NSHE
Science and Technology Plan

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Prepared by the Research Affairs Council

NEVADA SYSTEM OF HIGHER EDUCATION

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ACKNOWLEDGEMENTS

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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 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 and Information Technology (IT) leadership at the three NSHE research institutions, stakeholders from around the state, and NSHE System Computing Services (NSHE-SCS). 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.

NSHE has three research institutions: the Desert Research Institute (DRI), the University of Nevada, Las Vegas (UNLV), and the University of Nevada, Reno (UNR) and one emerging research institution: Nevada State University (NSU). DRI operations are supported primarily through external research funding while the universities receive more State General Fund revenue for instruction and service activities. Both UNLV and UNR are 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 research institutions for fiscal year 2024 was $206 million with the majority coming from federal (63%) and federal pass-through (21%) sources. Other sources include state, other government, and private industry/non-profit at 16% total. Research funding represented 45% 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), National Oceanic and Atmospheric Administration (NOAA), 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 as well as a unique landscape afforded by its geology and vast stretches of sparsely populated lands, creating an 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
- Clean Energy Technologies

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

Digital Technologies
- Networking
- Cybersecurity
- (Secure) 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: Collaborative Technology Ecosystem, Workforce Development, Technology Transfer, 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 mining[3], 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.

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[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 Resources[4] 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 companies[5]

Goals/Additional Focus Needed:
- Coordination of observation, modeling, planning, infrastructure, and policy efforts
- Development of regionally relevant tools and systems for increasing efficient response to changing water demand and supply patterns over short (seasonal) to long (decadal) times
- 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 improved to 39% in 2023, well past 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

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[4] http://water.nv.gov/
[5] https://waterstart.com/

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 the future energy economy
- 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; (5) high to very high summertime temperatures, with the two fastest warming cities in the US located in the state (Reno and Las Vegas); and (6) 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)
- Operational NSL statewide hazard monitoring network, including ALERTWildfire
- Western Regional Climate Center (DRI) network, data, and outreach expertise
- The Program for Climate, Ecosystem and Fire Applications (CEFA) and wildfire sciences 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
- Urban and extreme heat planning and impact mitigation strategies
- Interdisciplinary data management/products expertise and infrastructure
- Wildfire processes, mitigation, and impacts science

Agriculture and Food Security: Roughly one third of Nevadan adults are eligible for federal food aid and a third of these are 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 2024 reports that the state's food and agriculture sector contributed $6.5 billion to the state's economy in 2022, accounting for 19,466 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.
- DRI partnerships and collaborations with tribal communities on topics of water, agriculture, and the role of traditional practices.
- Partnerships with Federal Agricultural Research Services and Natural Resources Conservation Services as well as the Nevada Department of Agriculture

Goals/Additional Focus Needed:
- Infrastructure expansion for research and Extension program activities
- Strategic partnerships with communities/industries 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

Clean Energy Technologies: Nevada's rich deposits of critical materials such as lithium, rare earth elements, copper, nickel, and cobalt make the state a pivotal player in the global transition to clean energy and transportation technologies, electronics, and defense systems. The research advances in sustainable material recovery and development are needed to lay the foundation for Nevada's leadership in critical materials research and management, while also advancing clean energy and water resource solutions within the state. UNLV, UNR, and DRI are combining their

research strengths to develop innovative methods for extracting, refining, and recycling these materials, with a focus on improving efficiency and reducing environmental impact.

Strengths/Assets:
- Location of the only operating lithium mine in the United States
- Companies that have moved into Nevada targeting extraction, refining, and recycling these materials.
- The research capabilities of the University of Nevada, Las Vegas (UNLV), the University of Nevada, Reno (UNR), and the Desert Research Institute (DRI) represent a powerful collaborative force

Goals/Additional Focus Needed:
- Creation of an integrated research framework that connects critical materials recovery, energy needs, and sustainable water management.
- Collaborative efforts for leveraging each NSHE institution's research expertise to solve pressing issues, including increasing energy needs and resource scarcity.
- Coordinating skills and energies among academia, government agencies, industry leaders, and the private sector to evaluate the global supply chain of critical minerals and develop domestic resources.

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 insurance[6]. 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 people[7]. All of this combines to rank Nevada 48th for health system performance[8].

NSHE institutions address this infrastructure shortfall through education and research. Our universities and community colleges train physicians, physician 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

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[6] https://www.americashealthrankings.org/explore/annual/measure/Overall/state/NV

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

[8] 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 population[9].

