



NSHE Science and Technology Plan

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NEVADA SYSTEM OF HIGHER EDUCATION

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INTRODUCTION

This Nevada Science and Technology Plan (hereafter, “the Plan”) is presented by the Nevada System of Higher Education (NSHE) Board of Regents (BOR) and is intended to provide details about the direction, capability, and vision for educational, research, and economic development efforts in Nevada. This Plan allows NSHE and its community partners to frame future decisions and investment strategies for Nevada and public higher education. Through the years, the State of Nevada has partnered with NSHE to dedicate financial resources in support of science and technology education and research programs.

This Plan provides the foundation for coordinating research and education workforce development efforts statewide to benefit Nevada’s citizenry with consideration given to the research capacity and infrastructure already in place at NSHE institutions and potential opportunities for external funding. The Plan was initially developed by the research officers of the three NSHE research institutions. This update was developed in concert with input from the research faculty at the three NSHE research institutions and stakeholders from around the state. It was then reviewed and approved by the Nevada EPSCoR (Established Program to Stimulate Competitive Research) Advisory Committee (NVEAC) and the NSHE Board of Regents.

The three research institutions of NSHE are the Desert Research Institute (DRI), the University of Nevada, Las Vegas (UNLV), and the University of Nevada, Reno (UNR). DRI operations are supported primarily through external research funding while the two universities receive more State General Fund revenue for instruction and service activities. In 2019 both universities (UNLV and UNR) were ranked by the Carnegie Foundation as R1 Institutions (Doctoral Universities – Very high research activity). This classification places Nevada in a higher tier of

competitive universities and research impact capability, with implied research investment and outcomes necessary to maintain top-tier quality, reputation, and ranking. Total research funding for these three institutions for fiscal year 2019 was \$150 million with the majority coming from federal (60%) and federal pass-through (19%) sources. Other sources include state, other government, and private industry/non-profit at 21% total. Research funding represented 65% of sponsored projects for the NSHE research institutions.

Nevada's research activities historically depend heavily on external funding from governmental and private agencies including the United States Department of Agriculture (USDA), National Science Foundation (NSF), Department of Defense (DOD), Department of Energy (DOE), Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), and National Institutes of Health (NIH). In particular, the federally supported research-stimulation programs EPSCoR and NIH IDeA (Institutional Development Award) have assisted with Nevada's forward progress in research capability. Generally, funds received through the latter programs also require State General Fund matching dollars.

Nevada faces critical geographic and population issues common in other western states, creating opportunity for Nevada to lead in several key areas of research and development. Accordingly, key research priority areas are identified for further development within this Plan. These areas are designed to emphasize the societal and economic needs of the State, highlight the expertise that lies within the NSHE institutions to advance these areas, and set goals of regional and national research and innovation leadership. These are not in ranked order because each is critical to Nevada's economic and environmental future. Four overarching themes for these focus areas are Land and Natural Resources, Integrated Health and Wellness, Digital Technologies, and Infrastructure and Industrial Technologies.

RESEARCH PRIORITY AREAS

Land and Natural Resources

- Water Resources
- Sustainable Energy
- Environment and Natural Hazards
- Agriculture and Food Security
- Policy and Economics

Integrated Health and Wellness

- Health Care Access and Research
- Microbiology and Immunology
- Neuroscience
- Policy and Economics

Digital Technologies

- Networking
- Cybersecurity
- (Big) Data Management

- Computing Systems
- Software and Automation
- AI/ML and Analytics

Infrastructure and Industrial Technologies

- Transportation
- Applied Materials
- Biotechnology
- Robotics
- Advanced Manufacturing
- Logistics
- Mining

Each of these research priority areas is examined in this report with consideration given to the specific challenges facing Nevada, the assets available to meet these challenges, and strategies for how NSHE can provide the faculty expertise, applied and basic research, technology transfer, and graduates to help the State meet its goals in each area.

In order to ensure success in Nevada's research priorities, five cross-cutting strategic investment areas must be embedded into budgetary and development actions by NSHE and the individual institutions' research officers and campus executives: Workforce Development, Technology Transfer, Cyberinfrastructure, Communication and Outreach, and Convergence Research. These are described in the Common Strategies for Success section of this report.



LAND AND NATURAL RESOURCES

Research Focus on Land and Natural Resources

Nevada has the highest percentage of federally controlled land of any state at 80.1%¹. Much of this land exists in a rural, undeveloped condition, albeit with historical waves of utilization in mining, ranching, and energy sectors over the last 150 years. At the same time, Nevada has the 3rd highest percentage of state populations living in urban areas, at 94.2%². As Nevada is the 7th largest state by land area, as well as the most mountainous of the lower 48 U.S. states, these highly concentrated populations often rely on remote, distant locations for natural resources such as water and energy, as well as agriculture, recreation, and other uses. This spatial disconnect creates a challenge for state institutions to engage meaningfully with rural populations, industries, and land management policies.

Due to Nevada's history and unique geography, NSHE institutions have perhaps their longest research/service legacies in topics within land and natural resources, including mining³, ranching and agriculture, energy, water, and other environmental sciences. These are areas where the state retains great economic and scientific potential, with pre-existing capability, partnerships, and infrastructure. In particular, the boom-and-bust nature of tourism economies that drive much of the state's revenue at present underscores the need for continued diversification of capability in land-focused research topics with long-term impact, as global populations and pressures on natural resources increase. Investment and strategic coordination in these areas not only serves Nevada's distributed geography as the state population continues to expand but maintains leadership potential in key topics that will only increase in national/international importance with time.

¹ <https://fas.org/sgp/crs/misc/R42346.pdf>

² https://www2.census.gov/geo/docs/reference/ua/PctUrbanRural_State.xls

³ The topic of mining is detailed later in the section: Infrastructure and Industrial Technologies

Research focus areas under Land and Natural Resources:

