



NSHE Science and Technology Plan

Updated January 2015

Revised by the Research Affairs Council

Nevada System of Higher Education

BOARD OF REGENTS

Mr. Kevin Page, Chair
Mr. Rick Trachok, Vice Chair

Dr. Andrea Anderson
Mr. Cedric Crear
Mr. Robert Davidson
Dr. Mark Doubrava
Dr. Jason Geddes
Mr. Trevor Hayes

Mr. James Dean Leavitt
Mr. Sam Lieberman
Mr. Kevin Melcher
Ms. Allison Stephens
Mr. Michael Wixom

Scott Young, Acting Chief of Staff for the Board of Regents

OFFICERS OF THE NEVADA SYSTEM OF HIGHER EDUCATION

Daniel Klaich, Chancellor

Dr. Len Jessup, President
University of Nevada, Las Vegas

Mr. Bart Patterson, President
Nevada State College

Dr. Mark Curtis, President
Great Basin College

Dr. Michael Richards, President
College of Southern Nevada

Dr. Marc Johnson, President
University of Nevada, Reno

Dr. Maria Sheehan, President
Truckee Meadows Community College

Mr. Chester Burton, President
Western Nevada College

Dr. Stephen Wells, President
Desert Research Institute

RESEARCH AFFAIRS COUNCIL

Crystal Abba, Chair
Vice Chancellor for Academic and Student Affairs
Nevada System of Higher Education

Dr. Alan Gertler
Vice President for Research
Desert Research Institute

Dr. Mridul Guatam
Vice President for Research and Innovation
University of Nevada, Reno

Dr. Thomas Piechota
Vice President for Research and Economic Development
University of Nevada, Las Vegas

TABLE OF CONTENTS

Introduction	5
Natural Resources	
Alternative and Clean Energy.....	8
Climate Change.....	11
Water Resources	12
Human Health	
Health Care Access and Research.....	15
Public Health.....	17
Aging Services	19
Infrastructure and Technology	
Transportation.....	23
Materials Science	27
Biotechnology.....	28
Information Technology	31
Common Themes for Nevada	32
Conclusion	36



INTRODUCTION

This Nevada Science and Technology Plan is presented by the Nevada System of Higher Education Board of Regents as a blueprint for the future. It is intended to provide sufficient details about the directions, capability, and vision of the educational, research, and economic development efforts of the Nevada System of Higher Education (NSHE) and its community partners to frame future decisions about directions for Nevada and for public higher education. Through the years, the State of Nevada has partnered with NSHE and dedicated financial resources to support science and technology education and research programs.

This Plan provides the foundation for focusing research and education 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 developed by the research officers of the three NSHE research institutions in concert with their research faculty and reviewed by the statewide EPSCoR (Experimental Program to Stimulate Competitive Research) Advisory Council 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 funded primarily through external research funding while the two universities receive more State General Fund revenue for instruction and service activities. Total research funding for these three institutions for fiscal year 2014 was \$124.6 million with the majority coming from federal (54%) and federal pass-through (28%) sources. Other sources include state, other government, private industry/non-profit at 18%. Research funding represented 46% of sponsored projects for the NSHE research institutions.

Nevada is a member of the network of states participating in the federally-supported research-stimulation programs called the Experimental Program to Stimulate Competitive Research (EPSCoR) and Institutional Development Award (IDeA). EPSCoR began in 1979 at the National Science Foundation when five states received planning grants to develop strategies to build their research infrastructure. Nevada joined EPSCoR in 1985 with the awarding of its first planning grant and received its first infrastructure award in 1986. Since that time, Nevada has

been awarded more than \$51 million in infrastructure grants through 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). As Nevada moves forward in assembling greater research capability, EPSCoR is an important building block to assist in targeting key areas identified in this Plan. Generally, funds received through these programs also require State General Fund matching dollars.

First, a more sophisticated and educated workforce must be developed in the State by increasing the number of Nevadans who possess some postsecondary training in the fields of science, technology, engineering, and math—the so-called “STEM” disciplines.¹ In “Cracking the Code on STEM: A People Strategy for Nevada’s Economy,” the Brookings Institution calls for strengthening STEM education and workforce training, which “requires concerted efforts on the part of the public and civic sectors alike.”²

The sectors identified in the Brookings report include:

- Tourism, Gaming, and Entertainment;
- Clean Energy;
- Health and Medical Services;
- Aerospace and Defense;
- Mining and Materials, and Manufacturing;
- Business IT Ecosystems; and
- Logistics and Operations (including transportation).

NSHE research institutions (UNLV, UNR, DRI) conducted an assessment of how their research projects aligned with the economic development sectors noted above. Using data from 2012, over 860 research projects have direct links to single or multiple economic development sectors. The total sponsored research from these projects was over \$350 million. The largest sectors that the projects aligned with were Clean Energy (263 projects) and Health and Medical Services (241 projects).

Nevada faces critical issues at this time related to research and development, as do the other western states. To address these issues, key focus areas are identified and developed within this Plan. These areas are meant to emphasize the societal and economic needs of the State and highlight the expertise that lies within the NSHE institutions to advance these areas. These are not in ranked order because each is critical to Nevada’s economic and environmental future. Three overarching themes for these focus areas are Natural Resources, Human Health, and Infrastructure and Technology. Within each theme, the following areas will be addressed by this Plan.

¹ “Cracking the Code on STEM: A People Strategy for Nevada's Economy,” The Brookings Institution Advanced Industries Series, Nov. 2014. <http://www.brookings.edu/research/reports/2014/11/12-nevada-stem-economy>. Accessed Dec. 1, 2014.

² “Cracking the Code on STEM: A People Strategy for Nevada's Economy,” Nov. 2014.

Natural Resources (Arid Resources Technology)

- Alternative and Clean Energy;
- Climate Change; and
- Water Resources.

Human Health (Health and Medical Services)

- Health Care Access & Research;
- Public Health; and
- Aging Services.

Infrastructure and Technology (IT Entrepreneurship, Manufacturing & Logistics, Health and Medical Services)

- Transportation;
- Materials Science;
- Biotechnology; and
- Information Technology.

Each of these research focus areas is examined in this report with careful consideration given to the specific challenges facing Nevada, the assets available to meet these challenges, goals for the State of Nevada, and strategies for how the Nevada System of Higher Education (NSHE) can provide the faculty expertise, applied and basic research, technology transfer, and graduates to help the State meet these goals.



NATURAL RESOURCES

As our need for energy continues to expand, short-term energy demands often conflict with long-term needs for economic development, water resource availability, and environmentally sustainable growth. In addition to the negative environmental and climate impacts attributed to energy production from fossil fuels, approximately 45% of our current water use currently goes to thermoelectric energy production.³ The use of coal for electrical power generation requires water for cooling and results in emissions of criteria air pollutants, toxic chemicals, and climate forcing species. While nuclear power addresses energy and climate concerns, issues remain regarding water for cooling and waste storage/disposal, along with public acceptance. Given the resource availability coupled with extraction developments (fracking), energy from natural gas is increasing, but there are water use/quality issues. In short, conventional energy technologies have some combination of issues related to water quality/quantity for cooling and resource extraction/processing, gaseous pollutants, greenhouse gas emissions, and waste generation. Solutions to the coupled issues of energy needs/energy security/resource management and environmental sustainability include the implementation of clean energy systems, along with the development of a better understanding of water availability. Given its abundance of solar and geothermal resources, Nevada is uniquely positioned to lead the development of systems for our future energy requirements, while addressing the issues of water scarcity and climate impacts.

I. ALTERNATIVE AND CLEAN 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.

³ M.A. Maupin, J.F. Kenny, S.S. Hutson, J.K. Lovelace, N.L. Barber, and K.S. Linsey. An Estimated Use of Water in the United States in 2010, USGS Circular 1405.

Nevada's assets for creation of alternative and clean energy set the stage for its three research institutions to be involved in new discovery and technology transfer and its colleges to continue workforce training programs. The U.S. Department of Energy (DOE), through the Office of Energy Efficiency and Renewable Energy and the Office of Basic Energy Sciences, provided research funding and technical support for research in these areas. Nevada established the Nevada Renewable Energy Transmission Access Advisory Committee in order to identify needs and locations for new power transmission lines in the state. Additionally, there are 1) the Nevada State Office of Energy, 2) the legislated Nevada energy portfolio standard (which requires renewable energy on the grid), 3) a highly supportive citizenry, and 4) a powerful congressional delegation and state legislature that support renewable energy development.

In spite of considerable assets for alternative energy production, Nevada faces challenges in the development and utilization of new methods of energy. These include grid integration, a small amount of public and private investment in renewable energy development, and a large number of small companies all trying to address renewable energy needs with little statewide coordination.

