

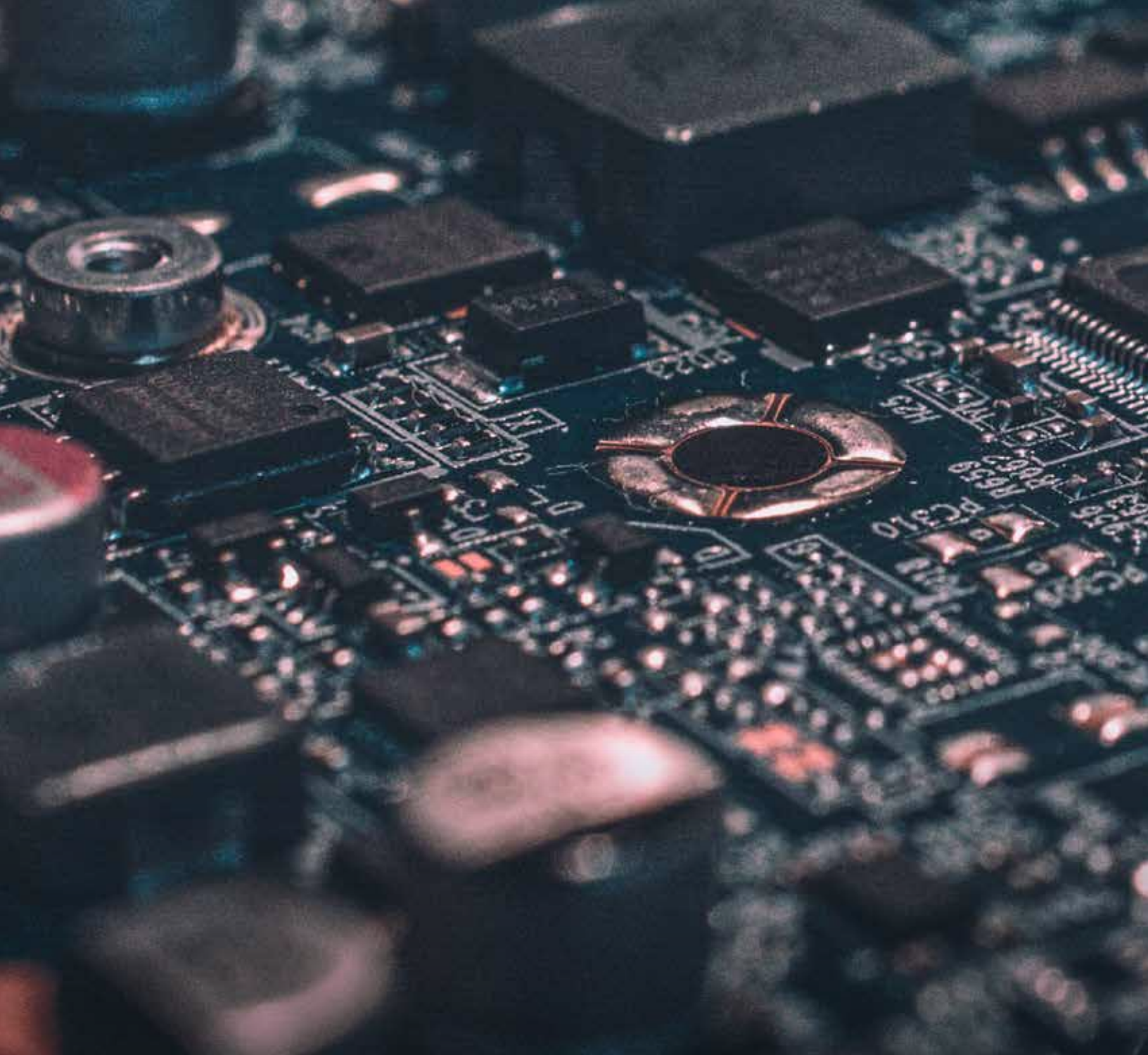
Vermont
Technology
Council



**2019 Vermont
Science and Technology Plan**

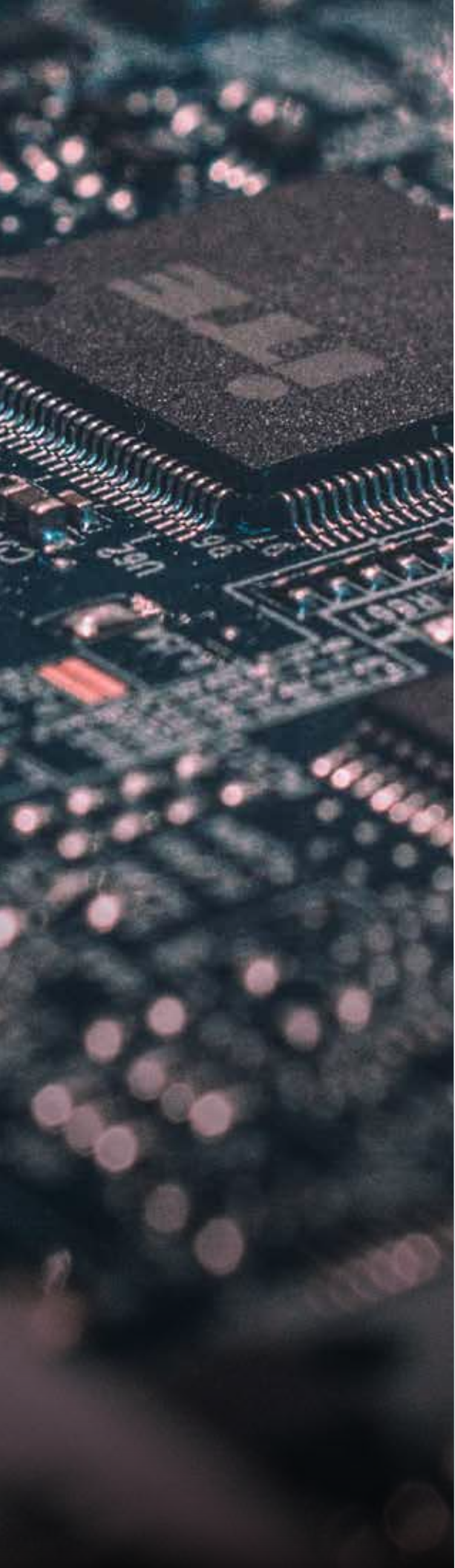
BUILDING VERMONT'S SCIENCE AND TECHNOLOGY ENTERPRISE

April 2019



VERMONT TECHNOLOGY COUNCIL MISSION

The Vermont Technology Council is a self-sustaining, independent organization established in 1993 that advocates for science and technology-based economic development. It strives to integrate the efforts of the private sector, higher education, and government to build a strong, vibrant, and flexible economy in Vermont based on science, technology, innovation, and entrepreneurship. The Council also serves as the State Committee for the Vermont Established Program to Stimulate Competitive Research (VT EPSCoR) and by, Executive Order of the Governor, is responsible for writing the State Science and Technology plan.