- **Water Resources:** The Nevada Division of Water Resources⁴ states that water is Nevada's most precious renewable natural resource, and a key element in safeguarding this limited resource is responsible management gained through education. Future economic growth and sustainability in the State of Nevada is completely dependent upon accurately quantifying inputs/outputs and responsibly managing storage and use of water resources. Our understanding of both the quantity and quality of water in Nevada, and of the complex responses needed due to variability in population and long-term climate, are improved through advanced education in science and engineering-based disciplines.
 - Strengths/Assets:
 - Diversity of faculty expertise to support world-class water-focused research
 - Unique observational and experimental facilities at all institutions
 - Rural sensor and data networks to support statewide water monitoring research
 - Hydrology graduate programs
 - Public/private investment in water technology and companies⁵
 - Goals/Additional Focus Needed:
 - Coordination of observation, modeling, planning, infrastructure, and policy efforts
 - Funding stability of NSHE water-focused programs, products, and infrastructure
 - Water-focused education with integration into Nevada P-16 curriculum
- **Sustainable Energy:** Nevada has an abundance of natural resources from solar, geothermal, and wind sources that provide the potential for the State to become energy independent and carbon neutral with the proper technical and financial resources in place. Few states have such a wide variety of assets. Development of these renewable energy resources, and the economic infrastructure to commercialize and bring them to market, will require partnerships between NSHE, industry, and government. In 2018, provider NV Energy achieved an overall 24.2% from renewable sources score and was well on the way to the required 25% by 2025. On April 22, 2019, Governor Sisolak signed into law Senate Bill 358, which increases Nevada's renewable portfolio standard to 50% by 2030.
 - Strengths/Assets:
 - Nevada State Office of Energy
 - Legislated Nevada energy portfolio standard (requiring renewable energy on the grid)
 - A highly supportive citizenry and positive public perceptions
 - Research in solar, grid, and micro-grid technologies
 - Goals/Additional Focus Needed:
 - Public and private partnerships in renewable energy development
 - Energy infrastructure and storage, renewable/recyclable energy
 - Technical and engineering workforce development for a clean energy economy

⁴ <http://water.nv.gov/>

⁵ <https://waterstart.com/>

- Energy education and public assistance programs
- **Environment and Natural Hazards:** Nevada has several geographic attributes that impact the response of human and natural systems to the environment and natural hazards over past, present, and future. These include, but are not limited to: (1) great contrasts in climate and ecosystems over short distances created by Nevada’s location and the Basin and Range topography; (2) a high degree of aridity and drought risk making Nevada the most arid state in the U.S.; (3) a highly concentrated/urbanized population; (4) high seismic activity of the Basin and Range province; and (5) wildfire-prone landscapes due to vegetation, seasonal climate characteristics, and patterns of historical and modern land use. These combinations are in no way unique globally; however, they do provide Nevada with the opportunity to lead science, knowledge, and practices associated with these land management and natural hazard challenges.
 - Strengths/Assets:
 - Established State Offices and Labs within NSHE (NSCO, NSL, NBMG)
 - Western Regional Climate Center (DRI) network, data, and outreach expertise
 - Faculty integration with USFS RMRS for forestry, rangeland science
 - Goals/Additional Focus Needed:
 - Coordinated strategy, resources, and development for Centers, Offices, and Labs
 - Wildland/urban interface planning and adaptation research
 - Interdisciplinary data management/products expertise and infrastructure
 - Wildfire processes, mitigation, and impacts
- **Agriculture and Food Security:** Roughly one third of Nevadan adults were eligible for federal food aid before the state was affected by the 2020 COVID-19 pandemic and a third of these were food insecure. A safe and secure food source is not only critical on a national and worldwide level, but as the pandemic’s effects on food supply chains have demonstrated, it is important at the local level as well. With 42% of the earth’s surface classified as dryland, similar to Nevada’s geography, this affords a unique opportunity for Nevada to take a leading role in developing sustainable dryland agricultural practices, a major challenge area for global food security. Opportunities exist to expand and improve traditional agricultural practices as well as to enhance indoor agricultural methods and production. Development of the agriculture industry in Nevada is not only important for local food security but also for Nevada’s tourism industry, which seeks to provide tourists with high quality food. The Nevada Department of Agriculture’s Biennial Report for 2019 reports that the state’s food and agriculture sector contributed \$1.3 billion to the state’s economy in 2017, accounting for 16,344 jobs with the primary products being livestock, wheat, and corn.
 - Strengths/Assets:
 - UNR College of Agriculture, Biotechnology, and Natural Resources, Nevada Agricultural Experiment Station, and Extension faculty, facilities, and programs.
 - Partnerships with Federal Agricultural Research Services and Natural Resources Conservation Services as well as the Nevada Department of Agriculture

- Startup companies spun off from NSHE institutions such as Tu Biomics⁶
- Goals/Additional Focus Needed:
 - Infrastructure expansion for research and Extension program activities
 - Strategic partnerships with communities/industry for supply chain and food security
 - Development of regional centers to address local food security and safety issues
 - Spatial mapping of soil, agriculture, horticulture, agricultural economics, and noxious and invasive weeds
 - Dryland farming/irrigation systems, and small- to medium-scale automation
- **Policy and Economics:** Due to sharp delineation of urban and rural populations, economics and policy mismatches remain prevalent between state- or federal-driven land and resources initiatives and rural communities/industries. NSHE researchers in the fields of economics, policy, and social sciences and industries such as mining, ranching, and agriculture have the opportunity to coordinate efforts to better assess impacts of high-level policy and strengthen rural communities.
 - Strengths/Assets:
 - Extension faculty, programs, outreach
 - Land-grant mission of the University of Nevada, Reno
 - Interdisciplinary economics and policy faculty
 - Goals/Additional Focus Needed:
 - Strategic and engaged community partnership building
 - Purposeful study of rural social/economic impacts of land management practices
 - Integration of land and natural resources in K-20 education

⁶ A startup driving the development of organic antifungal chemicals as a cost-effective alternative to currently available options.



INTEGRATED HEALTH AND WELLNESS

Research Focus in Integrated Health and Wellness

Health and wellness are essential for the quality of life that Nevadans deserve. They depend on the ability of Nevada's health infrastructure to identify and mitigate causes of disease and to provide appropriate health care when necessary. This infrastructure is overstretched as statewide training programs in the health professions (e.g., medicine, nursing, allied health, public health, nutrition, and others) cannot meet the demands as our population increases. In addition, Nevada is 50th in the nation for per-capita annual spending on public health (\$46 compared with \$220 for New Mexico, \$150 for Idaho, and \$80 for Utah) and 43rd in the nation for rate of health insurance⁷. Perhaps the most telling indicator of the capacity and function of Nevada's health care infrastructure is that the state is ranked 45th for active physicians per 100,000 people, 48th for primary care physicians per 100,000 people, and 50th for general surgeons per 100,000 people⁸. All of this combines to rank Nevada 48th for health system performance⁹.

NSHE institutions address this infrastructure shortfall through education and research. Our universities and community colleges train physicians, physician's assistants, nurses, dentists, psychologists, and social workers (among other health-related professionals) to address statewide shortages in these fields. Faculty members from UNR, UNLV, and DRI conduct world-class research, identifying the causes and mechanisms of disease, while training undergraduate and graduate students in their fields. Nevada's federally funded research efforts include neuroscience, cardiovascular disease, infectious disease, microbiology, immunology, muscular

⁷ <https://www.americashealthrankings.org/explore/annual/measure/Overall/state/NV>

⁸ Packham, J., and T. Griswold. 2020. Physician Workforce in Nevada: A Chartbook. University of Nevada, Reno, <https://med.unr.edu/statewide/reports> 28 pp

⁹ <https://scorecard.commonwealthfund.org/state/nevada/>

dystrophy, gastrointestinal disease, psychology and behavior, and personalized medicine. In the area of clinical research, NSHE faculty members are identifying local health problems and testing therapeutic approaches to alleviating them. Researchers are investigating suicide, HIV risk, Parkinson's disease, traumatic brain injury, and infectious diseases, including drivers of global pandemics. These NSHE programs are finding answers and training the people that will apply them to improve health outcomes for all Nevadans.