Strengths/Assets:
- LCME[10] accredited Schools of Medicine at both UNR and UNLV
- Two-year ARC-PA[11] accredited Physician's Assistant program at UNR
- NIH IdeA program[12]: funding research via INBRE[13], COBRE[14], and IdeA-CTR[15]
- Centers for Cardiovascular Physiology, Integrative Neuroscience, and Personalized Medicine
- Project ECHO[16], Nevada telehealth project at UNR for underserved populations
- Population Health: Healthy Nevada Project[17] with Renown Health
- UNR School of Community Health Sciences and UNLV School of Public Health
- Expertise in characterizing environmental contaminants causing health impacts

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)
- Environmental health impacts of emerging contaminants

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

[9] Packham, J., and T. Griswold. 2020. Physician Workforce in Nevada: A Chartbook. University of Nevada, Reno, https://med.unr.edu/statewide/reports 28 pp
[10] https://www.aamc.org/services/first-for-financial-aid-officers/lcme-accreditation
[11] http://www.arc-pa.org/
[12] https://www.nigms.nih.gov/Research/DRCB/IDeA/Pages/default.aspx
[13] https://www.nigms.nih.gov/research/drcb/IDeA/Pages/INBRE.aspx
[14] https://www.nigms.nih.gov/Research/DRCB/IDeA/pages/COBRE.aspx
[15] https://www.nigms.nih.gov/Research/DRCB/IDeA/Pages/IDeA-CTR.aspx
[16] https://med.unr.edu/echo
[17] https://healthynv.org/

immunological diagnostics, and microbial biotechnology. These inter-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 oppression[18], 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, automation, and telehealth, 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 other

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[18] https://www.un.org/en/un75/impact-digital-technologies

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:
- NSHE NevadaNet statewide fiber network of robust and high-bandwidth connectivity to all Nevada institutions and the Internet2 national research networking backbone
- Nevada Seismological Laboratory statewide research/service mountaintop network
- State and Industry partners, such as NDOT[19] and the technology company Switch
- UNLV's investment to modernize the network infrastructure with AI and virtualization capabilities[20]

Goals/Additional Focus Needed:
- Network performance and advanced systems telemetry architectures
- Modern/future network architectures for hyper-connected zones and Science DMZ(s)
- 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 digital forensics, cyber-physical systems, AI integration
- Industry and government partners (Las Vegas Metro Police Department, Reno Police Department, NV Energy, NV Department of Education, Nevada National Security Site, FBI, Vere Software, SNC, HPE, CISCO, NV Governor's Technology Office, NV Office of Cyber Defense Coordination)

Goals/Additional Focus Needed:
- Cooperative student-augmented SOC[21] operations/design w/public sector partners
- Testbed integration between institutions with multi-disciplinary research projects with a focus on both research/governmental and commercial cybersecurity
- Inter-institution collaboration on workforce credentialing, curriculum development, and cyber range environments

(Secure) 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 end-to-end in terms of access policy, security requirements, workflow, storage, analytics, derivatives, and archival has become a

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[19] Nevada Department of Transportation, https://www.nevadadot.com/
[20] https://www.it.unlv.edu/it-initiatives/network-infrastructure-modernization
[21] Security Operations Center

primary problem for the research community as they struggle to keep up with private sector practices and increasing funding agency requirements.

Strengths/Assets:
- Pilot work in EPSCoR projects for multi-disciplinary data management hosting in NSHE-SCS Research Engineering IT environment
- Membership in research-data-facing organizations, such as ESIP[22], CaRCC[23], RDA[24]

Goals/Additional Focus Needed:
- Research data management teams at NSHE institutions
- NIST 800-171 ready storage environments for NSHE research institutions
- NSHE Institutional participation in NIST standards and community
- Hybrid cloud optimization and practices for the data management lifecycle
- Architectures and plans for collaborative data organization across research institutions for regional synthesis and strategic team science

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, local 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:
- Centralized Research Computing initiatives at DRI, UNLV[25], and UNR[26]
- Institutional participation in national Research Computing community (CaRCC, CASC, Campus Champions)
- Pilot Campus Cyberinfrastructure awards (Network, Computing, Strategy/Planning)
- NV-DICE cooperative planning project between NSHE-SCS, UNLV, UNR, and DRI

Goals/Additional Focus Needed:
- Establish meaningful metrics to measure usage and impact of access across the computing spectrum
- Stabilization of production computing support staff, faculty/student access, and datacenter/IT environments
- 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
- Desktop to National Supercomputer training pipeline (workforce development)
- Alternative visualization technologies and facilities
- Preparation to engage/pilot future computing architectures

