NM EPSCoR State Committee Meeting
May 27, 2009

Lunch at the Amaya Restaurant
Hotel Santa Fe
1501 Paseo Peralta
Santa Fe, New Mexico
12:45 – 1:45 pm

Committee Meeting
Canyon Room
Hotel Santa Fe
2:00 – 4:00 pm

Agenda	
2:00	Welcome and comments. Jack Jekowski, Chairman
2:15	Current RII 3 Track 1 overview and progress. Bill Michener, Program Director
2:45	EPSCoR State Program activities update. Bill Michener and Katherine Mitchell, Associate Director
3:15	Discussion of committee member vacancies and action item on new Vice-Chairperson. Jack Jekowski
3:30	Emerging directions and philosophy within NSF. Jack Jekowski and Bill Michener
3:45	Review of New Mexico State S&T Plan. Tom Bowles, Science Advisor to the Office of the Governor
4:00	Proposed agenda items for fall meeting and final comments.

State Committee Members

May 2009

Co-Chairs
Jack Jekowski, Principal Partner, Innovative Technology Partnerships
(new Co-Chair TBA)

University Representatives
Dr. Vimal Desai Chaitanya, Vice President for Research, Graduate Studies, and International Programs; New Mexico State University.
Dr. Julia Fulghum, Vice President for Research & Economic Development; University of New Mexico
Dr. Van Romero, Vice President for Research; New Mexico Tech
Dr. Randy Jennings, Professor, Department of Biology; Western New Mexico University
Dr. John Montgomery, Assistant Dean, Liberal Artas and Sciences; Western New Mexico University
Dr. Linda LaGrange, Associate Vice President for Academic Affairs; New Mexico Highlands University
Dr. Anthony Sena, Provost; Northern New Mexico College
TBA; San Juan College

Los Alamos National Lab Representative
Dr. Nan Sauer, National Security Education Center Director, LANL
Dr. Kurt Steinhaus, Community Programs Office Director, LANL

Sandia National Lab Representative
Marie Garcia, University Research Program Manager, SNL

New Mexico Governor's Office Representatives
Dr. Thomas Bowles, Science Advisor to the Governor, Office of Science and Technology, State of NM

State Government Representative
Stephan Helgesen, Science and Technology Director, Economic Development Department, State of NM

State Government Legislators
Representative Danice Picraux, District 25, Bernalillo County
Senator Mary Kay Papen, District 38, Dina Ana County
Senator Linda Lopez, District 11, Bernalillo County

Private Industry Representatives
Ronald Tafoya, Senior Software Engineer, Intel Corporation
Beverlee McClure, President and CEO, Association of Commerce and Industry of New Mexico

State EPSCoR Office (Ex-Officio)
William Michener, State Director

New Mexico EPSCoR Bylaws and Program Responsibilities
Revised 20 November 2008

Council of University Presidents

Council Charge

New Mexico does not have a single Board of Regents for the University System, therefore, the EPSCoR program has identified the Council of University Presidents (CUP) as the umbrella organization for the State EPSCoR Program. The CUP has the following responsibilities:

- Oversees the activities of the State of New Mexico EPSCoR Committee
- Appoints State EPSCoR Committee membership
- Promotes EPSCoR activities within the state
- Promotes EPSCoR bills for support for matching money in the state legislature
- Approves changes in bylaws by a majority vote of the Council of University Presidents
- Approves the selection of the Project Director

New Mexico EPSCoR Committee

Committee Charge

The New Mexico EPSCoR Committee is an advisory body to the New Mexico Council of University Presidents and the Project Director. The purposes of the New Mexico EPSCoR Committee are: 1) to assist New Mexico in focusing and enhancing its capacity for research and development through a partnership of our academic institutions, national labs, industry, and state government; 2) to promote research in the universities, increase opportunities for training the workforce of scientists and engineers, and promote economic development of the state of New Mexico.

The EPSCoR Committee will achieve the purpose stated above by:

a. Developing a state strategic plan for advancing scientific and engineering research and training at the colleges and universities, selecting research priorities for EPSCoR emphasis, and developing strategies for investment of resources to enhance research capacity,
b. Cooperating with various state agencies and national laboratories in promoting research and development,
c. Promoting private sector involvement in university research and expediting technology transfer,
d. Coordinating applications for EPSCoR program funding from federal agencies as appropriate.

Committee Bylaws

1. The committee will be composed of members appointed by the Council of University Presidents, including:
    a. Representatives (1 each) from State and Tribal two and four-year colleges and graduate universities with experience in their institution's research role and mission;
    b. Representatives from Los Alamos National Lab and Sandia National Lab;
    c. A representative of the Governor's office;
    d. A representative of public education;
    e. One or more members of the New Mexico Legislature;
    f. Representatives of the private sector with experience in innovation and entrepreneurial activities; applied research and development; management and finance; or community economic development
    g. Representative(s) from other state EPSCoR programs as advisory, ex officio members;
    h. The Project Director of New Mexico as an ex officio member.
2. Committee members serve at the pleasure of the Council of University Presidents.
3. Vacancies in the membership of the Committee will be filled by appointment by the Council of University Presidents.
4. Members receive no compensation for their services. Travel and per diem expenses will be paid by the New Mexico EPSCoR administrative office pursuant to New Mexico state policy and regulation, dependent upon funding.
5. The Committee will hold its meetings at such times and places as determined by the Chairperson, or whenever any five members so request. At a minimum, the committee shall meet semiannually. A reasonable effort will be made to hold meetings at various New Mexico locations.
6. The Council of University Presidents will appoint a chairperson and vice-chairperson from among the membership. The chairperson is usually responsible for presiding at all committee meetings and signing all bylaws, resolutions, and minutes. She/he represents the committee and serves as the visible arm of the state's EPSCoR project. The vice-chairperson is to preside at all meetings in the absence of the Chairperson.
7. Sub-committees may be designated to serve as may be necessary to carry out the purposes of the EPSCoR Committee.
8. Bylaws can be revised by a majority vote of the Council of University Presidents.
9. The Committee performs the search for the Project Director and makes recommendations to the Council of University Presidents.
10. The Committee provides guidance with respect to selection of proposal foci.

EPSCoR State Office

EPSCoR Office Charge

The EPSCoR State Office is responsible for promoting and organizing New Mexico EPSCoR activities within the state, region and United States that benefit New Mexico. The Office represents the principle clearinghouse for EPSCoR information in the state. Specific responsibilities include:

1. Maintaining a website at www.nmepscor.org
2. Maintaining EPSCoR personnel databases and state statistics needed by New Mexico and federal EPSCoR organizations.
3. Developing requested reports and public information materials on the New Mexico EPSCoR program.
4. Representing New Mexico in EPSCoR Foundation and EPSCoR Coalition activities as appropriate.
5. Acting as the fiscal agent and providing reports for infrastructure awards from the National Science Foundation.
6. Providing review and fiscal management for EPSCoR funded subawards to other universities/colleges.
7. Developing appropriate project management teams for review and oversight
8. Organizing external reviews of EPSCoR projects and proposals.
9. Providing requested information on EPSCoR proposals submitted to other federal EPSCoR programs.
10. Identifying state and federal funding opportunities appropriate to EPSCoR activities.
11. Communication with state legislators and federal representatives on legislation appropriate to EPSCoR activities.
12. Recording minutes of Committee meetings (by a staff member from the EPSCoR Office).
13. Coordination with appropriate offices in other institutions:
    a. Sponsored research offices at Universities
    b. University research programs
    c. State Engineers Office
    d. State Commissions appropriate to EPSCoR research/education efforts
    e. New Mexico State Departments appropriate to EPSCoR efforts

14. Following the close of each university fiscal year, the Office will submit an annual report of its activities for the preceding year to the Council of University Presidents.

15. Representing state institutions in Legislative and Congressional activities requires specific policy objectives. These are:
    a. All activities of the EPSCoR Office of the nature described below would be reported to the Chair of the State EPSCoR Committee. The Chair and EPSCoR office would decide on issues to be taken to the State EPSCoR Committee.
    b. The efforts of the State EPSCoR Office would be devoted to represent all relevant institutions on EPSCoR issues. It would not represent or

promote the activities/interests of a single institution if it was the only institution involved in the issue.

c. With the permission of the institution, the EPSCoR Office could represent (or promote) a single institution in terms of how it is involved in an overall EPSCoR effort involving multiple institutions.

d. The EPSCoR Office would be a clearinghouse for information and, as requested, would pursue state and federal funding opportunities on behalf of EPSCoR institutions where appropriate. As requested by institutions, the Office may play a role in promoting collaboration among interested institutions, developing promotional materials, and working with the Legislature and Congress on behalf of those institutions.

e. The Chair and State EPSCoR Committee would determine the appropriate role of the EPSCoR office in the event there are conflicts of single vs. multiple institutional issues. An example would be if a single institution wanted to compete for a funding initiative vs. multiple New Mexico institutions competing for the same initiative. Such issues would be brought to the State EPSCoR Committee by the Chair the State EPSCoR Committee or representatives of said institutions.

f. The EPSCoR Office would develop promotional and informational materials (e.g., business cards, brochures) that reflect the independent status of the State EPSCoR Office and its function as coordinating the activities of institutions in New Mexico.

A New Foundation for the 21st Century
Technology Investments in the 2010 Budget

In the face of unprecedented challenges, technological advances can provide a powerful engine for advancing economic growth and new opportunity. Harnessing the full power and potential of new technologies can improve the lives of all Americans. (Recovery Act investments are listed in a separate column in the Table; dollar and percentage changes are from 2009 enacted appropriations (excluding Recovery Act funds) to the 2010 Budget.) The 2010 Budget invests in key technologies, including:

Broadband technology – The Administration is investing heavily in broadband infrastructure by implementing the $7.2 billion provided for this purpose in the Recovery Act to the Departments of Agriculture and Commerce (see Table). These investments will continue to be implemented in 2010. The 2010 Budget provides $82 million for continuing USDA support of rural broadband, distance learning, and telemedicine services, an increase of $23 million or 39 percent over the 2009 enacted level.

Health information technology (IT) – Building on the historic $19 billion investment in the Recovery Act, the Administration will continue efforts to further the adoption and implementation of health IT as an essential tool to modernize the health care system. $2 billion in Recovery Act investments will continue to be implemented in 2010, while the remaining $17 billion will be available as temporary incentive payments starting in 2011 to physicians and hospitals participating in Medicare for using certified electronic health records.

Education technology – Supporting cutting-edge educational technology, modernizing science laboratories, and forging partnerships to improve the use of science and technology in classrooms are key priorities throughout federal investments in education. $650 million in Recovery Act investments for Education Technology State Grants (ED-TECH) will continue to be implemented through the 2010-2011 school year, and the 2010 Budget provides an additional $100 million. Other Department of Education programs, including Title I Grants and Teacher Quality State Grants, also provide support for education technology.

Clean energy technology – In no area will innovation be more important than in the development of new technologies to produce, use, and save energy. The 2010 Budget sustains the Administration's commitment to developing a 21st century clean energy economy. In addition to energy research and development (R&D) investments, the 2010 Budget provides $3.1 billion for clean energy technologies, including deployment, demonstration, and commercialization assistance activities, to build on $31 billion in Recovery Act funding.

Federal information technology (IT) – Greater transparency, accountability, and public participation are central to the President's Open Government agenda. New technology has the potential to drive innovation in government. The 2010 Budget reflects the growing responsibilities for federal IT management with $75.8 billion for total federal IT spending, $5.1 billion or 7.2 percent more than the 2009 enacted level. New directions for federal IT in 2009, as well as allocations of Recovery Act investments, mean that federal IT spending estimates for 2009 and 2010 will likely change as plans are made to address the Administration's goal of greater openness in government, wider participation by citizens in government, and a more collaborative, cost-effective federal IT enterprise.

Next-Generation Manufacturing Technologies – The 2010 Budget provides significant funding for programs at the National Institute of Standards and Technology (NIST) that will foster innovation in manufacturing, including $125 million for the Hollings Manufacturing Extension Partnership (MEP), an increase of $15 million over the 2009 enacted level as part of the President's plan to double MEP funding between 2008 and 2015. The 2010 budget also provides $70 million for the Technology Innovation Program (TIP). While its initiatives are not solely directed at the manufacturing sector, the Economic Development Administration (EDA) will be spending at least $50 million to promote regional innovation clusters and $50 million to support business incubator networks. The 2010 Budget also funds research that benefits manufacturing in the NIST laboratories, and the Recovery Act provides $2 billion for grants to support manufacturing of advanced batteries.

Table. 2010 Budget for Selected Technology Programs
(budget authority in millions of dollars)

Technology Area Department/ Agency - Program	FY 2008	FY 2009	FY 2009 ARRA*	**FY 2010**	Change '09 to '10** Amount	Change '09 to '10** Percent
Broadband Technology:						
Dept. of Commerce Nat'l Telecomm. and Info. Admin.						
- Broadband Technology Opportunities Program	0	0	4,700	**0**	0	- -
U.S. Dept. of Agriculture Rural Utilities Service						
- Distance Learning, Telemedicine, and Broadband	53	59	2,500	**82**	23	39.0%
TOTAL Broadband	53	59	7,200	**82**	23	39.0%
Health Information Technology:						
Dept. of HHS Office of the Secretary						
- Office of National Coordinator for Health IT	61	61	2,000	**61**	0	0.2%
TOTAL Health IT 1/	61	61	2,000	**61**	0	0.2%
Education Technology:						
Dept. of Education School Improvement Programs						
- Enhancing Edu. Through Tech. State Prog. (ED-TECH)	267	270	650	**100**	-170	-62.9%
TOTAL Education Technology	267	270	650	**100**	-170	-62.9%
Clean Energy Technology:						
Dept. of Defense						
- Near Term Energy Efficiency Tech. Demos. And Res.	0	0	300	**0**	0	- -
Dept. of Energy						
- Energy Efficiency & Renewable Energy 2/	1,704	2,179	14,800	**2,319**	140	6.4%
- Advanced Battery Manufacturing Grants	0	0	2,000	**0**	0	- -
- Fossil Energy R&D 2/	727	876	3,400	**618**	-259	-29.5%
- Elec. Delivery and Energy Reliability 2/	136	137	4,500	**208**	71	51.8%
- Innovative Tech. Loan Guarantee Program 3/	4	0	5,990	**0**	0	- -
TOTAL Clean Energy Technology	2,572	3,192	30,990	**3,145**	-48	-1.5%
Federal Information Technology Spending (Gov't Wide)	66,405	70,716	4/	**75,829**	5,113	7.2%
Next-Generation Manufacturing Technologies:						
Dept. of Commerce						
- Manufacturing Extension Partnership (NIST)	90	110	0	**125**	15	13.4%
- Technology Innovation Program (NIST) 2/	46	60	0	**70**	10	16.5%
- Regional Innovation Cluster and Business Incubator 5/	0	0	0	**100**	100	- -
TOTAL Manufacturing Technologies 6/	136	170	0	**295**	125	73.3%

* American Recovery and Reinvestment Act (Public Law 111-5); funds will be spent over multiple years.

** Excludes Recovery Act appropriations. Change is regular FY 2009 appropriations to FY 2010 request.

1/ Health IT ARRA funding excludes an estimated $17 billion in incentives and investments through mandatory programs (Medicare and Medicaid) beginning in 2011.

2/ Includes some R&D funding. EERE includes Federal Energy Assistance spending.

3/ Appropriated funds only. The program leverages appropriated funds by up to 10 times in loans.

4/ Recovery Act allocations are not available at this time.

5/ Allocation within Commerce EDA programs, roughly half for innovation clusters and half for business incubators. For the past several years, EDA support of incubators has been approximately $10-$25 million a year.

6/ R&D spending in the NIST laboratories and other R&D agencies also contribute to manufacturing technologies.

Preparing Our Children for the 21st Century Economy

Science, Technology, Engineering and Mathematics (STEM) Education in the 2010 Budget

The 2010 Budget makes a renewed commitment to education in science, technology, engineering, and mathematics (STEM) fields because the progress and prosperity of future generations will depend on what we do now to educate our students. The 2010 Budget invests $3.7 billion in STEM education programs throughout the federal government in over 100 programs identified by the Academic Competitiveness Council (ACC; see Table), an increase of $98 million or 2.7 percent over the 2009 enacted level for these programs. In addition, the Recovery Act provides a preliminary $276 million for these programs, which will be spent over 2009 and 2010. (Preliminary allocations of Recovery Act investments are listed in a separate column in the Table; dollar and percentage changes are from 2009 enacted appropriations (excluding Recovery Act funds) to the 2010 Budget.)

For STEM programs, 2010 Budget highlights include:

- The President's commitment to triple the number of **Graduate Research Fellowships (GRF)** at the National Science Foundation (NSF) to 3,000 by 2013. The 2010 budget provides $122 million for the NSF GRF program.

- Funding for the **Math and Science Partnerships (MSPs)** are sustained at $179 million for the Department of Education component in the 2010 Budget, and $58 million for the NSF component. Both components facilitate partnerships between local school districts and higher education institutions to improve math and science education.

- A new Department of Energy (DOE) Energy Efficiency and Renewable Energy (EERE) **RE-ENERGYSE (REgaining our ENERGY Science and Engineering Edge)** program will form the core of DOE's participation in a joint DOE-NSF initiative to inspire tens of thousands of American students to pursue STEM careers, particularly in clean energy. The 2010 Budget provides $115 million for DOE to launch this program.

- $64 million, an increase of $12 million, for NSF's **Advanced Technological Education (ATE)** program to promote partnerships between higher education institutions and employers to educate technicians for the high-technology fields that drive our nation's economy. ATE focuses on two-year colleges.

- $798 million in the 2010 Budget, an increase of $8 million, for the **Ruth L. Kirschstein National Research Service Award (NRSA)** program at the National Institutes of Health (NIH). The NRSA program provides training for the next generation of biomedical researchers.

- An expansion of the Department of Defense's (DOD) **Science, Mathematics and Research for Transformation (SMART) program** of physical sciences and engineering graduate scholarships with a government service component, to $37 million in the 2010 Budget, up from the $28 million 2009 enacted level.

Table. Federal STEM Education Program Funding by Agency

(budget authority in millions)

	FY 2008 Enacted	FY 2009 Enacted	FY 2009 ARRA 1/	**FY 2010 Budget**	Change FY 09-10 2/ Amount	Change FY 09-10 2/ Percent
Corporation for Nat'l & Community Service	3	7	0	**7**	0	0.0%
Agriculture	44	47	0	**88**	41	87.2%
Commerce	47	50	43	**36**	-14	-28.0%
Defense	209	218	0	**229**	11	5.0%
Education	708	850	0	**763**	-87	-10.2%
Energy	20	24	13	**148**	124	516.7%
Health and Human Services	837	845	0	**853**	8	0.9%
Homeland Security	93	99	0	**106**	7	7.1%
Labor	0	10	0	**0**	-10	-100.0%
Interior	23	24	0	**26**	2	8.3%
Transportation	158	159	0	**174**	15	9.4%
Environmental Protection Agency	10	10	0	**11**	1	10.0%
NASA	147	169	0	**126**	-43	-25.4%
National Science Foundation	1,013	1,066	220	**1,109**	43	4.0%
Total STEM Education	3,312	3,578	276	**3,676**	98	2.7%

1/ Based on preliminary allocations of Recovery Act (P.L. 111-5) appropriations. These figures may change.

2/ Excludes Recovery Act appropriations. Change is regular FY 2009 appropriations to FY 2010 request.

OSTP - May 7, 2009

A Renewed Commitment to Science and Technology

Federal R&D, Technology, and STEM Education in the 2010 Budget

In the past, Federal funding for scientific research, technology, and education have yielded innovations that have transformed American life—technologies like the Internet, digital photography, bar codes, Global Positioning System technology, laser surgery, and chemotherapy. Today, the United States faces a new set of challenges, and science and technology can be a powerful ally in addressing them. The 2010 Budget builds on early accomplishments of the Obama Administration to make strategic Federal investments in research and development (R&D), 21st century technology, and science, technology, engineering, and mathematics (STEM) education.