Research focus areas under Integrated Health and Wellness:

- **Health Care Access and Research:** Recent years have seen an extraordinary increase in medical training and biomedical research in Nevada. Existing degree-granting programs have expanded and the numbers of graduates in all health-related professions have increased. New research programs have started at each of the NSHE research institutions, and several new research centers have been created. Nevada now ranks 25th among U.S. states for the number of undergraduate medical students per 100,000 population¹⁰.
 - Strengths/Assets:
 - LCME¹¹ accredited Schools of Medicine at both UNR and UNLV
 - Two-year ARC-PA¹² accredited Physician's Assistant program at UNR
 - NIH IDeA program¹³: funding research via INBRE¹⁴, COBRE¹⁵, and IDeA-CTR¹⁶
 - Centers for Cardiovascular Physiology, Integrative Neuroscience, and Personalized Medicine
 - Project ECHO¹⁷, Nevada telehealth project at UNR for underserved populations
 - Population Health: Healthy Nevada Project¹⁸ between DRI and Renown Health
 - UNR School of Community Health Sciences and UNLV School of Public Health
 - Goals/Additional Focus Needed:
 - Resources to boost clinician research in NSHE medical schools
 - Graduate medical education—Nevada ranks 44th in per-capita residents and fellows
 - Infrastructure and technologies for community-based research
 - Health science informatics (data and analytics expertise and infrastructure)
- **Microbiology and Immunology:** Microbiology and immunology research is conducted across UNR, DRI, and UNLV, supported by grants from the NIH, NSF, DOD, NASA, and DOE to study pathogens (including SARS-CoV-2), life in extreme environments, microbiology and immunological diagnostics, and microbial biotechnology. These inter-

¹⁰ Packham, J., and T. Griswold. 2020. Physician Workforce in Nevada: A Chartbook. University of Nevada, Reno, <https://med.unr.edu/statewide/reports> 28 pp

¹¹ <https://www.aamc.org/services/first-for-financial-aid-officers/lcme-accreditation>

¹² <http://www.arc-pa.org/>

¹³ <https://www.nigms.nih.gov/Research/DRCB/IDeA/Pages/default.aspx>

¹⁴ <https://www.nigms.nih.gov/research/drcb/IDeA/Pages/INBRE.aspx>

¹⁵ <https://www.nigms.nih.gov/Research/DRCB/IDeA/pages/COBRE.aspx>

¹⁶ <https://www.nigms.nih.gov/Research/DRCB/IDeA/Pages/IDeA-CTR.aspx>

¹⁷ <https://med.unr.edu/echo>

¹⁸ <https://healthynv.org/>

disciplinary programs span clinical microbiology and immunology programs, basic research, modeling, and big data approaches to the planet's most abundant organisms.

- Strengths/Assets:
 - UNR Department of Microbiology and Immunology focus on pathogen diagnostics
 - UNLV School of Life Sciences focus on basic and applied microbiology
 - DRI Earth and Ecosystem Sciences focus on life in extreme environments
- Goals/Additional Focus Needed:
 - Wider access to state-of-the-art technology from shared core biomedical facilities
 - Increased focus on diagnostics and testing
 - Resources to promote additional technology transfer
- **Neuroscience:** Neuroscience research is conducted across several departments at UNR and UNLV, supported by grants from the NIH and NSF, to study how brains and brain-like machines work. A high degree of cutting-edge interdisciplinary work is leading to the development of interdepartmental degree and research programs conducting studies across systems including genes, cells, invertebrate and vertebrate animals, humans, and machines.
 - Strengths/Assets:
 - UNR Institute for Neuroscience with focus on technology-based research
 - UNLV Departments of Psychology and Brain Health
 - Goals/Additional Focus Needed:
 - Access to state-of-the-art technology from shared core biomedical facilities
 - Controlled/sensitive data management with scalable capacity and security
 - Analytics and computing expertise to help scientists integrate across disciplines
- **Policy and Economics:** Information needed by Nevada public and private health policy makers is provided by epidemiologists and statisticians on the faculties of the NSHE research institutions. These individuals collect, collate, and analyze data concerning threats to Nevada health quality and the ability of the state's infrastructure to address them.
 - Strengths/Assets:
 - UNR Med Office of Statewide Initiatives
 - Nevada State Public Health Lab
 - UNR CHS Nevada Youth Risk Behavior Survey
 - Goals/Additional Focus Needed:
 - Planning and continuity support for NSHE medical schools
 - Outreach and education programs for community-based research initiatives



DIGITAL TECHNOLOGIES

Research Focus in Digital Technologies

Because all aspects of commerce, industry, society, and government are increasingly dependent upon digital or “information” technologies, increased research focus within these and related fields is of critical importance for Nevada to emerge as a capable contributor to advancements in technology development across a broad range of applications. Technology is generally seen as both a key to opportunity as well as a tool of oppression¹⁹, and improving Nevada’s capabilities to leverage technology and defend against abuse will have a lasting strategic impact for the state and its workforce.

Nevada continues to emerge as a strong center for businesses in the information technology (IT) sector due to improved digital infrastructures, the lack of seasonal natural disasters, proximity to Silicon Valley, and a mix of traditional and green energy sources that are reliable. This economic transformation in Nevada has brought new and unexpected private-public partnerships and collaborative research opportunities. Over the last decade, the state’s educational institutions have strategically added technology capability through faculty hires in complementary areas. Although NSHE is still in the early stages of established, comprehensive, and robust investments in technology fields, it is expected that emerging centers of excellence with regional and national capacity/capability will follow in the next 10 years from existing NSHE strengths in cybersecurity, wide-area networking, robotics, and automation, among others.

Research focus areas under Digital Technologies:

- **Networking:** The core foundation of any connected technology, networking remains a field of strategic capability that can support/enhance innovative and transformative activities in all

¹⁹ <https://www.un.org/en/un75/impact-digital-technologies>

other fields. Networking is a rapidly evolving field due to changes in wireless and security technologies as well as market-driven shifts such as the Internet of Things (IoT).

