are available to high-tech companies; and working with the West Virginia Department of Economic Development (DED) on recruitment of high-tech companies. Actions include supporting programs to move federal anchors to the state, leveraging R&D vouchers, and collaborating

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for high-tech company recruitment.

FY 23 Results and Recommendations for Focus Area Four:

The WV Regional Technology Park (WVRTP), the I-17 High Technology Park, and the Department of Economic Development continue to actively participate in *Opportunity Move*, the collaborative effort to relocate federal agencies to West Virginia.

NOAA's Science on a Sphere project at the WV Regional Technology Park opened in 2022, bringing innovative STEM-based education tools to middle and high school students, as well as the community.

It is hoped that the newly funding NSF Track-1 grant in neuroscience will attract new industries to West Virginia in the next 5-10 years.

Focus Area Five: Stakeholders

Vision: The vision is industry-academic-government stakeholders agree on the importance of science and technology in the state economy and collaborate on plan goals and actions.

Goals include establishing strong communications between stakeholders and working together to overcome challenges. Actions include conducting meetings for industry, academics, legislators, and executive branch stakeholders that identify two to three collaborative projects each year and reporting on the outcomes of the plan.

FY 23 Results and Recommendations for Focus Area Five:

New federal funding opportunities, including the Building a Better America guide to the Bipartisan Infrastructure Law and the creation of the NSF's Regional Innovations Engine program (NSF's Engines) have brought the state's key stakeholders in research and economic development together over the past year for multiple meetings to discuss funding opportunities. Concept papers for the NSF Engines program were submitted June 30, 2022, and the Community and Technical College System will partner with one of the Type 2 awards given to the Kentucky Science & Technology Corporation on Additive Manufacturing Forward Engine (AMFE).

Conclusion

The revised **Vision 2025** presents an opportunity for significant development of science and technology in West Virginia. The Division of Science and Research announced the plan in July 2021, and significant progress has been made in the areas of research funding. A full copy of **Vision 2025** may be accessed here: <https://westvirginiaresearch.org/vision-2025-west-virginia-science-technology-plan>

Attachments:

- 1) Research Challenge Grants 2017-2023
- 2) Announcement of new Research Challenge Grants for 2023-2027
- 3) Announcement of new EPSCoR RII Track-1 Neuroscience Grant

RESEARCH CHALLENGE GRANTS

How state funding encourages *job creation* and *private investment*

Research Challenge Grants offer return on investment

\$17.3 million

Localized Gas Utilization

External follow-on funding after initial award of \$1.3 million over five years

Jianli (John) Hu, Ph.D.
Research Challenge Grant recipient,
Localized Gas Utilization

"The RCG integrates **collaborations** wherein science & engineering faculty can engage with law, finance and geology to come up with **innovative solutions** to energy and environmental issues in West Virginia. The project has generated specific impacts on the advancement and realization of smart goals in The West Virginia Science and Technology Strategic Plan. The research activities result in a continuing stream of intellectual properties, federal grants and industrial investment to sustain the scientific advancements in energy research. With the help of the RCG, an interdisciplinary team has trained 25 PhD/MS students, 10 BS students and 4 postdocs.



\$33.1 million

Center for Cognitive Computing

External follow-on funding after initial award of \$1.3 million over five years

"The RCG grant has allowed me to extend WVU research activities on several critical national security topics as well as collaborating with state commercial and industrial companies. I have been able to advance **state-of-the-art machine learning** on biometrics and face recognition for national security. Due to this RCG, my research group **secured two large grants** and received two consecutive year supplemental grants. The RCG grant has also helped me collaborate on several projects with small businesses."



Nasser Nasrabadi, Ph.D.
Research Challenge Grant recipient,
Center for Cognitive Computing

"The Vaccine Development Center (VDC) has acquired \$26 million in extramural support from private and federal sources of funding. The VDC has **supported seven faculty-lead projects** over the past four years which has allowed labs to become more competitive for extramural support. Furthermore, the projects have resulted in **publications in high-tier journals**, illuminating research that is occurring in West Virginia. The VDC **partnerships have enabled three potentially lifesaving vaccines** to be moved into human clinical trials."

Heath Damron, Ph.D.
Research Challenge Grant recipient,
Vaccine Development Center



Research Challenge Grants (RCGs) are awarded every five years. RCGs support the creation of university-based research centers that can foster economic development and workforce advancement in alignment with the goals listed in the state Science & Technology Plan (S&T Plan). All three current projects were awarded \$1.3 million over five years. They have made excellent use of state funding by leveraging the initial investment into further funding from federal sources, supporting scores of graduate students and postdoctoral fellows, and producing hundreds of publications on important research. Increased funding of the Research Challenge Fund would be used for additional RCGs that have been very successful at garnering follow-on funding.