BACKGROUND

Vermont has a population characterized by a strong work ethic, creativity, and high levels of education. There is a broad base of innovative and technology-enabled enterprises, a well-respected PreK–12 education system, and a concentration of opportunities in higher education unparalleled for a state its size. These assets, combined with a brand identity as one of the most beautiful, healthy, and environmentally conscious places in America, have contributed to Vermont’s regular appearance on the nation’s lists of “best places to live.”¹

There are many factors that lead to being identified as one of the “best places to live”, including the quality of the natural environment. Vermont has worked diligently for many years to protect the natural environment. The state is known for its pristine natural resources, forests, streams, mountains, and lakes. Recreation and tourism contribute \$2.8 billion to the state economy, nearly 10% of its GDP. It is critical to continue the focus on better understanding the impact of natural and human-driven climate change on Vermont natural resources. The Lake Champlain Basin is an excellent setting for this work, serving as a laboratory for careful measurement of existing conditions, studies of changes over time, and modeling of future impacts. In fact, National Science Foundation EPSCoR funding has provided an advanced sensor array in two northern bays to support studies that have led to advancements in governance and policies already impacting the Basin. These activities also offer an excellent opportunity for research, a basis for education of young students in scientific inquiry, and the development of companies that provide services to protect that environment. There is a strong effort in these areas at the University of Vermont (UVM) Rubenstein School of the Environment, the College of Agriculture and Life Sciences, and at the College of Engineering and Mathematical Sciences. In addition, the Vermont Law School’s environmental law program – rated the number one program in the nation consistently over the past 3 decades – educates and trains a significant number of advocates for the environment.

A second major driver of becoming a “best place to live” is the availability, quality, and relative cost of healthcare. Based on the size and stability of the population and the agility afforded by a smaller bureaucracy, there is again the opportunity for Vermont to serve as a laboratory to address issues related to health. Researchers are studying the management of the overall health of a population, along with understanding how the health delivery system functions and identifying integrated approaches across the community to address such issues as the opioid crisis, obesity amongst our youth, and health disparities in a rural environment. There is potential for growth from the existing strong platform of innovation and research in health related areas, including efforts at the UVM Larner College of Medicine and the College of Nursing and Health Sciences, and the University of Vermont Medical Center. In addition, a growing number of private sector health-related businesses are addressing important health issues, including members of the statewide Vermont BioSciences Alliance.

Aligned with the trend nationally, Vermont is experiencing a resurgence of manufacturing, particularly advanced manufacturing. This has become a far more technology-enabled area, with an increased need for people with strong skills in the Science, Technology, Engineering, and Math (STEM) disciplines. Vermont manufacturing is one of the major private sector contributors to the economy, with approximately 30,000 well-compensated jobs, contributing \$2.8 billion to the state GDP. This era of changing technologies allows for real-time digital connection of machines, work processes, and systems with intelligent networks along the value chain that can control each other autonomously. The Institute for Advanced Science Convergence at Norwich University is one academic center working to overcome the barriers of integrating these technologies. Vermont can be a leader in this revolution by coordinating efforts between the entire educational system, the manufacturers, and

¹ CNBC, “These 10 states are the best places to live in America”, July 10, 2018, <http://www.cnbc.com/2018/06/22/americas-best-states-to-live-in-2018.html>



To continue to be one of the country's "best places to live", Vermont has the opportunity to build on existing strengths with research and development efforts in four focus areas:

- 1) Protecting the environment**
- 2) Healthcare technology and delivery**
- 3) Advanced manufacturing**
- 4) Computing technologies**

state government. In addition, internships in these areas that start in high school and continue through college could grow the workforce.

Computing technologies such as artificial intelligence, big data, digital forensics, and cybersecurity have been large economic drivers nationwide over the past 30 years and their economic impact is projected to increase. Vermont has established itself as a leader in these computing technologies, led by innovative programs at Vermont colleges and universities and forward-thinking government policy. For instance, The Center for Advanced Computing and Digital Forensics at Norwich University and The Senator Patrick Leahy Center for Digital Investigation at Champlain College are national leaders in digital forensics. In addition, the UVM Complex Systems Center is a multi-disciplinary center that provides insights into the nature and behavior of complex natural and human systems using data science, machine learning, and artificial intelligence.

Vermont EPSCoR investments contributed significantly to increased capacity for computing technologies in the state and throughout the region with over \$2 million for critical cyber infrastructure improvements as part of the five-state Northeast Cyberinfrastructure Consortium (NECC). In preparation for future opportunities in computing technologies, the Vermont legislature passed first-of-its-kind legislation to support the development of blockchain businesses and the use of blockchain technologies in government records in Vermont (S. 269). In February 2018, a Vermont resident used the blockchain to record the sale of their home, the first ever government-supported real estate transaction to make use of blockchain technologies. Once again, Vermont's creativity, strong higher education sector, and agile government make it an ideal laboratory for developing and commercializing computing technologies under a balanced regulatory structure that promotes economic growth while protecting consumers.

The availability, quality, and cost of education leading to the growth of a workforce to meet the demand of the employers in the state is an issue that cuts across these research and development focus areas. This is relevant for the full spectrum of the workforce and is particularly important to the Science and Technology Plan's goal to support STEM education. Success in education must begin with pre-school, and continue through higher education and continuing education, and include retraining for those changing careers and those who left the workforce and could rejoin. Vermont must educate, attract, and retain a workforce with the appropriate science and technology skills to support companies that compete nationally and globally. A strong and well-educated STEM workforce is the foundation for the future economy of the state: there must be strong support for research and development in both the private and higher education sectors, and there must be strong linkages between higher education and the private sector to support technology commercialization and to ensure development of the most effective workforce possible.

In the United States, over the past half century, the success of the economy has depended upon a strong commitment to science and technology. Discovery and innovation have been the drivers of job creation, job growth, and economic prosperity. The Vermont workforce has seen significant growth in technology-based activities in many areas including, but not limited to, computer hardware and software development, biomedical research, bio-technologic and biomedical equipment production, aerospace discovery and manufacturing, value-added food systems, sustainable energy research, and manufacturing. The National Science Foundation 2018 Science and Engineering Indicators (see appendix) point to both strengths and weaknesses that provide guidance for the strategies in this report.