- Strengths/Assets:
 - NDOT²⁰/NSHE statewide fiber network of robust and high-bandwidth connectivity
 - Nevada Seismological Laboratory statewide research/service mountaintop network
 - Industry partners, such as the Nevada-based technology company Switch
- Goals/Additional Focus Needed:
 - Network performance and advanced systems telemetry architectures
 - Modern/future network architectures for hyper-connected zones
 - Automated flow provisioning and optimization for variable-performance networks
- **Cybersecurity:** Increases in the complexity of technology bring increases in security threats from adversarial sources as well as greater variation in reliability and performance. Anticipating, detecting, and addressing security of data transmission, software applications, and device control across networks is a cornerstone of broad technology capability.
 - Strengths/Assets:
 - UNR Cybersecurity Center research, training, sandbox, and workforce development
 - UNLV Cybersecurity Center
 - Industry and government partners (Reno Police Department, NV Energy, NV Department of Education, Nevada National Security Site, FBI, Vere Software, SNC, HPE, and CISCO)
 - Goals/Additional Focus Needed:
 - Cooperative SOC²¹ operations/design
 - Testbed integration with multi-disciplinary research projects with a focus on both research/governmental and commercial cybersecurity
- **(Big) Data Management:** Explosion of digital data sources (such as IoT, simulations, imaging systems, etc.) has created exponentially increasing data across commerce, industry, engineering, science, and society. Managing these data in terms of workflow, storage, analytics, derivatives, and archival has become a primary problem for the research community as they struggle to keep up with private sector practices.
 - Strengths/Assets:
 - Pilot work in EPSCoR Track 1 projects for multi-disciplinary data management
 - Membership in research-data-facing organizations, such as ESIP²², CaRCC²³, RDA²⁴

²⁰ Nevada Department of Transportation, <https://www.nevadadot.com/>

²¹ Security Operations Center

²² Earth Science Information Partners, <https://www.esipfed.org/>

²³ Campus Research Computing Consortium, <https://carcc.org/>

²⁴ Research Data Alliance, <https://www.rd-alliance.org/>

- Goals/Additional Focus Needed:
 - Research data management teams at NSHE institutions
 - Software-based controlled and uncontrolled data structures and workflows
 - Hybrid-cloud performance optimization
 - Best/future practices for the data management lifecycle

- **Computing Systems:** Computing systems have diverged from the traditional dichotomy of either single-node desktops/servers or large batch “High Performance Computing” (HPC) to a spectrum of edge, throughput, cloud, HPC cluster, and national supercomputers. Research and expertise to apply and innovate across this spectrum has become a science and engineering differentiator, shortening times to discovery and solutions.
 - Strengths/Assets:
 - UNLV Supercomputing Institute, UNR OIT HPC Operations
 - Membership in national computing communities (NSF-XSEDE, CASC, PEARC)
 - Goals/Additional Focus Needed:
 - Application/algorithmic optimization for GPU and future HPC architectures
 - Faculty cross-training and facilitation in different computing architectures
 - Multi-disciplinary scalable computing integration and development
 - Hybrid/flexible architectures for edge/federated/throughput/cloud computing

- **Software and Automation:** Over the last decade, software development practice has made important transitions from classic standalone applications to cloud-friendly code-as-infrastructure approaches that support automation of digital processes at scale. More and more technologies rely on DevSecOps²⁵-based practices such as continuous development/delivery, automated testing, and team-based code repositories. Developing expertise and practice in this area is vital to Nevada’s industry, infrastructure, and academic competitiveness.
 - Strengths/Assets:
 - Strong computer science and engineering educational programs at UNR and UNLV
 - Domain research automation teams with software expertise (neuroscience, robotics)
 - Private-cloud automation pilots in UNR connected-community projects
 - Goals/Additional Focus Needed:
 - DevSecOps training/education, inter-institutional team formation, incentives
 - Models for code-as-infrastructure in both applied and experimental research
 - Innovative integration of software/coding expertise into other disciplines

- **AI/ML and Analytics:** Continued development of artificial intelligence, machine learning, and other advanced analytics techniques continues to dominate big data research and innovation. While these methods have typically been applied in supercomputing environments, it is now common to see refined AI/ML algorithms pushed out to the “edge”

²⁵ Development-Security-Operations: an integrated continuous improvement model of technology delivery.

on small, optimized computing devices. Nevada's IT industry and evolving infrastructure will depend more and more on these methods to ask and answer critical question of big data in healthcare, smart cities, manufacturing, earth and environment, and other fields.

- Strengths/Assets:
 - Many AI/ML-focused faculty hires in last five years at UNR and UNLV
 - Targeted educational outreach with Girls Who Code, NCWIT²⁶, Boys and Girls Club
- Goals/Additional Focus Needed:
 - Research and experimentation with distributed ML workflows from HPC to edges
 - Application of ML in production networking and cybersecurity environments
 - Development of advanced visualization analytics/workflows

²⁶ National Center for Women & Information Technology, <https://www.ncwit.org/>



INFRASTRUCTURE AND INDUSTRIAL TECHNOLOGY

Research Focus in Infrastructure and Industrial Technology

Growth in Nevada's economy in these areas has not been by accident, but rather a result of the economic development and diversification plan adopted by the State after the Great Recession of 2008. As the COVID-19 pandemic of 2020 demonstrates, supply chains and distribution networks are key infrastructure technologies that are necessary not only for companies' competitive advantage, but for the smooth operation of modern society. Leadership in industrial technologies is increasingly important to Nevada's future. Northern Nevada has been a central West Coast distribution point for many companies for decades, but the arrival of the Tesla Gigafactory reinforced the importance of northern Nevada's proximity to Silicon Valley. Southern Nevada has recently become a key distribution location for the American Southwest, with large numbers of distribution and manufacturing firms locating there. For the state to secure these aspects of its economy, it is crucial that NSHE continues to develop and sustain expertise in these areas.

In Nevada, we have researchers focused on many individual aspects of infrastructure and industrial technology, including mining, transportation, robotics, advanced materials, biotechnology, manufacturing, and logistics. Improving coordination across these has strong potential for leadership and innovation in NSHE research activities. For example, one key industrial technology where many of these disciplines overlap is the use of autonomous drones. Faculty at UNR and UNLV are studying various aspects of improving drones' technical performance, while faculty at UNR are studying their most efficient and effective use. Other faculty are developing advanced materials for products, improved electric vehicle technologies, robotic systems for human cooperation, identification technologies for tracking products, and

blockchain systems for tracking refurbished products. All these efforts are highly complementary, and large funded projects or public-private partnerships should leverage this diversity of expertise for Nevada's benefit.