At the same time, Nevada's increasing population and energy demands create pressure to hasten the development of these industries. Although Nevada has the potential to provide much of its energy in sustainable forms to citizens of the state and even to export energy to neighboring states, there is not a long and established history of infrastructure for research and education in renewable energy fields.

One particularly promising development, however, is the formation of the Water, Energy, and Environment Nexus under NSF EPSCoR support involving the three NSHE research institutions. This program builds upon the previous DOE funded Nevada Renewable Energy Consortium. The overarching goal of the Nexus is to position NSHE as the global leader in research on solar energy generation and its impacts on water resources and the environment. The project's mission is to advance our knowledge of green energy through research focused on solar energy generation technology, its environmental impacts, and associated water issues, and accelerate this research by developing new capabilities in cyberinfrastructure (CI).

The project is organized by four strategic goals: research, diversity, workforce development, and external engagement. The research goal will increase our knowledge of the Nexus among solar energy, limited water resources, and fragile environments, with an emphasis on: (1) novel technologies to minimize water use at solar energy facilities; (2) desert ecosystem responses to perturbations associated with development of solar energy facilities; (3) advanced and sustainable water/wastewater approaches to support water needs for solar energy development; (4) interdisciplinary approaches to renewable and solar energy supply; and (5) CI capabilities that accelerate the Nexus research, including advanced data services, real-time data streaming and visualization, data mining and analysis, image processing, data security, and cloud computing.

The key facilities that are being developed to improve Nevada's research infrastructure are the Nevada Environment, Water, and Solar Testing and Research Facility (NEW-STAR) that will support coordinated research on the Nexus topics, and the Nevada Research and Data Center (NRDC), which will provide enhanced CI capabilities including connectivity, data management,

communication, and processing. The diversity, workforce training, and external engagement components are designed to support the deployment and trained workforce needs required to develop and deploy current and future solar energy technologies.

Alternative and clean energy development is and must remain a high priority for Nevada. It represents a critical link in the ability of the State to provide for its rapid population growth while maintaining the beauty of the State and the quality of for its citizens.

Nevada Alternative and Clean Energy Goals

Goal 1: Identify and foster the development of diverse renewable and alternative energy sources for Nevada to become energy independent and, eventually, an energy exporter.

Goal 2: Provide incentives for efficiency-related renovations and update and enforce building code standards for energy efficiency in new and retrofitted buildings.

Goal 3: Support the production of trained technicians and professional architects, engineers, scientists, and contractors to provide the workforce needed for a clean energy economy.

Goal 4: Educate Nevada citizens about the benefits of conservation and using alternative and renewable energy and provide programs to assist citizens in practicing energy efficiency on a local scale.

NSHE Strategies to Support State Goals

- Increase faculty research and development (R&D) in alternative and clean energy by identifying and applying for funding sources in all related areas.
- Target additional research support and faculty hires in the most promising clean energy areas for Nevada (i.e., geothermal and solar assessment and technologies, biomass resource assessment and use, energy storage systems, development of algal feedstocks, etc.).
- Engage and advise researchers, experienced entrepreneurs, business executives, and venture capital to identify, commercialize, and fund promising technologies resulting from faculty R&D.
- Address the economic aspects of the clean energy marketplace by providing research and expertise on cost-benefit analyses, market barriers, economic impact studies, negative-cost options, and the efficacy of economic incentives.
- Assess the clean energy resource availability, life cycle assessment, environmental and climate impacts, water availability, and infrastructure impacts of clean energy development and implementation.
- Lend expertise to the policy-making and practical aspects of alternative and clean energy by providing research on land use, regulatory barriers, portfolio standards, retrofitting, construction management practices, and the coordination of federal, state, and local regulations.
- Expand certificate programs, minors, majors, and graduate degrees to respond to market demands for professional workers in alternative and clean energy development.
- Provide fast-track training programs to produce technicians and support personnel for jobs in the clean energy industry.

- Partner with energy companies, government entities, and public schools to develop public education campaigns about conservation and clean energy.

II. CLIMATE CHANGE

Climate change and variability are ongoing natural processes that have occurred on various timescales throughout earth's history, driven mainly by variations in the earth's orbit and changes in atmospheric composition. In recent years, an increasing body of evidence has shown that anthropogenic effects, manifested by increased CO₂, -non-CO₂ greenhouse gas, and black carbon - content of the atmosphere from burning of fossil fuels, have a profound influence on climate and have resulted in unprecedented and rapid climate change (e.g., global temperature increases). These effects are predicted to continue into the future and may become increasingly severe. Changes in climate occurring in the intermountain West (including Nevada) now are manifested by increases in seasonal, nocturnal, and annual temperature and changes in the amount and type of precipitation.

Nevada has several attributes that impact the response of human and natural systems to climate change – past, present, and future. These include, but are not limited to: (1) great contrasts in climate and ecosystems over short distances created by the Basin and Range topography of the most mountainous state in the lower 48 states of the U.S.; (2) a high degree of aridity throughout Nevada, which is the most arid state in the U.S.; (3) a highly urbanized and rapidly growing population ($\geq 90\%$ of which lives in urban areas, making Nevada the most urban state in the nation); and (4) extensive areas of largely undeveloped, publically owned lands (86% of Nevada is federally owned, the highest percentage in the nation). The combination of rapidly growing urban centers in an arid, scarcely populated region is characteristic of Nevada but also occurs in many other parts of the world.

Climate, especially temperature and precipitation, has a major influence on the structure and function of ecosystems and the services (e.g., nutrient cycling, water supply) that ecosystems provide to humans. In the face of rapid and unprecedented climate change, such services may no longer be sustainable in their present quantity and quality. Understanding the nature of this uncertainty lies at the heart of the proposed goals.

Responding to human perceptions and responses to climate change is another important component to progress in this area. Climate change now and in the future will have significant effects on public policy. There will be a need to engage stakeholders in identifying their needs and to develop a two-way exchange of information between stakeholders and the science community.

Many of the State's goals in the area of climate change are embedded in the previous five year NSHE NSF EPSCoR grant.

Nevada Climate Change Goals

Goal 1: Improve climate modeling capabilities and evaluate the impact of climatic change (past, present, and future) on the State's natural resources to answer questions of resilience, resistance, and thresholds.

Goal 2: Engage citizens, industry, government, and the science community to collaborate on changes to public policy, land management, and water management in response to climate change research and developments, including regional approaches.

Goal 3: Improve the statewide computing infrastructure and compilation of integrated data sets to facilitate shared research from multiple sources as well as to support integrated policy-making.

Goal 4: Support the production of more scientists and engineers in order to provide teachers in science, technology, engineering, and mathematics (STEM) fields.

NSHE Strategies to Support State Goals

- Increase faculty research on climate change and its impacts by identifying and applying for funding sources in all related areas.
- Develop improved capabilities to downscale global projects to a regional scale that is relevant for decision making.
- Have NSHE institutions serve as repositories of integrated statewide and regional data and high-end data visualization capabilities.
- Develop and apply climate-change models to help predict Nevada's future water availability and use.
- Assess the impact of a changing climate on Nevada's water resource availability, environmental quality, and ecosystem function and services.
- Engage and advise individuals, businesses, and state, local, and federal agencies to develop balanced, effective, innovative, and politically acceptable strategies for mitigating and adapting to climate change in the State and region.
- Develop an integrated program in which science, technology, engineering, and mathematics (STEM) teaching in P-16 will be fostered through use of climate change as an example of fundamental physical and geographical concepts in an earth systems framework.

III. WATER RESOURCES

The Nevada Division of Water Resources 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 and geographic growth in the State of Nevada is completely dependent upon accurately quantifying and carefully managing water resources. Improving the understanding of available water resources (both quantity and quality) and the potential complex responses due to climate variability and change is accomplished through advanced education in science and/or engineering-based disciplines. Careful management of these resources involves the development and implementation of successful public policies by well trained professionals with academic backgrounds ranging from social science to engineering.

The Nevada System of Higher Education has a wealth of faculty expertise and infrastructure to support world class research and educational programs concerning water. To date, however, most of these resources have not been integrated either geographically or institutionally. A prior NSF EPSCoR grant for a system-wide Access Grid Node makes possible the offering of course work, seminars, and other meetings in a way that truly supports the emergence of technology to overcome the limitations of place. The environmental lysimeter facility in Boulder City (funded by the previous NSF EPSCoR statewide grant) to investigate Scaling Environmental Processes in Heterogeneous Arid Soils (SEPHAS) created a focal point for future collaborative research among a growing community of NSHE faculty with interests in water resources.