The challenges of perceptions about the state must be also be recognized and addressed, specifically a general perception that Vermont is not "business friendly". This includes views that Vermont is a state with high taxes, high cost of utilities, numerous regulations, few incentives, and expensive housing, which offset the benefits of an extraordinary natural environment, a well-educated workforce, excellent healthcare, and higher education. The drivers behind the negative perception of doing business in the state need to be identified through social science research and addressed

by policy changes if there is to be consistent future growth of technology-enabled business and new job creation.

The 2019 Vermont Science and Technology Plan is adapted from the 2013 Plan with updates to the goals, strategies, and indicators, as well as the addition of research and development focus areas for the state that were identified through input from stakeholders in academia, government, and the private sector. The 2019 Plan sets forth recommendations for specific and measurable action strategies to help ensure economic and social prosperity for all Vermonters, and is intended to identify existing strengths in the state and help position the economy for the accelerated growth of science- and technology-based companies. Researched and written by the Vermont Technology Council, the Plan articulates a strategy and set of goals that can serve as guidelines for our government leaders, the private sector, and K-12 and higher education. The Plan is envisioned as a living document, subject to formative assessment and modification to adjust to ever-changing conditions and opportunities.

VISION

Create an ecosystem where science, technology, innovation, research & development, entrepreneurship, lifelong learning, training, and talent development for leaders and workers are available to support a vibrant and prosperous economy and a sustainable environment for all Vermonters.

GOALS

There is a significant need to increase the number and quality of workers with STEM-related skills. This can be accomplished by the development of an integrated continuum of workforce education from PreK through 12, postsecondary education, internship development, lifelong learning, and retraining resources. Ensuring that Vermonters are appropriately prepared for technology-based jobs is critical to realizing our overall goals; a constant pipeline of workers is needed to drive the economy of the state.

- **Increase the number of STEM workers through the education of Vermonters or through the relocation of skilled workers to Vermont (Strategies 2,3)**
- **Increase continuous workforce training and development to support the transformation of business in Vermont (Strategies 2,3,4)**
- **Increase the size and reach of the science and technology ecosystem and community with support and mentorship for early career STEM entrepreneurs and professionals (Strategies 2,3,4,5)**
- **Increase employment in science and technology-based enterprises (Strategies 3,4)**
- **Increase research and development activity (Strategies 1,5,6)**
- **Increase the number of small to medium manufacturers using advanced digital and intelligent technologies (Strategies 5,6)**
- **Increase cross-sector partnerships to leverage investments, support, and expertise (Strategies 1,4,5,6,7,8)**



STRATEGY 1

Develop a more complete understanding, through rigorous scientific research, of the impact of natural and human induced environmental and climate change in Vermont

Vermont is known worldwide for its natural beauty, a pristine environment, and its outdoor activities. Tourism is a major part of the state economy and environmental protection plays a critical role, so policy tends to support the Vermont brand for that purpose. The desire to maintain both a working landscape in Vermont and pristine environmental conditions has presented challenges to the state. In addressing such challenges, Vermont has become a leader in environmental management and conservation, striving to understand and solve the world's most pressing environmental issues as well as preparing the next generation of environmentally and socially responsible leaders, scientists, practitioners, and advocates.

Efforts to integrate the environmental and climate change work underway in the branches of government, the education sector, and private sectors should be initiated to foster collaboration and efficient allocation of resources. The Lake Champlain Basin provides an opportunity to document changes and test interventions that may impact long term outcomes. This work would span agriculture, forestry, urban planning, transportation, water and waste management, and sustainable growth. Robust research could provide a platform to support STEM education from middle school through post graduate work, and provide the opportunity for teachers and students to engage in actual scientific effort, with the added benefit of inspiring interest in STEM careers. An additional outgrowth of this effort would be the stimulation of businesses engaged in creating solutions and approaches to supporting the natural environment.



STRATEGY 2

Increase the number of students who will pursue STEM-related careers and advance beyond K–12 to higher education and encourage diverse education pathways

A critical stage in the workforce continuum is the transformation of skills development potential into a related career path. A multifaceted strategy includes creating an effective public awareness campaign highlighting the evolution of STEM education opportunities that appeals to our 21st century students at all levels of education; updating curricula so students can discuss, understand, and address real world challenges; encouraging and requiring current science and math teachers to explore further professional development in their content areas; increasing the overall number of well-prepared science and math teachers; and developing a STEM certificate program to formalize accreditation toward STEM jobs. Ongoing funding for current efforts such as the Vermont Genetics Network's support of faculty and student research at state and independent colleges, Learn to Earn, and Tech Centers will further foster experiential learning for high school and higher education students.

In 2016, the percentage of the 25-44 year old population in Vermont holding a high school degree was 93.2%, well above the national average of 88.8%. The percentage of fourth and eighth grade students achieving proficiency in mathematics in Vermont ranks in the top half in the nation. The funding for K–12 education is among the highest in the US, based both on cost per student and as a percentage of state GDP. Despite these exemplary student performance metrics and the resources spent on K–12 education, in 2012, only 53.2% of Vermont high school graduates went on to higher education, a rate that places Vermont 44th out of 51 states, including the District of Columbia. A concerted effort is needed to help K–12 students better understand that post-secondary education is affordable and essential for a technology-based workforce. Vermont's advanced manufacturing sector reports they cannot find enough STEM-qualified employees. Technical colleges and 2-year institutions, as well as four-year colleges and universities, can provide this training. In 2017, the number of Vermont technical workers was 1.59% of the total workforce, tied for 10th in the US. A substantial opportunity exists to increase the number of technology workers by further developing and increasing awareness of programs to prepare students to join the technical workforce.