Research focus areas under Infrastructure and Industrial Technology:

- **Transportation:** The transportation sector is undergoing rapid technological change. Advances in connected and autonomous vehicle technology, a proliferation of electric vehicles, and on-demand services all offer opportunities to change the future of mobility. This makes transportation a key area of research emphasis for Nevada, with our highly urban populations facing longer commutes to emerging distribution, industrial, and technology business centers.
 - Strengths/Assets:
 - Connected and automated mobility pilots at UNR²⁷ and UNLV²⁸
 - Legislative/policy support to integrate advanced vehicle technologies and services
 - Electric vehicle technology powertrain and control development
 - Faculty partnerships with regional transportation organizations and local governments
 - UNLV RailTEAM²⁹—improving high-speed railroad infrastructure
 - Goals/Additional Focus Needed:
 - Modeling altered travel patterns based on emerging technologies and services
 - Integrating advanced vehicle technologies with existing and planned infrastructure
 - Road user safety, vulnerable road users, urban non-motorized travel
 - Facilitating safe and equitable access to employment and services
 - Electric vehicle and storage systems engineering
- **Advanced Materials:** In 2014, the National Science and Technology Council (NSTC) identified advanced materials as one of the top priorities for global competitiveness and stated that “advanced materials are essential to economic security and human well-being, with applications in multiple industries, including those aimed at addressing challenges in clean energy, national security, and human welfare”³⁰. Advanced materials research and development offers Nevada the ability to diversify and strengthen local economies in these fields.
 - Strengths/Assets:
 - Several faculty hires in computation-focused materials for rapid innovation
 - Materials Characterization Nevada provides services to industry
 - Materials under extreme environments (molten salts, high temperatures)
 - Research and education on batteries, nuclear materials & nanotechnology
 - Several faculty hires in advanced manufacturing fields

²⁷ <https://www.unr.edu/ncar/programs/intelligent-mobility>

²⁸ <http://nevadacam.org/>

²⁹ Rail Transportation Engineering and Advance Maintenance, <https://www.unlv.edu/railteam>

³⁰ Frontiers of Materials Research, the National Academies of Sciences, Engineering, Medicine, 2019

- Goals/Additional Focus Needed:
 - Non-metallic materials such as glass, ceramics, and composites
 - In-situ spectroscopy instrumentation for nanoscale research
 - Biomedical materials research
 - Focus on recycling/reprocessing/reclamation

- **Biotechnology:** Biotechnology provides commercial solutions to address the medical, environmental, agricultural, and industrial challenges of the 21st century. Biotechnology will lead to the development of new drugs to cure cancer and disease, microbes to remove environmental contaminants, and crop plants to feed the world. Two multinational companies, Charles River Laboratories and Hamilton Company, serve as industry anchors in Nevada. NSHE-sponsored biotech incubators have led to the establishment of successful biotechnology startups, and several companies are highly dependent on NSHE institutions for educating and training their workforces.
 - Strengths/Assets:
 - Public access to biotechnology incubator space (e.g., UNR Bioscience Entrepreneurial Lab³¹)
 - UNR BS and MS Biotechnology programs ranked 15th in the nation by Money Inc.³²; UNLV BS in Biology with Biotechnology concentration
 - Review of biotechnology curriculum by industry partners
 - NV Governor’s Office of Economic Development workforce development (e.g. LEAP³³)
 - State-of-the-art biotechnology instrumentation (e.g., Hamilton Center of Laboratory Automation³⁴; Nevada Genomics Center³⁵; Nevada Genomics Core Facility³⁶, Mick Hitchcock PhD Nevada Proteomics Center³⁷; Nevada Center for Bioinformatics³⁸)
 - Goals/Additional Focus Needed:
 - Business ecosystem for NSHE-facilitated, biotech industry-funded research
 - Sustained state-of-the-art biotech instrumentation support and expertise
 - Biotech-oriented graduate student assistantships
 - Continuing-education programs with the latest science for existing biotech workers

- **Robotics:** Nevada has specifically identified robotics (ground and aerial / UAVs) as an area for STEM workforce development³⁹, and the field encompasses most of the aspects of STEM

³¹ <https://www.unr.edu/ncar/infrastructure/bel>

³² <https://moneyinc.com/colleges-with-the-best-biotechnology-degree-programs/>

³³ <https://www.diversifynevada.com/programs-incentives/workforce-development/leap/>

³⁴ <https://www.unr.edu/nevada-today/news/2013/hamilton-robotics-university-collaborate->

³⁵ <https://www.unr.edu/genomics>

³⁶ <https://www.unlv.edu/genomics>

³⁷ <https://www.unr.edu/proteomics>

³⁸ <https://www.unr.edu/bioinformatics>

³⁹ https://nvworkforceconnections.org/wp-content/uploads/2016/12/lo-res_WorkForce-Annual-Report-pages-2015-Final.pdf

critical for a 21st century Nevada workforce. In addition, as more Nevada jobs are lost to automation in various industries, investment in robotics education in Nevada can help ready the workforce of tomorrow to balance this trend. Sustained investment would lead to tighter connections with industry partners and more innovation.

- Strengths/Assets:
 - Many robotics faculty hires in the last 10 years
 - Top 20 university in the U.S. in robotics publications⁴⁰
 - Connections to many other top-ranked robotics universities
- Goals/Additional Focus Needed:
 - Student training in robotics (MS/PhD program).
 - Human-robot teaming research that enables collaborative physical and non-physical interaction.
 - Trustworthy systems development and deployment for industrial applications.
- **Advanced Manufacturing:** The dominant supply chain strategy for the first two decades of the 21st century has been one of increased outsourcing to overseas locations, primarily driven by lower wages in developing countries. However, there are significant national downsides to outsourcing large percentages of production to facilities outside the U.S. and North America. Increasing wages in China and Southeast Asia have reduced the labor cost differential, and robotics has increasingly made human labor more efficient. These factors and more have caused companies to consider bringing production back to the U.S. or North America. Advanced manufacturing is among the fastest growing industries in Nevada. According to the Nevada Department of Employment, Training and Rehabilitation (DETR), manufacturing grew 10.2% in 2018. In October 2018, more than 27,400 people were employed in advanced manufacturing in Reno-Sparks and 26,100 in greater Las Vegas.
 - Strengths/Assets:
 - Nevada's tax climate, geographical location, and low-cost, reliable energy
 - UNR Advanced Manufacturing Initiative is bringing new faculty to campus
 - TMCC Cyberphysical Manufacturing Lab⁴¹ with newly created linked degree BAS in Cyberphysical Manufacturing⁴²
 - TMCC-Festo⁴³ and WNC-Siemens⁴⁴ partnerships are training students for Industry 4.0 certification
 - Faculty expertise in robot-human collaborative interaction
 - Leading expertise in refurbishing and remanufacturing
 - Goals/Additional Focus Needed:
 - Blockchain technology for storing product histories and refurbishing

⁴⁰ <http://csrankings.org/#/index?robotics>

⁴¹ <https://www.rgi.com/story/money/business/2018/10/24/tmcc-industry-4-point-0-manufacturing-lab-tesla-robots/1752955002/>

⁴² <https://www.tmcc.edu/news/2019/08/bachelor-applied-science-cyber-physical-manufacturing>