In order to promote the development of water technology commercialization and business development efforts in Nevada, GOED provided Knowledge Fund support to start up the Nevada Center of Excellence (NvCOE). The NvCOE is a collaborative public-private partnership led by DRI that includes GOED, DETR, SNWA, IBM, and the other NSHE institutions. This effort is designed to drive innovation-based economic development and workforce development by applying research, commercialization and commercially viable service-based solutions to address regional, national and global challenges related to water resources. This unique partnership has already resulted in a number of successful outcomes in the area of technology development.

Nevada Water Resources Goals

Goal 1: Accurately assess the total quantity and quality of available water resources in Nevada and collaborate with the intermountain states on a regional approach to expanding freshwater supplies and increasing efficiency of use.

Goal 2: Improve predictive water management tools and develop new visualization tools for both scientific exploration and public education.

Goal 3: Support increased production of trained technicians and professional scientists, engineers, and policy analysts in the field of water resources.

Goal 4: Facilitate the collection and integration of knowledge, data, and information on interactions between water resources, ecosystems, and large-scale climatic patterns in Nevada for the benefit of improved public policy decisions.

NSHE Strategies to Support State Goals

- Increase faculty research and development (R&D) in water resources by identifying and applying for funding sources in all related areas.
- Expand capabilities and research support to assess water resource availability, quality, and issues related to domestic, agricultural, and industrial needs.
- Evaluate the impact of hydrologic fracturing (“fracking”) for energy production on water availability and quality.
- Integrate water and water-related issues into the Nevada P-16 curriculum as part of an overall plan for educating the public, as well as current and future teachers, on the importance of water and water-policy related issues in the semi-arid southwest, including Nevada.

- Engage the Nevada Water Resources Research Institute (a statewide entity serving all of NSHE) to facilitate access to water resource information throughout the State.
- Collaborate with the Nevada Center of Excellence (a non-profit organization linking NSHE with other public and private entities) to develop water technologies and enhance business development efforts.
- Expand certificate programs, minors, majors, and graduate degrees to respond to market demands for technicians and professional workers in water-related professions.
- Develop an integrated statewide water resources academic program that builds upon the existing, internationally recognized graduate program in hydrologic sciences while elevating a complementary water resources management program to national prominence.
- Engage researchers from across Nevada, the United States, and the globe to use NSHE's state-of-the-art SEPHAS facility to better understand water movement and water quality transformations in semi-arid settings.
- Make available as a shared community resource NSHE's emerging high-end visualization capabilities (e.g., DRI's 4-sided and 6-sided CAVES and UNLV's Geovisualization Facility) as a means to integrate cutting-edge scientific visualization with public policy needs.



HUMAN HEALTH

IV. HEALTH CARE ACCESS AND RESEARCH

Nevada has come through a phase of significant growth followed by significant economic stress, with a resultant disinvestment in higher education that affected public medical education. Nevada is also characterized by having few public or community not-for-profit hospitals where most graduate medical education (residency and fellowship training, GME) is usually based, resulting in a pipeline of public medical education that is small and weak relative to the State's needs.

Nevada's citizens are among the least healthy of all state populations. The State's all-cause mortality, care of chronic diseases such as diabetes and respiratory disease, the delivery of preventive services such as immunizations and prenatal care, the quality and quantity of mental health care available, the risk of suicide, and many other medical and mental health measures of quality all rank Nevada in the lowest quintile of all U.S. states. Nevada ranks among the bottom five states in the number of physicians and nurses. Compared to neighboring or similar Western states, Nevada's public medical school is the smallest and it has the fewest medical residency training positions of any state with a medical school. Other health professions training programs (e.g. nursing, allied health, public health, nutrition, and others) are limited and do not meet the demands for health professionals in the State. Overall Nevada's health care system is characterized by having limited access, especially for indigent or underinsured patients, and is known to be among the more expensive in hospital charges, yet ranked near the bottom of all states in per capita state spending for health care programs.

In addition to these areas of poor performance, Nevada ranks nearly at the bottom of all states in the per capita number of Nevada students who enroll in any medical school, making the expansion of its public medical education system challenging. The pipeline deficiencies are further exacerbated by an increasing number of medical school graduates who are leaving the state for GME, partly because of programs that are not available (e.g. anesthesiology), and partly because of perceptions of lower quality of training, or lesser GME resources (such as uncompetitive resident salary and benefit schedules). A majority of these students do not return to the state.

In spite of these severe problems, Nevada has a number of assets which are beginning to make a difference. Prior decisions to coordinate all health-related programs from the eight NSHE institutions into a Health Sciences System (HSS) are providing a more integrated approach to the State's educational needs and research efforts. One goal of the Health Sciences System is to coordinate and integrate the different health education programs from multiple institutions to create efficiency and effectiveness and to focus on specific and serious needs in Nevada.

Most of the problems in Nevada's health care system can be solved only by building more education and training of health care providers at all stages of the pipeline. Building this educational pipeline must be accompanied by a concurrent increase in federal research grants and contracts to build a vibrant medical research center in Nevada. The current focus of most planning, affiliation agreements, recruitment, NSHE discussions, legislative requests and initiatives is on building an adequate health care workforce in NSHE institutions.

Nevada Health Care Goals

Goal 1: Improve health care access to all Nevadans by promoting health care education, research, and training as a top priority to Nevada business, academic and political leaders.

Goal 2: Deliver or facilitate the delivery of essential health care services through new affiliations, health system development, and the training of new and more health care professionals so as to ensure health and function are improved, families are strengthened, public health is protected, and citizens achieve their highest level of self-sufficiency.

Goal 3: Develop and expand a statewide biomedical, behavioral and health services research enterprise that supports economic development, technology transfer, and educational opportunities.

Goal 4: Expand the production of trained technicians, health care professionals, and health services experts to provide quality health care for all Nevadans.

NSHE Strategies to Support State Goals

- Build and expand the education pipeline for health care workers at all levels by offering coordinated certificate programs, minors, majors, graduate, and professional degrees to respond to market demands.
- Pursue the development of inter-institutional health sciences programs to promote integration, collaboration, and synergy among health professions.
- Engage statewide stakeholders in developing and implementing strategies for meeting the immediate and future workforce demands.
- Develop statewide multi-use facilities for health care education and research.
- Manage public-access clinics that provide in-service training for students while benefiting low-income residents.
- Enhance opportunities and funding for medical and dental residencies, nurse practitioners, and other advanced health care training.

- Provide state-of-the-art continuing health professions education for Nevada health care workers.
- Strengthen and expand the research infrastructure for health sciences programs at NSHE institutions.
- Help develop a statewide, electronic medical information management system.

V. PUBLIC HEALTH

Public health agencies are responsible for monitoring and maintaining the quality of public health services; maintaining the quality of medical services through licensure and certification of facilities; protecting individuals, families, and the community from threats such as epidemics and environmental contaminants; promoting healthy living conditions and lifestyles; and communicating both surveillance and epidemiologic data to public health officials, health care providers, industries, and community members. It includes working with communities continuously to communicate relevant information, assist their mobilization efforts, and provide technical assistance and consultation.

The frontier nature of most of Nevada leads to many challenges in developing a public health delivery system in the State that is compounded by a lack of providers for both primary and specialty care or public health practitioners, which is found even in the most urban communities. Among Nevada's 17 counties, approximately 87 percent of the State population resides in two urban areas: Clark and Washoe counties. Carson City and Elko are designated as a Small Metropolitan Area. Douglas, Lyon, and Storey counties are rural; and Esmeralda, Humboldt, Lander, Lincoln, Mineral, Nye, Pershing, and White Pine are frontier counties.⁴ Currently only Clark County, Carson City and Washoe County have developed public health infrastructures to support public health needs. The Division of Public and Behavioral Health is responsible for the frontier populations and over the last 5 years, the recession has impacted the number and distribution of public health practitioners (mainly community health nurses) throughout the remainder of the state. Tourism impacts the size and variety of public health emergencies that are mostly seen in the two most populated counties. Adequate preparedness, monitoring systems, and statewide communication continue to challenge public health infrastructures and stress the need for trained personnel and sophisticated surveillance capacity.

Rural and frontier residents, while comprising a small portion of the State's population, often require unique responses to their personal and community health issues. They are generally older, poorer, and have fewer health resources than their urban counterparts. Given the provider and public health shortages that are common in many rural areas, some rural clients drive more than 100 miles to access care, and rural hospitals and communities are exploring partnerships with larger health departments to leverage services. In particular, the renaissance in mining presents bigger challenges to the environmental public health infrastructure that stress the rural systems even more.

⁴Health Workforce in Nevada, 2013 Edition.

Nevada's public health statistics are daunting. Nevada ranks 49th in public health funding per person.⁵ In looking at health determinants, although Nevada has made progress in obesity levels (now at 7th in the US), smoking continues to place the State at 34th and premature deaths (years lost per 100,000 population) is at 35th. Lack of health insurance (ranked at 49th) and primary care physicians (at 47th) impact health outcomes such as cardiovascular deaths (33rd) and poor mental health days (28th). In addition, the geographical disparities already described rank Nevada at 45th and identify unique challenges for the state.