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[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/
[25] https://www.it.unlv.edu/researchit
[26] https://www.unr.edu/cyberinfrastructure

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 DevSecOps[27]-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)
- DevOps-first Infrastructure and Operations teams at UNLV that support academic and administrative needs who strive to scale these services to the research community
- DevOps-first Research Engineering team at NSHE-SCS
- Research-driven capabilities development in the hybrid-cloud space

Goals/Additional Focus Needed:
- DevSecOps training/education, inter-institutional team formation, incentives
- Repeatable patterns 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" 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 questions of big data in healthcare, smart cities, manufacturing, earth and environment, and other fields.

Strengths/Assets:
- Many AI/ML-focused faculty hires in the last five years at UNR and UNLV
- Distributed AI/ML clusters at UNLV[28] & UNR for applied interdisciplinary research
- IT-provisioned AI/ML tooling for scientific research applications at DRI
- AI Fellows program in UNLV[29] to encourage pilot AI use by faculty and staff
- Targeted educational outreach with Girls Who Code, NCWIT[30], Boys and Girls Club

Goals/Additional Focus Needed:
- Institution-wide cooperative AI plans, development support, and governance
- Research and experimentation with distributed ML workflows from cloud to edges
- Application of ML in production networking and cybersecurity environments
- Development of advanced visualization analytics/workflows

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[27] Development-Security-Operations: an integrated continuous improvement model of technology delivery.
[28] https://www.unlv.edu/generative-ai/advancing-research | https://www.unlv.edu/nipm
[29] https://www.unlv.edu/generative-ai/pilot-program
[30] National Center for Women & Information Technology, https://www.ncwit.org/

- Research data homogenization and management for inference workloads
- Research, development, and training of science domain-aware LLMs in the traditional autoregressive and emerging diffusion modalities

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 we saw in 2020, 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. Northern Nevada is poised to become the site of numerous large data centers owing to its favorable natural hazard risk profile and business climate. While these will serve as a critical part of the region's and nation's AI infrastructure for the 21st Century, resource planning and expertise is needed to accommodate the associated, massive energy and water needs. 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 UNR[31] and UNLV[32]
- 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 RailTEAM[33]—improving high-speed railroad infrastructure
- Private sector appetite for investment in demonstration and full projects – Brightline high speed rail, Boring Company tunnel transport systems

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"[34]. 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

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[31] https://www.unr.edu/ncar/programs/intelligent-mobility
[32] http://nevadacam.org/
[33] Rail Transportation Engineering and Advance Maintenance, https://www.unlv.edu/railteam
[34] Frontiers of Materials Research, the National Academies of Sciences, Engineering, Medicine, 2019

- Materials under extreme environments (molten salts, high temperatures)
- Research and education on batteries, nuclear materials & nanotechnology
- Several faculty hires in advanced manufacturing fields

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 Lab[35])
- UNR BS and MS Biotechnology programs ranked 15th in the nation by Money Inc.[36]; UNLV BS in Biology with Biotechnology concentration
- Review of biotechnology curriculum by industry partners
- The Nevada Institute of Personalized Medicine (NIPM[37]) working to improve individual and systemic health care through translational clinical scientific research, education and workforce training, commercialization of technologies, and job creation
- NV Governor's Office of Economic Development workforce development (e.g., LEAP[38])
- State-of-the-art biotechnology instrumentation (e.g., Hamilton Center of Laboratory Automation[39]; Nevada Genomics Center[40]; Nevada Genomics Core Facility[41], Mick Hitchcock PhD Nevada Proteomics Center[42]; Nevada Center for Bioinformatics[43])

Goals/Additional Focus Needed:
- Business ecosystem for NSHE-facilitated, biotech industry-funded research

[35] https://www.unr.edu/ncar/infrastructure/bel
[36] https://moneyinc.com/colleges-with-the-best-biotechnology-degree-programs/
[37] https://www.unlv.edu/nipm
[38] https://www.diversifynevada.com/programs-incentives/workforce-development/leap/
[39] https://www.unr.edu/nevada-today/news/2013/hamilton-robotics-university-collaborate-
[40] https://www.unr.edu/genomics
[41] https://www.unlv.edu/genomics
[42] https://www.unr.edu/proteomics
[43] https://www.unr.edu/bioinformatics