⁴³ <https://www.tmcc.edu/news/2018/11/industry-4.0-lab-leads-tmcc-into-the-future>

⁴⁴ <https://www.wnc.edu/siemens-mechatronics-level-1-training-available-technicians/>

- Circular economy research and optimization for Nevada’s rural-urban divides
 - Re-shoring or nearshoring: modeling flexibility and risk benefits
 - Industry 4.0 certifications, partnerships, research and integration
 - Optimized and reliable supply chain backed by logistics
 - Integrated workforce continuing education and training
- **Logistics:** With the advent of high-speed connectivity and other technologies, rural populations hold tremendous potential to contribute to next-generation manufacturing, distribution, and material production initiatives. For goods to be transported, decisions must be made about where they are to be produced, where they are to be sent, which suppliers to use, how to get the inputs to them, and how to get the products efficiently and quickly to where they are to be sold. Efficient usage of resources requires mathematical optimization, a field now known as business analytics.
 - Strengths/Assets:
 - Faculty closely engaged with practitioners in international organizations
 - Graduate and undergraduate programs in Business Analytics at UNR
 - Advanced manufacturing hires with supply chain interests
 - Goals/Additional Focus Needed:
 - Drone productivity and safety benefits in logistics and distribution
 - Business analytics to improve efficiency of logistics operations
 - Safe handling of e-waste, product collection and refurbishing
 - **Mining:** Nevada is the most mineral-rich state in the U.S. and has a large and established mining industry, producing over 80% of the gold recovered in the country. Many rural communities in Nevada rely on mining for local economic development, and close partnerships exist between NSHE mining and engineering programs and multinational companies. While gold and other historically precious metals are the primary resources mined in the state, several rare metals and elements for defense and technology applications have not been extensively sought after in Nevada.
 - Strengths/Assets:
 - Well-established leadership mining and engineering programs at UNR
 - Integration with environmental stewardship and engineering research
 - Strong industry partnerships and workforce development pipeline
 - Autonomous Robots Lab⁴⁵ research partnerships
 - Goals/Additional Focus Needed:
 - Artificial intelligence and autonomous systems for production and safety in mining
 - Mine health and safety educational program for Nevada miners
 - Community resilience support for boom-and-bust economies
 - Rare earth/critical mineral exploration and processing and mine re-processing
 - Research and development of mine closure plans and life-cycle-analysis

⁴⁵ <https://www.autonomousrobotslab.com/autonomous-navigation-and-exploration.html>



STRATEGIES FOR SUCCESS

In order to ensure success in the above Research Priority Areas, five components must be embedded into investment and development actions: Workforce Development, Technology Transfer, Cyberinfrastructure, Communication and Outreach, and Convergence Research. Advances in the Research Priority Areas are highly faculty- and funding-dependent; however, the following strategies are directly enabled by NSHE and the individual institutions and are therefore responsibilities of the Research Officers/Administrators at NSHE and each institution. Success in these cross-cutting strategic investment areas ensures that faculty, students, and support staff can maximize their potential to positively impact Nevada and the nation.

- **Workforce Development:**

- **Introduction:** Capacity-building and investment in research infrastructure needs to be paired with STEM workforce development for the *sustainability of the research infrastructure* so that material and program investments are used to develop competitive talent. At the core, this relies on a strong and cohesive STEM pipeline to prepare diverse and talented individuals. This also directly serves local *economic development*, as attainment of bachelor's degrees in STEM fields is a key factor in social and economic mobility for individuals from all Nevada communities.
- **State:** The current state of STEM workforce development in Nevada involves distinct yet overlapping goals between higher education and industry. In higher education, Nevada's universities, state college, and community colleges offer a plethora of degree and training options in STEM fields, ranging from competitive graduate programs to pre-Baccalaureate technical training programs. Goals emphasize a strong and accessible STEM pipeline from K-12 to the PhD level. In industry, business growth and workforce attraction has been focused on the computer sciences, software technologies, automation, and operating processes. Emphasis is placed on workforce needs at the intersection

between computer sciences and automation, specifically for technology jobs and advanced manufacturing, with technical training to fill job openings quickly. Thus, the most significant areas of overlap between higher education and industry priorities are in the computer sciences and other emerging digital technologies.

- **Strategies/Action Items:**
 - Diversity, inclusion, and accessibility for the STEM pipeline. Create accessibility mechanisms that overcome opportunity gaps, such as the digital divide, in both rural and urban settings to improve workforce development efforts at the K-12 level. In higher education, increase early mentorship opportunities to increase diversity and inclusion.
 - Work-based learning. Seek partnerships for NSHE students to land work-based learning opportunities (such as internships, externships, and apprenticeships) during and immediately after their course of study.
 - Technology program development. Investment in comprehensive digital technologies infrastructure and professional expertise to enable relevant and competitive training and education across the technology stack.
 - Fostering interest in STEM careers. Foster career visibility, accessibility, and increased retention by offering undergraduate research, dual credit, and summer bridge programs.
 - Diversified approaches to STEM training. Offer STEM education programs that develop both critical thinking and occupation-specific training to meet diverse needs of both students and industry.
 - Nimble educational partnerships. Create opportunity for collaboration between the private sector and education systems responsive to economic changes, while also offering students a return on investment for time spent in training.

- **Goals/Expectations:**
 - Inclusion and accessibility:
 - Broaden participation so the diversity of STEM degree holders is representative of Nevada's communities.
 - Foster talent and interest in STEM careers from K-12 to the PhD level, and include rural partners in opportunities.
 - Build strong bridges between higher education and industry to increase workforce STEM skills and knowledge transfer.
 - Coordination and Partnerships:
 - Partner with business to create diverse on-ramps and bridges into the workforce.
 - Improve internet connectivity, access to technology, and local capability for all communities across the state, including rural and Tribal stakeholders.
 - Collect robust, statewide longitudinal data for workforce development across STEM pipeline to identify pockets of excellence and areas needing improvement.

- **Technology Transfer:**
 - **Introduction:** University research sometimes gives rise to discoveries and innovations that can be commercialized. The federal government recognized this decades ago and passed legislation including the 1980 Bayh-Dole Act, which, among other things,

requires recipients of federal research funding to make discoveries available in the most expeditious way possible to benefit taxpayers. In most instances, publication in peer-reviewed journals and presentations to research conferences and colloquia fulfill this requirement. In some cases, however, university research may give rise to discoveries and innovations that can be made into products that benefit society. The list of such products ranges from everyday consumer items to medical breakthroughs to innovations in engineering and computer science. University technology transfer offices (TTOs) act as conduits connecting research discoveries with companies capable of developing those discoveries into products. In some cases, the faculty or student who made the discovery may create a new company to accomplish this. This entrepreneurial activity and commercialization of innovations created in Nevada's research laboratories serves a critical function for fulfilling the academic mission and should be encouraged and facilitated. Without these functions, research discoveries and innovations languish in laboratories and are never developed into products that can benefit Nevadans and society at large. Further, revenues that accrue to the institutions from such activities must be used to fund continuing research.