Fueling poor health behaviors is the low rate of high school graduation (ranked 50th) and children living in poverty (23rd). In addition, low graduation rates suggest that there is lack of qualified students to enroll in health professions.⁶

Solutions to these problems require coordination among agencies. As an example, positive gains in immunization rates (from 50th to 40th) may have been due to a statewide initiative consisting of local and statewide coalitions, NSHE schools and other state agencies specifically targeting this public health challenge. This success suggests that if the State's rankings are to improve, close collaboration will be required among government officials, public and private health providers, and NSHE faculty to address these indicators effectively.

Overall, there needs to be more communication and less fragmentation of services among policy-makers, state agencies, health systems, tribal health systems, and between some public and private providers in the State of Nevada. It is essential to have the data needed to educate policy-makers who make funding decisions on local, State, and national level. This will help forge the path necessary to build and strengthen the current public health system as Nevada moves into the future.

Nevada Public Health Goals

Goal 1: Protect and advance public health, safety, and quality of life for the well-being of all Nevadans as well as visitors to the State.

Goal 2: Deliver or facilitate essential public health services and prevention programs to protect and improve the lives of Nevada residents.

Goal 3: Help identify and work to eliminate health disparities through directed public policy.

Goal 4: Collect and make available data needed by policy-makers who fund public health services.

NSHE Strategies to Support State Goals

- Develop and expand statewide academic programs in public health at all levels by offering coordinated certificate programs, minors, majors, graduate and dual graduate, and

⁵ United Health Foundation, 2012.

⁶ Health Workforce in Nevada, 2013 Edition.

professional degrees to respond to market demands and build towards larger schools of public health that can address more complex issues.

- Engage statewide stakeholders in developing and implementing strategies for addressing public health needs and expand the number of contracts and grants to evaluate these strategies.
- Establish a close partnership with the state and county health districts to evaluate and implement training to advance the knowledge and skills of public health professionals.
- Establish foci of research in areas of critical public health challenges like mental health, immunization practices, tobacco cessation, alcohol and drug addiction, domestic violence, and disaster preparedness by identifying and applying for funding sources in all related areas.
- Help address the growing needs of and health disparities among target populations in Nevada, such as rural residents, minority populations, and children, through public service programs and faculty research.
- Promote initiatives and research in critical environmental challenges such as water quality, air quality, lead exposure, and radiation exposure.
- Translate university research and expertise into information that can be used by government agencies to promote appropriate policy decisions.
- Have NSHE institutions serve as repositories of integrated statewide and regional public health data with the capacity to provide analysis as needed.

VI. AGING SERVICES

By 2033, the elder population (i.e., individuals ages 65 and older) in the State of Nevada will increase by approximately 58%.⁷ A 2013 report by the UNR Sanford Center for Aging highlights that between 2000 and 2010, Nevada's elder population grew by over 48%, a higher growth rate than any other state except Alaska.⁸ Reasons for this growth in Nevada's elder population are attributed to issues such as immigration of retirees, aging of the existing population, and the out-migration of younger people, especially in rural environments. While these reasons vary, the impact of the elder population is multi-faceted, affecting all aspects of Nevada communities. This population change will impact transportation needs, housing requirements, workforce pools, and health care costs to name a few. One way that the health of elders can be assessed is by considering Medicare utilization. In Nevada, 84% of Medicare recipients are 65 and older.⁹

The following highlight several key points relating to Nevada's elder population:

⁷Nevada State Demographer. (2014). Nevada County Age, Sex, Race and Hispanic Origin Estimates and Projections 2000 to 2033.

⁸Broadus, A.D., Sacks, T.M., & Fadali, E.R. (2013). Elders Count Nevada. University of Nevada, Reno: Sanford Center for Aging.

⁹ Henry J. Kaiser Family Foundation (2012). State health facts. Dual eligible as a percent of total Medicare beneficiaries. Retrieved June 2014 from <http://kff.org/medicaid/state-indicator/duals-as-a-of-medicare-beneficiaries/>.

Race/Ethnicity: Nevada is becoming increasingly diverse in terms of the racial/ethnic and cultural characteristics of its population. Projections indicate that Nevada's population self-identifying as a minority will increase from approximately 46% in 2014 to approximately 54% in 2033, a 37% increase within the next 19 years.¹⁰ In light of this demographic transition, the State will need to increase its efforts in coming years to develop effective outreach efforts to connect with these elders as well as build its capacity to offer a mix of services and supports that culturally reflect the increasingly diverse population.

Disability and Aging: Of an estimated 376,225 non-institutionalized elders in Nevada, approximately 36% self-identify as having at least one disability.¹¹ These disabilities are self-reported in the following categories: sensory, physical, mental, self-care, and/or homebound status. As elders continue to age, the level of associated disability is also expected to increase, with approximately half of elders in Nevada reporting some disability by age 75.¹²

Suicide and Aging: Nevada has one of the highest suicide rates among elders, with approximately 24 deaths per 100,000 attributed to suicide.¹³ While major depression is the most common psychiatric disorder among the elderly, care providers, including many primary care physicians, are not identifying this disorder in elders. Data provided by the Centers for Medicare and Medicaid Services indicate that approximately 12% of individuals who receive Medicare services are being treated for depression.¹⁴

Chronic Disease: Data provided by the Centers for Medicare and Medicaid Services indicate that approximately 50% of Nevadans are being treated for hypertension (high blood pressure) and approximately 42% are being treated for hyperlipidemia (high cholesterol). Arthritis (25%), diabetes (24%), chronic kidney disease (16%), heart disease (11%) and COPD (11%) remain the highest chronic conditions being treated in the State. Individuals who have arthritis are more likely to have other chronic conditions, such as diabetes (50%), high blood pressure (approximately 41%), coronary heart disease (61%) or have suffered a heart attack (approximately 55%) or stroke (approximately 46%), making behavioral therapies more difficult to implement.¹⁵

¹⁰ Nevada State Demographer (2014). *Age, sex, race, and Hispanic origin estimates and projections October 2014*. Retrieved October 2014 from ndemography.org/data-and-publications/age-sex-race-and-hispanic-origin-estimates-and-projections.

¹¹ U.S. Census Bureau. (2013) American Community Survey, Table S0201.

¹² U.S. Census Bureau. (2012) American Community Survey, Table B1801.

¹³ Centers for Disease Control and Prevention. (2012). WISQARS.

¹⁴ Centers for Medicare and Medicaid Services. (2012). Medicare chronic conditions dashboard: County level. Retrieved December 2014 from http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Dashboard/Chronic-Conditions-County/CC_County_Dashboard.html

¹⁵ Centers for Disease Control and Prevention (2011). Behavioral risk factor surveillance system survey data. *Nevada: Chronic Health Indicators: Arthritis*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Retrieved June 2014 from <http://apps.nccd.cdc.gov/brfss/>.

Alzheimer's Disease: Approximately 7% of individuals receiving Medicare services are being treated for Alzheimer's dementia. It is estimated that there are currently 37,000 Nevadans living with Alzheimer's disease, a number projected to increase to 64,000 (73% increase) by 2025.¹⁶ This increase is expected to have a significant impact on the state's ability to provide health care services to elders, as well as supportive services to families serving as care partners.

Nevada Aging Services Goals¹⁷

Goal 1: Older Nevadans have a seamless and comprehensive support services delivery system to improve their independence and dignity.

Goal 2: Older Nevadans, persons with disabilities, their families and caregivers have access to a statewide network of single point of entry sites that provide a comprehensive array of information, referral, intake assessment and eligibility determination services.

Goal 3: Older Nevadans and their families have choices they can make about their long-term care options.

Goal 4: Older Nevadans are active and healthy with the support of evidence-based health promotion and disease and disability prevention programs.

Goal 5: Older Nevadans have an efficient system that promotes and protects their safety and rights.

NSHE Strategies to Support State Goals

- Expand existing focus on aging, health, and well-being (as evidenced in the UNR Gerontological Academic Program) by supporting and increasing gerontological education in all academic programs, especially the health disciplines, to prepare graduates for the breadth of professions that serve elder Nevadans and reduce workforce shortages.
- Increase interdisciplinary faculty and student research activities related to aging, the aging experience, and aging services to generate new knowledge to inform evidence-based practice, with appropriate supports to enable successful collaborative applications for research funding.
- Promote health equity among elders in Nevada through public service programs, service learning opportunities and research that culturally reflects the increasing diversity of elder Nevadans.
- Provide access to lifelong learning programs and opportunities for civic engagement for elder Nevadans, including the development of mechanisms to encourage and support education and access to courses for students of all ages.
- Expand partnerships and collaborations between public and private institutions that provide research and services for elder Nevadans.