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STRATEGY 3

Create a mechanism for graduates already in or who have left the workforce to re-train in STEM disciplines

Workers in Vermont who are highly skilled, or have high skill potential, need increased opportunity to constantly improve their skills as lifelong learners. This is true regardless of their employment level or particular business sector. As the manufacturing sector becomes more advanced, the need for workers skilled in using advanced digital and intelligent technologies and “smart” manufacturing systems will increase. This could be addressed through the creation of more public-private-industry-higher education partnerships like the Vermont Additive Manufacturing Partnership at Vermont Technical College. Some skilled individuals who are dislocated or underemployed leave Vermont to find new career opportunities due to limited options in their field. In addition, older workers who have left the workforce, parents returning to the workforce after having a family, and veterans are a significant potential resource to meet the needs of technology-enabled employers. Specialized programs focusing on retraining, education, mentoring, and career support for available technology-enabled careers will allow greater reentry into the highly-skilled employment market. This can be supported with tuition, funds for books, child care, and programs designed to remove barriers, which will increase accessibility to these much-needed initiatives. Partnering these programs with existing entities such as the Vermont Training Program, the Workforce Education Training Fund, and other Department of Labor resources will maximize current workforce capital. A concerted effort to identify companies that have the capacity and willingness to offer work experiences is also a critical component.

STRATEGY 4

Maximize the opportunities for STEM students to complete internships and/or cooperative programs with technology-based companies; career path guidance increases the probability of working in Vermont

Providing high school and higher education students the opportunity to complete internships or cooperative programs with Vermont companies will expose interested students to a spectrum of careers and help them develop an appreciation of the numerous employment opportunities in the state. It is also an opportunity for employers to identify their future workforce. Students will return to their schools with insights about the skills they need to be competitive once they graduate, influencing their choice of courses and encouraging changes in curriculum that may be needed. This effort will also facilitate dialogue between employers and educators, providing the opportunity to better understand their respective needs. A number of programs throughout the state support internships and an increase of 10% per year in the number of placements is recommended.

Given that just over half of the approximately 7,700 Vermont high school graduates move on to higher education, it is remarkable that over 44,000 students are enrolled in higher education in the state of Vermont. The quality of our institutions of higher education attracts well-qualified high school graduates to Vermont. In 2016, the number of bachelor’s degrees conferred in Vermont in science, engineering, and technology per 1,000 individuals 18-24 years old was seventh in the nation. Regardless of whether these graduates are Vermont residents, an increased effort is needed to retain them in technology-enabled companies within the state. Further growth in internship and cooperative programs is encouraged to increase the retention of our higher education science and engineering graduates.

Through some combination of graduates of Vermont institutions of higher education and recruitment of individuals from outside the state, Vermont has a relatively high percentage of postsecondary degree holders in the 25-44 year old cohort. In 2016, 40.5% of that age group held postsecondary degrees, placing Vermont 10th in the country. Despite this position, anecdotal information suggests that a shortage of engineers and computer and mathematical scientists are available to support companies in Vermont. In 2017, 0.91% of the Vermont workforce was engineers, ranking Vermont 40th in the nation and quite below the US average of 1.24%. Computer and mathematical scientists in 2017 represented about 2.31% of the workforce, positioning Vermont at 29th in the nation.

STRATEGY 5

Promote the availability of state or private funding to support early-stage science and technology-based companies and increase the support for co-working space, business incubators, and accelerators for early stage technology-enabled companies.

To create more and better paying jobs in Vermont, increased support for early stage funding of start-up companies is essential. Many of these companies have high-quality, well-protected intellectual property that serve as their basis and are less likely to have traditional assets to serve as collateral. Actions that could potentially increase the availability of funds include federal and state resources, investment by state pension dollars in funds restricted to Vermont, and favorable tax treatment for individuals investing in Vermont companies.

The Vermont Seed Capital Fund (<https://vcet.co/capital/>) was founded to provide early stage, high-risk companies with equity. As of June 2018, the Fund had invested \$4.2 million into 22 companies. The funds have been leveraged 38x with another \$159 million in co-investment with accredited angel investors, strategic corporate investors, and other institutional venture capital firms.

Efforts to commercialize the discoveries of faculty, staff, and students enrolled in higher education should be strongly encouraged. Efforts like the Office of Technology Commercialization and the UVM Ventures Fund at the University of Vermont should have increased support and these types of services should be made readily available to all of higher education.

The state's lending authority, VEDA, has an Entrepreneurial Loan Program specifically to help drive investment and growth in companies offering technology goods and/or services. Programs like this must continue to be funded, structured, and staffed so that more aggressive loans to companies with higher risk collateral are available, allowing those companies to secure financing either for physical assets or working capital.

A substantial opportunity exists to increase the desirability of investing in Vermont-based companies. To explore creative ways for the public and private sector to optimize the pool of capital for businesses at all stages of development, a group should be convened by the Secretary of Commerce and Community Development for broad ranging and innovative discussions.

The state should increase support for space and expertise to support fledgling technology enabled companies in areas where there is reasonable demand. This includes enterprises like Vermont Center for Emerging Technologies, the Black River Innovation Campus, and the Generator Maker Space.

STRATEGY 6

Develop a stronger support system to assist higher education and the private sector in securing increased federal- and state-funded grants and contracts (including SBIR and STTR), private sector contracts, and foundation support for research

Research and development (R&D) funding activity in Vermont is relatively strong, with substantial opportunity for growth. Increased R&D will support innovation and the creation of new knowledge, leading to the growth of existing companies and the creation of new ones. The University of Vermont has a strong research enterprise – particularly in the biomedical area – that must be well supported. In addition, a plan to increase the research efforts across all of higher education in areas such as engineering, computer science, social science, and the physical sciences should also be developed. Continued support for both the Vermont Genetics Network and EPSCoR will further facilitate the growth of research at all Vermont institutions of higher education. An increased effort by the State of Vermont to capitalize on the research infrastructure in higher education would have a substantial impact on both STEM education and the research productivity.

Providing high-level technical and financial support for grant seekers will produce more competitive applications and help guide novice grant applicants. One way to provide support is to fund additional services that assist grant seekers in the preparation, analysis, process, and procedures needed to meet the stringent requirements to qualify for, submit, and win grants and contracts. Effectively transitioning an idea to a commercially-viable product requires a continuum of support and collaboration with existing higher education research institutions and companies. Increased support for the services will aid grant seekers in science and technology companies and higher education.





STRATEGY 7

Encourage and facilitate opportunities for R&D collaborations between the private sector and higher education with clear and consistent policies for contractual relationships and management of intellectual property

Institutions of higher education are, and should be, a greater resource for the private sector. Interaction with faculty researchers, as well as access to specialized research equipment, provides resources at the cutting edge of innovation. Substantial expertise in the creative use of social media and software development is also available on higher education campuses. Companies at any stage of development could benefit enormously by utilizing existing expertise, laboratories, and facilities on academic campuses. As recommended by the 2012 Governor's Report on UVM, a concerted effort to build awareness about faculty expertise and equipment resources on campuses could be of great interest to the private sector. Efforts to develop a real-time inventory of faculty expertise and physical resources of Vermont institutions of higher education are encouraged. This information should be proactively shared with the private sector and between and within the institutions. The work of the Vermont Genetics Network and Vermont EPSCoR, including the online database of core facilities and Pilot Awards that foster private sector-higher education collaboration, should be augmented.