- **State:** NSHE's research institutions have made significant strides in building their TTO programs. However, programs remain understaffed and unable to provide resources to help early-stage innovations span the "valley of death" between discovery and commercially viable production. Nevada's Knowledge Fund enabled the institutions to create several programs, including the "Innovation" Centers at UNR and UNLV; UNR's Center for Applied Research; the Applied Innovation Center at DRI, which resulted in the creation of the Institute for Health Innovation (IHI) with Renown; the Nevada Institute of Personalized Medicine at UNLV; and other centers and projects often linked to early-stage, high-growth companies. These projects and centers have garnered several million dollars in grant funding and supported well over 100 startup companies that have, in turn, raised over \$50 million in investment and created more than 100 high-paying jobs since 2013.
- **Strategies/Action Items:**
 - Advocate for reconstitution and sustainability of the Knowledge Fund.
 - Make proof-of-concept grants available.
 - Provide matching dollars for SBIR/STTR⁴⁶ awards.
 - Rework Nevada and NSHE's conflict of interest and related policies to better enable faculty to engage in entrepreneurial activity.
 - Provide adequate support for TTOs to facilitate their IP protection, commercialization, and entrepreneurial activities to better support faculty.
- **Goals/Expectations:**
 - Nurture the NSHE entrepreneurial ecosystem, especially within its research institutions.
 - Catch up to peer institutions in tech transfer integration and success.
 - Create a community of motivated faculty, staff, and students who all share successes.

⁴⁶ Small Business Innovation Research (SBIR), Small Business Technology Transfer (STTR), <https://www.sbir.gov/>

- Measure and communicate TTO activities and success stories.
 - Create a positive feedback loop of competitive success, job creation, and hires.
- **Cyberinfrastructure:**
 - **Introduction:** Developing and sustaining strategic cyber (or, digital) infrastructure is key to establishing new scales and velocities of research and education in Nevada. Efficient and expert leverage of networking, computing, software applications, and data management remains a primary differentiator of leadership-class programs across states and academia. Because modern technologies can be created and operated with a relatively small central team, and yet serve a much larger user community, improving human and machine cyberinfrastructure at NSHE and institutional scales for science, engineering, and educational support remains the key investment multiplier for Nevada. Unless these elements are present, few, if any, of the research and strategic objectives in this report will be regionally, nationally, or globally competitive. Nevada’s communities stand to benefit tremendously from improved technological capability in the NSHE system that will provide cutting-edge connectivity, access to modern computing and data-focused resources, expertise with emerging software and security technologies, and collaborations with outside expert teams.
 - **State:** Nevada is far behind most of the U.S. in terms of institutional-scale research technology infrastructure and expertise. As of 2020, NSHE did not have membership in the national research and education network community The Quilt⁴⁷, making Nevada the only state besides Vermont without representation. NSHE institutions do not operate any regionally or nationally federated computing infrastructure as part of the NSF-XSEDE⁴⁸, Open Science Grid⁴⁹, or Pacific Research Platform⁵⁰ systems, all of which enable member researchers to access much larger systems and resources. Until 2018, NSHE institutions had not obtained any campus improvement awards from the NSF Campus Cyberinfrastructure program, and Nevada was one of the last states to do so when UNR obtained a campus research networking grant. Primary reasons for these shortfalls include a lack of strategic guidance and investment across NSHE, as well as a general absence of engagement with the national research computing communities to build organizational capacity and practices in these areas. If NSHE is to succeed in supporting Carnegie R1 research activities, becoming competitive in academic research, and transforming service to the state, a rapid evolution in cyberinfrastructure capability is required.
 - **Strategies/Action Items:**
 - Assess current research technology readiness and availability to all NSHE researchers and disciplines, using national survey mechanisms.
 - Create, support, and prioritize institutional cyberinfrastructure programs directly charged with building capability and capacity for modern research technology support.

⁴⁷ <https://www.thequilt.net/>

⁴⁸ <https://www.xsede.org/>

⁴⁹ <https://opensciencegrid.org/>

⁵⁰ <https://pacificresearchplatform.org/>

- Integrate national best practices with cyberinfrastructure program development to avoid steep learning curves and fast-track Nevada’s peer capability status.
 - Coordinate campus-level technology with large research initiatives to avoid parallel development and leverage investments.
 - Establish technology cross-training initiatives at the graduate and undergraduate levels to improve workforce development in Nevada.
 - Create sustainability plans that protect research technology investment and expertise on decadal timescales.
- **Goals/Expectations:**
 - Research-ready technology organizations with broad capabilities and national community connections.
 - Strong data management, data re-use, and data risk mitigation capabilities.
 - Fast, reliable, and flexible networks for research workflows on campuses and across the state.
 - Rapid and automated provisioning of storage and computing resources for research projects, with streamlined and appropriate funding mechanisms.
 - Cadre of cyber expertise in networking, computing, software, data management, and analytics available for timely design, consulting, training, and development of innovative technology applications in research areas. Ability of larger organizations (i.e., universities) to provide direct access to advanced technologies such as computing and software resources to smaller Nevada organizations (i.e., community colleges and rural K-12).
- **Communication and Outreach:**
 - **Introduction:** Solutions to the state’s most serious problems must be based on science, research, and data. This requires transmitting information to the public about the critical importance of these focus topics. Policymakers and government officials particularly need to become knowledgeable to make informed decisions. For example, wildland fire science has a critical impact on society in the western U.S. and the health and wellbeing of Nevadans in terms of human smoke exposure and safety and ecosystem services. A better-informed public can support the difficult decisions that policymakers and administrators will have to make regarding this and other focus areas.
 - **State:** NSHE organizations use multi-faceted communication platforms that include marketing, updated project websites, informational materials and educational videos, content delivery through traditional and social media, and reporting of accomplishments to NSHE’s Chancellor and Vice Presidents for Research. Communicating audience-specific information is central to Nevada’s ability to reach its diverse communities. Current communication channels need to be augmented and additional tools secured to improve Nevada’s interaction with targeted constituent groups.
 - **Strategies/Action Items:**
 - Strengthen internal communications between K-12 and NSHE institutions.
 - Facilitate stakeholder-driven research priorities.