¹⁶ Alzheimer's Association. *2014 Alzheimer's Disease Facts and Figures*.

¹⁷ Nevada Aging and Disability Services Division State Plan for October 2012 –September 2016.



INFRASTRUCTURE AND TECHNOLOGY

As Nevada seeks to recover from the long-term effects of the Great Recession, economic development and diversification have emerged as central priorities in science and technology planning. A 2011 report by the Brookings Institution, “Unify, Regionalize, Diversify: An Economic Development Agenda for Nevada,” identified seven major industries and some 30 narrower target opportunities distributed throughout the state that hold potential for economic growth and diversification.¹⁸ These seven industries, which correlate to targeted economic development sectors identified by the Nevada Governor’s Office of Economic Development, include the following: Tourism, Gaming, and Entertainment; Health and Medical Services; Business IT Ecosystems; Clean Energy; Mining, Materials, and Manufacturing; Logistics and Operations; and Aerospace and Defense. All of these areas require consideration of the needs and contributions of higher education relative to technology and infrastructure support systems.

Additionally, greater intellectual capital must be produced through research. To bolster its innovation capacity, the State should make strategic investments in “impact scholars” at its universities; incentivize university-industry research collaboration; boost industry R&D through competitive tax incentives; leverage federal resources to catalyze high-impact R&D; and assist small business in winning SBIR/STTR funds.¹⁹

Further, the State must invest in adequate infrastructure at its public institutions to support science and technology endeavors. Cutting-edge equipment and facilities are required to advance research and education; strained state budgets resulting from the recession have limited the ability of research universities to supply both hard infrastructure and staff resources to promote

¹⁸ “Unify, Regionalize, Diversify: An Economic Development Agenda for Nevada,” The Brookings Institution Metropolitan Policy Program, Nov. 2011. <http://www.brookings.edu/research/papers/2011/11/14-nevada-economy>. Accessed Dec. 1, 2014.

¹⁹ “Unify, Regionalize, Diversify: An Economic Development Agenda for Nevada – Executive Summary.” The Brookings Institution Metropolitan Policy Program, Nov. 2011. http://www.brookings.edu/~media/research/files/papers/2011/11/14%20nevada%20economy/1114_nevada_summary.pdf. Accessed Dec. 2, 2014.

growth in research activities and the graduate education necessary to support them. As the State emerges from trying economic times, increased emphasis on these priorities will enable higher education to bolster the State's efforts at economic recovery and to address challenges in the following areas of interest.

VII. TRANSPORTATION

On July 6, 2012, President Obama signed into law the Moving Ahead for Progress in the 21st Century Act (MAP-21).²⁰ This legislation set seven goals for transportation within our nation, including the following:

- **Safety**—To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
- **Infrastructure condition**—To maintain the highway infrastructure asset system in a state of good repair.
- **Congestion reduction**—To achieve a significant reduction in congestion on the National Highway System.
- **System reliability**—To improve the efficiency of the surface transportation system.
- **Freight movement and economic vitality**—To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
- **Environmental sustainability**—To enhance the performance of the transportation system while protecting and enhancing the natural environment.
- **Reduced project delivery delays**—To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

Nevada shares all of these goals with the nation. In terms of square miles, Nevada is ranked the seventh largest state in the nation, and, as a result, its population centers are spread across many miles. A recent Brookings Institution report addressed transportation as a key infrastructure issue, indicating that the state (and the region as a whole) lacks the robust and supportive multi-modal transportation network that is critical to its economic and ecological future. The report recommends that Southern Nevada create an intermodal connection that links freight (rail) and air transport; that Interstate 11 be completed to link Las Vegas to Interstate 40 at Kingman, AZ;

²⁰ "Moving Ahead for Progress in the 21st Century (MAP-21). Safety Provisions," Federal Highway Administration. http://www.fhwa.dot.gov/map21/safety_overview.cfm. Accessed July 31, 2013.

and that congestion be relieved along Interstate 15 to Los Angeles from Nevada.²¹

On a national level, Highway Traffic Safety grants from the National Highway Traffic Safety Administration (NHTSA) for FY2013 were estimated to be \$643 million.²² In spite of enormous resources spent on highway traffic safety, motor vehicle crashes are of critical concern in the United States. Based on statistical projections from NHTSA's Fatality Analysis Reporting System (FARS), traffic fatalities increased from 32,367 in 2011 to 34,080 in 2012, a 5.3% increase. In fact, 2012 was the first year since 2005 to have a year-to-year increase in fatalities, which indicates that considerable work is needed to improve highway safety.²³

The Highway Safety Improvement Program (HSIP) from the Federal Highway Administration (FHWA) is a critical component of the safety provisions in MAP-21.²⁴ As a part of HSIP, state Departments of Transportation (DOTs) developed a Strategic Highway Safety Plan (SHSP) to identify, analyze, and address traffic safety problems. State-of-the-art tools have been created to support the development of SHSP and generate better traffic solutions for existing and emerging safety problems. Some of these tools include the Interactive Highway Safety Design Model (IHSDM), the *Highway Safety Manual* (HSM), and the software tool, Safety Analyst. These tools can be used by DOTs to satisfy MAP-21's performance-based federal program, which mandates that state DOTs establish safety performance targets and achieve them within two years.²⁵ State DOTs across the nation, including the Nevada Department of Transportation (NDOT), are very interested to start using the available state-of-the-art tools for the development of SHSP. UNLV and UNR have begun working with NDOT on achieving this goal. Considering that traffic safety is a critical issue in Nevada, NDOT has established a Zero-Fatalities program with the objective to improve overall traffic safety in the state. The program involves engineering, enforcement, and education.

Travel demands due to population growth are escalating in Nevada. As reported by NDOT, Las Vegas is the tenth most congested city in the United States. By 2030, driving times during commute hours will exceed those currently experienced in Los Angeles. From 1990 to 2013, vehicle miles traveled on all of Nevada's streets and highways increased from nine billion to

²¹ "Unify, Regionalize, Diversify: An Economic Development Agenda for Nevada – Full Paper," The Brookings Institution Metropolitan Policy Program, Nov. 2011. <http://www.brookings.edu/research/papers/2011/11/14-nevada-economy>. Accessed Dec. 2, 2014.

²² "Early Estimates of Motor Vehicle Traffic Fatalities in 2012," National Highway Traffic Safety Administration. April 2013. <http://www-nrd.nhtsa.dot.gov/Pubs/811741.pdf>. Accessed May 30, 2013.

²³ Budget Estimates Fiscal Year 2013, National Highway Traffic Safety Administration. <http://www.nhtsa.gov/Laws+&+Regulations/NHTSA+Budget+Information>. Accessed May 30, 2013.

²⁴ "Moving Ahead for Progress in the 21st Century (MAP-21) – Safety Provisions," Federal Highway Administration. http://www.fhwa.dot.gov/map21/safety_overview.cfm. Accessed July 31, 2013.

²⁵ "Moving Ahead for Progress in the 21st Century (MAP-21) – Safety Provisions," Federal Highway Administration.

23.57 billion.²⁶ These increases demand interdisciplinary and creative new solutions if quality of life is to be sustained in Nevada.

According to the Texas A&M Transportation Institute's 2012 Urban Mobility Report, as a consequence of traffic congestion in 2011, Americans traveled 5.5 billion hours of extra time and purchased an extra 2.9 billion gallons of fuel; a 20-minute trip in light traffic extended to 60 minutes, and 56 billion pounds of additional CO₂ were produced. Hence, congestion costs are increasing. Extra time and fuel cost in urban areas have increased from \$24 billion in 1982 to \$94 billion in 2000 and to \$121 billion in 2011 (all values in constant 2011 dollars). The average commuter cost in 2011 was \$818 compared to an inflation-adjusted \$342 for 1982.²⁷

These national trends are consistent with those observed in Nevada. In 2011, Las Vegas experienced 45,419,000 hours of total annual delay, 44 hours of annual delay per auto commuter, 21 excess fuel gallons per auto commuter, and \$906 annual congestion cost per auto commuter. In 2011, in Reno-Carson City, the annual congestion cost per auto commuter in was \$590 and the annual delay per commuter was 27 hours. The Nevada-statewide total congestion cost for 2011 was estimated to be \$1.1 billion.²⁸

A proposed interstate highway corridor (Interstate 11) linking Phoenix and Las Vegas is considered a valuable economic development strategy designed to improve opportunities to expand travel, trade, and tourism in the western United States. Progress continues on the I-11 & Intermountain West Corridor Study, led by the Nevada (NDOT) and Arizona (ADOT) transportation departments; it is a two-year, multiphase, high-level study examining the benefits, feasibility, opportunities, and constraints of the proposed new interstate highway corridor.²⁹