Already in this Administration, the President has signed into law the 2009 Omnibus Appropriations Act (Public Law 111-8) and the American Recovery and Reinvestment Act (Public Law 111-5). Both boosted the budgets of key programs not only for their potential contributions to economic recovery but also because science and technology can help reorient the U.S. economy through strategic investments in clean energy, broadband, health care information technology, and education. These laws are critical down payments toward doubling Federal investments in key science agencies over a decade, meeting a Presidential commitment to invest $150 billion during the next 10 years in a clean energy future, and enhancing America's capacity to understand the dimensions of climate change and respond to them effectively. The 2010 Budget builds on these early accomplishments with continued investments in R&D, technology, and STEM education.

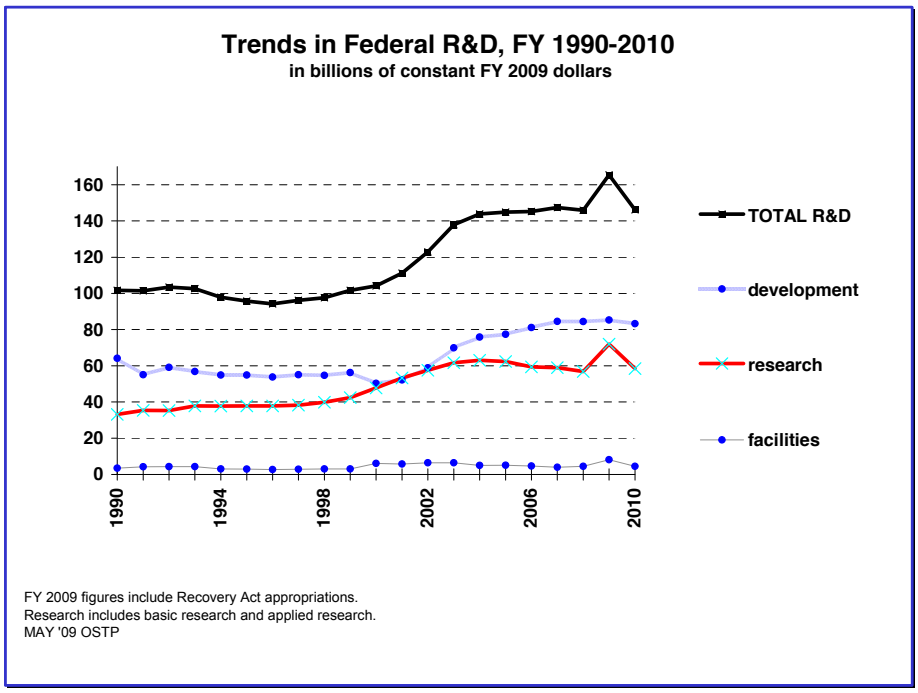

Figure 1.

Priorities for Federal Research and Development in the 2010 Budget

The President's Fiscal Year (FY) 2010 Budget proposes $147.6 billion for the Federal investment in research and development (R&D). That is $555 million or 0.4 percent more than the 2009 enacted level (see Table 1). In 2009, 2009 enacted appropriations and preliminary allocations of Recovery Act funding increase the Federal R&D investment to a record $165.4 billion; Recovery Act funds will be spent in 2009 and 2010 (see text box: R&D

Funding in the American Recovery and Reinvestment Act of 2009). In real terms, the 2009 enacted level and 2010 Budget are among the two largest R&D investments in history (see Figure 1). These investments, spread across two dozen Federal departments and independent agencies, reflect the Administration's recognition that science, technology, and innovation are critical tools for making progress toward the national goals of a prosperous economy, a clean energy future, a healthy American people, and a strong and secure America. The Federal R&D investment also recognizes that the urge to probe more deeply into the unknown and expand the frontiers of human knowledge is at the core of the American experience.

R&D Funding in the American Recovery and Reinvestment Act of 2009

The American Recovery and Reinvestment Act of 2009 (Public Law 111-5), enacted on February 17, provided Federal R&D funding to spur new discoveries in energy, medicine, climate, and technologies for the future.

Within the Department of Health and Human Services (HHS), the National Institutes of Health (NIH) received $10 billion for biomedical research and laboratory renovation and construction. In addition, $1 billion was included for comparative effectiveness research at NIH and the Agency for Healthcare Research and Quality.

The Recovery Act included a $5.2 billion investment in key science agencies, including: $3.0 billion at NSF for basic research, education and human resources, research facilities construction, and research instrumentation; $1.6 billion at DOE's Office of Science for energy frontier research collaborations, and infrastructure investments at the national laboratories; and $580 million at the Department of Commerce's National Institute of Standards and Technology (NIST) for standards research, advanced measurement equipment, and construction of NIST research facilities. This investment by itself is an almost 50-percent increase for these programs over the 2008 enacted level and represents a significant down payment toward the President's plan to double the funding for these agencies over a decade.

The National Aeronautics and Space Administration (NASA) received $1 billion for activities such as an acceleration of earth science climate research missions, and development of the next generation air transportation system. The National Oceanic and Atmospheric Administration (NOAA) received $170 million for climate modeling, and $660 million that includes support for maintenance and construction of research vessels and facilities. The U.S. Geological Survey received $140 million for facility renovation and construction and for seismic and volcanic monitoring systems.

The 2010 Budget includes a special emphasis on **basic and applied research** to fundamentally improve our understanding of nature, revolutionize key fields of science, and foster radically new technologies. The Federal research portfolio (comprising basic and applied research) totals $59.0 billion in the 2010 Budget (see Table 3), up $376 million or 0.6 percent compared to the 2009 enacted level (excluding Recovery Act funding). After four years of decline in real terms (see Figure 2) from 2004 to 2008, the 2009 enacted level and 2010 Budget represent a real-dollar turnaround in Federal research investments across the spectrum of the sciences and engineering. (Preliminary allocations of Recovery Act investments are listed in separate columns in Tables 1 and 3; dollar and percentage changes are from 2009 enacted appropriations (excluding Recovery Act funds) to the 2010 Budget.)

The 2010 Budget provides $84.1 billion in development funding. The Recovery Act and 2009 enacted appropriations provide unprecedented Federal support for R&D facilities and capital equipment totaling $8.2 billion (see Table 1), including support for the construction and renovation of laboratory facilities at government laboratories, contractor-operated national laboratories, and academic institutions as well as competitively awarded funding for the purchase of major research instrumentation. In the 2010 Budget, R&D facilities and capital equipment funding totals $4.5 billion, including substantial support from the National Aeronautics and Space Administration (NASA; $2.4 billion) for scientific facilities including the International Space Station and the Department of Energy (DOE; $1.2 billion) for a suite of scientific user facilities at DOE laboratories.

The 2010 Budget invests in four key R&D priorities:

Investing in the Sciences for a Prosperous America. Federally supported basic research, aimed at understanding many features of nature—from the size of the universe to the nature of subatomic particles, from the chemical reactions that support a living cell to interactions that sustain ecosystems—has been an essential feature of American life and helped drive our economic success for over 50 years. While the outcomes of specific projects are never predictable, basic research has been a reliable source of new knowledge that has fueled important developments in fields ranging from telecommunications to medicine, yielding positive rates of economic return and creating entirely new industries with high-tech, high wage jobs.

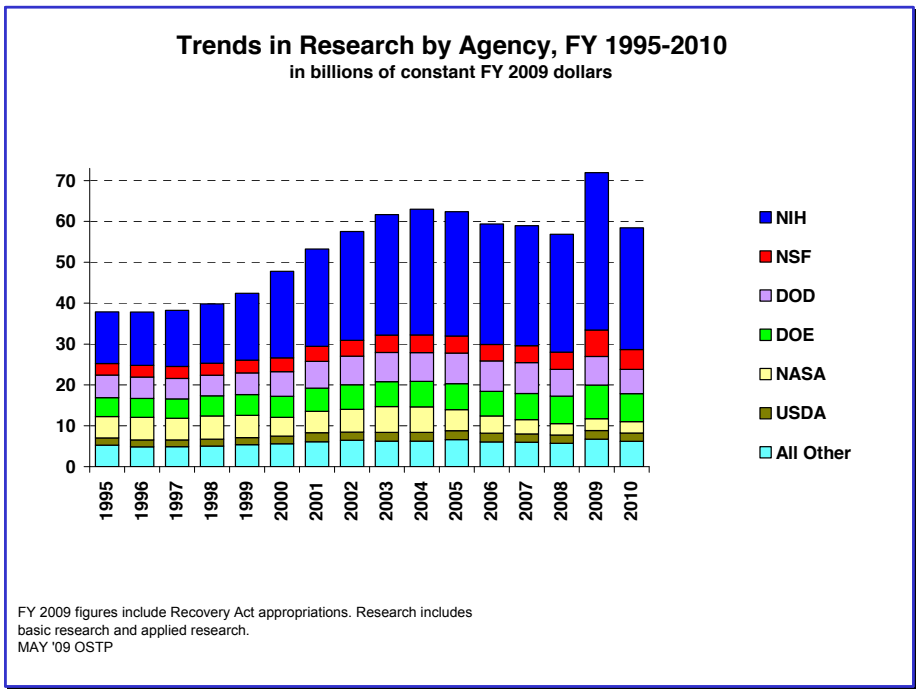

Figure 2.

The President plans to double Federal investments in three key basic research agencies, the National Science Foundation, Department of Energy's (DOE's) Office of Science, and the laboratories of the Department of Commerce's National Institute of Standards and Technology, over a decade by 2016, building on down payments in the Recovery Act (see text box: The President's Plan for Science and Innovation). These increases in research funding will help the United States to remain prosperous.

To increase the impacts of these investments, the 2010 Budget also emphasizes support for researchers at the beginning of their careers to sustain and expand the Nation's scientific and technical workforce, including a plan to triple the number of NSF's Graduate Research Fellowships by 2013.

A Clean Energy Future. The Administration envisions a United States that can lead the world in the research, development, demonstration and deployment of clean energy technology. Investments in clean energy R&D will drive a new energy economy that reduces dependence on oil, creates green jobs, and reduces the impact of climate change.

The 2010 Budget builds upon substantial clean energy R&D investments in the Recovery Act to forge a comprehensive approach to transforming our energy supply and slowing global climate change through cutting-edge science and technology. R&D funding will support renewable energy and energy efficiency technologies such as advanced batteries, solid-state lighting, solar, biomass, geothermal, and wind power. The 2010 Budget also supports the development and testing of carbon capture and storage technologies that will reduce carbon emissions from our use of fossil fuels and basic research to support transformational discoveries and accelerate solutions in the development of clean energy.

The President's Plan for Science and Innovation:
Doubling Funding for Key Basic Research Agencies in the 2010 Budget

The 2010 Budget sustains the President's commitment to double the budgets for three key basic-research agencies over a decade. Building on investments in the Recovery Act and the 2009 Omnibus Appropriations Act, the 2010 Budget provides substantial increases in funding for the National Science Foundation (NSF), the Department of Energy's Office of Science (DOE SC), and the National Institute of Standards and Technology (NIST) laboratories and establishes a clear path to completing the doubling effort in 2016.

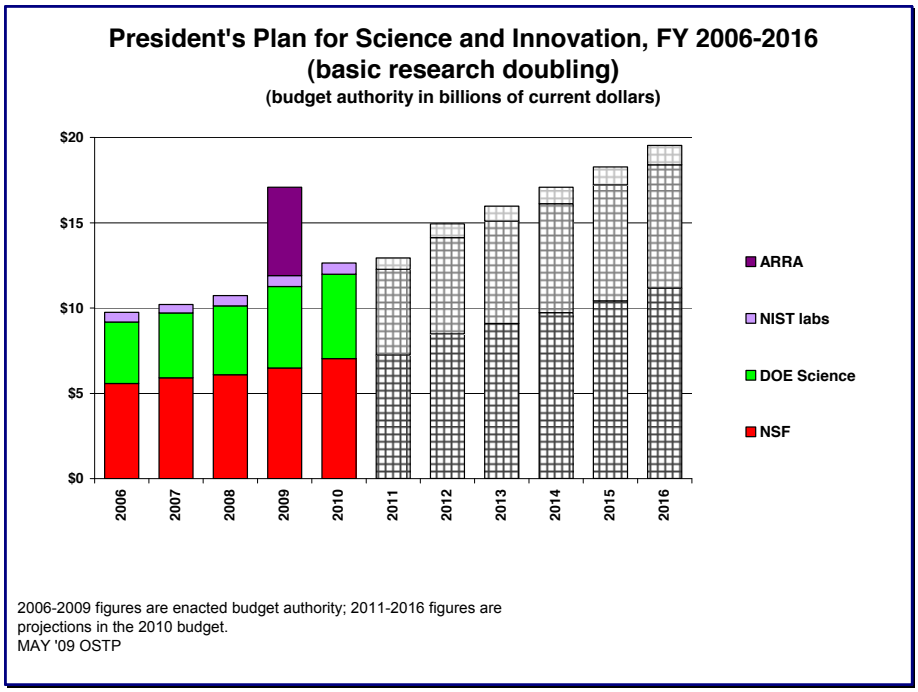

Figure 3.

Federally supported basic research has been a reliable source of new knowledge and new products. It has fueled important developments in fields ranging from telecommunications to transportation to medicine, and has yielded positive rates of economic return by creating entirely new industries with highly skilled, high-wage jobs. The President's Plan for Science and Innovation and the America COMPETES Act have identified NSF, DOE SC, and NIST as key to our nation's prosperity and to preserving America's place as the world leader in science and technology. Although the previous Administration voiced support for efforts to double these agencies' budgets between 2006 and 2016, these efforts fell short in 2007 and 2008. In 2009, the American Recovery and Reinvestment Act and the 2009 Omnibus Appropriations Act signed by President Obama finally put these agencies back on a doubling trajectory. **The 2010 Budget builds on these early Administration accomplishments with a requested $12.6 billion total for NSF, DOE SC, and the NIST labs, an increase of $731 million or 6.1 percent above the 2009 enacted total** (excluding Recovery Act funds of $5.2 billion for the three agencies). These substantial increases keep the agencies on track for the fourth year of a ten-year doubling trajectory. In addition, the 2010 Budget establishes projections laying out a clear path to completing the doubling effort in 2016 with $19.5 billion for the three agencies, double the $9.7 billion they received in 2006. Between 2009 and 2016, the Obama Administration's enacted and proposed budgets would add $42.6 billion to the 2008 budgets for these basic research agencies, with a special emphasis on encouraging high-risk, high-return research and supporting researchers at the beginning of their careers.

Healthy Lives for All Americans. Federal R&D investments in health result in knowledge and technologies that are vital for promoting longer, healthier lives for all Americans. The Administration is committed to funding biomedical and health research and to policies that increase the impact of these investments on health outcomes. The 2010 Budget emphasizes research to promote healthy living and disease prevention.

A Safe and Secure America. New developments in science and technology offer hope of predicting and preventing destabilizing or paralyzing natural and manmade threats, as well as minimizing their impacts and recovering from them as quickly as possible. The Budget accelerates the development of new medicines, vaccines, and production capabilities for biodefense by investing in countermeasures development. The Budget also invests in the technological capabilities necessary to monitor nuclear nonproliferation compliance and to prevent weapons of mass destruction from entering the country.

Highlights of Key R&D Funding Agencies in the 2010 Budget

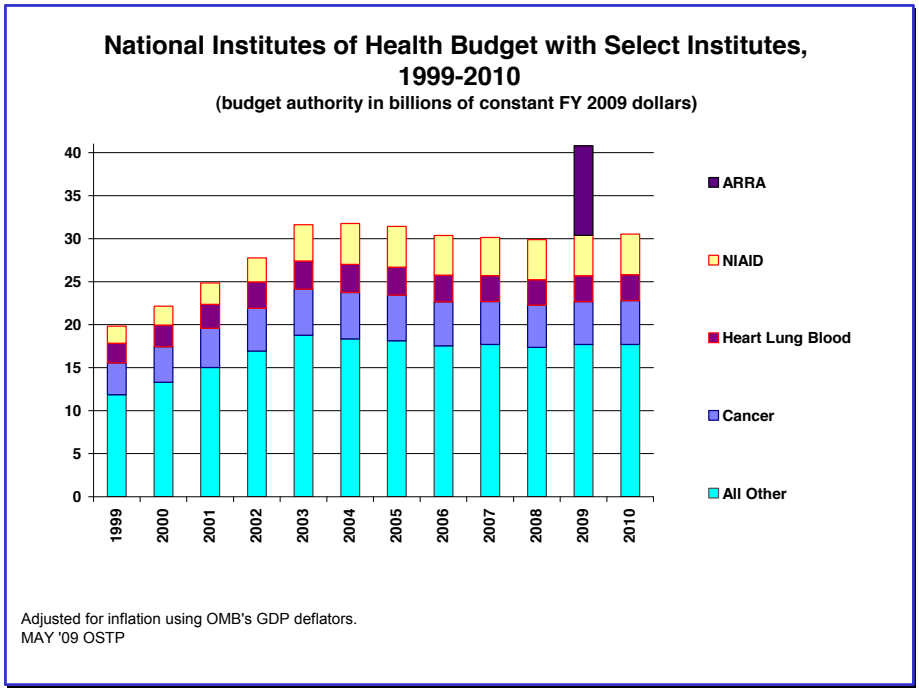

Figure 4.

- The **National Institutes of Health (NIH)** has at its mission the discovery of knowledge and therapies that will lead to better health outcomes for all Americans. The 2010 Budget proposes $30.8 billion in appropriations for NIH, an increase of $443 million or 1.5 percent above the 2009 enacted level. In addition, NIH received $10.4 billion in Recovery Act funding, which will be spent in 2009 and 2010. After relatively sustained funding between 2004 and 2008, the Recovery Act provides an unprecedented increase for NIH. The 2010 Budget continues the Administration's support for biomedical research (see Figure 4). The 2010 Budget includes over $6 billion to support cancer research as part of the President's sustained commitment to double NIH-wide funding for cancer research over the next 8 years, while also maintaining growth for non-cancer research. In 2010, the NIH Common Fund (CF) will invest $549 million, an increase of $8 million over 2009, to support cross-cutting, trans-NIH programs that require participation by at least two NIH Institutes or Centers (ICs) or that would otherwise benefit from strategic planning and coordination. Elsewhere within the Department of Health and Human Services (HHS), the 2010 Budget accelerates the development of new medicines, vaccines, and diagnostics for biodefense by investing $305 million in Advanced Research and Development, $30 million more than the 2009 enacted level.

- The **National Science Foundation (NSF)** is the primary source of support for academic research for most non-biomedical disciplines, funding basic research across the entire spectrum of the sciences and engineering. It is well

regarded for funding nearly all of its research through a competitive, peer-reviewed process. The increase in NSF funding to $7.0 billion in the 2010 Budget, 8.5 percent more than the 2009 enacted level, will support many more researchers, students, post-doctoral fellows and technicians contributing to the innovation enterprise (see text box: The President's Plan for Science and Innovation). The 2010 Budget also fulfills the President's commitment to triple the number of NSF's Graduate Research Fellowships to 3,000 by 2013.

- The 2010 Budget sustains the **Department of Defense's (DOD's)** critical role in supporting technological advances with $3.2 billion for the Defense Advanced Research Projects Agency (DARPA) for its support of longer-term breakthrough research, 4 percent more than the 2009 enacted level. The Budget maintains scientific and technological preeminence for our armed forces with a total R&D investment of $79.7 billion, a decrease of $1.9 billion from the 2009 enacted level due to proposed cuts in lower-priority weapons development programs and congressional projects. The 2010 Budget sustains DOD's commitment to increasing its support for basic research with a $1.8 billion investment, a substantial increase over the 2009 enacted level after adjusting for approximately $150 million in 2009 congressional projects that would not be renewed in 2010. Within the basic research portfolio, funding for the National Defense Education Program (NDEP) increases to $90 million in 2010 from $69 million.

- The **National Aeronautics and Space Administration (NASA)** 2010 Budget provides $18.7 billion for space-based research that supports the Administration's commitment to deploy a global climate change research and monitoring system, a robust program of space exploration involving humans and robots, the safe flight of the Space Shuttle, continued use of the International Space Station, and a renewed commitment to aeronautics research. NASA's R&D portfolio totals $11.4 billion in the 2010 Budget, an increase of $1.0 billion or 10 percent over the 2009 enacted level (see Table 1).