- Enhance communication with industry sectors about ongoing academic research activities.
 - Directly promote research impacts in policy and resource management to legislators.
 - Promote education and training opportunities for underrepresented groups.
 - Increase public knowledge of research activities and benefits, particularly those with state support (for example, through the Knowledge Fund).
 - Increase outreach to industry to foster engagement with NSHE researchers and projects.
- **Goals/Expectations:**
 - Consistent internal and external communication across multiple platforms provided to project members and stakeholders.
 - Research results disseminated via national and international conferences and publications in high-impact, peer-reviewed journals.
 - Social media presence increased to communicate project activities and results, along with links to businesses, non-profit groups, other scientists, and state and national agencies.
 - Relevant news, project updates/highlights, and lay articles communicated monthly to a broad audience, including senior academic administrators and government officials.
 - Training sessions provided to faculty and students on effectively communicating their science.
 - Additional dissemination of important information facilitated through meetings, workshops, symposia, and other events, both virtual and face-to-face.
- **Convergence Research/Science with Society:**
 - **Introduction:** The NSF has identified Convergence Research as one of its Ten Big Ideas⁵¹. Convergence Research is defined by NSF as “merging ideas, approaches, tools, and technologies from widely diverse fields of science and engineering to stimulate discovery and innovation”. In practical terms, we need to move this to “science with society” as a means of addressing massively complex problems that also mitigate societal needs. Too often, scientists superficially link to communities, limiting mutual trust, understanding, and capacity to implement outcomes. This new approach provokes and facilitates novel solutions through research co-design, communication, implementation, and co-production of knowledge. Nevada is becoming increasingly managed and populated on both urban and rural fronts. Our societal and environmental stability as well as health depend on our ability to understand and wisely steward the interrelated complexities of these systems.
 - **State:** Nevada has had some experience and success in developing convergence research and science with society. As a land grant university, UNR has a long history of Extension activities that have built trust and durable relationships with stakeholders in many cities and rural communities across the state. Like UNR, UNLV and DRI have developed many successful partnerships between scientists and stakeholders. Nevada State College and our

⁵¹ https://www.nsf.gov/news/special_reports/big_ideas/

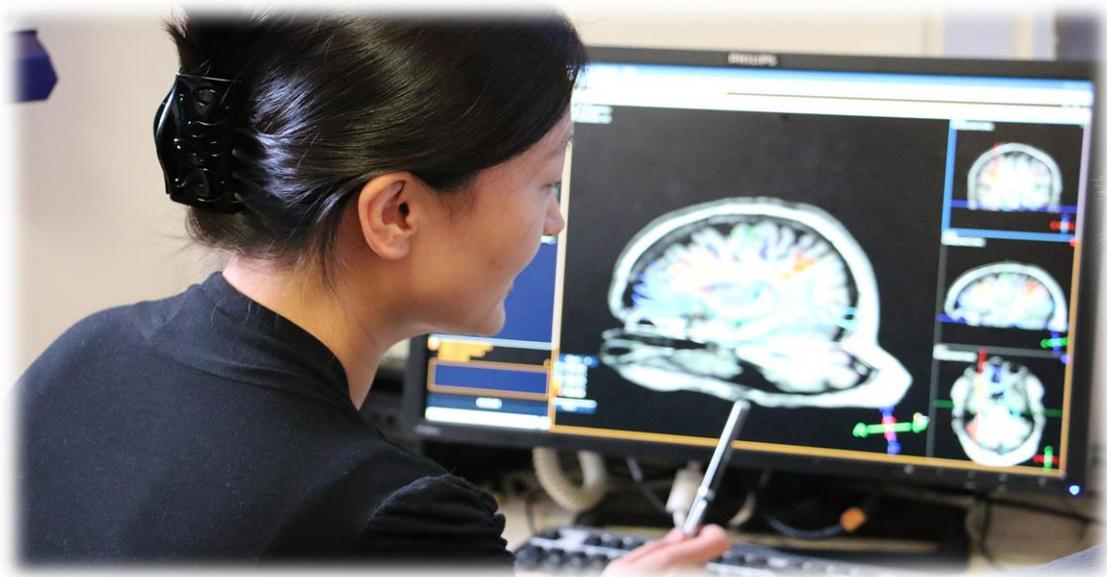
community colleges continue to educate historically underrepresented groups and first-generation college graduates, further expanding the reach of science with society.

○ **Strategies/Action Items:**

- Develop durable public-private partnerships that collaboratively link research to decision making.
- Purposefully create and foster topical NSHE research centers with high disciplinary dimensions and resources.
- Co-create a full understanding of the complex linkages and feedbacks among the state's socio-economic and environmental components, especially linkages involving Nevada's critical economic and public sectors.
- Co-develop full-circle solutions to translate stakeholder-driven issues into socio-economic and environmental research and innovation for decision making and implementation outcomes.
- Co-create and communicate partner-based solutions to regional policy and governance needs.
- Foster career pipelines between NSHE partners and Nevada's public and private sectors.

○ **Goals/Expectations:**

- We need solutions in the face of non-stationarity, non-linearity, tipping points, and extreme phenomena. We need to make decisions with limited data and uncertainty. These needs fundamentally require that scientists and communities build mutual trust, respect, and understanding to co-design, co-develop, and co-implement solutions. While we cannot predict the future, a "science with society" approach builds anticipatory capacity to face known and unknown stressors.



CONCLUSION

These four Research Focus Areas and five Strategies for Success provide a broad blueprint for investing resources and developing new programs in science and technology for Nevada. These lists are not exhaustive by any means, but represent a substantial cross-section of active science- and technology-based research in Nevada. DRI, UNLV, and UNR each have specific areas of excellence identified by their scientists, engineers, researchers, and faculty. NSHE community colleges and the state college have an active role in providing the educational underpinning necessary in all science and technology efforts. Often, workforce needs arise that cannot be anticipated, as do research opportunities. Therefore, this report is not intended to represent all the potential opportunities that may come Nevada's way, or rule out other areas requiring attention.

Nevada's success in the years ahead will require that institutions of higher education and the State work together in a focused manner to build science and technology infrastructure and to make difficult choices among many opportunities. Building a better Nevada will require recruiting the nation's best and brightest scientists who can work in the laboratory and in the field, and creating an effective and efficient infrastructure to support them. It will require sacrifices of less-important initiatives to focus on the critical ones facing the state. This Plan is an initial design to help shape that conversation.

PHOTOGRAPH INFORMATION

- **Cover:** North Diamond Peak, Diamond Range, Eureka, NV (facing West)
- **Introduction:** South Diamond Peak (facing North)
- **Land and Natural Resources:** NevCAN Spring 4 station, Mt. Washington, Snake Range, White Pine County. (Near Great Basin Nat. Park)
- **Integrated Health and Wellness:** Stock Photo Marketing and Communications, UNR.
- **Digital Technologies:** Stock Photo, OIT, UNR
- **Infrastructure and Industrial Technology:** Stock Photo Marketing and Communications, UNR.
- **Strategies for Success:** Near Bald Mountain, Pine Grove Hills, Lyon County, NV
- **Conclusion:** Previous Science and Technology Plan