According to the *State of Nevada Transportation 2013 Facts and Figures*, the Union Pacific Railroad (UPRR) and Burlington Northern Santa Fe Railway (BNSF) operate within the state. The UPRR is the largest carrier in Nevada and owns all 1,085 main line route miles in the state. Nevada's current passenger rail service consists of Amtrak's California Zephyr route, which travels between Chicago and the San Francisco Bay Area. Several proposed projects to bring passenger rail service between Las Vegas and southern California exist, including the XpressWest (formerly DesertXpress) that would run from Las Vegas to Victorville. Other projects include the Maglev, Pullman Palace Car Company, and the X-Train.³⁰ Recently, the Transportation Research Center (TRC) at UNLV completed a feasibility study of a Land Ferry,

²⁶ 2014 Annual Vehicle Miles of Travel 2013 HPMS Data Year, Nevada Department of Transportation. Sept. 2014. [https://nevadadot.com/uploadedFiles/NDOT/About_NDOT/NDOT_Divisions/Planning/Roadway_Systems/2013%20Annual%20Vehicle%20Miles%20of%20Travel%20\(AVMT\).pdf](https://nevadadot.com/uploadedFiles/NDOT/About_NDOT/NDOT_Divisions/Planning/Roadway_Systems/2013%20Annual%20Vehicle%20Miles%20of%20Travel%20(AVMT).pdf). Accessed Dec. 2, 2014.

²⁷ Congestion Data for Your City – Urban Mobility Information, Texas A&M Transportation Institute. <http://mobility.tamu.edu/ums/congestion-data/>. Accessed Dec. 1, 2014.

²⁸ Congestion Data for Your City, Texas A&M Transportation Institute.

²⁹ "Nevada, Arizona Officials See Progress on Interstate 11 Corridor Study," Nevada Department of Transportation. http://www.nevadadot.com/News/Press_Releases/2013/Nevada_Arizona_Officials_See_Progress_on_Interstate_11_Corridor_Study.aspx. Accessed Dec. 3, 2014.

³⁰ State of Nevada Transportation 2013 Facts and Figures, Nevada Department of Transportation.

which is a rail system capable of carrying trucks to reduce truck traffic on highways, along the I-80 corridor in Nevada.³¹ The study showed an opportunity to gain long-term financial benefits by constructing the Land Ferry to handle some of the heavy truck traffic currently using I-80.

Finally, Nevada is positioned well for development of the unmanned aerial system (UAS) industry. This includes the best and most available air space, experts from NSHE and the military, an ideal climate, and low costs for startups. In addition, Nevada was designated as one of six sites in the national that will develop testing and operation of UAS. NSHE institutions are working closely with GOED to develop applied research initiatives through the Knowledge Fund where companies will partner with NSHE.

Nevada Transportation Goals

Goal 1: Create an effective and innovative combination of federal, state, and local highways; high-speed and light rail; and air connections to reduce congestion, improve connectivity, increase reliability, and shape economic development within the state and region.

Goal 2: Preserve and manage the state’s existing transportation assets and increase the number of transportation choices within the state and region, with emphasis on innovative financing options and attention to the needs of elderly, disabled, tribal, and rural populations.

Goal 3: Participate in regional governance efforts to establish coordinated mechanisms to address transportation needs.

Goal 4: Optimize safety on Nevada transportation corridors and develop policies and procedures that reflect a coordinated approach to traffic incident management.

Goal 5: Improve the state freight network to support the economic development of the region.

Goal 6: Improve the overall project procurement process to reduce cost and delays as well as to promote the economic development of the region.

Goal 7: Expand the UAS industry for the state and provide the necessary workforce.

NSHE Strategies to Support State Goals

- Organize and focus existing research talent and resources on transportation issues facing the intermountain west.
- Create a statewide database of expertise in the area of transportation and infrastructure to foster communication and collaboration.
- Serve as the non-partisan convener of high-level meetings of key officials within Nevada and among the intermountain west states to discuss common issues and strategies for addressing transportation and infrastructure needs.

³¹ Merrill S., Paz A., Molano V., Stephen H., Maheshwari P., Shrestha P. “The Ability of a Land Ferry System to Alleviate the Increasing Costs of Maintaining the I-80 Transportation Corridor: An Economic Assessment.” 94th Annual Meeting of the Transportation Research Board, 2015. Washington, D.C.

- Utilize the nationally recognized University Transportation Centers at UNR and UNLV for translation of applied research into information that can be used by government agencies to promote appropriate policy decisions.
- Increase faculty research and development (R&D) in multi-modal transportation and traffic safety by identifying and applying for funding sources in all related areas.
- Cultivate public/private partnerships among researchers, business executives, and venture capital to identify, commercialize, and fund promising technologies resulting from faculty R&D.
- Address the economic aspects of multi-modal transportation by providing research and expertise on cost-benefit analyses, economic impact studies, rural transportation needs, and innovative financing.
- Provide research and development using unmanned aerial systems that will help attract industry to the state.
- Develop education programs in UAS that will support economic development.

VIII. MATERIALS SCIENCE

In 2011, 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.”³² The innovation in advanced materials will offer the United States not only the ability to greatly strengthen domestic industries in these fields but also to achieve global competitiveness in the 21st century.

- **Materials for National Security:** Advanced materials play an important role in many areas of national security such as critical minerals, energy storage, electronic materials, and lightweight materials.
- **Materials for Human Health and Welfare:** Advanced materials play an important role in many areas of human health and welfare such as biocompatible materials like prostheses and artificial organs. Protective materials designed to prevent injury are a good example that can benefit diverse user groups.
- **Materials for Clean Energy Systems:** Advanced materials play an important role in reducing our dependence on oil. High-efficiency solar cells and energy storage devices are also good examples.

Material science is becoming an economic driver for Nevada. For example, Tesla recently selected Nevada as the official site for its “Gigafactory” that will be the world’s largest and most advanced battery factory with potential economic impact of \$100 billion to the state over the next 20 years. The key component of the battery technology is based upon advanced materials.

Nevada has a number of nationally and internationally competitive research groups working on synthesis, processing, fabrication, characterization, and modeling of materials at both of the state’s universities. UNLV’s materials research groups are clustered in both the sciences and

³² Science and Technology Council/Executive Office of the President, Materials Genome Initiative for Global Competitiveness, Washington, D.C. 20502, June 24, 2011.

engineering, with interdisciplinary teams working on projects with exciting commercial potential. In particular, UNLV has top-notch groups in energy conversion technologies (batteries, solar cells, hydrogen, organic electronics, nuclear fuels, thermoelectricity, etc.) and in functional materials (smart materials, plastics, composites, sensors, actuators, etc.). It should be noted that UNLV's battery technologies can directly support Tesla's effort at their Gigafactory. Smart materials technologies, however, have great potential for use more widely, including in medical, commercial, entertainment, military, and aerospace fields with a broad range of applications, such as smart textiles, artificial muscles, smart optics, and embedded smart sensors. UNR is particularly interested in "smart materials." There are a number of types of smart materials, including piezoelectric materials, electroactive materials, and many more. Emerging application areas of interest to Nevada include, but are not limited to, (1) energy harvesting, (2) design of smart structures, and (3) structural health monitoring.

Nevada Materials Science Goals:

Goal 1: Expand and strengthen development and use of advanced materials and systems in Nevada by supporting additional research, development, and deployment capabilities in advanced materials technologies.

Goal 2: Assist local industries in improving their position as leaders in advanced materials technology and strengthening working partnerships with government, universities, and private industry to support economic development and technology transfer.

Goal 3: Attract advanced materials companies and services to Nevada.

NSHE Strategies to Support State Goals

- Hire faculty researchers and obtain equipment to fill key gaps and integrate Nevada's advanced materials researchers into nationally competitive research teams.
- Increase faculty research and development (R&D) in advanced materials by identifying and applying for funding sources in all related areas.
- Make closer connections between local industry, the legislature, citizens, and the academic community about the value of advanced materials.
- Assist the Las Vegas Global Economic Alliance, the Economic Development Authority of Western Nevada, and the Northern Nevada Development Authority – as well as the Governor's Office of Economic Development– with their efforts to actively recruit advanced materials-related high-tech companies to Nevada.
- Cultivate public/private partnerships among researchers and business communities to identify and commercialize promising advanced materials technologies resulting from faculty R&D.

IX. BIOTECHNOLOGY

Biotechnology encompasses many uses of living organisms, their cells, their products, and their processes for the betterment of mankind. This area of research has rapidly expanded since completion of the Human Genome Project in 2003. Biotechnology has been used to advance human health, agriculture, forensics, environment, and other industrial applications. As of 2006, global biotechnology revenues exceeded \$58 billion, with 1,452 biotechnology companies in the

U.S. alone employing more than 180,000 people. Biotechnology is one of the fastest growing industries in Nevada with 654 jobs in 31 establishments and an output of \$281 million (data from 2007).³³

The Nevada System of Higher Education has a wealth of faculty expertise and infrastructure to support world-class research and educational programs in biotechnology. Some commercial and organizational successes, recent growth and interest, and new developments offer potential for biotechnology growth in Nevada.