- The **Department of Energy (DOE)** R&D portfolio totals $10.7 billion in the 2010 Budget, an increase of $119 million or 1.1 percent over the 2009 enacted level (excluding $2.4 billion in preliminary allocations of Recovery Act funds for R&D activities; see Table 1). DOE's Office of Science (DOE SC) supports grants and infrastructure for a wide range of basic research impacting economically significant areas such as nanotechnology, high-end computing, energy, and climate change. The 2010 Budget of $4.9 billion, 3.5 percent more than the 2009 enacted level, increases funding for both research and cutting-edge facilities, as part of the President's commitment to double funding over a decade (see text box: The President's Plan for Science and Innovation). The 2010 DOE SC Budget improves our understanding of climate science, continues the U.S. commitment to international science and energy experiments, and expands Federal support at the frontiers of energy research. The 2010 Budget invests in DOE's clean energy R&D programs to reduce dependence on foreign oil and to accelerate the transition to a low-carbon economy. The 2010 Budget provides $320 million for solar energy R&D, nearly double the 2009 enacted level of $175 million, and $238 million for energy conservation building technologies, also nearly double the 2009 enacted level of $140 million. DOE also proposes to fund an initial eight multi-disciplinary Energy Innovation Hubs at a total of $280 million to support cross-disciplinary R&D focused on the barriers to transforming energy technologies into commercially deployable materials, devices and systems.

- **Department of Homeland Security (DHS)** R&D increases to $1.1 billion in the 2010 Budget, up $29 million or 3 percent from the 2009 enacted level.

- R&D in the **U.S. Department of Agriculture (USDA)** appears to fall to $2.3 billion in the 2010 Budget from higher 2008 and 2009 enacted levels but after adjusting for 2008 and 2009 congressional projects that would not be renewed in 2010, USDA R&D funding increases in 2010. The 2010 Budget invests in the science and technology needed to combat natural and manmade threats to our nation's food supply, including $132 million in USDA for research associated with the safety of the U.S. food supply. The 2010 Budget provides $37 million in new intramural research funding for bioenergy, nutrition, climate, and world hunger research, and a $70 million extramural initiative of research and extension funds for rural revitalization. The 2010 Budget sustains the Agriculture and Food Research Initiative (AFRI) of competitively awarded research grants at $202 million.

- The Department of Commerce's **National Institute of Standards and Technology (NIST)** invests in technological innovation through research, advanced measurement, and standards development. The 2010 Budget of $652 million for NIST's intramural laboratories will improve NIST's research capabilities by providing high

performance laboratory research and facilities for a diverse portfolio of basic research in areas such as health information technology, the digital smart grid, and carbon measurements. NIST's 2010 Budget is part of the President's commitment to double funding over a decade (see text box: The President's Plan for Science and Innovation). Commerce's **National Oceanic and Atmospheric Administration (NOAA)** is a leading sponsor of oceanic and atmospheric research and is one of the key sponsors of climate science capabilities in the Federal government. The 2010 Budget allocates $644 million for NOAA R&D programs within a total NOAA Budget of $4.5 billion.

- The **Department of Veterans Affairs (VA)** 2010 Budget provides $1.2 billion for R&D programs, an increase of $140 million or 14 percent over the 2009 enacted level. VA research focuses on biomedical research topics of special relevance to the wounded warrior, and supports a robust program of clinical and translational research.

- The 2010 Budget provides $730 million for R&D in the **Department of the Interior**. The 2010 Budget provides $649 million for R&D in Interior's lead science agency, the **U.S. Geological Survey (USGS),** a 6 percent increase. The total USGS Budget of $1.1 billion is a $54 million increase over the 2009 enacted level.

- The **Environmental Protection Agency (EPA)** R&D portfolio of $619 million in the 2010 Budget is a $39 million or 7 percent increase over the 2009 enacted level.

- The 2010 Budget provides $939 million for **Department of Transportation (DOT)** R&D, an increase of $26 million or 3 percent over the 2009 enacted level. The 2010 Budget sustains aviation R&D investments in the Federal Aviation Administration (FAA) and highway R&D investments in the Federal Highway Administration (FHWA).

Multi-agency initiatives

A number of research investments are being addressed through multi-agency research activities coordinated through the National Science and Technology Council (NSTC) and other interagency forums. Many of the challenges simply cannot be addressed by a single agency. Moreover, innovation often arises from combining the tools, techniques, and insights from multiple agencies. Table 2 shows details of three such interagency efforts: networking and information technology R&D, nanotechnology R&D, and climate change R&D. (Preliminary allocations of Recovery Act investments are listed in a separate column in Table 2; dollar and percentage changes are from 2009 enacted appropriations (excluding Recovery Act funds) to the 2010 Budget.)

Networking and Information Technology R&D: The 2010 Budget provides $3.9 billion for the multi-agency Networking and Information Technology Research and Development (NITRD) Program, an increase of $44 million or 1.1 percent over the 2009 enacted level (excluding Recovery Act funds). NITRD programs also receive $706 million in Recovery Act funding based on preliminary agency allocations. NITRD plans and coordinates agency research efforts in cyber security, high-end computing systems, advanced networking, software development, high-confidence systems, information management, and other information technologies. In 2008, the NITRD agencies addressed the recommendations contained in the President's Council of Advisors on Science and Technology (PCAST) NITRD Program Review by establishing a robust strategic planning activity scheduled to conclude in 2009. The NITRD Subcommittee also published the Federal Plan for Advanced Networking R&D in 2008, and has continued to address cyber security research under the R&D-related components of the Comprehensive National Cybersecurity Initiative.

The 2010 Budget retains the important focus on investment in high-end computing research for both national security and large-scale scientific applications, particularly in advanced scalable simulations. The 2010 Budget also emphasizes foundations for assured computing and secure hardware, software and network design and engineering to address the goal of making Internet communications more secure and reliable. Reports and general information about NITRD are available at *www.nitrd.gov/*.

Nanotechnology R&D: The 2010 Budget provides $1.6 billion for the multi-agency National Nanotechnology Initiative (NNI), a slight cut of $17 million or 1.0 percent from the 2009 enacted level (excluding Recovery Act funds) from the proposed elimination of 2009 Department of Defense congressional projects in 2010. NNI programs

also receive $140 million in Recovery Act funding based on preliminary agency allocations. The NNI focuses on R&D that creates materials, devices, and systems that exploit the fundamentally distinct properties of matter as it is manipulated at the nanoscale (roughly 1 to 100 nanometers). The results of NNI-supported R&D enable breakthroughs in biomedical detection and treatment, manufacturing at or near the nanoscale, environmental monitoring and protection, energy conversion and storage, and novel more powerful electronic devices, among many others.

Guided by the NNI Strategic Plan, participating agencies will continue to support nanoscience and nanotechnology development through investigator-led research; multidisciplinary centers of excellence; education and training; and infrastructure and standards development, including user facilities and networks that are broadly available to support research and innovation. In addition, consistent with the NNI Strategy for Nanotechnology-Related Environmental Health, and Safety (EHS) Research, agencies continue to maintain a focus on the responsible development of nanotechnology, with attention to the human and environmental health impacts, as well as ethical, legal, and other societal issues. Participating agencies provide $88 million for nano EHS research in the 2010 Budget, 23 percent more than the enacted 2009 level. Reports and general information about the NNI are available at *www.nano.gov/*.

Climate Change R&D: The U.S. Climate Change Science Program (CCSP) coordinates climate research among the 13 departments and agencies that participate in the CCSP. The 2010 Budget provides $2.0 billion for CCSP programs, an increase of $46 million or 2.3 percent over the 2009 enacted level (excluding Recovery Act funds). CCSP programs also receive $461 million in Recovery Act funding based on preliminary agency allocations, including $237 million for NASA climate activities. The 2010 Budget supports research activities including the development of an integrated earth system analysis capability; a focus toward creating a high-quality record of the state of the atmosphere and ocean since 1979; development of an end-to-end hydrologic projection and application capability; enhanced carbon cycle research on high latitude systems; quantification of climate forcing and feedbacks by aerosols, non-carbon dioxide greenhouse gases, water vapor, and clouds; assessment of abrupt change in a warming climate; examination of the feasibility of development an abrupt change early warning system; understanding climate change impacts on ecosystem functions; and refining ecological forecasting. Among agencies the U.S. Geological Survey (USGS) continues to expand its Global Change program and other related activities, to $63 million (up 40 percent), while the National Science Foundation (NSF) provides $300 million for CCSP activities in the 2010 Budget, an increase of $80 million or 36 percent over the 2009 enacted level. Reports and general information about the CCSP are available on the program's website: *www.climatescience.gov/*.

Science, Technology, Engineering, and Mathematics (STEM) Education in the 2010 Budget

The 2010 Budget makes a renewed commitment to education in science, technology, engineering, and mathematics (STEM) fields because the progress and prosperity of future generations will depend on what we do now to educate our students. The 2010 Budget invests $3.7 billion in STEM education programs throughout the federal government in over 100 programs identified by the Academic Competitiveness Council (ACC; see Table 4), an increase of $98 million or 2.7 percent over the 2009 enacted level for these programs. In addition, the Recovery Act provides a preliminary $276 million for these programs, which will be spent over 2009 and 2010. (Preliminary allocations of Recovery Act investments are listed in a separate column in Table 4; dollar and percentage changes are from 2009 enacted appropriations (excluding Recovery Act funds) to the 2010 Budget.)

For STEM programs, 2010 Budget highlights include:

- The President's commitment to triple the number of **Graduate Research Fellowships (GRF)** at the National Science Foundation (NSF) to 3,000 by 2013. The 2010 budget provides $122 million for the NSF GRF program.

- Funding for the **Math and Science Partnerships (MSPs)** are sustained at $179 million for the Department of Education component in the 2010 Budget, and $58 million for the NSF component. Both components facilitate partnerships between local school districts and higher education institutions to improve math and science education.

- A new Department of Energy (DOE) Energy Efficiency and Renewable Energy (EERE) **RE-ENERGYSE (REgaining our ENERGY Science and Engineering Edge)** program will form the core of DOE's participation in

a joint DOE-NSF initiative to inspire tens of thousands of American students to pursue STEM careers, particularly in clean energy. The 2010 Budget provides $115 million for DOE to launch this program.

- $64 million, an increase of $12 million, for NSF's **Advanced Technological Education (ATE)** program to promote partnerships between higher education institutions and employers to educate technicians for the high-technology fields that drive our nation's economy. ATE focuses on two-year colleges.

- $798 million in the 2010 Budget, an increase of $8 million, for the **Ruth L. Kirschstein National Research Service Award (NRSA)** program at the National Institutes of Health (NIH). The NRSA program provides training for the next generation of biomedical researchers.

- An expansion of the Department of Defense's (DOD) **Science, Mathematics and Research for Transformation (SMART) program** of physical sciences and engineering graduate scholarships with a government service component, to $37 million in the 2010 Budget, up from the $28 million 2009 enacted level.

Technology Programs in the 2010 Budget

In the face of unprecedented challenges, technological advances can provide a powerful engine for advancing economic growth and new opportunity. Harnessing the full power and potential of new technologies can improve the lives of all Americans. (Recovery Act investments are listed in a separate column in Table 5; dollar and percentage changes are from 2009 enacted appropriations (excluding Recovery Act funds) to the 2010 Budget.) The 2010 Budget invests in key technologies, including:

Broadband technology – The Administration is investing heavily in broadband infrastructure by implementing the $7.2 billion provided for this purpose in the Recovery Act to the Departments of Agriculture and Commerce (see Table). These investments will continue to be implemented in 2010. The 2010 Budget provides $82 million for continuing USDA support of rural broadband, distance learning, and telemedicine services, an increase of $23 million or 39 percent over the 2009 enacted level.

Health information technology (IT) – Building on the historic $19 billion investment in the Recovery Act, the Administration will continue efforts to further the adoption and implementation of health IT as an essential tool to modernize the health care system. $2 billion in Recovery Act investments will continue to be implemented in 2010, while the remaining $17 billion will be available as temporary incentive payments starting in 2011 to physicians and hospitals participating in Medicare for using certified electronic health records.

Education technology – Supporting cutting-edge educational technology, modernizing science laboratories, and forging partnerships to improve the use of science and technology in classrooms are key priorities throughout federal investments in education. $650 million in Recovery Act investments for Education Technology State Grants (ED-TECH) will continue to be implemented through the 2010-2011 school year, and the 2010 Budget provides an additional $100 million. Other Department of Education programs, including Title I Grants and Teacher Quality State Grants, also provide support for education technology.

Clean energy technology – In no area will innovation be more important than in the development of new technologies to produce, use, and save energy. The 2010 Budget sustains the Administration's commitment to developing a 21st century clean energy economy. In addition to energy research and development (R&D) investments, the 2010 Budget provides $3.1 billion for clean energy technologies, including deployment, demonstration, and commercialization assistance activities, to build on $31 billion in Recovery Act funding.

Federal information technology (IT) – Greater transparency, accountability, and public participation are central to the President's Open Government agenda. New technology has the potential to drive innovation in government. The 2010 Budget reflects the growing responsibilities for federal IT management with $75.8 billion for total federal IT spending, $5.1 billion or 7.2 percent more than the 2009 enacted level. New directions for federal IT in 2009, as well as allocations of Recovery Act investments, mean that federal IT spending estimates for 2009 and 2010 will likely change as plans are made to address the Administration's goal of greater openness in government, wider participation by citizens in government, and a more collaborative, cost-effective federal IT enterprise.

Next-Generation Manufacturing Technologies – The 2010 Budget provides significant funding for programs at the National Institute of Standards and Technology (NIST) that will foster innovation in manufacturing, including $125 million for the Hollings Manufacturing Extension Partnership (MEP), an increase of $15 million over the 2009 enacted level as part of the President's plan to double MEP funding between 2008 and 2015. The 2010 budget also provides $70 million for the Technology Innovation Program (TIP). While its initiatives are not solely directed at the manufacturing sector, the Economic Development Administration (EDA) will be spending at least $50 million to promote regional innovation clusters and $50 million to support business incubator networks. The 2010 Budget also funds research that benefits manufacturing in the NIST laboratories, and the Recovery Act provides $2 billion for grants to support manufacturing of advanced batteries.

Table 1. R&D in the FY 2010 Budget by Agency
(budget authority in millions of dollars)

	FY 2008 Actual	FY 2009 Estimate	FY 2009 ARRA 1/	**FY 2010 Budget**	Change FY 09-10 2/ Amount	Percent
Total R&D						
Defense (military)	80,278	81,616	300	**79,687**	-1,929	-2.4%
Health and Human Services	29,265	30,415	11,103	**30,936**	521	1.7%
Nat'l Institutes of Health	*28,547*	*29,748*	*10,400*	***30,184***	*436*	*1.5%*
All Other HHS R&D	*718*	*667*	*703*	***752***	85	12.7%
NASA	11,182	10,401	925	**11,439**	1,038	10.0%
Energy	9,807	10,621	2,446	**10,740**	119	1.1%
Nat'l Science Foundation	4,580	4,857	2,900	**5,312**	455	9.4%
Agriculture	2,336	2,421	176	**2,272**	-149	-6.2%
Commerce	1,160	1,292	411	**1,330**	38	2.9%
NOAA	*625*	*700*	*1*	***644***	*-56*	*-8.0%*
NIST	*498*	*550*	*410*	***637***	*87*	*15.8%*
Interior	683	692	74	**730**	38	5.5%
U.S. Geological Survey	*586*	*611*	*74*	***649***	*38*	*6.2%*
Transportation	875	913	0	**939**	26	2.8%
Environ. Protection Agency	551	580	0	**619**	39	6.7%
Veterans Affairs	960	1,020	0	**1,160**	140	13.7%
Education	313	323	0	**384**	61	18.9%
Homeland Security	995	1,096	0	**1,125**	29	2.6%
All Other	761	818	0	**947**	129	15.8%
Total R&D	143,746	147,065	18,335	**147,620**	555	0.4%
Defense R&D	84,337	85,426	300	**83,760**	-1,666	-2.0%
Nondefense R&D	59,409	61,639	18,035	**63,860**	2,221	3.6%
Basic Research	28,613	29,881	11,365	**30,884**	1,003	3.4%
Applied Research	27,413	28,766	1,920	**28,139**	-627	-2.2%
Total Research	56,026	58,647	13,285	**59,023**	376	0.6%
Development	83,254	83,887	1,408	**84,054**	167	0.2%
R&D Facilities and Equipment	4,466	4,531	3,642	**4,543**	12	0.3%

1/ Based on preliminary allocations of Recovery Act (P.L. 111-5) appropriations. These figures may change.
2/ Excludes Recovery Act appropriations. Change is regular FY 2009 appropriations to FY 2010 request.
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Table 2. Interagency Science and Technology Initiatives
(budget authority in millions)

	FY 2008 Actual	FY 2009 Estimate	FY 2009 ARRA 1/	**FY 2010 Budget**	Change FY 09-10 2/ Amount	Percent
National Nanotechnology Initiative (NNI)						
National Science Foundation	409	397	108	**423**	26	6.5%
Defense	460	464	0	**379**	-85	-18.3%
Energy	240	332	25	**347**	15	4.4%
NASA	17	17	0	**17**	0	0.0%
Commerce (NIST)	86	88	7	**92**	3	3.9%
HHS - National Institutes of Health / CDC	311	319	0	**338**	19	6.1%
Agriculture	10	9	0	**9**	0	0.0%
EPA	12	16	0	**18**	1	7.9%
DHS	3	9	0	**12**	3	28.6%
Justice	0	0	0	**0**	0	33.3%
DOT - FHWA	1	3	0	**3**	0	0.0%
Total Nanotechnology	1,549	1,654	140	**1,637**	-17	-1.0%
Networking and Information Technology R&D (NITRD)						
Commerce	84	94	197	**111**	17	17.6%
Defense	1,096	1,281	0	**1,141**	-140	-10.9%
Energy	409	438	157	**485**	48	10.9%
Environ. Protection Agency	6	6	0	**6**	0	0.0%
Health and Human Services	956	981	0	**995**	14	1.4%
NASA	69	74	13	**73**	-1	-1.1%
National Science Foundation	947	1,004	340	**1,111**	107	10.6%
All Other	5	5	0	**5**	44	1.1%
Total IT R&D	3,572	3,882	706	**3,927**	44	1.1%
Climate Change Science Program (CCSP)						
National Science Foundation	207	220	95	**300**	80	36.4%
Energy	128	157	76	**165**	8	5.1%
Commerce (NOAA)	272	369	53	**297**	-72	-19.5%
Agriculture	65	56	0	**59**	3	5.4%
Interior (USGS)	34	45	0	**63**	18	40.0%
Environ. Protection Agency	17	18	0	**21**	3	16.7%
National Institutes of Health	4	4	0	**4**	0	0.0%
NASA	1,084	1,086	237	**1,071**	-15	-1.4%
All Other (Smith., AID, DOT, State)	21	25	0	**46**	21	84.0%
Total CCSP	1,832	1,980	461	**2,026**	46	2.3%

1/ Based on preliminary allocations of Recovery Act (P.L. 111-5) appropriations. These figures may change.
2/ Excludes Recovery Act appropriations. Change is regular FY 2009 appropriations to FY 2010 request.
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Table 3. Research in the FY 2010 Budget
(budget authority in millions of dollars)

	FY 2008 Actual	FY 2009 Estimate	FY 2009 ARRA 1/	**FY 2010 Budget**	Change FY 09-10 2/ Amount	Change FY 09-10 2/ Percent
RESEARCH (basic + applied)						
Defense (military)	6,454	6,914	85	**6,032**	-882	-12.8%
Basic Research ("6.1")	*1,599*	*1,822*	*3*	***1,796***	*-26*	*-1.4%*
Health and Human Services	29,088	30,245	9,603	**30,766**	521	1.7%
Nat'l Institutes of Health	*28,412*	*29,615*	*8,900*	***30,051***	*436*	*1.5%*
NASA	2,743	2,617	271	**2,828**	211	8.1%
Energy	6,641	7,093	1,142	**6,906**	-187	-2.6%
Nat'l Science Foundation	4,124	4,445	2,000	**4,900**	455	10.2%
Agriculture	2,025	2,109	0	**2,033**	-76	-3.6%
Commerce	933	1,023	110	**1,020**	-3	-0.3%
NOAA	*544*	*603*	*0*	***540***	*-63*	*-10.4%*
NIST	*373*	*402*	*110*	***461***	*59*	*14.7%*
Interior	597	617	74	**658**	41	6.6%
U.S. Geological Survey	*524*	*544*	*74*	***579***	*35*	*6.4%*
Transportation	667	672	0	**694**	22	3.3%
Environ. Protection Agency	472	495	0	**534**	39	7.9%
Veterans Affairs	904	960	0	**1,092**	132	13.8%
Education	198	204	0	**221**	17	8.3%
Homeland Security	629	681	0	**698**	17	2.5%
All Other	551	572	0	**641**	69	12.1%
Total Research	56,026	58,647	13,285	**59,023**	376	0.6%

1/ Based on preliminary allocations of Recovery Act (P.L. 111-5) appropriations. These figures may change.
2/ Excludes Recovery Act appropriations. Change is regular FY 2009 appropriations to FY 2010 request.