GROW

Grow research programs at institutions to help secure federal funding that will spur economic development

DEVELOP

Develop STEM talent pipeline to increase the STEM-ready workforce in West Virginia

RETAIN

Keep expertise in the state with competitive programs that provide quality experiences to attract and retain students

How further investment in the Research Challenge Fund would *positively impact* West Virginia

SUMMER UNDERGRADUATE RESEARCH EXPERIENCES

The Summer Undergraduate Research Experiences (SURE) program provides stipends to **fully or partially support research for 100 undergraduate students annually**. Marshall University, Shepherd University, West Liberty University, West Virginia University, West Virginia State University, and West Virginia Wesleyan College host these students. The sum of six awards is \$300,000 per year, for three years from 2020-2022.

INSTRUMENTATION & INNOVATION GRANTS

Instrumentation Grants provide \$20,000 to purchase **modern instruments for advanced undergraduate laboratories**. Innovation Grants provide one-time awards of about \$40,000 each for **equipment, supplies and minor renovations of laboratory spaces for undergraduate education and research**.

An external, expert peer review service is provided for STEM faculty. This allows them to develop competitive proposals for funding from federal agencies. Last year, 32 faculty proposals were reviewed, 1 large scale proposal to the National Science Foundation (NSF) was reviewed multiple times, and 50 proposals were reviewed for 9 competitions for about \$150,000. Administration and cost share to NSF EPSCoR RII grant was also provided at \$255,000.

STEM FELLOWS

STEM Fellows offers **funding for doctoral (Ph.D.) students studying science, technology, engineering and mathematics (STEM)** at Marshall University (MU) and West Virginia University (WVU). This grant provides **significant support** to both schools for their research programs and **helps maintain their respective research classifications**. The total for five years will be \$800,000 to MU and \$1,675,000 to WVU.

OPPORTUNITY FUND

The Opportunity Fund provides **small, one-time awards** less than \$5,000 each to assist faculty and STEM programs with expenses related to development of proposals for federal funding, and for summer student programs. Total funding per year is \$40,000.

Learn more at wvresearch.org or call us at **304.558.4128**



Science,
Technology
& Research



WEST VIRGINIA
Higher Education
Policy Commission

For immediate release: February 10, 2023

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NEWS RELEASE

Faculty awarded over \$3.9 million for the creation of university-based research centers in West Virginia

CHARLESTON, W.Va. – Over \$3.9 million in state funding will foster economic development and workforce advancement by supporting the creation of university-based research centers in West Virginia.

[STaR Division: Science, Technology & Research \(STaR\)](#) at the West Virginia Higher Education Policy Commission awarded three Research Challenge Grants (RCGs) worth approximately \$1.3 million each to directly support research conducted by students and faculty at West Virginia higher education institutions. Research teams are comprised of faculty from Bluefield State University, Concord University, Marshall University, West Virginia University and West Virginia State University. The awards were announced on Friday, February 10 at the Culture Center on the West Virginia State Capitol complex.

“We are excited to be able to fund these three excellent research projects with Research Challenge Grants for 2023-27 cycle,” said **Dr. Juliana Serafin, senior director of STaR**. “We look forward to the growth in research enterprise and economic development that will result from this investment by the state of West Virginia.”

Research Challenge Grants are supported by the Research Challenge Fund, established by the West Virginia Legislature in 2004 to build research capacity and competitiveness at the state’s colleges and universities. The fund is managed by STaR.

“These awards give researchers, especially students, the opportunity to collaborate with those at other institutions in the state and develop partnerships that will make their funding proposals more competitive,” Serafin said.

The RCGs promote statewide research collaboration among higher education institutions, an important factor when competing for federal funding, particularly from the National Science Foundation. Broadening the participation of first-generation college students and other underrepresented groups is also crucial.

“We are thrilled today to be able to present new state-funded research grants to faculty representing several of our universities that will create new opportunities for our students to collaborate with each other, with those at other universities and with outstanding faculty who are

pushing them toward trailblazing discoveries,” said **Dr. Sarah Armstrong Tucker, West Virginia’s Chancellor of Higher Education.**

Past Research Challenge Grant winners emphasized how the state-funded grants provided clout when seeking further support with federal agencies and industry donors. Awardees from the 2017-2022 cycle transformed their initial \$1.3 million investments into more than \$59 million in combined follow-on funding to continue their research projects.