Additionally, the prospects of a new medical school at UNLV hold tremendous promise for research and development in many biotech areas in Southern Nevada and throughout the state. Given that the average research funding for U.S. medical schools is \$85 million annually, growth in research in biotechnology is one anticipated benefit of the new school.

Currently, biotechnology in Nevada centers on the two urban areas: Las Vegas and Reno. The proximity of Reno to San Francisco and Las Vegas to San Diego/Los Angeles makes these two locations desirable for relocation among California companies. Reno companies have begun to develop as the result of faculty research, and this research has been enhanced by the collaboration between UNR researchers and the Whittemore Peterson Institute for Neuro-immune Disease. The location of the Reno Medical School can also serve as a catalyst for biotechnology development. Notable companies involved in biotechnology in Northern Nevada include Charles River Laboratories, Medelis, and Sierra Sciences.

Collaborations in Southern Nevada have also stimulated bioscience research. The formation of the Cleveland Clinic Lou Ruvo Center for Brain Health has attracted world-class researchers and clinicians to southern Nevada, and significant partnerships with UNLV researchers have developed. A number of biotech companies are also establishing a presence in the Las Vegas area, including Omniture, Spectrum Pharmaceuticals, Ampac Fine Chemicals, Cardiovascular Biotherapeutics, Novum Clinical Research, Idexx Laboratories, Varian Medical Systems, DSX Therapeutics, Research and Diagnostic Antibodies, Elutin Vacular Inc., Corcell, Synaptec, Lucine Biotechnology, Inc. and several other small companies. DRI also has a growing biotechnology program focused on microbial genomics and beneficial products.

Two grass roots organizations – Nevada Biotechnology and Bioscience Consortium and SciTech – have successfully brought together a group that meets monthly for the southern Nevada biosciences community. The Las Vegas Global Economic Alliance named the life sciences as one of its primary targets for attracting new and relocating businesses. At this time, there is interest by not only academicians but also business owners and entrepreneurs in attracting additional private industry in this area and advancing the biosciences community in Nevada. However, this is still a burgeoning effort, and the number of businesses is still quite small.

Faculty research efforts in biotechnology are leading to promising developments in such areas as using robotic equipment in human prosthetics, improving medical treatment for cancer through developments in radiation chemistry, using industrial enzymes in biomass applications, creating

³³ Biotechnology, Nevada Governor's Office of Economic Development.
<http://nv.diversifynevada.com/industry/biotechnology/>. Accessed Dec. 2, 2014.

methods for stopping anthrax, studying cellular responses to DNA damage, examining new catalysts for production of biofuels, and improving cardiovascular functions.

A related effort in bioinformatics seeks to accelerate biological research at UNLV, UNR, DRI, and affiliated research centers by assisting investigators with the application of computing to biological problems and providing preliminary data for grant applications. A recently developed partnership with Switch Supernap will greatly enhance faculty access to supercomputing resources for such research.

Nevada Biotechnology Goals

Goal 1: Commercialization – To promote discovery and development of university research, help recruit and retain biotechnology companies, define biotechnology industry needs, and implement a pipeline to facilitate discovery to startup for university research. The latter includes development of incubator space for university startups.

Goal 2: Organization – To bring together university researchers with the local biotechnology companies. This also includes different state governmental entities working together to produce a consensus on a unified plan, including a set of goals, strategies, milestones, and implementation plans.

Goal 3: Dissemination – To enhance university outreach and market biotechnology research and developments to prospective students, industry, government, educators, and the general public.

Goal 4: Education – To create a pipeline from primary school to Ph.D. for training a biotechnology workforce. This includes education of scientists and educators, as well as the general public, on the local and national benefits of advancing biotechnology.

Goal 5: Support – To enhance support for biotechnology research and commercialization by enhancing private and government funding, infrastructure, and support for growing research faculty at NSHE institutions.

NSHE Strategies to Support State Goals

- Increase faculty research and development (R&D) in biotechnology by identifying and applying for funding sources in all related areas.
- Assist the Las Vegas Global Economic Alliance, the Economic Development Authority of Western Nevada, and the Northern Nevada Development Authority – as well as the State Division of Economic Development – with their efforts to actively recruit biotechnology and biomedical companies to Nevada.
- Develop more degree and certificate programs at the universities and colleges to support life sciences employers.
- Engage and advise researchers, experienced entrepreneurs, business executives, and venture capital to identify, commercialize, and fund promising biotechnologies resulting from faculty R&D.

X. INFORMATION TECHNOLOGY

Nevada has been emerging as a strong center for businesses in the information technology (IT) sector due to a strong digital infrastructure, the lack of natural disasters, and a mix of traditional and green energy sources that are reliable. In Southern Nevada, Switch Communications is the world's largest data center and has also developed the InNEVation Center for entrepreneurs and technology startups. In addition, Intel has partnered with UNLV to setup one of the fastest supercomputers at the Switch Data Center. In Northern Nevada, Apple Computer is building their iCloud data center in Reno, and this has spurred on other technology companies. For Nevada to fully optimize the use of these resources, the broadband communications network must be bolstered.

Broadband communications networks are fairly robust in Nevada's high population areas but inadequate in the rural areas. Renewable energy portfolio requirements for utilities and industry are creating a need for much more sophisticated and faster responding ancillary services to manage the electric grid. Additionally, the future of distributed generation will be enhanced with similar ancillary services. These same ancillary services can be employed to upgrade agricultural irrigation systems that will assist in the economical conservation of Nevada's water supply.

Simply put, a robust, statewide Nevada broadband network will provide the extended "highway" by which its scientists and students may develop and employ innovative technology.

Information Technology Goals

Goal 1: Improve access of information technology for addressing social, economic, and environmental needs of the state.

Goal 2: Develop an improved cybersecurity infrastructure in the state that will protect the public and private sector.

Goal 3: Develop and expand a statewide information technology research enterprise that supports economic development, technology transfer, and educational opportunities.

Goal 4: Expand the production of trained technicians and IT professionals.

NSHE Strategies to Support State Goals

- Build and expand the IT pipeline at all levels by offering coordinated certificate programs, minors, majors, graduate, and professional degrees to respond to market demands.
- Pursue the development of inter-institutional IT programs to promote integration, collaboration, and synergy among health professions.
- Engage statewide stakeholders in developing and implementing strategies for meeting the immediate and future workforce demands.
- Develop statewide multi-use facilities for IT education and research.
- Strengthen and expand the research infrastructure for IT programs at NSHE institutions.



COMMON THEMES FOR NEVADA

“Innovation is the strong driver of economic growth, new industries and jobs, and a high standard of living, both in the United States and globally. In the last half-century, innovation in turn has been increasingly driven by educated people and the knowledge they produce, particularly through scientific and technological research and development. In the United States, the primary source of the new knowledge and talented individuals who apply it to achieve our security, health, prosperity, and other national goals continues to be the basic research and graduate education programs of our nation’s research universities.”³⁴

In line with the assertions made in the National Academy of Sciences Report regarding the United States, it can be safely claimed that as the State of Nevada pursues economic growth and the goals that it has established for itself, the research institutions in the State have proven themselves to be major drivers of innovation. “At a time when new knowledge and technological innovation are critical to economic growth”³⁴ the State and its research universities are investing in their own competitiveness.

In close partnership with the local, regional, and state economic development agencies, the State’s institutions of higher education should serve as leaders and the drivers of an Innovation Ecosystem in the State.

- Technological innovations at the NSHE institutions will be the driver of economic growth, new industries and jobs, and a high standard of living, in the region and the State
- In partnerships with the local, regional, and state economic development organizations, the three research institutions will help achieve economic diversity and prosperity in northern Nevada.

³⁴ “Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation’s Prosperity and Security”, (2012) National Academy of Sciences.

Paraphrasing Ron Daniels, President, Johns Hopkins University, it is a fundamental imperative for state's universities to help build innovation ecosystems in their respective regions.

Equally critical is workforce development and ensuring that there is a continuous stream of a talented pipeline that will support the technological innovations and advancements in areas such as advanced manufacturing, health care, software and computers, and security.

The Advanced Manufacturing Partnership (AMP) Steering Committee presented a set of recommendations to the President on capturing domestic competitive advantage in advanced manufacturing. Those recommendations were “built around three pillars: enabling innovation, securing the talent pipeline, and improving the business climate”³⁵ and called for a partnership between educational institutions (community colleges to doctoral granting institutions), industry and the public sector. The collective expertise of the AMP Steering Committee provides encouragement that such a partnership will maximize the momentum towards more innovations in pedagogy and will enable the establishment of vibrant innovation ecosystems in regions centered around institutions of higher education.