STRATEGY 8

Ensure that cyberinfrastructure capacity and connectivity meet the growing needs of the private and public sectors

Technology infrastructure is critical for Vermont to be competitive regionally, nationally, and globally. Broadband inter- and intra-state connectivity is required for economic development as well as for cutting-edge research, computation, and education. Similarly, intelligent distribution of a reliable, sustainable, and affordable energy supply is required for Vermont to succeed in a technology-based economy.

Cyberinfrastructure is being developed in accordance with the 2014 Vermont Telecommunications Plan. Both higher education and the private sector require significant bandwidth and low latency communication to conduct R&D and move large data sets between organizations within the state and globally. Continued support for private and public sector collaborations to build a vibrant cyberinfrastructure are encouraged. One example of this collaboration within higher education is the Northeast Cyberinfrastructure Consortium (NECC), a high bandwidth research and education network funded by the National Science Foundation and the National Institutes of Health through Vermont EPSCoR and the Vermont Genetics Network. NECC connects research and educational institutions in Vermont, New Hampshire, Maine, Rhode Island and Delaware for shared research centers and cloud computation projects.

A collaboration between higher education, government, and Internet providers is the creation of the Vermont Unified Community Anchor Network (VT UCAN), which connects community anchor institutions (e.g. higher education, government, K-12 institutions, and libraries) across the state to Internet2 and each other, leveraging the University of Vermont's Internet2 membership. Around 200 sites are currently connected across the state. Finally, BTV Ignite, part of the nationwide US Ignite initiative, is a non-profit organization sponsored by the government, business, and academic communities to research, develop, test, refine, and deploy next-generation, gigabit-enabled Internet applications that take advantage of Burlington's city-wide fiber optic gigabit network infrastructure.



NATIONAL SCIENCE FOUNDATION 2018 SCIENCE AND ENGINEERING INDICATORS

The data provided in the text and these graphs are available from the National Science Foundation at <https://www.nsf.gov/statistics/2018/nsb20181/>. All Vermont rankings are out of 51, which includes the 50 states and the District of Columbia.

For the figures selected, the Vermont Science and Technology Plan authors have provided an interpretation of the data and have drawn conclusions relative to their importance to the Plan.

FIGURE 1

Fourth Grade Mathematics Performance (S-1)

At both the fourth (shown in Figure 1 at right) and eighth grade level (shown in Figure 2 below), Vermont ranks among the highest of the states and DC. This is an important foundation and needs to be maintained to build the STEM workforce needed for Vermont.

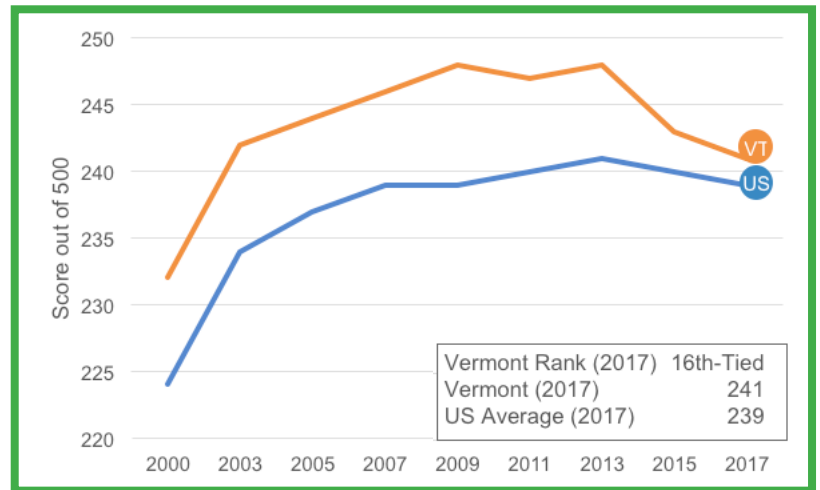
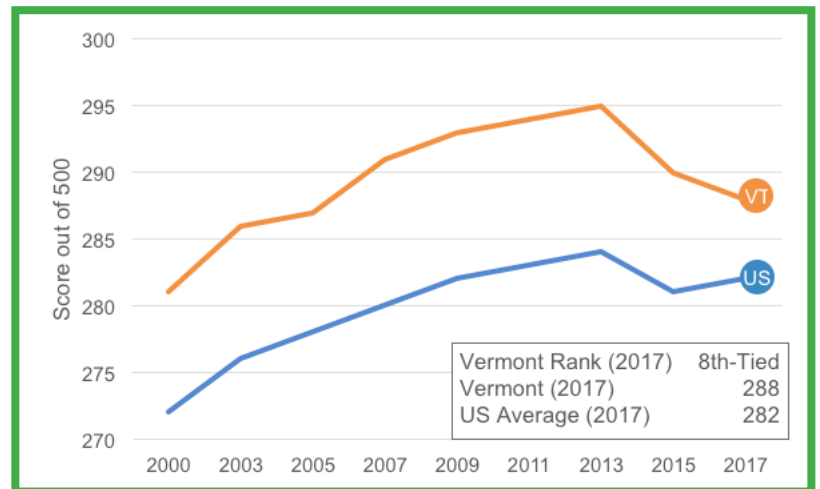


FIGURE 2

Eighth Grade Mathematics Performance (S-5)



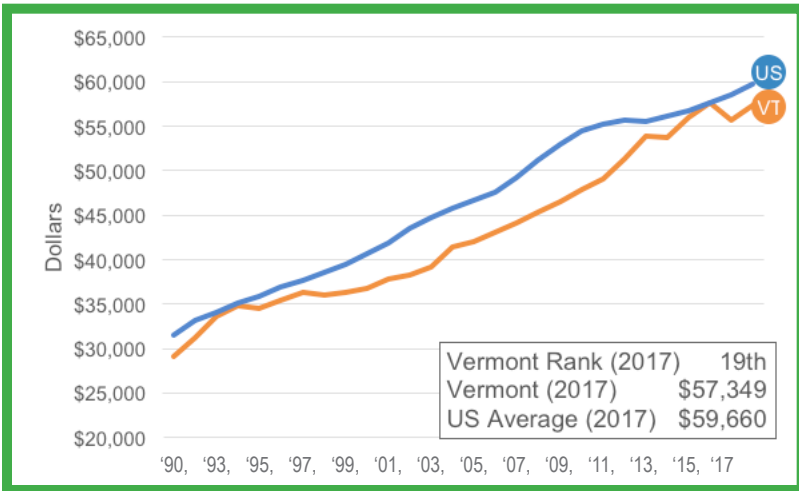


FIGURE 3
Public School Teacher Salaries (S-9)

Vermont teacher salaries for the past 20 years (seen in Figure 3 at left) tend to be within about 10% of the US average. Over the last 15 years, the cost per student (seen in Figure 4 below) has increased substantially and Vermont is among the highest in the nation.