Research Challenge Grant Awards

Drs. Xin Li, V’yacheslav Akkerman, Lian Li, Wenyan Li, Bin Liu and Aldo Romero of West Virginia University and **Drs. Xiaojuan (Judy) Fan and Huong Nguyen** of Marshall University were awarded \$1,315,000 over five years for “Data Driven Autonomous Experiments for Energy Sciences Principles of Machine Learning.”

“The new Research Challenge Grant project connects artificial intelligence (AI) researchers with energy science researchers to explore the emerging frontiers of ML-based autonomous experiments for material discovery and energy systems,” said Xin Li, project principal investigator. “It will provide an excellent opportunity for STEM students to engage with cutting-edge research that can impact our state’s future.”

The team plans to work on expanding convergence research at the intersection of artificial intelligence/machine learning and energy sciences by developing a class of novel physics-informed surrogate models.

Drs. Oishi Sanyal, Madelyn Ball, Jianli (John) Hu, Yuhe Tian, and Carrie White of West Virginia University; **Drs. Rosalynn Quiñones-Fernández and Roozbeh (Ross) Salary** of Marshall University; **Dr. Tesfaye Belay** of Bluefield State University; and **Dr. Rodney Tigaa** of Concord University were awarded \$1,300,000 over five years for “Metal-Embedded Carbon-based Catalytic Membranes for Co-production of Ammonia and Ethylene.”

“Receiving the Research Challenge Grant allows our team to pursue a high-risk but impactful research direction and obtain preliminary data prior to applying for external federal grants,” said Sanyal, project principal investigator. “Along with research, this grant involves a strong education component which will be used to train the next generation of STEM workforce across four West Virginia-based institutions. Funds like these are critical to support students from all backgrounds, including underserved and underrepresented communities, and train them in cutting-edge technologies. The state of West Virginia will clearly benefit from such a trained workforce as they will contribute to research, entrepreneurship and future manufacturing.”

The team plans to develop a novel dual-layered catalytic hollow fiber membrane for co-production of ethylene and ammonia from natural gas in microwave-enhanced reactions.

Drs. Cosmin Dumitrescu, V’yacheslav Akkerman, Omid Askari, Jianli (John) Hu, Bingyun Li, Earl Scime and Xueyan Song of West Virginia University; **Dr. Rodney Tigaa** of Concord University; and **Dr. Eyas Mahmoud** of West Virginia State University were awarded \$1,300,000

over five years for “Synergistic Conversion of Captured CO₂ and Green H₂ to Value-Added Products for a Decarbonized Economy.”

“The project objective is to develop process-intensified modular technologies that will convert captured carbon dioxide and green hydrogen to green ethylene and green ammonia,” said Dumitrescu, project principal investigator. “The production of green ethylene is an opportunity to revive West Virginia’s polymer industry, while green ammonia is an efficient, decarbonized and low emissions alternative to electrification for hard-to-electrify industries.”

The team plans to advance current science and technologies to promote local utilization of captured carbon dioxide and the production of green hydrogen in West Virginia residential, commercial, and industrial sectors.

“With the help of the Research Challenge Grant funding, the project will create an interdisciplinary STEM team dedicated to supporting underrepresented communities and the necessary infrastructure to grow project activities into a vibrant, self-sustaining research and development nucleus,” Dumitrescu said.

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NEWS RELEASE

West Virginia awarded \$20 million in scientific research funding from National Science Foundation

West Virginia has received more than \$105 million in EPSCoR funding and co-funding since 2001

CHARLESTON, W.Va. – West Virginia has been awarded a highly competitive, five-year \$20 million grant from the National Science Foundation's (NSF) Established Program to Stimulate Competitive Research (EPSCoR) that will boost academic scientific research and upgrade infrastructure at West Virginia University (WVU), Marshall University (MU), West Virginia State University (WVSU) and Shepherd University. EPSCoR is facilitated by the West Virginia Higher Education Policy Commission's Division of Science, Technology & Research (STaR).

This funding establishes the WV Network for Functional Neuroscience and Transcriptomics (WV-NFNT), a statewide collaboration of neuroscientists and bioinformaticists working to position West Virginia as a center for impactful neuroscience research.