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Table 4. Federal STEM Education Program Funding by Agency
(budget authority in millions)

	FY 2008 Enacted	FY 2009 Enacted	FY 2009 ARRA 1/	**FY 2010 Budget**	Change FY 09-10 2/ Amount	Percent
Corporation for Nat'l & Community Service	3	7	0	**7**	0	0.0%
Agriculture	44	47	0	**88**	41	87.2%
Commerce	47	50	43	**36**	-14	-28.0%
Defense	209	218	0	**229**	11	5.0%
Education	708	850	0	**763**	-87	-10.2%
Energy	20	24	13	**148**	124	516.7%
Health and Human Services	837	845	0	**853**	8	0.9%
Homeland Security	93	99	0	**106**	7	7.1%
Labor	0	10	0	**0**	-10	-100.0%
Interior	23	24	0	**26**	2	8.3%
Transportation	158	159	0	**174**	15	9.4%
Environmental Protection Agency	10	10	0	**11**	1	10.0%
NASA	147	169	0	**126**	-43	-25.4%
National Science Foundation	1,013	1,066	220	**1,109**	43	4.0%
Total STEM Education	3,312	3,578	276	**3,676**	98	2.7%

1/ Based on preliminary allocations of Recovery Act (P.L. 111-5) appropriations. These figures may change.

2/ Excludes Recovery Act appropriations. Change is regular FY 2009 appropriations to FY 2010 request.

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Table 5. 2010 Budget for Selected Technology Programs
(budget authority in millions of dollars)

Technology Area Department/ Agency - Program	FY 2008	FY 2009	FY 2009 ARRA*	**FY 2010**	Change '09 to '10** Amount	Change '09 to '10** Percent
Broadband Technology:						
Dept. of Commerce Nat'l Telecomm. and Info. Admin.						
- Broadband Technology Opportunities Program	0	0	4,700	**0**	0	- -
U.S. Dept. of Agriculture Rural Utilities Service						
- Distance Learning, Telemedicine, and Broadband	53	59	2,500	**82**	23	39.0%
TOTAL Broadband	53	59	7,200	**82**	23	39.0%
Health Information Technology:						
Dept. of HHS Office of the Secretary						
- Office of National Coordinator for Health IT	61	61	2,000	**61**	0	0.2%
TOTAL Health IT 1/	61	61	2,000	**61**	0	0.2%
Education Technology:						
Dept. of Education School Improvement Programs						
- Enhancing Edu. Through Tech. State Prog. (ED-TECH)	267	270	650	**100**	-170	-62.9%
TOTAL Education Technology	267	270	650	**100**	-170	-62.9%
Clean Energy Technology:						
Dept. of Defense						
- Near Term Energy Efficiency Tech. Demos. And Res.	0	0	300	**0**	0	- -
Dept. of Energy						
- Energy Efficiency & Renewable Energy 2/	1,704	2,179	14,800	**2,319**	140	6.4%
- Advanced Battery Manufacturing Grants	0	0	2,000	**0**	0	- -
- Fossil Energy R&D 2/	727	876	3,400	**618**	-259	-29.5%
- Elec. Delivery and Energy Reliability 2/	136	137	4,500	**208**	71	51.8%
- Innovative Tech. Loan Guarantee Program 3/	4	0	5,990	**0**	0	- -
TOTAL Clean Energy Technology	2,572	3,192	30,990	**3,145**	-48	-1.5%
Federal Information Technology Spending (Gov't Wide)	66,405	70,716	4/	**75,829**	5,113	7.2%
Next-Generation Manufacturing Technologies:						
Dept. of Commerce						
- Manufacturing Extension Partnership (NIST)	90	110	0	**125**	15	13.4%
- Technology Innovation Program (NIST) 2/	46	60	0	**70**	10	16.5%
- Regional Innovation Cluster and Business Incubator 5/	0	0	0	**100**	100	- -
TOTAL Manufacturing Technologies 6/	136	170	0	**295**	125	73.3%

* American Recovery and Reinvestment Act (Public Law 111-5); funds will be spent over multiple years.

** Excludes Recovery Act appropriations. Change is regular FY 2009 appropriations to FY 2010 request.

1/ Health IT ARRA funding excludes an estimated $17 billion in incentives and investments through mandatory programs (Medicare and Medicaid) beginning in 2011.

2/ Includes some R&D funding. EERE includes Federal Energy Assistance spending.

3/ Appropriated funds only. The program leverages appropriated funds by up to 10 times in loans.

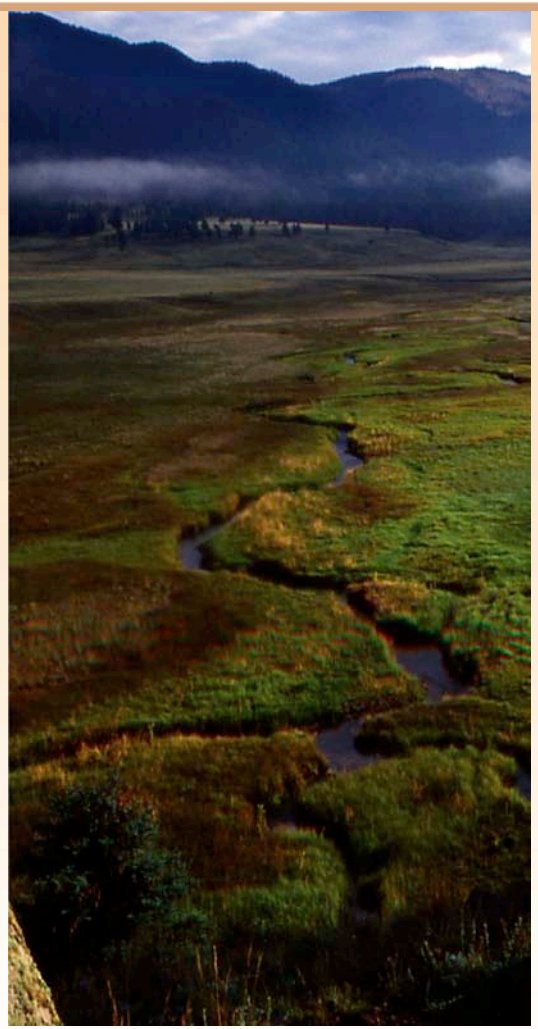
4/ Recovery Act allocations are not available at this time.

5/ Allocation within Commerce EDA programs, roughly half for innovation clusters and half for business incubators. For the past several years, EDA support of incubators has been approximately $10-$25 million a year.

6/ R&D spending in the NIST laboratories and other R&D agencies also contribute to manufacturing technologies.

New Mexico EPSCoR

NM EPSCoR State Committee Meeting



Agenda

2:00 - Welcome and comments. Jack Jekowski, Chairman

2:15 – Current RII Track 1 overview and progress. Bill Michener, Program Director

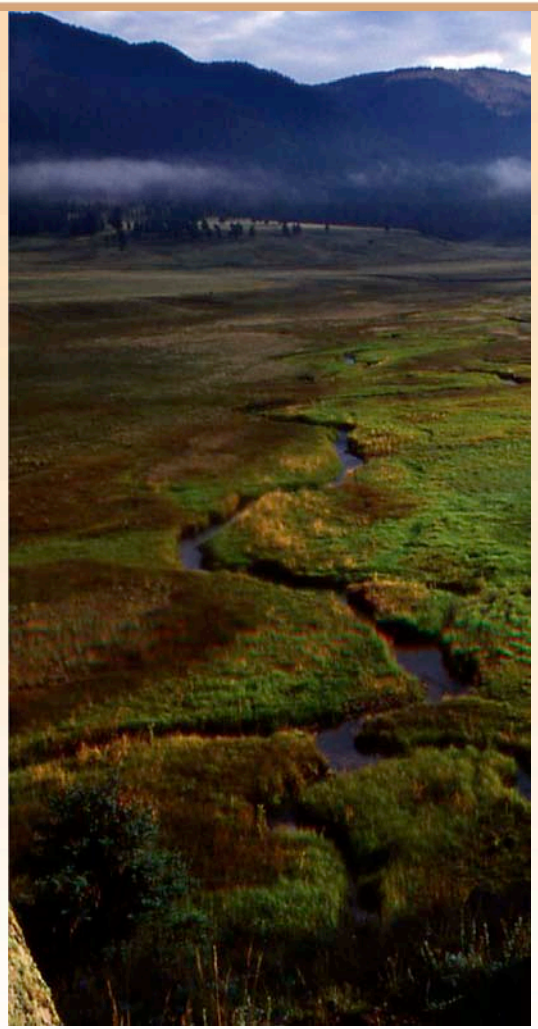
2:45 - EPSCoR State Program activities update. Bill Michener and Katherine Mitchell, Associate Director

3:15 - Discussion of committee member vacancies and action item on new Vice-Chairperson. Jack Jekowski

3:30 - Emerging directions and philosophy within NSF. Jack Jekowski and Bill Michener

3:45 - Review of New Mexico State S&T Plan. Tom Bowles, Science Advisor to the Office of the Governor

4:00 - Proposed fall agenda items and final comments.



New Mexico EPSCoR State Committee Meeting

May 27, 2009

I. NM EPSCoR RII Phase 3: Project Update

II. NM EPSCoR State Program: News and Issues

Bill Michener & Katherine Mitchell

Program Director Associate Director

Part One: NM EPSCoR RII 3 Project Update

- Climate Impacts on New Mexico's Mountain Sources of Water
- Year One: 9/1/09 – 8/31/09

- Project Oversight and Management Structure
  - New staff additions and introductions
  - Organizational chart (in packet)

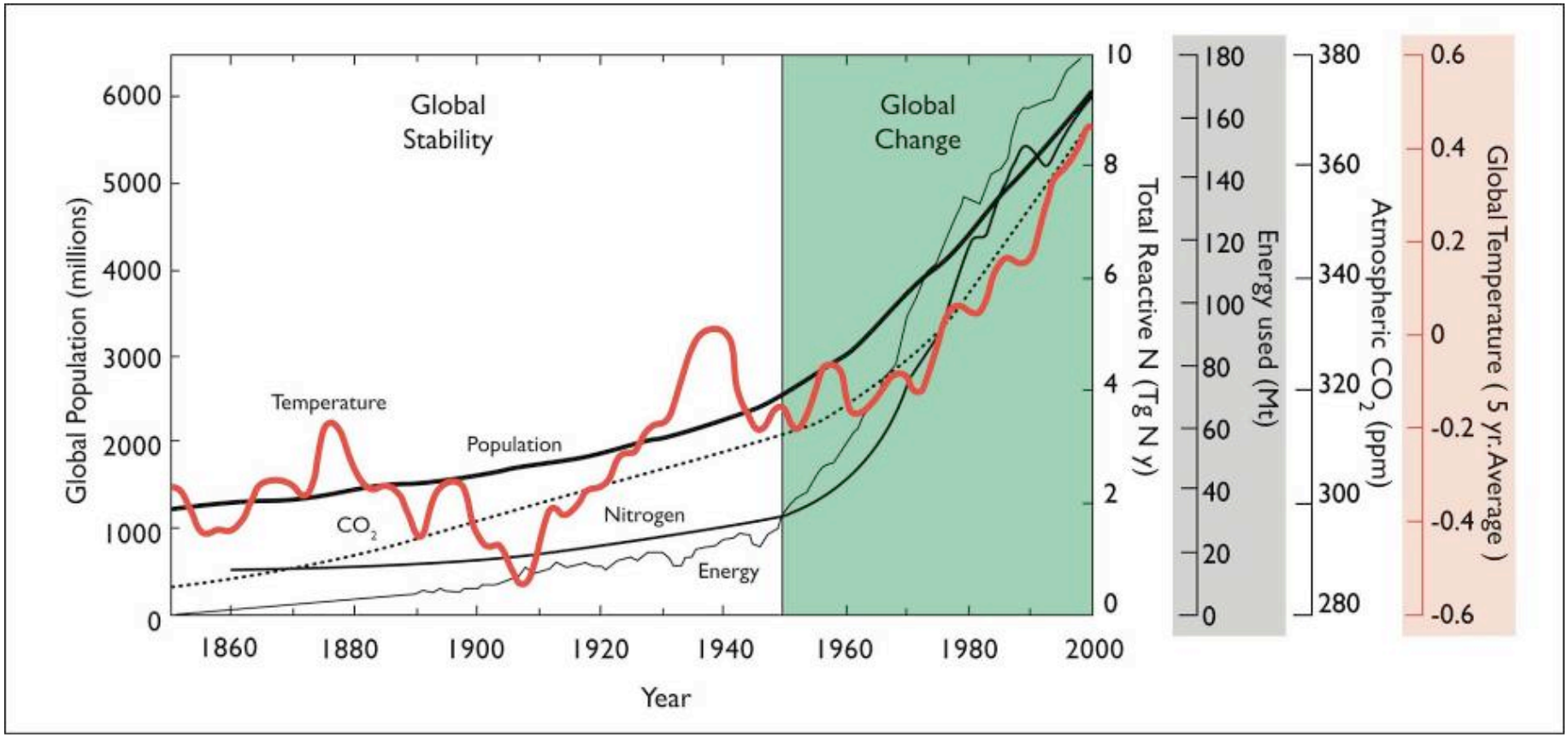
Overview

- New Mexico and Climate Change: Background

- NM EPSCoR RII Phase 3: Climate Impacts on New Mexico's Mountain Sources of Water
  - Research Infrastructure
  - Cyberinfrastructure
  - Human Infrastructure

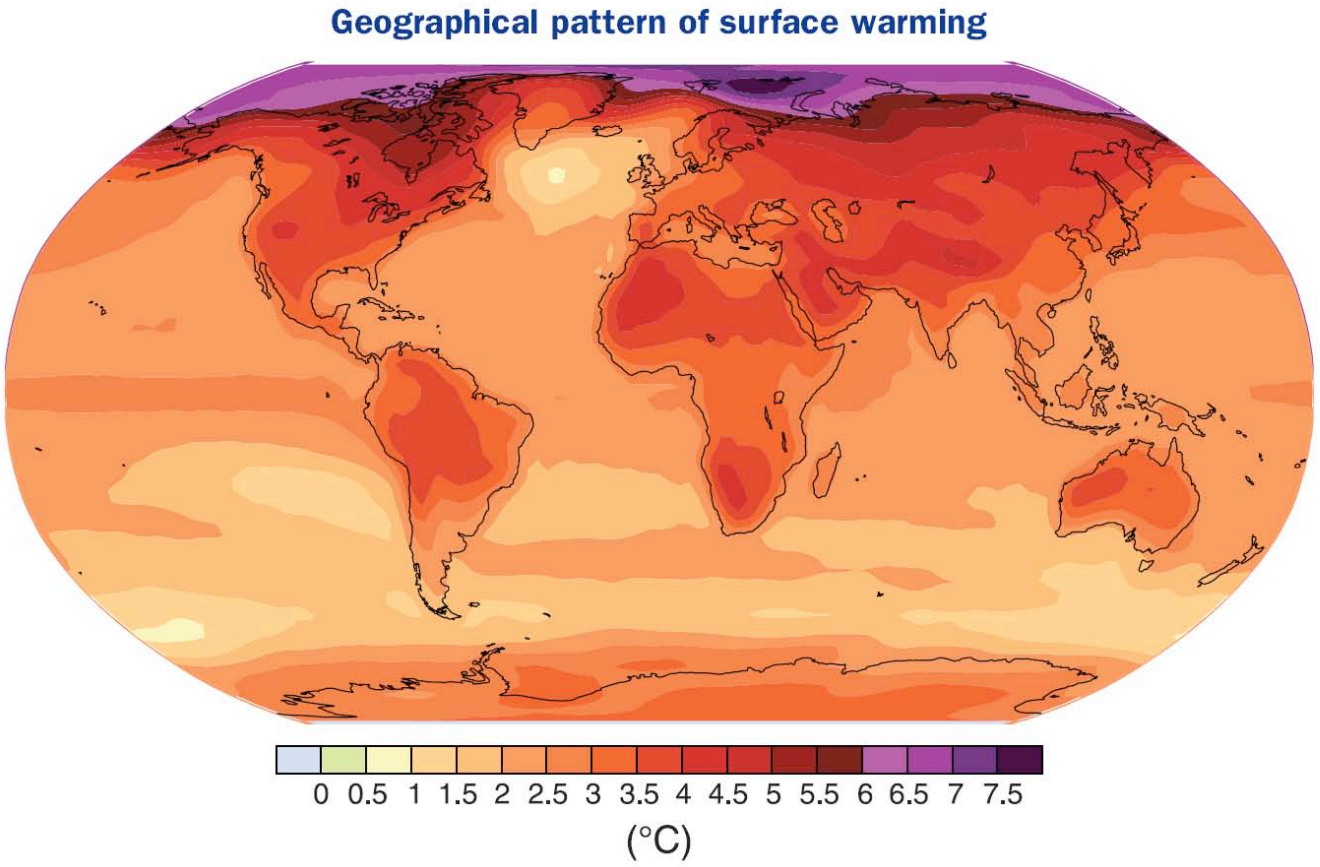

Living with Cancer
The changing science
Beyond Baghdad: Where The Enemy Has Its Own Surge
The Sopranos' Last Song: What Exit Will Tony Take?
TIME
SPECIAL DOUBLE ISSUE
The Global Warming Survival Guide
51 Things You Can Do to Make a Diffe
2ND-QTR SIZZLE PROFITS AT 900 COMPANIES (P. 74)
PAYING FOR COLLEGE BEWARE OF THOSE HIGH 529 FEES (P. 96)
TERRORISM WHAT COMPANIES STILL NEED TO DO (P. 26)
BusinessWeek
GLOBAL WARMING
Why Business Is Taking It So Seriously
BY JOHN CAREY (P. 60)
SPECIAL REPORT GLOBAL WARMING
TIME
BE WORRIED. BE VERY WORRIED.
Climate change isn't some vague future problem—it's already damaging the planet at an alarming pace. Here's how it affects you, your kids and their kids as well
EARTH AT THE TIPPING POINT
HOW IT THREATENS YOUR HEALTH
INDIA CAN HELP D—OR DESTROY IT
CRUSADERS
Adapted for A NEW GENERATION from the New York Times Bestseller
an inconvenient truth
the crisis of global warming
AL GORE
nature
Eocene global warming
Hydrothermal vents prompt methane release
Malaria parasite
Photonic crystals
Perfecting the defects
Galapagos giant tortoise
SPECIAL REPORT
TIME
HOW TO SAVE THE EARTH
The hot and wild weather is a sign of things to come. But fresh ideas and new technology can cool us down and make this a GREEN CENTURY
TIME
007 at 25
Where's the Beach?
America's Vanishing Coastline
TIME
The Heat Is On
How the Earth's Climate Is Changing
Why the Ozone Hole Is Growing
SPECIAL REPORT Fighting for Global Markets
W YORKER
GLOBAL WARMING CARTOONS - 2007 - 21C
CHINA
JAPAN
RUSSIA
PACIFIC OCEAN
TEXAS
UTAH
LAS VEGAS
ST LOUIS
CHICAGO
PENNSYLVANIA
ATLANTIC OCEAN
Dr. Bush's Rx for Health Care
TIME
VANISHING OZONE
THE DANGER MOVES CLOSER TO HOME
THE BIG DRY
TIME
GLOBAL WARMING
Climbing temperatures.
Melting glaciers. Rising seas.
All over the earth we're feeling the heat.
Why isn't Washington?
JOE KLEIN ON IRAQ
BROKEBACK MOUNTAIN: GIDDY-YEP, I'M GAY
TIME
New Orleans Blues
It's worse than you think. Three months after Katrina, the city still suffers
BY CATHY BOOTH THOMAS