Critical to the deployment of new advanced manufacturing technologies will be a skilled workforce trained and ready to lead this revolution in manufacturing. Exciting examples of novel partnerships between industry, educational institutions, and the public sector have come to the attention of the AMP Steering Committee that address skills gaps in manufacturing. These partnerships are at the regional level and engage community colleges. A focus on these best practices and participation of all players (government, industry, and academies) will lead to further innovations in education and new excitement for the careers that will be created by a vibrant advanced manufacturing sector in the United States.

The State of Nevada has to promote workforce development ranging from basic manufacturing to advanced manufacturing, investments in our institutions of higher education and community colleges, build and expand the education pipeline for health care workers at all levels by offering coordinated certificate programs, minors, majors, graduate, and professional degrees to respond to market demands, pursue the development of inter-institutional health sciences programs to promote integration, collaboration, and synergy among health professions, and engage statewide stakeholders in developing and implementing strategies for meeting the immediate and future workforce demands.

Nevada is not currently performing at the level needed in many of the areas critical for the future of the State. National reports on education, health, technology, and research indicate that the State is performing near or at the bottom in many of the categories that would normally provide attractive assets to families and businesses considering moving to Nevada. The State can no longer do “business as usual” if it is to prosper.

The NSHE Science and Technology Plan contains several recurring themes in all of the focus areas needed to support the State moving forward.

³⁵ “Report to the President on Capturing Domestic Competitive Advantage in Advanced Manufacturing”, Advanced Manufacturing Partnerships Steering Committee.

Communication and public awareness

Solutions to the State's most serious problems must be based on science, research, and data. This requires transmitting information to the public, from K-12 to adult retirees, about the critical importance of these focus topics. Policymakers and government officials particularly need to become knowledgeable to make informed decisions.

For example, public awareness about the need to develop alternative and renewable energy sources and to protect water resources seems essential as quality of life issues for all Nevadans. A better informed public can support the difficult decisions that policymakers and administrators will have to make.

Workforce training and education

In every focus area, new education and training opportunities will need to be initiated or augmented to accompany science and technology development. Ultimately this education and training will lead to higher-wage employment and a population prepared for the future. Without this targeted education and training, only the most basic entry jobs will be available to too many current Nevada citizens. Start-up companies will not develop. Out-of-state businesses will not relocate to this State.

In addition to certificates, associate degrees, and bachelor's degrees, advanced education is key to science and technology development. Opportunities for graduate students to attend the universities and to work with a mentor through research projects are the only ways that students dedicated to solving Nevada's problems will be found. Graduate students who are educated and trained in Nevada most often pay special attention to solving Nevada's problems.

Collaboration among business/industry, government, and college and university faculty

In almost every focus area, collaborations with industry have been proposed as a road to future success. Partnerships with industry and business, either to support education proper or to invest in technologies and practices for the development of new ideas and inventions, provide ways to help financially, educationally, and economically. Industry leaders will need to help support and define their educated employees of the future in order to build the essential workforce.

Support of research and development projects that lead to new ways of doing business, new tools for better business success, or business spinoffs that promote economic development and diversity is a partnership that requires two-way communication between faculty, researchers, and business leaders. Ways of making that collaboration successful and removing bureaucratic impediments to working together must be found. Greater economic diversity in Nevada is essential to avoid future economic fluctuations caused by an economy defined by only one or two industries.

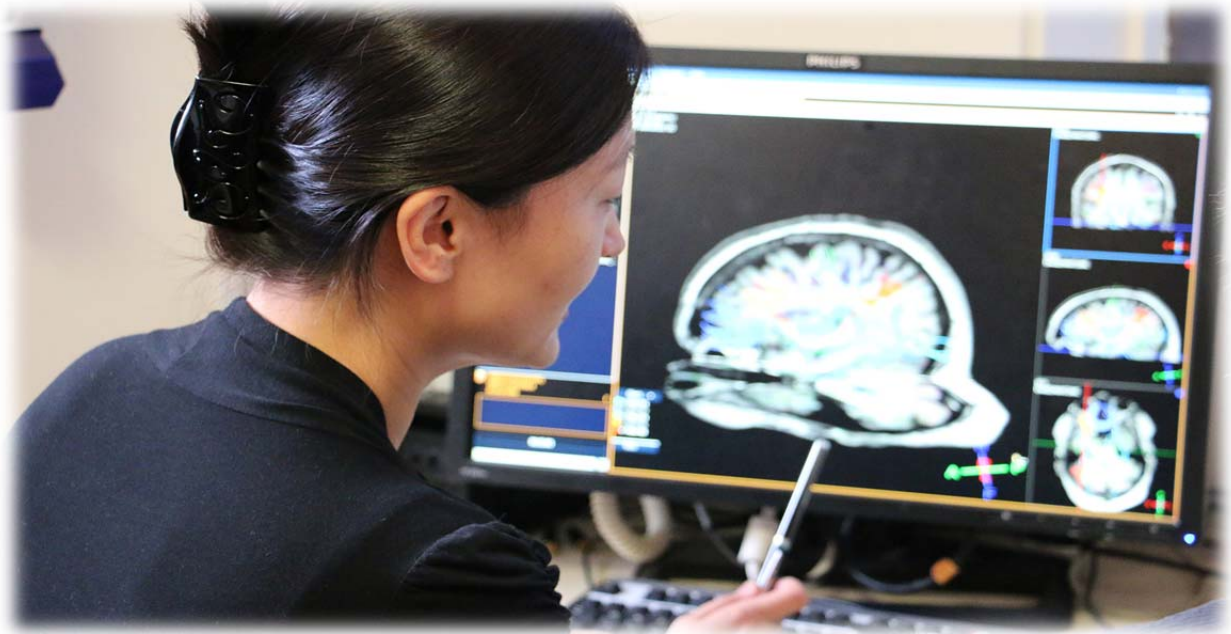
Shared resources and information

In this day of advanced information technology, large amounts of records are accumulated and kept in databases. There is a need and a desire by both NSHE and the State to share electronic data and common databases in order to better understand and solve some of the critical problems (such as water resources) and to provide improved healthcare services (electronic health records). Shared physical resources also make sense. Nevada cannot afford duplication of efforts and facilities when so many important problems face the State and resources are limited. Obvious areas of sharing resources include renewable energies, business practices, software development, and engineering design for building, bridges, and roads.

Research infrastructure investment

Nevada's science and technology infrastructure has been greatly enhanced by EPSCoR and IDeA programs supported by federal agencies. The intent of these programs is to provide the "seed corn" that helps scientists become nationally competitive in world class research. NSF, NASA, Space Grant, DOE, DoD, and NIH programs to stimulate competitive research have provided Nevada with \$51 million in research support for equipment and facilities and to pay for research done at its research institutions. Along with research infrastructure goes human infrastructure. Most of these programs provide graduate and undergraduate support for students to pursue their interests in STEM fields. Further, many of them develop opportunities for "at risk" students to participate and be stimulated by science and technology. From middle and high school through the community college level, these students take part in science and technology education and research that builds a pipeline of future workers in key areas in support of Nevada's economic future. All NSHE institutions, including Nevada State College and the community colleges, participate in the various pipeline activities.

This investment is essential if Nevada is to move forward in research, technology transfer, and economic development. But EPSCoR and IDeA programs are not sufficient. The State of Nevada, along with private donors, must step forward with more financial building blocks essential for Nevada's three research institutions to be nationally and internationally competitive. Programs like the Knowledge Fund that was supported at a level of \$10 million in 2013 was a good initial investment from the State. These are investments that will yield returns for the future far beyond the cost.



CONCLUSION

These nine focus areas and five common themes provide a broadly written blueprint for the investment of resources and the development of new programs in science and technology for Nevada. These lists are not exhaustive by any means. DRI, UNLV, and UNR each have specific areas identified for excellence by their scientists, engineers, researchers, and faculty. NSHE community colleges and the state college have an active role in providing the educational unpinning necessary in all science and technology efforts. Often workforce needs arise that cannot be anticipated, just as do research opportunities. Therefore, the lists are not intended to represent all of the potential opportunities that may come Nevada's way or rule out other areas requiring attention.

But Nevada's success in the years ahead will require higher education and the State working together in a focused manner to build science and technology infrastructure and to make difficult choices among the many opportunities. It will require the recruitment of the nation's best and brightest scientists who can work in the laboratory and in the field to build a better Nevada. It will require sacrifices of less-important initiatives to focus on the critical ones facing the State. This Plan is a beginning design to help shape that conversation.