- 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 (including ground and aerial / UAVs) as an area for STEM workforce development[44], and the field encompasses most of the aspects of STEM 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 40 university in the U.S. in robotics publications[45]
- Connections to many other top-ranked robotics universities
- Burgeoning robotics startup ecosystem in Southern Nevada

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
- Staffing workforce development to support robotics/automation systems operation

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)[46], manufacturing grew 60% over the period 2015 – 2025. In March 2025, about 30,500 people were employed in advanced manufacturing in Reno-Sparks and another 30,300 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

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[44] https://nvworkforceconnections.org/wp-content/uploads/2016/12/lo-res_WorkForce-Annual-Report-pages-2015-Final.pdf
[45] http://csrankings.org/#/index?robotics
[46] https://www.nevadaworkforce.com/Home/DS-Results-OES2

- TMCC Cyberphysical Manufacturing Lab[47] with newly created linked degree BAS in Cyberphysical Manufacturing[48]
- TMCC-Festo[49] and WNC-Siemens[50] 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
- Circular economic 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 input 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 such as lithium and elements for defense and technology applications are being sought in Nevada.

Strengths/Assets:
- Well-established leadership mining and engineering programs at UNR

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[47] https://www.rgj.com/story/money/business/2018/10/24/tmcc-industry-4-point-0-manufacturing-lab-tesla-robots/1752955002/
[48] https://www.tmcc.edu/news/2019/08/bachelor-applied-science-cyber-physical-manufacturing
[49] https://www.tmcc.edu/news/2018/11/industry-4.0-lab-leads-tmcc-into-the-future
[50] https://www.wnc.edu/siemens-mechatronics-level-1-training-available-technicians/

- Location of the only operating lithium mine in the United States
- Integration with environmental stewardship and engineering research
- Strong industry partnerships and workforce development pipeline
- Autonomous Robots Lab[51] 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

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[51] 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: Collaborative Technology Ecosystem, Workforce Development, Technology Transfer, 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 Executive Leadership 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.

Collaborative Technology Ecosystem:

Introduction: Developing and sustaining strategic IT infrastructure is key to establishing new scales and velocities of research and education excellence in Nevada. Efficient and expert leverage of networking, computing, software applications, security, and data management remains a primary differentiator of leadership-class research programs across states and academia. As modern IT systems may be created and operated with a relatively small central team and yet serve a much larger user community, improving human and machine IT infrastructure at NSHE and institutional scales for science, engineering, and educational support remains **the key investment multiplier** for Nevada. Along with the rest of the public/academic sector, NSHE faces serious challenges with IT engineering recruitment and retention, which elevates the need to be highly coordinated and collaborative with development of technology expertise and solutions across institutions. Unless IT elements are aligned and modernized across the education and research missions, few (if any) of the strategic directions in this Plan will emerge as regionally, nationally, or globally competitive. Nevada's communities stand to benefit tremendously from improved technology

capability across the NSHE System that will provide cutting-edge connectivity, access to modern computing and data-focused resources, expertise with emerging software and security requirements, 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 recently as 2020, Nevada did not have membership in the national research and education network community The Quilt[52], 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-ACCESS[53], Open Science Grid[54], or National Research Platform[55] 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 historic lack of strategic IT 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. Recent (post-2022) changes in institutional IT leadership and elevation of institutional IT leadership to Cabinet-level positions at UNLV and UNR have signaled institutional intent to incorporate technology as a key element of high-level strategy. NSHE-SCS has created a new mission area (NSHE Research Engineering[56]) and invested in additional foundational Federated Identity and Access[57] services to support multi-institutional research and open the door to cooperative Research IT planning, projects, and systems between institutions. Establishment of key Research Computing Director roles in UNR, UNLV, and DRI IT organizations ensure that focus on supporting research activities will increase. UNLV has identified physical space on campus and appointed a faculty advisory committee for development of an interdisciplinary research cyberinfrastructure center to support faculty and student researchers. However, if NSHE is to succeed in supporting Carnegie R1 research activities, increase standing in science-driven education, and transform higher-education service to the state, a rapid evolution in collaborative technology capability and investment over the next few years at both Institutional and NSHE levels is required.

Strategies/Action Items:
- Assess current technology readiness and availability to all NSHE researchers and disciplines, using national survey mechanisms.
- Expand, support, and prioritize institutional IT programs directly charged with building capability and capacity for modern research support.