Global change

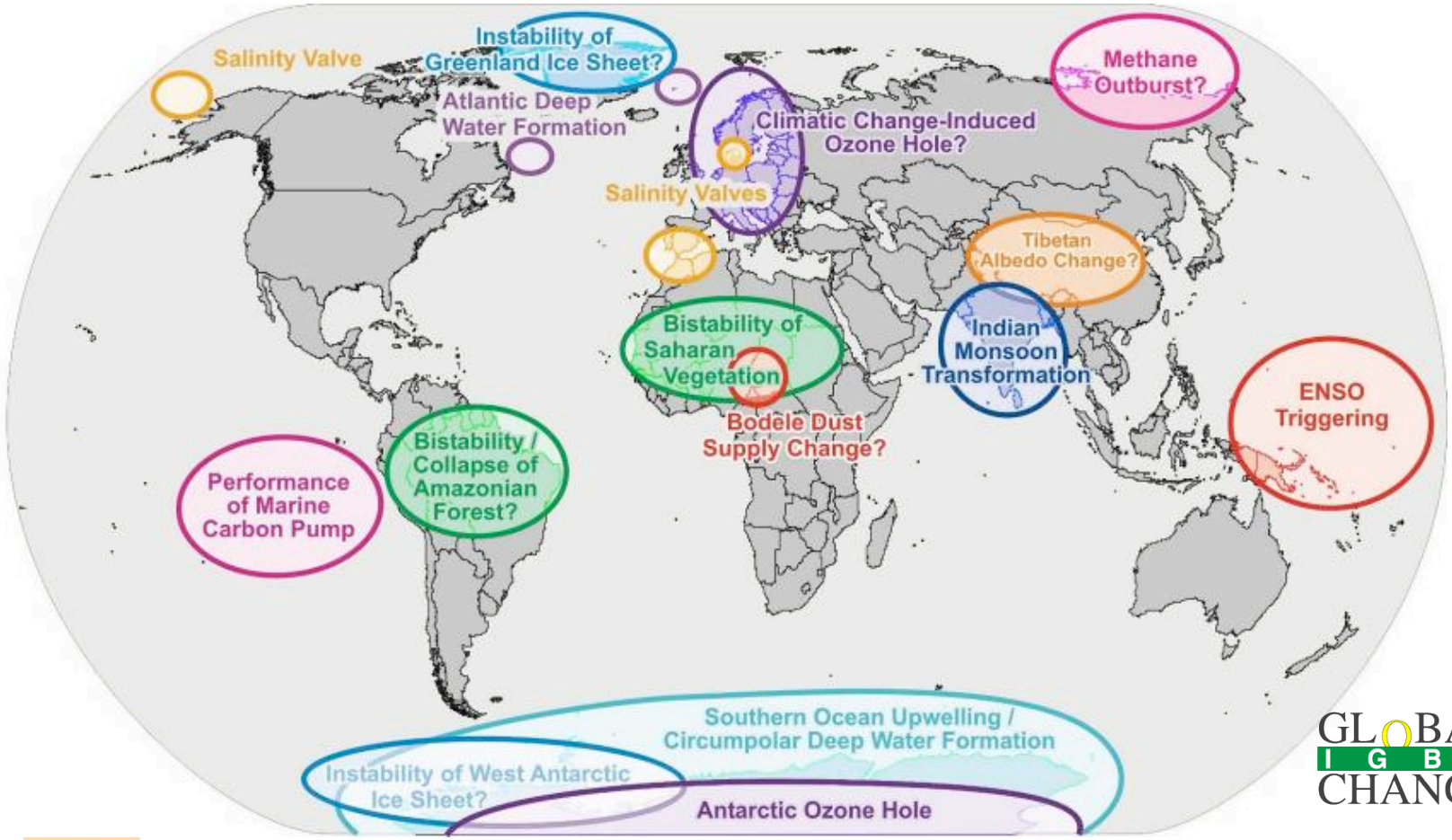


Smith, Knapp, Collins. In press.

Critical areas in the Earth's system

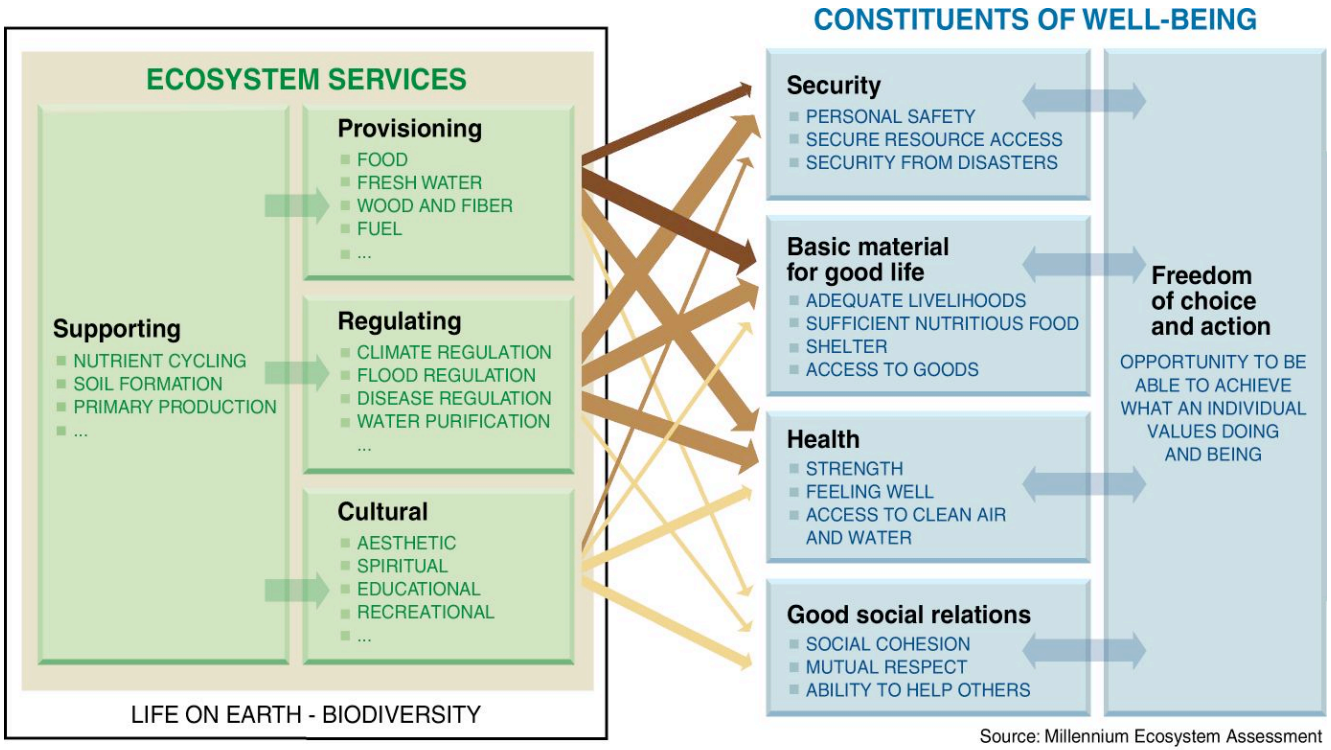


Critical areas in the earth system



GLOBAL CHANGE IGBP

Coupled human & natural systems



Source: Millennium Ecosystem Assessment

New Mexico climate change challenges

ABQJOURNAL
ALBUQUERQUE JOURNAL - ONLINE EDITION

Climate Change Could Cause Permanent Drought
By John Fleck / Journal Staff Writer 4/05/2008

Lincoln National Forest Managers Plan for Early Fire Season
Associated Press / ABQ Journal 3/09/2009

US FOREST SERVICE **Southwestern Region**

Drought Increases Bark Beetle Infestation Throughout New Mexico
US Forest Service/ Southwest Region 2/21/2008

New Mexico climate change challenges: relevant recent research and events

An Overview of Potential Economic Costs to New Mexico of a Business-As-Usual Approach to Climate Change.

New Report, February, 2009, Climate Leadership Initiative, U of Oregon

- *Could cost NM $3.2 billion annually, $3430 per household, as of 2020*
- *Dr. Janie Chermak, UNM served as NM Economist*

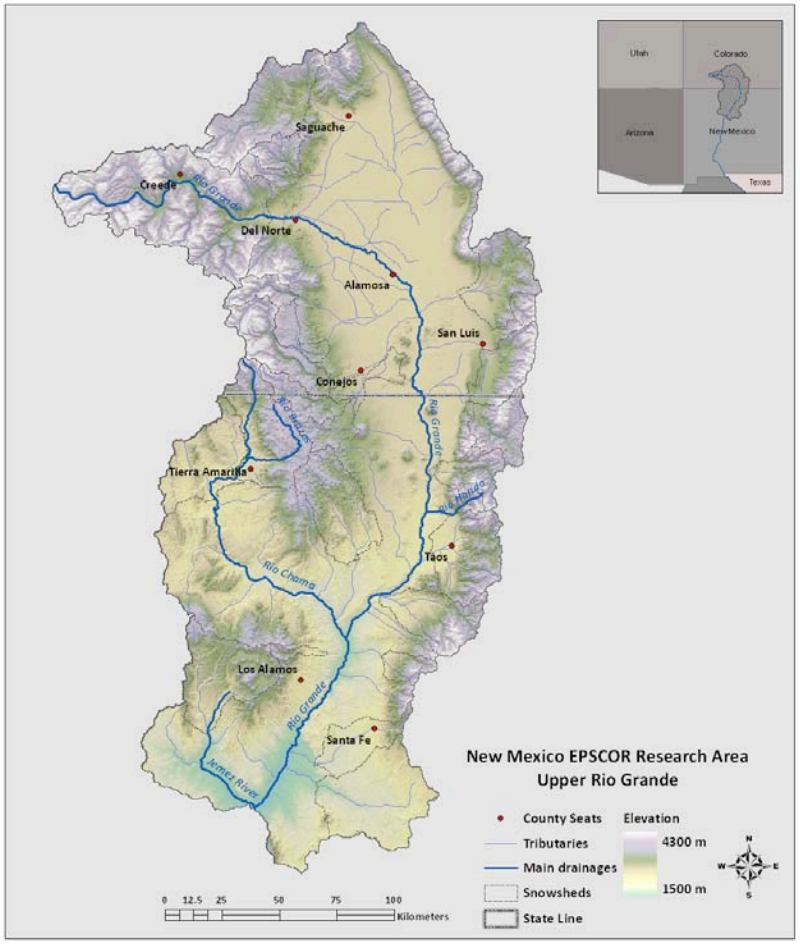
Sustainable Water Deliveries from the Colorado River in a Changing Climate

Barnett and Pierce, Proc. Nat. Acad. Sci., Early Edition, April, 2009

- *Reduced runoff by 10% could cause water delivery schedule to be missed 58% of the time by 2050*
- *We have no similar study for NM, nor good model predictions of reduced runoff*

EPSCoR RII-3: Climate Impacts on New Mexico's Mountain Sources of Water

Mission: "Provide the critical gap infrastructure, computational support, and education and outreach opportunities to foster excellence in climate change research and education."



EPSCoR RII-3: Climate Impacts on New Mexico's Mountain Sources of Water

I. Research Infrastructure	-climate and hydrology observational networks -in-situ hydrometeorology and in-stream sensors -infrastructure development seed grants -multi-disciplinary model development -innovation working groups
II. Cyberinfrastructure	-data acquisition, processing, storage -high performance computing -interoperability -collaboration technologies -NM climate change web portal
III. Human Infrastructure: Education	-teacher professional development institute -undergraduate research opportunities program -climate change research training group -junior faculty leadership training -NSF Days
IV. Human Infrastructure: Outreach	-climate change exhibit -climate change seminar series -climate change science cafes -Town Hall meeting -web content
V. Diversifying the Human Infrastructure	-place based, locally relevant science education -strategic student recruitment (BS, MS, PhD) -diversity approach embedded throughout -programmatic collaboration and networking

I. Research Infrastructure

1. Climate and hydrology observational networks
   - Update: Additions and upgrades to SNOTEL, SCAN, & RAWS stations underway
   - NMSU, State Climatologist position

I. Research Infrastructure

2. In-situ hydrometeorology, in-stream sensors, & lab instruments

- Update: Field season preparations well underway.
  - Valles Caldera meeting was first week of May for site inspection and Year One research objectives: [Parmenter (VCNP), Crossey (UNM), Dahm (UNM), Martinez (NMHU), Pullin (NMT), Wilson (NMT)]
- Update: NM EPSCoR scientists to attend CUAHSI optical sensor workshop in Vermont
- Update: NMHU major equipment purchases completed
  - 1. Ion Chromatograph System
  - 2. Total Organic Carbon Analyzer
  - 3. Graphite Furnace Atomic Absorption Spectrometer
- On site training for Edward Martinez and up to 5 students began in May

I. Research Infrastructure

3. Infrastructure development seed grants

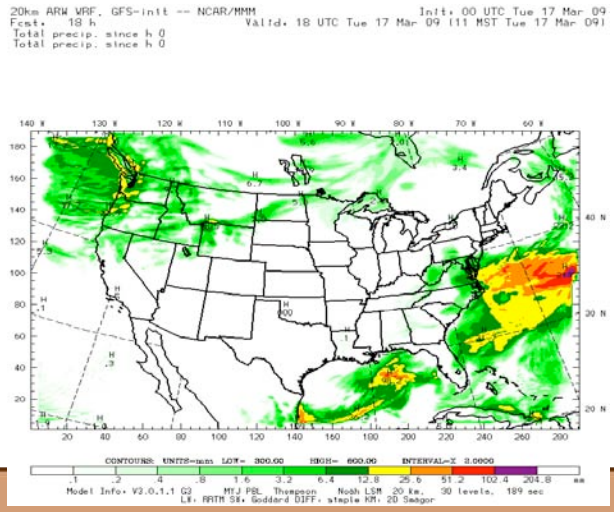
- Increase impact of NM EPSCoR research on critical student populations at non-PhD granting institutions
  - Update: RFP to be developed in fall 2009

I. Research Infrastructure

4. Multi-scale multi-disciplinary model development

- Update: Climate modeling new lead Investigator, Joseph Galewsky, E&PS UNM
  - Downscaling from global to regional, Precipitation processes in mountainous terrain
  - Encanto test runs last fall with his weather simulation
- Update: High Performance Computing Post Doc position this fall

NCAR WRF model
Used for downscaling
Grad student training



I. Research Infrastructure

5. Innovation working groups

- week-long working groups
  - 8-12 individuals
  - 3-5 full days
  - 2+ NM academic institutions
- outcome: synthesis papers and cross-cutting program proposals

- Update: IWG Call for Proposals issued mid-May to all EPSCoR scientists, due June 1 for Management Team Review
  - Full RFP on website

II. Cyberinfrastructure

1. Data acquisition, processing and storage
2. High Performance Computing
3. Interoperability
4. Collaboration Technologies
5. NM Climate Change Web Portal

- Update: Post-doc HPC programmer to start in fall
- Tri-state meeting CI group began on data and interoperability standards
- Web portal began development
- Collaboration technologies (SVN)

III. Human Infrastructure: Education

1. Teacher Professional Development Institute

- Annually, 9th grade teachers in an intensive field experience - paired with development of classroom curriculum in climate change

- Update: The Northern Network
- 2009 Summer Institute at Valles Caldera
- 5-days, June 8-12
  - morning field courses
  - afternoon – data and curriculum development for next school year
- 14 teachers recruited from northern NM schools
- 4 math-science pairs (8 teachers)

III. Human Infrastructure: Education

New EPSCoR Partnership with The Northern Network

- "The Northern New Mexico Network is a non-profit consortium of 28 school districts in northern NM whose goal is to exert collective action ***to improve the quality of life in rural northern New Mexico by being an advocate and catalyst for the improvement of education.***"

- Long term relationship with the northern school districts
- Teacher Professional Development emphasis
- 'Circuit Riders' in place for on-site STEM teacher support throughout school year
- Some financial support from NM PED Math and Science Bureau

III. Human Infrastructure: Education

2. Undergraduate Research Opportunities Program

- Aimed at the non-PhD granting schools undergrad students
- 9 weeks summer research with EPSCoR scientists
- Program Manager, Mike Pullin, NMT

- 2009 UROPUpdate:
  - student recruitment, selection completed
  - 10 students from 4 institutions:
    - San Juan, NMHU, ENMU, N NM College

- Research experiences at 4 institutions:
  - NMSU, Hydrometeorology
  - NMSU, Acequia hydrology
  - UNM-EDAC, env. data management
  - NMT, Acquatic chemistry
  - NMHU, Grazers and Water Quality

III. Human Infrastructure: Education

3. Climate Change Graduate Research Training

- LANL Institute Advanced Studies (IAS)

- Update: “Simulating the Spatial-Temporal Patterns of Anthropogenic Climate Change”

- A workshop in the EPSCoR Bridging Disciplines, Bridging Scale Series, July 2009, Santa Fe

- Topic: climate model down-scaling methods
- Output: paper on method comparison
- Audience: 15 – 20 faculty and graduate students in earth and climate science

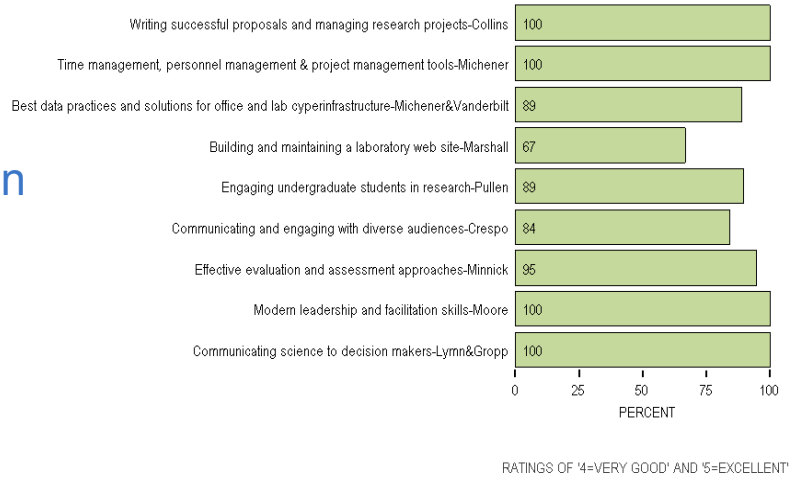
III. Human Infrastructure: Education

4. Junior Faculty Leadership Training

- UPDATE: January 6-8, 2009
  - Held in residence at Sevilleta
  - 19 faculty from 5 NM institutions
    - NNMC, NMT, ENMU, NMSU, UNM

- Presentations to enhance leadership skills and to increase competitiveness for national funding
  - Nadine Lynn (ESA) and Robert Gropp (AIBS) on interacting with policy makers
  - Carl Moore on leadership and facilitation

- Very high rates of program satisfaction among participants



IV. Human Infrastructure: Outreach

Climate change exhibit at the New Mexico Museum of Natural History and Science

- >200,000 annual visitors
- "Science on a Sphere" interactive

Climate Change Seminar Series

Climate Change Science Cafés

Town Hall Meeting in 2011

- UPDATE:
- Climate Change Education Coordinator hired
- Guest exhibit curator contracted, Dr. David Gutzler
- Science on Sphere product selected and in production, exhibit design underway

V. Diversifying the Human Infrastructure

1. Place based, locally relevant science education
   - Teacher professional development and Science Cafés
2. Strategic student recruitment

   UROP, Mike Pullin did an excellent job
3. Diversity embedded throughout
   - Town Hall, Faculty Leadership

   training, annual mtgs., etc.
4. Collaboration and networking
   - AGEP, ADVANCE, AIHEC, AISES, etc

5. Update Personnel

- Hiring Outreach, Education and Diversity Coordinator
- Marnie Carroll, Dine College, Dir. Of Environmental Institute will lead a permanent working group on diversity

Part Two: EPSCoR State Program News & Issues

- Communications
  - Website is online www.nmepscor.org
  - New Logo, Posters, brochures, post cards
- Strategic Plan completed, submitted, approved
  - Available on our website (Exec summary in packet)
- Office move to Science and Technology Park
- Western Tri-State Consortium: NM, Idaho, Nevada
  - Collaborative trans-jurisdictional alliance on common themes of climate change and water resources (map in packet)
  - First Annual Meeting in Boise, Idaho in March
    - Over 100 attendees from education, outreach, science components
    - Attendees, agenda, presentations, available at our website

Part Two: EPSCoR State Program News & Issues

- Funding: NSF EPSCoR Track 2, Cyberinfrastructure
  - Tri-State Consortium CI plan and joint proposal
  - $2 million per year for 3 years
  - Submitted and Reviewed, June 1 announce awards
- Funding: NSF EPSCoR new C2, Cyberinfrastructure
  - $1 million per year for 2 years; focus on MSIs
  - Stimulus set aside money, Congressionally legislated $50 million to NSF EPSCoR for the C2 award
  - RFP on June 15, 2009 with submission due Sept. 15, 2009
- Funding: DOE EPSCoR State-Laboratory Partnership
  - Approximately 6 New Mexico proposals will go in
  - Dine College – Lawrence Livermore Lab proposal

Part Two: EPSCoR State Program News & Issues

- NSF EPSCoR PD/PA meeting in DC, May 18 – 22
- NM EPSCoR External Advisory Committee, late August
- NSF Reverse Site Visit in DC, September 14
  - Up to 4 presenters (Jekowski, Michener, Mitchell, Wilson)
- EPSCoR States National Meeting in Alabama, October 20
  - Held at Perdido Beach
  - New Mexico attendees from State Committee

Thank you !