"I'm thrilled to see that West Virginia has been awarded such important funding, and it's further proof that we're leading the way in education, innovation, science, and technology," **Gov. Jim Justice said**. "This will provide a significant boost to the research programs at our state's leading universities and is a testament to the hard work and dedication of the West Virginia Higher Education Policy Commission. We look forward to the positive impact this grant will have on our state's academic and scientific community and economy."

"West Virginia's universities continue to make our state and country proud with innovative scientific research projects, and I'm thrilled the National Science Foundation is investing \$20 million over five years to establish the West Virginia Network for Functional Neuroscience and Transcriptomics (WV-NFNT)," **said U.S. Senator Joe Manchin**. "I was proud to support this historic investment, which will allow our hardworking students, faculty and staff to continue to make groundbreaking strides in neuroscience and related research. This shows that given the right tools, West Virginia's researchers can compete with anyone in the country. I look forward to seeing the positive impacts of this funding for decades to come and, as a member of the Senate Appropriations Committee, I will continue advocating for resources to boost scientific research opportunities across the Mountain State."

"West Virginia has been a leader in neuroscience capabilities and research for years, and it's

important that our higher education institutions have the resources and tools they need to continue that leadership into the future, especially when they are able to collaborate as they are in this effort. I have been a steadfast supporter of ESPCoR programs, as they give our students and professionals unprecedented opportunities to advance scientific progress right here in West Virginia. I will continue to advocate on behalf of our institutions in West Virginia, and work to provide the resources they need to develop innovative solutions that impact our state, country, and world,” **U.S. Senator Shelley Moore Capito said.**

Project leadership includes:

- *Principal Investigator:* Dr. Juliana Serafin, senior director of science and research at the West Virginia Higher Education Policy Commission
- *Co-Principal Investigator:* Dr. Suzanne Strait, associate director of science and research at the West Virginia Higher Education Policy Commission
- *Co-Principal Investigator:* Dr. Randy Nelson, chair and professor of the WVU Department of Neuroscience at West Virginia University
- *Co-Principal Investigator:* Dr. Nadja Spitzer, associate professor of biological sciences at Marshall University
- *Co-Principal Investigator:* Dr. Umesh Reddy, professor of genetics and genomics at West Virginia State University

“Neuroscience researchers and STEM education leaders in West Virginia are honored by NSF’s selection of the WV-NFNT project for funding,” said **Dr. Serafin**. “We are looking forward to significant growth in neuroscience and related STEM fields during the grant period.”

West Virginia has now received more than \$105 million from NSF EPSCoR as funding or co-funding over the past 22 years, according to Dr. Sarah Armstrong Tucker, West Virginia’s Chancellor of Higher Education.

“Together with our research and university partners, West Virginia has made great progress in positioning our state as a leader in scientific research,” said **Chancellor Tucker**. “We are tremendously grateful to the NSF and to Senators Manchin and Capito for their support, and for their continuing faith in West Virginia’s faculty and student researchers. With this funding, we have the opportunity to take neuroscience and related research to new levels of discovery – which could impact real lives and our economic future in tremendous ways.”

“For the United States to remain the global leader in science, engineering and technology, we must energize talent in every region and every state in our nation. Through EPSCoR, NSF catalyzes the development of research capabilities across the country, creating sustainable scientific infrastructure and communities of innovation,” said **NSF Director Sethuraman Panchanathan**. “This year’s EPSCoR awards will serve individual states and the country as a whole with critical research on wildfire management, climate change resilience, biomanufacturing and advanced biomedical devices, and data science in the service of all disciplines.”

Project Background

Neuroscience and data science were identified as areas of existing strength with high potential for growth in the [West Virginia Science & Technology Plan](#), published in 2021. The WV-NFNT will foster collaborations among neuroscientists and bioinformaticists from the four universities while positioning the state as a center for one of the most impactful neuroscience research areas – circuit and synaptic plasticity, the study of changes in neurons and the

connections between them as the result of developmental or environmental changes. The WV-NFNT will expand the capability and diversity of those working in the fields of neuroscience and data science by implementing specific education and workforce development activities to engage students, especially those who are rural, first-generation college students, and other underrepresented groups.

NSF EPSCoR Background

The National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR) enhances the research competitiveness of targeted jurisdictions - whether state, territory or commonwealth - by strengthening science, technology, engineering and mathematics (STEM) capacity and capability through investments, from talent development to local infrastructure. EPSCoR envisions its jurisdictions as recognized contributors to the national and global STEM research enterprise. West Virginia's most recent EPSCoR-funded Track-1 project was awarded in 2015 and wrapped up this year.

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