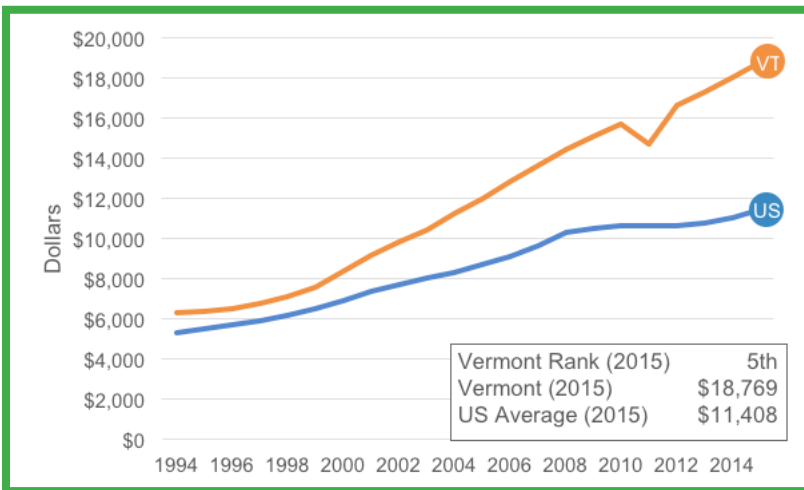


FIGURE 4
Current Expenditures per Pupil for Elementary and Secondary Public Schools (S-11)

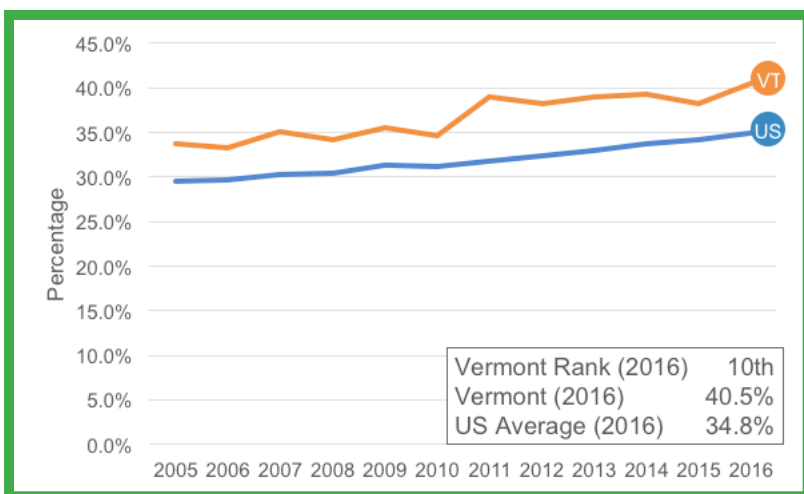


FIGURE 5
Bachelor's Degree Holders among Individuals 25-44 Years Old (S-30)

Despite a low percentage of Vermont high school graduates going on to higher education, the 25-44 age cohort demonstrates that Vermont has an above average number of holders of bachelor's degrees compared to the US average. This may be a reflection of the number of institutions of higher education in Vermont that attract highly qualified students.

FIGURE 6

Individuals in Science and Engineering Occupations as a Percentage of all Occupations (S-32)

In 2011, individuals working in science and engineering occupations as a percentage of all occupations was near the national average. Since that time, Vermont has trended downward relative to the US overall. If Vermont is to grow its technology-based business sector, one will expect to see an increase in this indicator. The downward trend could reflect either availability of jobs or the lack of a workforce that can fill jobs of this nature.

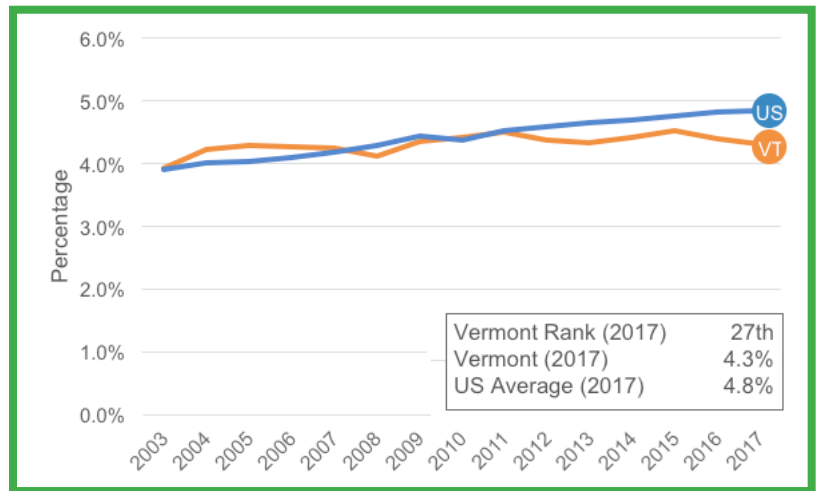


FIGURE 7

Life and Physical Scientists as a Percentage of All Occupations (S-34, S-36)

Since 2004, Vermont has been above the national average for life and physical scientists as a percentage of all occupations. As technology-based business increases, this indicator should show improvement.