New Mexico EPSCoR

NM State EPSCoR Committee

Jack Jekowski, ITP
William Michener, NM EPSCoR
Dr. Vimal Desai Chaitanya, NMSU
Dr. Julia Fulghum, UNM
Dr. Van Romero, NMT
Dr. Randy Jennings, WNMU
Dr. John Montgomery, ENMU
Dr. Nan Sauer, LANL
Dr. Linda La Grange, NMHU
Stephan Helgesen, Econ. Dev. Dept., NM
Dr. Anthony Sena, NNMC
Marie Garcia, SNL
Rep. Danice Picrauz
Sen. Mary Kay Papen
Sen. Linda Lopez
Ron Tafoya, Intel
Dr. Tom Bowles, Gov. Science Advisor, NM
Dr, Kurt Steinhaus, LANL
Beverlee McClure, ACI

NM EPSCoR Office

William Michener, State Director
Katherine Mitchell, Associate Director

Management Team

Research & Cyberinfrastructure

Karl Benedict, UNM
Janie Chermak, UNM
Edward Martinez, NMHU
Al Rango, NMSU
Sam Fernald, NMSU
Marnie Carroll, DINE
Todd Ringler, LANL
John Wilson, NMT

Human Infrastructure

Mary Jo Daniel, NM PED
Rhea Graham, Sandia Pueblo
Robert Parmenter, VCNP
Michael Pullin, NMT
Clyde Romero, Taos Pueblo
Anne Watkins, Biophilia
Jessica Sapunar-Jursich, NMMNHS

Office Staff

Anna Morrato, Program Administrator
Megan Gallegos, Accountant II
Celina Gomez, Fiscal Tech
David Danzilio, Student Employee

Cyberinfrastructure

(Web Portal, HPC Programming, Collaboration, Interoperability)

Project Personnel

Max Bleiweiss, NMSU
Robert Bowman, NMT
Laura Crossey. UNM
Leeann DeMouche, NMSU
Joe Galewsky, UNM
Edward Martinez, NMHU
Michael Pullin, NMT
Al Rango, NMSU
Jose Rivera, UNM
Janie Chermak, UNM
Cliff Dahm, UNM
Sam Fernald. NMSU
Bill Fleming, UNM
Brian Hurd, NMSU
Robert Parmenter, VCNP
Todd Ringler, LANL
John Wilson, NMT
Vince Tidwell, SNL

Research Infrastructure

(Equipment, Model Development, Innovation Working Groups)

Project Personnel

Karl Benedict, UNM
Joe Galewsky, UNM
Todd Ringler, LANL
Vince Tidwell, SNL
Renzo Sanchez-Silva, UNM

Human Infrastructure

(K-12 & Higher Education, Public Outreach & Communication, Diversity)

Project Personnel

Mary Jo Daniel, NM PED
Rhea Graham, Sandia Pueblo
Robert Parmenter, VCNP
Michael Pullin, NMT
Todd Ringler, LANL
Clyde Romero, SFIS
Marnie Carroll, Dine

AAAS Review

External Advisory Committee

Elsa Bailey, Elsa Bailey Consulting Inc.
Steve Borleske, DE EPSCoR
Ruby Leung, Pacific NW Laboratories
Bridget Scanlon, U. Texas
Steven Semken, ASU
Amelia Ward, U. Alabama
Mark Williams, U. Colorado

Minnick & Associates, Inc.

Call for Proposals: Innovation Working Groups

1717 Roma NE
MSC05 3180
University of New Mexico
Albuquerque, NM 87131-0001
Phone: 505-277-6790 / 6793

[Full RFP available on NM EPSCoR Website]

Simulating the Spatial-Temporal Patterns of Anthropogenic Climate Change
A Workshop in the Bridging Disciplines, Bridging Scale Series

Los Alamos Institute for Advanced Studies
LANL Center for Nonlinear Studies
New Mexico EPSCoR

Coordinated by Todd Ringler and Sara Rauscher

Dates: July 20-22 in Santa Fe Room at La Fonda Hotel in Santa Fe, NM

Over the last several decades climate system models have been the primary tool used to understand the environmental impacts of anthropogenic climate change. Now these same models are faced with a new and substantially more complicated mission: to provide information of sufficient spatial and temporal resolution to support the wide spectrum of policy initiatives that will be developed to address anthropogenic climate change at the local, regional and national scale. This workshop will focus on the challenge of providing policy-relevant knowledge of anthropogenic climate change through numerical simulation.

Different methodologies are being advanced to obtain the requisite regional climate information needed to develop and evaluate policy alternatives: dynamic downscaling with limited-area simulations, empirical statistical downscaling, quasi-uniform global climate modeling, and variable-resolution global climate modeling. During the workshop, we will evaluate each approach in terms of its current ability to "add value" to the regional climate change knowledge base. In particular, we will examine the current challenges preventing the method from reaching its full potential as well as the future outlook for the method's ability to contribute to regional climate change science. Moreover, we will explore the characterization of uncertainty in regional climate change projections. In order to focus the discussion, we will emphasize applications for climate change impacts on water resources over North America.

Two major outcomes of this workshop are expected. First, the workshop findings will be summarized in a white paper and presented to the DOE Climate Change Prediction Program for consideration in future program development activities. Second, the workshop white paper will be expanded into a review article discussing the merits of the various approaches in simulating the regional spatial-temporal patterns of anthropogenic climate change.

Funding is in place to conduct workshops in the Bridging Disciplines, Bridging Scales Series once per year for the next five years. Over the duration of the activity, we hope to build connections between regional climate change science and systems closely linked to socio-economic function, such as water availability, ecosystem services, and energy production.

Travel funds are available. Please contact T. Ringler or S. Rauscher for details.

Climate Change Impacts on New Mexico's Mountain Sources of Water

Todd Ringler, Theoretical Division, LANL

This IAS-supported effort will engage LANL in a large, multi-institutional effort to quantify the impact of anthropogenic climate change on the water resources of northern New Mexico. The snow-melt dominated watersheds of northern New Mexico, including those in the Sange de Cristo, San Juan, and Jemez Mountains, are considered to be especially vulnerable to anticipated climate change due to their latitudinal location in western North America. In order to comprehensively address both the scientific challenges and the socioeconomic implications of this work, the project will bring together people from more than twenty institutions, agencies, and laboratories from around the state, including climate scientists, economists, and policy makers.

IAS participation in this proposal will significantly enhance the educational component of this effort through support for graduate summer schools, support for an annual workshop entitled "Bridging Disciplines, Bridging Scales," and support for developing and administering new curriculum that will be available to the primary research institutions through IAS distance learning facilities.

Graduate Summer School in Regional Climate Modeling: These summer schools will bring together PhD students from NM institutions, along with other exceptional students from around the states, for an intensive study of regional climate modeling. Students will be exposed to the state-of-the-art in global climate modeling, regional climate downscaling, surface hydrological modeling, and economic modeling. The emphasis will be on how to connect these various modeling approaches in a physically realistic and computationally tractable manner. Tentative schedule: Hosted every other year at LANL depending on need and faculty participation. Travel, housing and per diem expenses covered for approximately ten students per summer school.

"Bridging Disciplines, Bridging Scales" Workshop: The focus of these workshops will be on how we relate changes in the physical climate to socioeconomic impacts. The major themes will be how to institute connections across disciplines (e.g. climate change, surface hydrology, economic modeling) and how to bridge the tremendous gaps in spatial and temporal scales (e.g. from global climate change to economic impacts in New Mexico). Scientists from around NM will be joined by national and international leaders in these fields. Tentative schedule: Hosted annually at LANL.

Graduate Seminar in Climate Change: This course will be hosted at the LANL Institute for Advanced Studies (IAS) and broadcasted to New Mexico universities through the IAS distance learning facilities. The seminar course will include EPSCoR scientists and recognized experts from within and outside the state that are engaged in climate, hydrology and socioeconomic studies related to climate change. Tentative schedule: Offered annually depending on need and faculty participation.

NM EPSCoR RII3: Climate Change Impacts on New Mexico's Mountain Sources of Water

Strategic Plan

Climate change is affecting natural environments around the world. NM EPSCoR RII3 addresses a key challenge that is of worldwide significance—understanding and forecasting the effects of climate change on water supply and sources in arid regions, as well as the socioeconomic implications. The overarching **vision** for the NM EPSCoR Program is to enable:

"An environment in which New Mexico scientists and educators are fully competitive in climate change research and education."

NM EPSCoR RII3 is designed to enhance research competitiveness through investment in three strategic areas: *(1) critical Research Infrastructure, (2) Cyberinfrastructure, and (3) Human Infrastructure.* These investments will help establish NM as a laboratory for climate change research, and as a model for science-based public policy. The multi-disciplinary, multi-scale effort is envisioned to transform climate change science and policymaking in NM by providing the tools required for quantitative, science-driven discussion of difficult water policy options facing the State in the 21st Century. These goals are articulated in the NM EPSCoR **mission**:

"Provide the critical gap infrastructure, computational support, and education and outreach opportunities to foster excellence in climate change research and education."

Proposed research infrastructure investments support development of watershed-scale observational databases and coupled atmosphere-land surface-hydrology models needed in NM for water supply forecasting and water resources decision support. RII3 also supports research on the socioeconomic impacts of basin-scale hydrologic changes to *acequias* - the traditional water supply system for agriculture in small communities that has been an integral cultural feature of NM for centuries. New cyberinfrastructure investments will facilitate the rapid delivery of climate change data and information to scientists, educators, decision-makers, and the public. Proposed investments in outreach and communication will create an informed citizenry that is aware of climate change impacts on natural resources. In addition, education and diversity investments are closely integrated to increase impact on the critical student population at NM's non-PhD granting institutions. Innovative elements of the outreach, education and diversity programs reach a large and diverse population in both rural and urban areas, with an emphasis on involving and supporting the State's 'majority minority' population of Native Americans and persons of Hispanic descent.

Through novel projects and partnerships that are facilitated by NM EPSCoR Research Infrastructure Improvements, scientists and educators will contribute to serving the needs of science, education, and the public. In order to achieve the broadest impact, New Mexico RII3 participants have strategically defined the scope of what we do, the stakeholders we serve, and how we intend to achieve our mission. In the remainder of this document, we focus on 14 specific strategic objectives and the key actions that will enable us to achieve these objectives. The objectives are grouped by major focal area for the investment: (1) research infrastructure; (2) cyberinfrastructure; and (3) human infrastructure. An accompanying ***Implementation Plan*** provides details with respect to the activities supported, participants, planned actions, deliverables and milestones, resources, efforts to promote sustainability, and any changes that are envisioned for implementation since the original proposal was submitted.

Strategic Objectives

Research Infrastructure Improvements

Objective 1: Enhance climate and hydrology research infrastructure (from data acquisition through modeling).
Actions

- Significantly upgrade climate and hydrology observing networks in northern New Mexico.
- Map snowfall utilizing historic and current satellite data.
- Support development of coupled atmosphere-land surface process models.
- Apply and improve existing models for snowmelt runoff, surface water-groundwater interactions, and basin-wide partitioning of water resources for urban, agricultural and other uses.

Objective 2: Improve water quality monitoring in high altitude stream environments.
Actions
- Develop new and apply existing water quality sensors for the autonomous monitoring of stream waters in high altitude environments.
- Deploy a set of state-of-the-art, near-real-time, autonomous water quality sensors for monitoring the quality of surface water in at least two watersheds in New Mexico that are fed by snowmelt.
- Use data from co-located hydrology sensors and the water quality sensors to understand the controls on water quality in each watershed.
- Develop a diverse group of interdisciplinary and multi-institution collaborators, facilities, and educational efforts within New Mexico concerned with understanding stream water chemistry dynamics.

Objective 3: Develop interdisciplinary socioeconomics and acequia research capacity.
Actions
- Install new *in situ* infrastructure and use high-resolution satellite data and simulation models to characterize acequia system flow distribution and surface-groundwater hydrological interactions.
- Document the ancient customs and traditions of acequia systems during times of climate variability.
- Develop and use data and simulation models to improve the understanding and management of water in New Mexico's agro-environmental systems.
- Significantly increase overall system dynamics economic-behavioral-physical modeling capabilities via development of a collaborative interdisciplinary team and through expansion of modeling tools.

Objective 4: Provide critical gap infrastructure for New Mexico Highlands University.
Actions
- Upgrade the aquatic chemistry laboratory at NMHU for state-of-the-art water quality analysis that enhances the ability to perform research on climate change and water resources.
- Provide training in the use of the instrumentation for graduate and undergraduate students.
- Incorporate use of instruments in course curricula.

Objective 5: Use Innovation Working Groups (IWG) to address key scientific, education, diversity, and workforce development challenges.
Actions
- Support IWGs that address challenges in the climatological, hydrological, and socioeconomic sciences, as well as education, communication and outreach, and diversity.
- Support an interdisciplinary IWG entitled "Bridging Disciplines and Bridging Scales" that will focus on how to build connections across disciplines (e.g. climate change, surface hydrology, economic modeling) and how to bridge the tremendous gaps in spatial and temporal scales (e.g. from global climate change to economic impacts in NM).
- Support Tri-State NSF EPSCoR IWGs for Nevada, NM and Idaho that will promote regional and inter-jurisdictional collaborations.

Objective 6: Provide Critical Infrastructure Gap Seed Awards to increase the impact of NM EPSCoR on the critical student population at New Mexico's non-PhD granting institutions.
Actions
- Provide seed awards to the regional universities and tribal colleges.
- Support purchase of research and teaching equipment related to climate change, hydrology and water quality.
- Provide funding for student researcher salaries, research supplies, and student conference travel.
- Integrate proposed activities with the Undergraduate Research Opportunities Program.

Cyberinfrastructure Improvements

Objective 7: Enhance scientific data and model output generation, management, discovery, and use through cyberinfrastructure.
Actions
- Develop efficient data acquisition, processing, and storage models that enable streamlined management of data products acquired and generated by the project.
- Develop a model for the effective use of high performance computing.

- Support interoperable data discovery and delivery.
- Deploy collaboration tools that facilitate knowledge exchange.
- Develop a portal that provides a single point of access for project products, services, and information.

Human Infrastructure Improvements

Objective 8: Enhance diversity in all elements of the EPSCoR Program.
Activities
- Increase the research capacity of non-PhD granting institutions (focusing on underrepresented groups).
- Increase and improve the quality of STEM education in K-12 schools in rural areas and on tribal lands.
- Support diversity training for teachers and university/college faculty.
- Increase the number of incoming students into STEM disciplines from underrepresented groups.
- Utilize one IWG per year to monitor diversity goals and advise programs on diversity issues.

Objective 9: Enhance professional teacher development for STEM areas in northern New Mexico.
Actions
- Support teams of middle school teachers that will participate in a three-day Summer Institute and weekend workshops where they will be engaged in scientific research and best pedagogy practices.
- Provide hands-on classroom science materials to teachers.
- Provide additional mentoring and support during the school year.

Objective 10: Develop an Undergraduate Research Opportunity Program that increases the exposure of students at non-PhD granting institutions to high quality, relevant, hypothesis-driven research.
Actions
- Engage undergraduates, recruited from institutions serving large populations of Hispanic and Native American students, in four to nine weeks of summer research with faculty mentors.
- Develop and support an initial week of workshops and short courses on climate change, hydrology, and water quality, which will be taught by EPSCoR-supported faculty.
- Conclude the program with a statewide conference where students will present the results of their research to an audience of students, faculty, and research staff.

Objective 11: Design and develop graduate research training group opportunities.
Actions
- Design and develop a Climate Change Graduate Seminar Course that will include EPSCoR scientists and recognized experts from within and outside the state.
- Support a Graduate Summer School in Regional Modeling that will include extensive hands-on training in running relevant climate, hydrologic, and socioeconomic models.

Objective 12: Inform faculty about funding opportunities via NSF Days.
Actions
- Develop and support NSF Days, a workshop, where NSF Program Directors will meet with faculty from colleges and universities to discuss relevant funding opportunities and strategies for seeking funding.

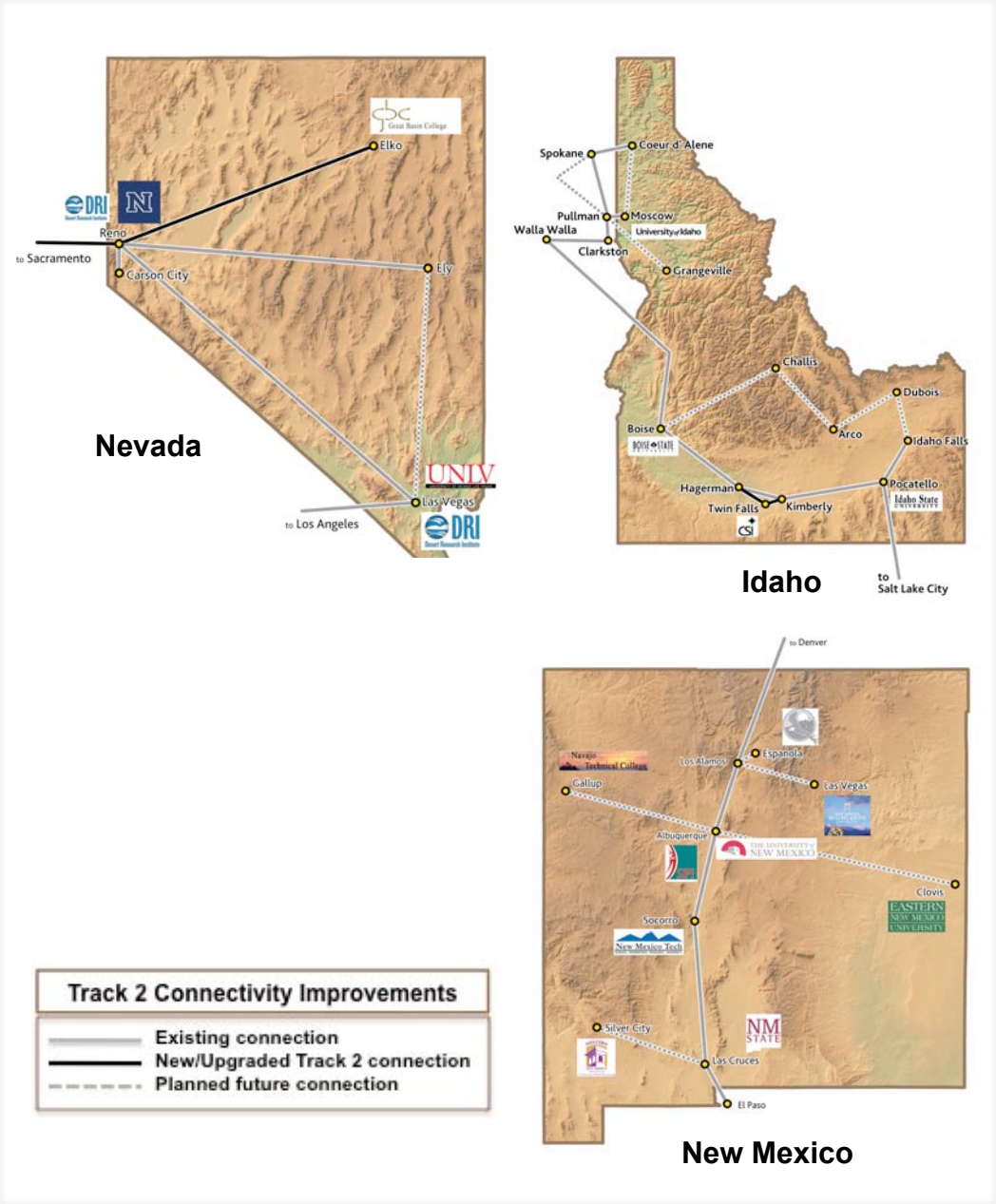
Objective 13: Enhance leadership skills for faculty via a Faculty Leadership Fellowship Program.
Actions
- Provide training for early-career faculty to enhance competitiveness and leadership skills.