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[52] https://www.thequilt.net/
[53] https://www.access-ci.org/
[54] https://opensciencegrid.org/
[55] https://nrp.ai/
[56] https://scs.nevada.edu/research-engineering/
[57] https://scs.nevada.edu/services-catalog/service-summary-federated-identity-services/

- Integrate and adopt national best practices with research IT program development to avoid steep learning curves and fast-track Nevada's peer capability status.
- Coordinate campus- and NSHE-level technology with large research projects to leverage investments and avoid duplicative development.
- Focus on new capabilities for secure, scalable data storage and archival, interdisciplinary AI/ML infrastructure, and cloud-integrated CI/CD workflows to support cutting-edge, collaborative research.
- Establish cybersecurity guidelines to secure sensitive research data, ensuring alignment with federal requirements (e.g., CMMC, NIST 800-171, NSPM-33).
- Establish innovative IT cross-training initiatives for graduate and undergraduate students as part of new Research Computing investments to improve workforce development in Nevada.
- Leverage NSHE-SCS NevadaNet[58], the NSL network[59], and key agency partners to create a "Nevada Science Network" designed to enable regional science-driven projects, cooperative technology education, and friction-free exchange of campus-level research cyberinfrastructure.
- Create NSHE and institutional sustainability plans that protect research technology investment and expertise on decadal timescales.

Goals/Expectations:
- Revised institutional strategic plans with clear priorities for rapid technology evolution, expertise development, and long-term sustainability.
- Collaborative, research-ready technology organizations across NSHE with broad capabilities and national community engagement.
- Strong regional data management, data re-use, and data risk mitigation capabilities.
- Fast, reliable, and flexible networks for research and science-driven educational workflows on campuses and across the state.
- Rapid, automated, and secure provisioning of storage and computing resources for research and education projects, with streamlined and sustainable funding mechanisms.
- Critical mass of cyber expertise across NSHE in networking, computing, software, data management, security, and analytics available for timely design, consulting, training, and development of innovative technology applications in research areas.
- Ability of research-intensive organizations (i.e., universities) to provide direct access to advanced IT systems to other Nevada organizations (i.e., community colleges, rural K-12, state and local partners).
- Develop responsive, consultative IT services that embed support staff within research teams or provide domain-specific expertise on-demand.
- Track utilization, scientific outcomes, cost-efficiency, and impact of research IT investments to inform continuous improvement and accountability.

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[58] https://scs.nevada.edu/services-catalog/service-summary-commodity-and-research-internet/
[59] http://www.seismo.unr.edu/

- Position NSHE institutions as key collaborators in national-scale cyberinfrastructure projects, testbeds, and science networks.

Workforce Development:

Introduction: Capacity-building and investment in research infrastructure needs to be paired with STEM workforce development for the *health 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. 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. As such, NSHE Workforce Development strategies should be highly coordinated with those for a Collaborative Technology Ecosystem (see above).

Strategies/Action Items:
- Create accessibility mechanisms that overcome the state's size and population's geographic distribution to improve workforce development efforts at the K-12 level. In higher education, increase early mentorship opportunities.
- 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.
- 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 opportunities for collaboration between the private sector and education systems responsive to economic changes, while also offering students a return on investment for time spent on training.

Goals/Expectations:

Increase STEM Participation and Impact:
- Increase the number of STEM degree holders across 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.
- Create incentives (e.g., fellowships, local hiring pipelines, post-graduate placements) that encourage graduates to stay and contribute to Nevada's economy.

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.
- Create interdisciplinary innovation labs or "sandboxes" for students to gain real-world research, data, and development experience.

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 fulfil 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 "Innevation" 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 sustainability and expansion of the Knowledge Fund.
- Make proof-of-concept grants available.
- Provide matching dollars for SBIR/STTR[60] 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.
- Measure and communicate TTO activities and success stories.
- Create a positive feedback loop of competitive success, job creation, and hires.

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.

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[60] Small Business Innovation Research (SBIR), Small Business Technology Transfer (STTR), https://www.sbir.gov/

Strategies/Action Items:
- Strengthen internal communications between K-12 and NSHE institutions in the areas around technology and workforce development pipelines.
- Create a community network to develop a shared science-driven technology vision among the higher education institutions and state agency stakeholders.
- Increase project-level storytelling for general audiences that highlight regional collaboration and outcomes.
- Enhance communication with industry sectors about ongoing academic research activities and technology developments.
- 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, technology teams, 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.
- Open channels and shared success stories between NSHE researchers, technology teams, students, and regional stakeholders.
- Training sessions provided to faculty and students on effectively communicating their science.
- Additional dissemination of important information facilitated through regional 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 Ideas[61]. 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