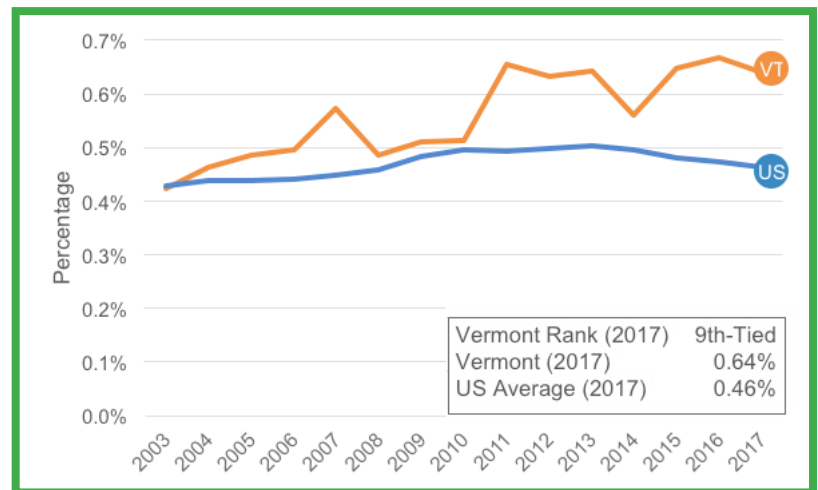
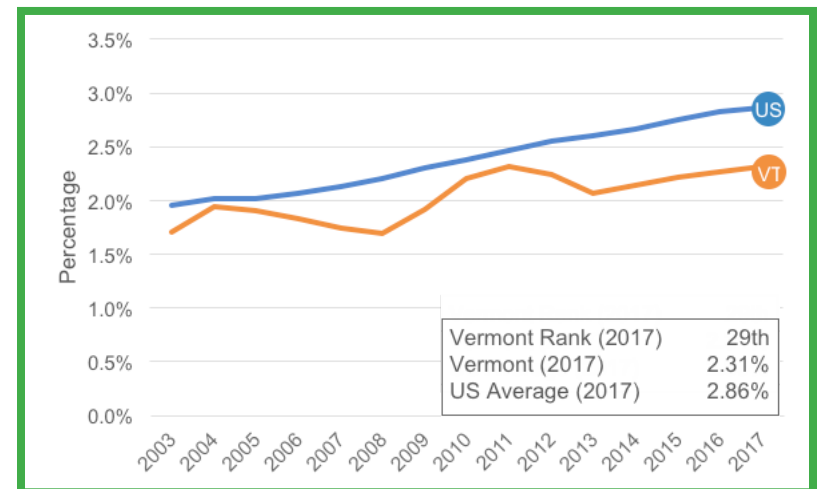


FIGURE 8

Computer and Mathematical Scientists as a Percentage of All Occupations (S-35)

As of 2014, the percentage of computer specialists in the workforce in Vermont is significantly below the national average and has been consistently below that average for the past decade. As technology-based business increases in Vermont, one should expect an increase relative to the national data.



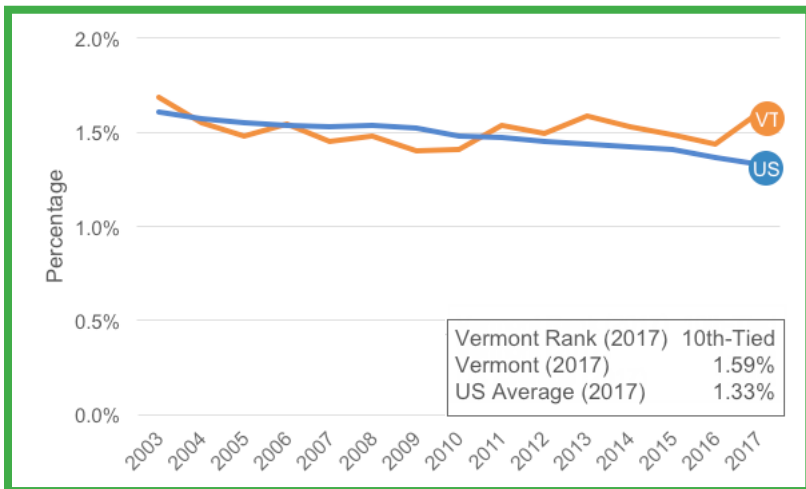


FIGURE 9
Technical Workers as a Percentage of all Occupations (S-39)

In 2006, the percentage of the Vermont workforce was at the national average. However, from 2007-2010, Vermont experienced a decline in the percentage of technical workers, dropping to 29th in the nation in 2009. Then, as technology-based business increased in Vermont, the percentage of technical workers rebounded while the national percentage declined, raising Vermont to a tie for 10th in the nation in 2017.

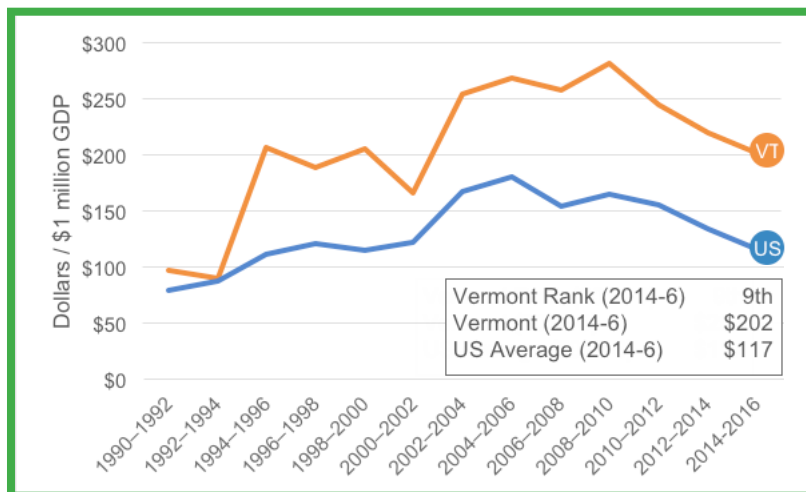


FIGURE 10
Average Annual Federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Funding per \$1 Million of GDP (S-55)

Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding over the last decade has been substantially above the national average. However, Vermont's funding level relative to the State's GDP is significantly down from its peak in 2008-2010. This suggests that there is an opportunity to improve SBIR/STTR funding to foster the growth of technology-based companies in Vermont.

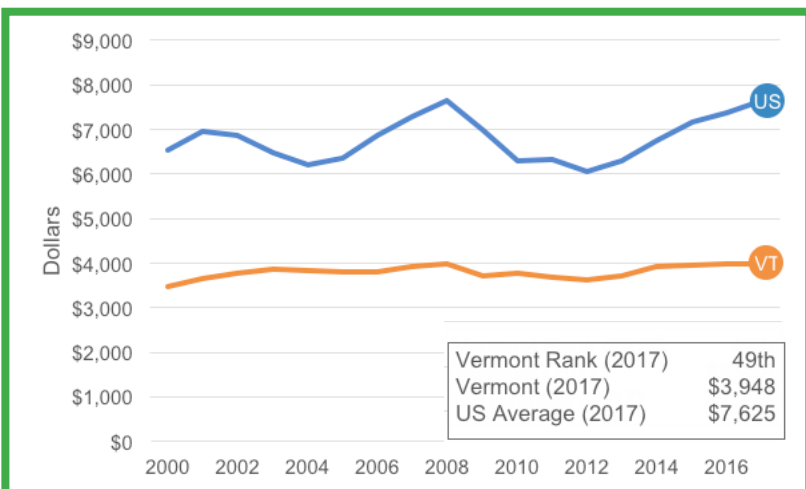


FIGURE 11
State Support for Higher Education per Full-Time Equivalent Student (S-28)

Vermont ranks 49th in its support for funding of higher education in the US, at 51.8% of the national average on a per student basis. Opportunities to make targeted investments, particularly those related to STEM education and research, should be a goal for the State.