Objective 14: Create a citizenry that is informed about climate change and its impact on NM's natural resources via public outreach and communication.
Actions
- Create a new Climate Change Exhibit at the New Mexico Museum of Natural History and Science.
- Develop a statewide Seminar Series.
- Provide community-based Science Cafés in northern New Mexico.
- Support a Town Hall that focuses on ways to promote economic development amidst climate change and uncertain water resource availability.
- Create a Climate Change Web Portal that provides easy public access to scientific information

Western Tri-State Consortium

New Mexico has joined the Nevada and Idaho NSF EPSCoR programs in forming a consortium of EPSCoR states with similar research agendas related to climate change and water resources. The consortium model significantly increases opportunities for scientific collaboration and enhances each state's ability to secure competitive funding and tackle complex climate change research agendas.

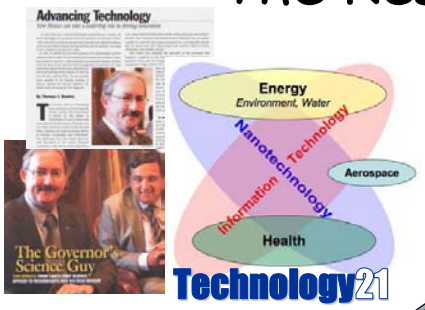
The Tri-State Consortium held their first annual meeting, Building Regional Collaborations, in Boise, ID on March 30-April 1, 2009. [See NM EPSCoR Website for agenda, attendees, and presentations]



The Tri-State Consortium jointly submitted a proposal for an NSF RII Track 2 Cyberinfrastructure award. Proposed Track 2 improvements in connectivity and bandwidth are illustrated above.

May, 2009
Jack Jekowski
jpjekowski@aol.com
505 280-2217

The Research Investment Landscape in New Mexico

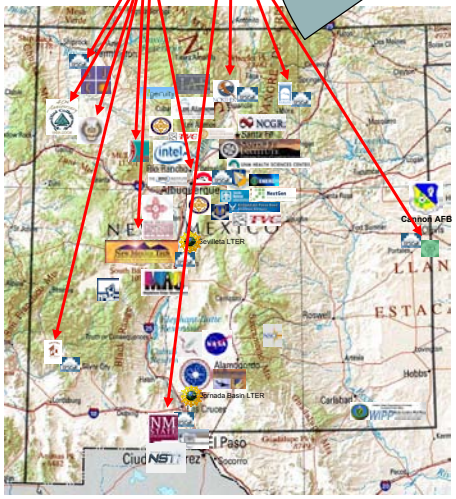


Sustainability and Build Out of Support for New Capacity and Partnerships Between University Research and Private Sector

Richardson Appoints New Director for Office of Science and Technology
Thursday, November 02, 2006
Helgesen is a Career Diplomat and Small Business Specialist
SANTA FE – Governor Richardson has appointed Stephan Helgesen, a former U.S. diplomat and small business specialist, as the Director of the Office of Science and Technology at the Economic Development Department (EDD).

Early Investment in Research Infrastructure

http://www.nmepscor.org/



University of New Mexico, New Mexico State University, New Mexico Tech, Western New Mexico University, Eastern New Mexico University, New Mexico Highlands University, Northern New Mexico College, San Juan Community College, Southwestern Indian Polytechnic Institute, Diné College, Crownpoint Institute of Technology

- NM Computing Applications Center
- Institute for Advanced Studies
- NM Research Council
- Research Institutions
- Technology Ventures Corp
- Regional Development Corp
- Economic Development entities
- Research Parks
- Federal Agencies
- National Laboratories
- New Mexico Economic Development Partnership

Air Force Research Lab; Los Alamos National Laboratory, National Center for Genome Research; New Mexico State University; New Mexico Tech; Sandia National Laboratories; The MIND Institute; UNM Health Science Center; The Santa Fe Institute; New Mexico Spaceport; NASA White Sands; White Sands Missile Range; Intel; EPSCoR; Technology Research Collaborative; Magdelena Ridge Observatory; National Radio Astronomy Observatory; Long Term Ecological Research Sites; New Mexico Space Port; Cannon, Holoman, Kirtland Air Force Bases; U.S. Dept of Energy; Western NM University; Eastern NM University; Highlands University; Northern New Mexico College; 23 Community Colleges; Institute for Advanced Studies; NM Computing Applications Center; National Security Technology Incubator; Southwestern Indian Polytechnic Institute; Diné College; Crownpoint Institute of Technology.

Investment Support and Commercialization

NEW MEXICO ECONOMIC DEVELOPMENT Department

STATE INVESTMENT COUNCIL
Private Equity Investment Program

Gateways for NMCAC

NM Research Applications Center

Science & Technology Corporation @ UNM Research Park
NMSU Arrowhead Research Park
National Security Technology Incubator
NM Tech Research/Industrial Park

Funding:
- New Mexico Computing Applications Center
- Technology Development Fund
- Energy Innovation Fund
- Water Innovation Fund

Technology Clusters:
- Aerospace
- Bioscience and Health
- Energy/Environment/Water
- Information Technology
- Nanotechnology
- Economic Development, Education, and Workforce Development

NEW MEXICO COMPUTING APPLICATIONS CENTER

Technology21

Innovation and Technology in the 21st Century
Creating Better Jobs For New Mexicans

A Science and Technology Roadmap for New Mexico's Future

New Mexico Governor Bill Richardson's Office
and
New Mexico Economic Development Department

January 2009

Foreword

In October 2006, Governor Bill Richardson requested that a Science and Technology (S&T) Plan for New Mexico be developed by his science advisor that would provide guidance on how the State could effectively leverage its remarkable science and technology. The charge in developing this plan is to provide a prioritized assessment of the opportunities that exist or could be developed that would drive technology-based economic development (TBED) in New Mexico.

In order to achieve that goal, the Plan must identify a sustainable process by which the State could make investments that would provide full oversight and accountability and a pathway towards achieving a significant return on its investments. Finally, the Plan must address Science, Technology, Engineering, and Mathematics (STEM) education as that lays the foundation for the workforce development that is essential to driving economic development in New Mexico.

The Plan that is described in this document – Technology21 - is meant to provide a *roadmap* of where the State should be going in encouraging and driving innovation and defining the means for reaching those goals. There have been many previous studies that have dealt with aspects of the State's S&T resources, none has been comprehensive enough. This plan is not meant to supplant those efforts, but rather to draw on them, extensively, as we complete the task of integrating all of the elements into a single plan.

The State owes a debt of gratitude to the many people who generously volunteered their time and effort in developing this plan. It is through their efforts that all of New Mexico will benefit as we begin a coordinated journey towards leveraging our considerable resources that will draw on the S&T strengths in New Mexico to drive long-term, sustainable technology-based economic development.

Thomas Bowles
Science Advisor to
Governor Bill Richardson

September 3, 2008

Acknowledgements

The Science and Technology Plan for New Mexico was funded in part by the New Mexico Economic Development Department.

The dedicated work of many individuals and groups led to the development of this plan and our thanks go out to all those who contributed to this roadmap. In particular, a core working group and several teams were created in order to draw on their wide-ranging expertise and perspectives. The core working group consisted of: Tom Bowles (chair), Stephan Helgesen (vice-chair), Charryl Berger, Scott Bryant, Garrey Carruthers, Vimal Chaitanya, Sarah Cottrell, Casey de Raad, Bill Feiereisen, Jim Fries, Julia Fulghum, Bill Hume, Margaret McDaniel, Jack McIver, Fred Mondragón, Andrew Neighbour, James Peery, Gary Resnick, Van Romero, Gene Simmons, Roy Soto, Betty Sparrow-Doris, Kurt Steinhaus, Rick Stulen, Alan Varela, Terry Wallace, Eric Witt, Terry Yates, and Faye Vowell. The leads of the various working groups are acknowledged in the relevant sections of the document. In addition, we would also like to recognize the efforts of the more than 150 individuals who contributed to various aspects of this roadmap, among them Claudia Ahlstrom, Ed Angel, Janice Arnold-Jones, Kevin Billings, Scott Burchiel, John d'Antonio, Mary Jo Daniel, Reed Dasenbrock, Bob Eisenstein, Bill Flores, John Heaton, Ed Hendrick, Jim Hoecker, Bob Hwang, Jack Jekowski, Jay Jordan, Melanie Kenderdine, Jesse Last, Irene Lee, Lorie Liebrock, Doug Lynn, Fernando Martinez, Lenny Martinez, Bob Mayer, Ernie Moniz, Craig OHare, Jose Olivares, Thor Osborn, Julia Phillips, Joanna Prukop, Jordyn Phelps, Rick Scott, Sig Silber, Jerry Simmons, Roy Stoesz, Jim Stout, Lisa Szot, Toni Taylor, Ellen Veseth, Steve Walsh, and Demeng Zangchai. We would also like to particularly thank Mary Ann Scott who was instrumental in compiling the document.

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Overview

1a. Introduction

New Mexico is a state with a wealth of human capital - a place where innovation and modern technology combine to create new ideas and new opportunities. It is also a state with age-old traditions that have guided our commercial and business life for generations. It is this very combination and the synergy that results from an occasional friendly clash of cultures that makes us a vibrant investment site for science and technology (S&T) companies.

Our S&T assets are many and varied, but reside physically in our research universities and our Federal laboratories (the latter contribute $6.0 billion, annually, to the State's economy). This financial underpinning has enabled us to consolidate and focus on specific scientific research and attract new companies to our state. These new commercial relationships have helped us become a world leader in many S&T disciplines.

New Mexico's success is rooted in a top-down and bottom-up support for science. Our Governor and our Congressional delegation have steadfastly supported our State's efforts to leverage those assets while our technologists and researchers continue to distinguish themselves through their discoveries.

Through a strong mix of Federal Grants and local incentives, New Mexico has attracted significant investment and created many new technology-based jobs. In fact, it is expected that technology-based economic development (TBED) will be the principal driver of economic growth in New Mexico for several decades to come.

In this respect, we are very similar to many states, and that similarity makes us competitors as well as potential collaborators.

Technology, like investments, goes where it can grow… fastest and best.

In order for New Mexico to retain its competitive edge and insure its attractiveness as a future investment site, we must have a plan to support and capitalize on the development of high-potential technologies. The plan must also have a set of realistic goals and a strategy to achieve them if we are to leverage and maximize our resources.

Technology21 defines the way in which the State can most effectively promote science and technology in the 21st century to drive high-tech-based economic development, create more high-paying jobs for New Mexicans, and to ensure we are fully competitive in the knowledge economy. Technology21 is meant to serve as a *roadmap* that identifies specific S&T opportunities the State should support along with a sustainable mechanism to provide that support. The Plan also addresses our many needs in the areas of science education, capital formation, workforce development, and public-private sector cooperation - all essential to creating the workforce that will drive our innovation economy forward. It also speaks to the need for establishing a New Mexico Technology Innovation Center to better coordinate and manage our many State projects and science and technology relationships.

1b. New Mexico's Future

New Mexico is a land of diversity of thought, culture, and people. Unfortunately, our economy is not so diverse. Government is the largest employer and most of the rest are retail, tourism-related, or healthcare jobs. We are facing a serious workforce crisis in New Mexico: while we have relatively low unemployment, our per capita income is one of the lowest in the country.

We cannot compete in the new world economy if our jobs are still in the old world economy. We must find new ways to stimulate high technology-based job growth so that we become a magnet for attracting new investment to the State. We must lead instead of follow. If we see ourselves as leaders in science and technology development then we must confront some sobering realities. We face four challenges:

Challenge #1 Addressing rising energy costs

In the past, we have been able to compete because of our low labor costs, low cost of living, Federal government revenue, and a vast storehouse of energy reserves, among other factors. Our future will be different. All costs will rise, especially those associated with energy and transportation. Growing our technology will become more expensive with each passing year. As we see this year, our budget surpluses from fossil fuels are not sustainable. We will switch from being an oil-exporting state to becoming an oil-importing state in 2015. The demands from our society for more energy, improved infrastructure, more evenly distributed healthcare and better social services will be impossible to meet unless we act now to grow our economy.

To address rising costs, we must develop economically competitive sources of renewable clean energy. Technologies emerging from our labs and universities have the potential to revolutionize the energy sector. Growing algae in the desert using our untapped sources of saline water could make New Mexico a major provider of transportation fuels for the country. Our immense solar resources, coupled with new technologies being developed in New Mexico could position us to be the most important state for solar energy. The New Mexico Green Grid Initiative can make New Mexico a national leader in implementing the Smart Grid with renewable energy. While we have the natural resources and scientific resources necessary to make this happen, we also need to provide the means to transition these possibilities into reality. Technology21 will do just that.

Challenge #2 Using technology for clean, green growth

Our planet is under siege by climatic forces and by our rapid consumption of our most precious resources. Our environmental and economic futures depend on finding new technology solutions to the nation's most pressing problems of climate change, water shortages, and fossil fuel dependency. A clean and green economic future also relies on our ability to develop new businesses in areas such as aerospace, biotechnology, information technology, and nanotechnology. We must grow our base of technology jobs, expand new technology-driven company start-ups, and recruit more out-of-state firms. This is vital if we are to firm up and diversify our economic base and provide a bright and sustainable future for all New Mexicans. To expand our clean and green economic base, we must dedicate a relatively small but consistent portion of our budget to move our discoveries from the laboratory to the people. This requires a commitment to creating a Technology Innovation Center (the core of Technology21) that will support or coordinate promising *commercializable* technologies in four areas: energy, water,

supercomputing, and clean and green technology innovation. Similar centers have been created by other states for the same purposes, and the vast majority of them have profited from the economy of scale and coordination that these centers have provided.

Challenge #3 Profiting from Federal Investments

Our science and technology advantage over other states has been our unique Federal government relationship with our national laboratories. With over $6.0 billion in annual revenue derived from the Federal government to operate its many facilities here, we are fortunate but also vulnerable to Washington's changing priorities. New policy decisions could lead to base closures or substantial reductions of missions for the national laboratories.

To avoid such losses and the subsequent economic impact on New Mexico, we must forge stronger and more flexible relationships with the labs that focus on commercial technology transfer and retaining Intellectual Property (IP) and human capital. We must draw on our scientific resources to provide solutions to energy problems and to produce the clean and green technologies needed to create better-paying jobs in rural and urban New Mexico. Technology21 provides the means for us to most effectively meet those challenges.

Challenge #4 Producing more technologists to satisfy projected workforce needs

We have not graduated or retained enough qualified workers to keep pace with company growth. The lack of preparation of our students in Science, Technology, Engineering, and Mathematics (STEM) areas, coupled with the large percentage of high school and college dropouts, is a significant barrier to growing businesses in New Mexico. In turn, this prevents us from improving the standard of living of New Mexicans. The need to act is critical and immediate in order to break the vicious cycle that traps our young people in a lifetime of minimum wage jobs.

Addressing this challenge requires us to substantially improve the performance of students in STEM areas that are of relevance to grow high-tech business. New Mexico Project 2012 (a joint Public and Higher Education initiative) is designed to advance our students to the forefront in STEM areas, nationally. Technology21 will support Project 2012 through initiatives such as the supercomputing center and will work with the Departments of Economic Development and Workforce Solutions to ensure that our educational system and business community become full partners in developing the right mix of commercially-relevant curricula.

Building the three-legged stool of success: Technology-Based Economic Development, Workforce Development, and Education

No state has been successful in achieving technology-based economic development without solving its workforce and educational problems. New Mexico is no different. We are faced with a potential 'Catch 22' situation. Currently, there are not enough specialized technology workers to satisfy the demand for them, and we won't get more investment until we graduate more of them. The solution to this problem requires a coordinated effort between high-tech economic development and education and workforce development. Technology21 provides the means to achieve that coordination.

We must act quickly to improve STEM education, increase our graduation rates, and develop specialized training programs to train workers needed for the future workforce. If we don't address this crisis quickly, we will lose companies as they move out of state to find the workforce they need; we will lose more of our most talented graduates to attractive out-of-state jobs and would leave those remaining graduates with only a selection of poor-paying jobs. A continuing lack of a qualified and educated workforce places us at risk of losing venture capital investments and a subsequent loss of our ability to attract high-tech companies to New Mexico.

All of the solutions have one thing in common; they cannot be achieved by one government department or by the private sector alone. They demand a coordinated approach and on-going cooperation from all New Mexicans, but especially by policy-makers, legislators, state agencies, and the 'implementers' on the ground. Technology21 provides the best way possible to provide the coordination needed to meet these challenges.

1c. Recommendation

The State Science and Technology plan has taken over 18 months to complete. Over 100 people representing the academic, scientific, business, government and non-profit communities from all parts of the State worked on it. The outcome of this effort concluded that meeting the needs identified in the S&T Plan can be met by implementing the following recommendation:

Establish and fund the New Mexico Technology Innovation Center (TICenter)

Technology21 is a roadmap that charts a course for economic and technological development that is integrated with educational and workforce development initiatives. It builds on the experiences of other states' plans, but is specific to New Mexico.

The TICenter is essential to bring all sectors of the S&T community together - a place where programs, activities, and grants can be monitored, coordinated and supported. It is also a place where a state-sponsored Technology Development Fund could be administered and directed towards commercializable technologies to meet market pull and help emerging technologies prosper with the State's help. The TICenter would be the principal liaison between all New Mexico state government departments, community-based technology programs, federal labs, universities and colleges, and private sector companies. At its core, the TICenter would administer or help coordinate four funds that would be used to support emerging technologies: the New Mexico Computing Applications Center, Technology Innovation Fund, the Water Innovation Fund, and the Energy Innovation Fund. Absent a positive decision on this recommendation, the State will not have the necessary resources to effectively implement and coordinate the technology development that is critical to improving the standard of living of New Mexicans across the entire state.

1d. The TICenter

The TICenter would have reporting responsibility and accountability to the Department of Economic Development, the Governor's Office, and the State Legislature. It would be a nonprofit organization with an executive board as well as a technical advisory committee of subject matter experts. It would have the flexibility to contract for R&D services, provide funding for technology development, create initiatives to respond to market opportunities, form partnerships with any combination of public, private, and government entities, and create and commercialize new intellectual property. It would oversee and administer the Technology Innovation Fund and serve to coordinate the Supercomputing, Energy, and Water Innovation Funds that are currently administered by other state agencies. Finally, it is designed to ultimately achieve self-sustaining operation through its ability to attract Federal and private funding and through the intellectual property it develops. This structure would allow the TICenter to be able to respond most effectively to market opportunities. This full range of capabilities is critical in addressing the pressing needs that exist in New Mexico to make technology-based economic development a driving force in improving the quality of life for all citizens.