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[61] https://www.nsf.gov/news/special_reports/big_ideas/

knowledge. Development of a science-driven technology ecosystem across NSHE will be crucial to enabling these processes and outcomes. 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.
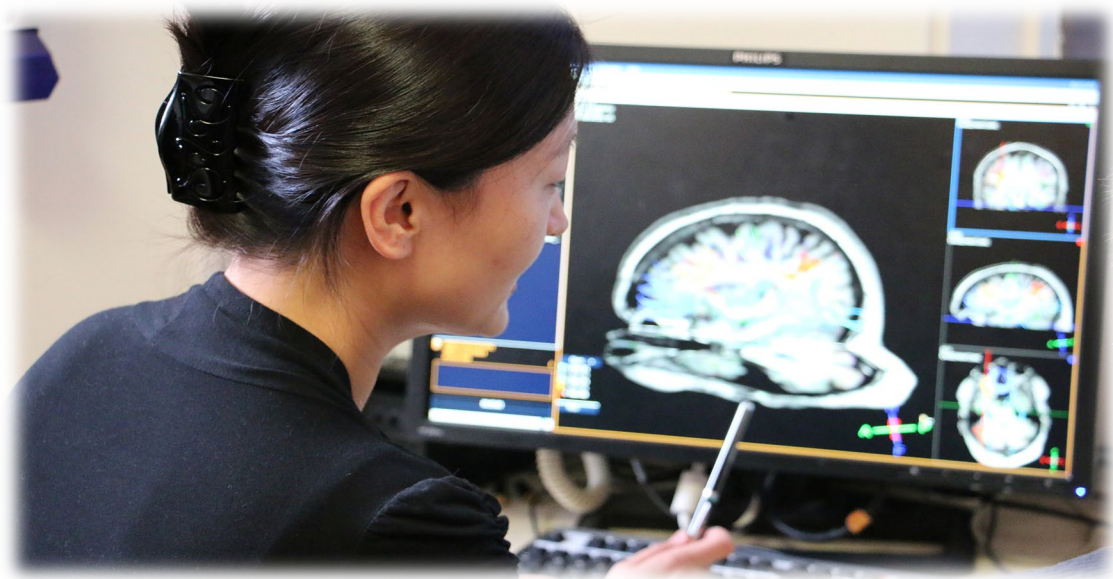
State: Nevada has had some experience and success in developing convergence research and science with society. As a land grant university, UNR has a long history of Extension activities that have built trust and durable relationships with stakeholders in many cities and rural communities across the state. Like UNR, UNLV and DRI have developed many successful partnerships between scientists and stakeholders. Nevada State University and our community colleges continue to educate historically underrepresented groups and first-generation college graduates, further expanding the reach of science with society. In order to expand and promote these engagement models, as well as leverage multi-institution collaboration on science-driven public service, existing outreach and partnership programs need an evolved technology ecosystem with secure but friction-free access, data exchange, collaborative computing, digital science product creation, and data curation environment for modern synthesis and application (e.g., AI-enhanced outcomes).

Strategies/Action Items:
- Develop durable public-private partnerships that collaboratively link research to decision making, enabled by collaborative technologies.
- Purposefully create and foster topical NSHE research centers with high disciplinary dimensions and friction-free 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 data-driven partner-based solutions to regional policy and governance needs.
- Foster career pipelines between NSHE partners and Nevada's public and private sectors.

Goals/Expectations:
- Re-framing of the higher-education relationship with the rest of the Nevada public sector, private industry, and general population. Science-based education across NSHE possesses the potential to assist with rapid response to unforeseen or extreme events, as well as long-term data-driven knowledge creation through observatory infrastructure, open science, and open data. These societal needs associated with resources and events 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 university 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.

NSHE and the three research institutions recognize that in the modern era of ubiquitous digital services, accelerating technological complexity, and emerging disruptions such as Artificial Intelligence, the need to elevate technology excellence and capabilities across the Nevada higher-education system has never been more apparent. Information technology foundations are crucial to achieving our near- and long-term goals in education and related science and engineering research.

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, Eureka, NV (Scotty Strachan)
Introduction: South Diamond Peak, Eureka, NV (Scotty Strachan)
Land and Natural Resources: NevCAN Spring 4 station, Mt. Washington, Snake Range, Ely, NV (Scotty Strachan)
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: Bald Mountain, Pine Grove Hills, Yerington, NV (Scotty Strachan)
Conclusion: 2015 Science and Technology Plan