FIGURE 12

R&D as a Percentage of Gross Domestic Product (S-41)

Total research and development investment as a percentage of GDP in Vermont has been persistently 0.5% below the US average since 2005 and has fallen even further off the national average in recent years. As the economy becomes more and more technology-based, the spending in R&D should increase.

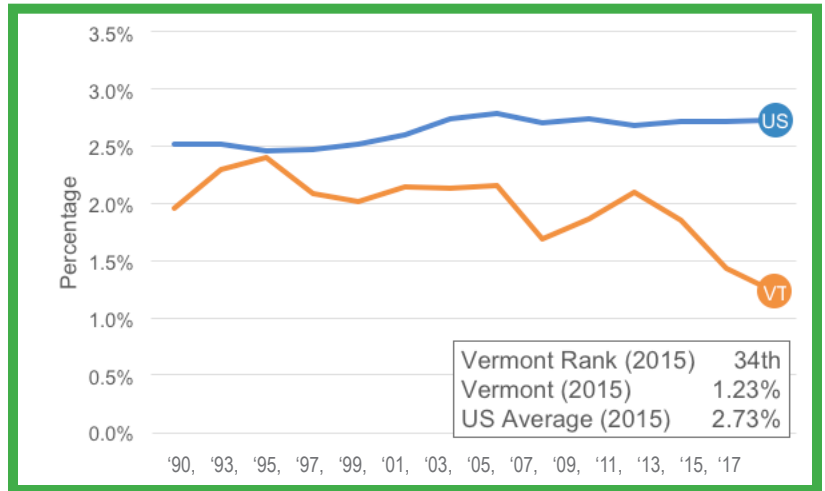


FIGURE 13

Academic Science and Engineering R&D per \$1,000 of Gross Domestic Product (S-46)

An important component of the R&D expenditures in Vermont is at the institutions of higher education. As a percentage of GDP, academic science and engineering R&D has ranked consistently higher than the national average, but that lead has vanished in recent years. The support for research in higher education should be a priority given the potential for discovery to serve as a base for economic growth.

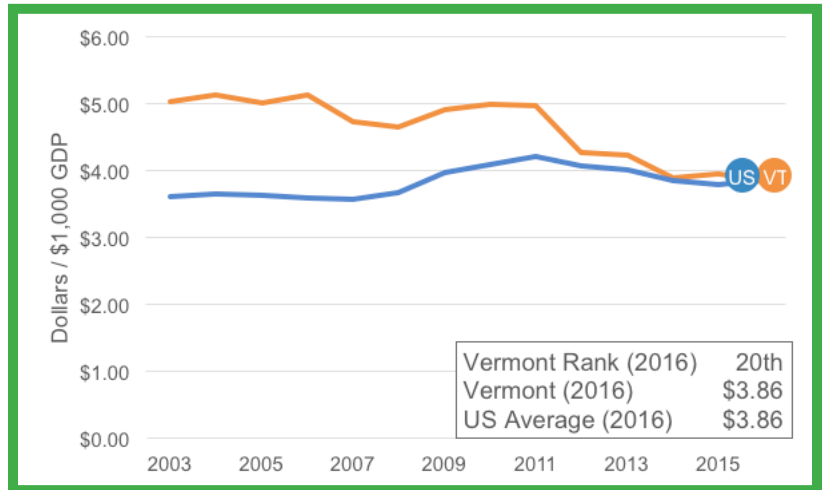
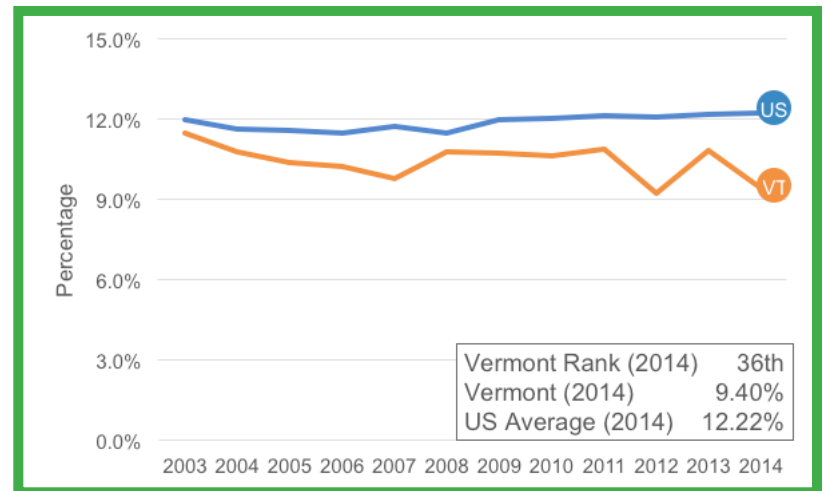


FIGURE 14

Employment in high Science, Engineering and Technology (SET) Employment Establishments as a Percentage of Total Employment (S-54)

Employment in high SET Employment establishments as a percentage of total employment in Vermont has been consistently below the national average and continues to fall further behind. If Vermont is to grow its technology-based business sector, one should expect to see an increase in this indicator. The downward trend could reflect either availability of jobs or the failure to cultivate a workforce that can fill jobs of this nature.



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Rob Miller

President
Vermont State Employee's Credit Union

Richard Schneider

President
Norwich University

Richard Tarrant

Chairman of the Board
Marathon Health

Lisa Ventriss

President
Vermont Business Roundtable

Prepared and Approved by the Vermont Technology Council, April 2019

The Science and Technology Plan prepared by the Vermont Technology Council is acceptable to the Vermont EPSCoR jurisdiction.

John N. Evans, Ph.D.

***President, The Vermont Technology Council
Chair, Vermont EPSCoR Statewide Board***



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