The TICenter is essential to bring all sectors of the S&T community together - a place where programs, activities, and grants can be monitored, coordinated and supported. It is also a place where a state-sponsored Technology Development Fund could be administered and directed towards commercializable technologies to meet market pull and help emerging technologies prosper with the State's help. The TICenter would be the principal liaison between all New Mexico state government departments, community-based technology programs, federal labs, universities and colleges, and private sector companies. At its core, the TICenter would administer or help coordinate four funds that would be used to support emerging technologies: the New Mexico Computing Applications Center, Technology Innovation Fund, the Water Innovation Fund, and the Energy Innovation Fund. Absent a positive decision on this recommendation, the State will not have the necessary resources to effectively implement and coordinate the technology development that is critical to improving the standard of living of New Mexicans across the entire state.

1e. New Mexico's Major Technology Clusters

Technology21 has targeted five major clusters for support: Aerospace, Bioscience, Energy/Environment/Water, Information Technology and Nanotechnology. The reasons for their selection are explained in detail later in this report, but are based on our state's current concentration of investment, both in terms of research and development, actual company presence as well as on the data and recommendations of all five industry advisory groups. All are expected to post significant gains in the coming years due to industry's own projected growth and by the adoption of Technology21. The working groups made specific recommendations to advance Technology-Based Economic Development in these clusters as well as in education and workforce development:

Aerospace: Driving economic growth in aerospace requires *a statewide clearinghouse for aerospace technology development that also provides a mechanism for private aerospace companies to participate in and gain access to funded research.* The absence of a mature, full-spectrum aerospace engineering department in the State is a weakness that must be addressed. Without the appropriate education and training of students, professionals and technicians, the State will not be able to convince medium-to-large sized aerospace businesses to locate to New Mexico and remain here. In addition, New Mexico has a great opportunity to capitalize on Spaceport America, which can be a platform for innovation and TBED.
Bioscience and Health: New Mexico has world-class capabilities in specific areas of bioscience and biotechnology that could serve as the basis for increased economic growth. *These are in the areas of biofuels, genomics, neuroscience, health research, and development of diagnostics and sensors.* Biotechnology has seen rapid growth in New Mexico and is a prime source of high-tech economic development. Investments are needed to provide an even broader base of bioscience-related jobs in bioenergy, human health, animal health, and agriculture.

Energy/Environment/Water: These three areas are inextricably tied together such as in the area of fossil fuels, where more water than fuels is extracted from the ground and which has a significant environmental impact. *The growth and sustainability of the energy sector is tied to environmental issues and is dependent on predictable supplies of water.* In the area of renewable alternative energy, we have enormous opportunities to develop solar energy, algal-based biofuels, and "Green Grid" technologies. Greater emphasis must be placed on shortening the time from the testing to production stage and investing in high-potential commercializable technologies if the State is to compete on a national level with a broader mix of energy sources.

Information Technology: *This is an area where New Mexico has tremendous strengths such as in high performance computing, remote sensing networks, and digital media.* The State's supercomputing initiative (the New Mexico Computational Applications Center or NMCAC) promises to position New Mexico as a national leader in the area of IT-based economic development. The opportunities for strong growth in the areas of digital media and homeland security are considerable. Continued legislative support is critical to its success.

Nanotechnology: This area has great potential. New Mexico ranks third in nanotech intensity in the country. *Significant Federal investment, most recently in the Center for Integrated Nanotechnology at Los Alamos and Sandia National Laboratories, positions the State to capture increased revenues in this emerging field.* More must be done to transfer technologies such as ultra-short pulse lasers out of the labs and universities into the commercial sector and to inform companies of the advantages of locating to a state with a diverse platform of nanotechnology.

Economic Development, Education, and Workforce Development: It is essential to keep several overarching requirements at the forefront of science and technology development decision-making. They are: to assure that all new State S&T investments be based on 'market pull' (commercializable R&D and applications); to spread investment in rural as well as urban New Mexico whenever possible; to focus on the inseparable nature of education and workforce development to economic and S&T development; and to match the business community's commercial curricula needs with those of the universities' capabilities.

1f. Funding the TICenter

A small staff would be associated with the TICenter to provide the coordination and oversight of the programs for which the TICenter has responsibility. The technology development funding that the TICenter would oversee or coordinate falls into four categories:

1. New Mexico Computing Applications Center (NMCAC). Complete the effort started in FY08 to bring the Supercomputing Center fully on line with major business partners. Provide support for targeted areas in economic and workforce development. Support the Center goals in education, telehealth, and community development. Implement gateways in combination rural/urban New Mexico. The NMCAC was established with state funding and designed to transition to self-sufficient operation over a five-year period. As state funding is reduced in the out years, that funding can be applied to help ramp up the Technology Development Fund.

2. A Technology Development Fund to support innovation and commercializable technologies in the areas of Aerospace, Biotechnology, Information Technology, and Nanotechnology. This will provide the diverse high-tech economic base that is essential if New Mexico is to achieve a healthy and sustainable economic future. This program needs to increase to a reasonable level over several years as an ongoing effort that will ultimately (within 15 years) transition to self-sustaining operation through the Intellectual Property it will hold. The initial focus will be the New Mexico Green Grid Initiative.

3. An Energy Innovation Fund program to support innovation in energy technologies that are important to New Mexico and offer the prospect of significant return on investment. This will drive our State's efforts to achieve a clean and sustainable energy future where clean energy is an important economic factor. This program needs to be an ongoing effort supported by the State.

4. A Water Innovation Fund program to support innovation in water technologies that are important to New Mexico. This will provide novel means of conserving water and developing new sources of usable water that are essential if we are to grow. This program needs to be an ongoing effort supported by the State.

1g. Conclusion

This plan provides the basis for the State to optimally capitalize on the science and engineering resources that exist in New Mexico. It provides a process that will assure commercial and scientific groups, associations, institutions, companies and government leaders can collaborate in a more highly-targeted, focused way along well-defined technology lines. It provides well-defined priorities within the five cluster areas identified in which New Mexico can compete effectively on national and international scales. As a result of the collective statewide efforts that have gne into this plan, we have provided, for the first time ever in New Mexico, a roadmap for how the State can most effectively significantly increase the number of high-value, high-tech jobs for citizens across all of New Mexico. We have the natural and intellectual resources to realize the vision of this plan. It is now up to us to act to carry out the recommendations made in the plan.

2. Basis for the Plan

New Mexico is rich with opportunities that provide the basis for moving the State to the forefront in innovation and TBED. The State has been fortunate to have budget surpluses with substantial revenues derived from fossil fuels. It also has tremendous potential for producing renewable energy (primarily wind and solar) along with excellent prospects for large-scale production of biodiesel. We have a remarkably strong and robust basic research and development foundation, driven by more than $6.0 billion of annual Federal investments. We have a Governor with a strong and proven background in leading innovation and technology along with a Congressional delegation who are major supporters of the 'America Competes Initiative.' In short, we have all the ingredients necessary for New Mexico to become a national leader in innovation and technology-based economic development. What is now required is a plan that effectively harnesses these resources and integrates our efforts to turn this enormous potential into reality.

2.a. Purpose of the Plan

The New Mexico Science and Technology (S&T) Plan was developed as a *roadmap* rather than a vision of what we would like to achieve. While it does lay out the strengths of existing technology and suggests synergies with emerging technologies, it is meant primarily to provide guidance to the State by identifying a proposed set of paths for New Mexico's private and public sector to further develop current S&T capabilities and create new ones that will move New Mexico to the forefront in innovation and Technology-Based Economic Development. In addition to identifying opportunities, the Plan provides recommendations for an enduring and sustainable process that will enable us to:

1. implement the steps required for New Mexico to become preeminent in several, new, important technology sectors;
2. support the development of new, local, technology companies;
3. retain existing companies, patents and IP in the State;
4. recruit non-New Mexican technology firms to the State;
5. grow the State's workforce through the creation of commercially-relevant technology-based curricula at both the intermediate and college level;
6. stimulate investment in rural as well as urban New Mexico.

National Rankings

New Mexico ranks 1st in per-capita PhD scientists and engineers

New Mexico ranks 2nd in R&D intensity.

New Mexico ranks 2nd in Federal laboratory and campus funding

New Mexico ranks 6th in science and engineering graduate students.

New Mexico has over 1,000 high-tech companies and ranks 11th in R&D.

New Mexico high-tech industry accounts for over 45,000 jobs with an annual payroll of over $3.0 billion with average annual salaries of $47,665.

2.b. Goals of the Plan

The overarching goal of this Plan is to coordinate and integrate State investments in technology development with the Federal investments in basic research through technology maturation to commercialization. This will drive strong growth of a technology-based economy in New Mexico resulting in the creation of high-paying, high-tech jobs for New Mexicans across the entire state.

It is the remarkable intellectual assets at our national laboratories, universities, and high-tech businesses that differentiates New Mexico and provides the basis for us to significantly expand in the knowledge economy. Since New Mexico has a small population and a smaller economy than many other states, we must carefully prioritize how we use state funding for innovation. Any investment made must provide significant return to New Mexico in economic and workforce development and address important issues in the State in energy, water, environment, health, and other key areas. This Plan provides the basis for determining priorities in the five cluster areas defined. Those priorities are not meant to be an intrinsic comparison of the relative merits of one cluster area over another. Rather the priorities are determined primarily by market opportunities and by the urgency with which particular issues of importance to New Mexico must be resolved.

The second overall goal is to increase the amount of commercially-relevant research and development and seed capital/venture capital funding to create a strong platform for technology-based economic development to take root and have the financial means to grow and compete. This provides the means to grow our technology-based economy through the recruitment of out-of-state companies, the creation of new in-State ones (from commercialization of patents and IP), and retain current S&T companies (to stop *technology bleed* to other states)

Given the high level of Federal investment in basic R&D in New Mexico and the growing level of venture capital (VC) in the State (including the investments made by the State Investment Council), the greatest need is in the area of technology maturation. This is not unique to New Mexico, but is widely recognized as a problem for R&D businesses to cross the “valley of death” that exists between the point of proof-of-principle for a new technology to the developmental stage at which VC firms would be interested. It is essential that we find a way to help close this critical gap. The processes proposed in this Plan for State investments in technology development are aimed at providing a bridge between early-stage R&D and commercialization.

The third overall goal of this Plan is to recommend ways to effectively support Science, Technology, Engineering, and Mathematics (STEM) initiatives in New Mexico. This is critical if we are going to develop the highly skilled workforce that is required for the TBED this Plan will create. While each of the working groups (described below) was charged with providing recommendations for support of STEM education in their areas, we also created a separate Education/workforce Development Working Group tasked with considering statewide approaches to supporting STEM education and workforce development.

An important aspect of this Plan is developing a model for how investments should be made through a coordinated and sustained investment by the State based on the State's needs and

market pull (with some technology push). The model developed here is transparent and meets all the criteria for success. An important part of the Plan is that it provides accountability, metrics, and return on investment.

As stated in the Executive Summary, the State's S&T Plan is meant to be a *roadmap*, indicating the paths New Mexico should take to reach its destination of increasing long-term sustainable high-wage employment; stimulating new, high-tech company growth and expansion and retention of existing New Mexican companies. Following this roadmap will require a steadfast commitment and belief that the decisions to be taken are sound and timely. Implementing those decisions will require resolve, cooperation, coordination and communication by the stakeholders.

2.c. Development of the Plan

The elements of this Plan were developed by seven working groups that obtained input from a wide variety of sources. Five of those groups are discipline-oriented in areas of S&T strength in New Mexico. Those groups focused on opportunities in Aerospace, Bioscience, Energy/Environment/Water, Information Technology, and Nanotechnology. There were also two cross-disciplinary working groups that dealt with crosscutting issues in economic development and education/workforce development. The input from these working groups was consolidated by a core team that included representatives from the State, economic development groups, universities, and the national laboratories.

This Plan has been prepared following interviews and roundtable conversations with science, technology, academic, business and financial professionals across the state. It has been formulated by integrating input from all of the above-mentioned groups. The Plan's recommendations are based on that input and on a survey of the current S&T capabilities of New Mexican companies and institutions as well as on an assessment of the level and sophistication of technologies now in use in the State. In addition, the plan draws on several existing documents that addressed various aspects of a State S&T Plan, including the recent efforts in BioTeP, HyTeP, and MiniTeP. This Plan provides information on possible individual projects as examples of the opportunities that exist in New Mexico. It does not, however, address funding for individual projects or potential private sector partners. Instead, it provides an assessment of the likely directions technology will take (based on market needs and forces); the likely funding required; and the commercial potential. Most importantly, it provides a process to respond to those opportunities, and the mechanisms that are proposed include a process for review of individual projects and partners.

In the following sections, we will address the opportunities that exist or could be created in New Mexico that could serve as the basis for strong TBED. In each discipline area, we provide an overview, followed by an analysis of opportunities and issues. Recommendations for the path forward are also provided in each area. We will then present the crosscutting issues in economic development and education/workforce development. Finally, we will present a proposed process for realizing those opportunities.

2.d. Science, Engineering, and Technology Strengths

New Mexico is a national leader in Federal support for basic and applied research. This is largely due to the presence of two national laboratories, military research facilities, and research universities located in the State. In addition, over the last several years, New Mexico has worked successfully to significantly increase the amount of venture capital in the State. As a result, we are well positioned to draw on our resources:

New Mexico ranks second in the nation in R&D intensity

New Mexico ranks second in Federal laboratory/campus funding

New Mexico ranks second in Federally performed R&D expenditures per capita

New Mexico has a planned commitment of more than $200 million in state funds to be invested with resident venture capital firms. The total fund capital of New Mexico residents VC firms is over $1.1 billion. Over a dozen VC firms are located here and the number of firms is increasing.

New Mexico has over 1,000 high-tech companies and is ranked eleventh in the nation in R&D.

New Mexico high-tech industry accounts for over 45,000 jobs with an annual payroll of over $3.0 billion with average annual salaries of $47,665.

New Mexico ranks first in PhD scientists and engineers as a percentage of the workforce and sixth in the nation in science and engineering graduate students.

Following the creation of the national laboratories and the location of military research installations in New Mexico after World War II, five core areas of R&D strength have emerged in the State. In the following sections, we describe the resources and opportunities available in each of those five areas and discuss what is necessary to effectively use them to stimulate the growth of sustainable, high-wage industries and businesses as well as satisfy their workforce requirements.

2.e. Competition from other states

After reviewing science plans from several other states, we found that wherever a single entity was formed to fund new commercially-viable technology, coordinate the state's grants and monitor R&D projects, the experience was almost universally positive. Economies of scale were achieved by bringing together seemingly disparate elements of the states' S&T activities under one operating entity.

According to a study done by the Kauffman Foundation and the Information and Technology & Innovation Foundation entitled, "The 2007 State New Economy Index," New Mexico ranks 33rd in overall ranking among all 50 states. The study used 26 indicators divided into five categories: knowledge jobs, globalization, economic dynamism, transformation to a digital economy, and technological innovation capacity. There were only three western states among the top ten ranked states: California (#5), Colorado (#9) and Washington (#4). All the remaining seven of the top ten were eastern seaboard states. The highest-ranked state was Massachusetts, which invests 5% of its state budget in R&D. With its concentration of software

companies, hardware and biotech firms, not to mention its world-class universities, Massachusetts enjoys a significant advantage over the competition.

Other states like Colorado have more in common than just their high-tech firms; they have a high concentration of managers, professionals and college-educated residents working in knowledge jobs. With one or two exceptions, these states' manufacturers tend to be more geared toward global markets both in terms of export orientation and the amount of foreign direct investment. According to the study, "The IT revolution gives companies and individuals more geographical freedom, making it easier for businesses to relocate or start up and grow in less densely populated states farther away from existing agglomerations of industry and commerce."

Venture capital (VC) continues to be one of the critical factors for states' success. Venture-backed firms were an important source of national job growth, adding 600,000 jobs between 2000-2003 (6.5% increase), while overall employment at private firms decreased by 2.3%. The study said that, "The majority of investments continue to take place in a handful of traditionally strong states. In 2005, 79% of investments went to the top ten states, up from 69% in 2000."

The top five states for venture capital as a percentage of worker earnings in 2007 were: Massachusetts, California, Washington, Colorado and Utah, which tracks closely with the level of innovation and technology development that those states have supported. While New Mexico has strong VC growth, the total dollar amount of VC investment is still small. By supporting late-stage commercializable R&D through Technology21, we can give New Mexico a distinct advantage in attracting VC investments.

The bottom line is that those states that have enacted programs similar to Technology21 have reaped the benefits and are now among the highest performing states in the country.

2.f. A critical success factor: Time

Timing is one of the most obvious factors in achieving success, but there are a number of factors that have created a window of opportunity for New Mexico:

- The global economy is investing in high-tech business at unprecedented levels. This is driven in large part by the energy and climate crises.
- Our package of business incentives makes us an attractive investment site for new technology-based companies.
- Our 'critical mass' of R&D at the Federal labs and at our research universities is a very strong draw for businesses to locate here.
- Our Federal labs and universities are focusing more strongly than ever before on technology transfer.
- We have strong Congressional, executive, and legislative leadership.
- We have budget surpluses that can be invested to assure a sound and prosperous future.

3. The Five Innovation Clusters

3.a. Aerospace

Description

The State of New Mexico is at the forefront of a burgeoning but still nascent aerospace industry. State and Federal technology development initiatives are dispersed throughout the State and are under the auspices of many funding agencies.

New Mexico has a strong tradition of performing advanced space research, and one of its main strengths is its diverse character. One of our main weaknesses, however, is the general lack of focus on the interrelation and collaboration of such research. There are numerous related technologies that are tied together (aerodynamics, small satellite development, space situational awareness and control, space electronics, propulsion, etc.). However, no top-level technology roadmap or organization exists that would help coordinate this journey toward to a coherent aerospace business plan. An organization such as a clearinghouse would permit entrepreneurs both inside and outside New Mexico to obtain the necessary data and business intelligence on which to base their business decisions.

The State receives significant federal funding through the Department of Defense (DOD) in Aerospace through the Air Force Research Laboratory, Space and Missiles Center, and the newly established Operationally Responsive Space Office. However, over 60% of the funds entering the state through these organizations leave the State to industries outside of New Mexico. Efforts to attract small, medium and large space industries to establish here by the Phillips Technology Institute have met with limited success. When assessing the issues, the main obstacle is the lack of workforce available to the relocated industry through the local universities as well as the lack of aerospace education programs necessary to continually develop and maintain their workforce.

NEW MEXICO RECEIVES SIGNIFICANT FEDERAL FUNDING THROUGH THE DEPARTMENT OF DEFENSE THROUGH THE AIR FORCE RESEARCH LABORATORY, SPACE AND MISSILES CENTER AND THE NEWLY ESTABLISHED OPERATIONALLY RESPONSIVE SPACE OFFICE...

HOWEVER, OVER 60% OF THESE FUNDS LEAVE THE STATE TO INDUSTRIES OUTSIDE NEW MEXICO!

There are opportunities, however. The 2006 Base Realignment and Closure (BRAC) Commission determined that 210 Air Force Research Laboratory positions at Hanscom Air Force Base will be moved to the Kirtland Air Force Base location. These positions are part of the Space Vehicles Directorate in the Battlespace Environment Division. New, state-of-the-art facilities will be built to accommodate them. Current personnel will be relocated, and highly technical positions will need to be filled. All this must occur by 2011. Currently, the education programs in the State do not specialize in the space sciences and space environment. The function being moved is a critical national capability and is the nation's center of excellence in space weather. Again, a key aspect to the success of the move is having the right education programs in aerospace engineering and space sciences.

Advisory Group Recommendation - Strengthen and develop relevant aerospace and space science education programs.

The State should focus on strengthening and developing much-needed aerospace and space science education and training programs for the three State research universities. By bolstering and supporting these programs, we would be better positioned to attract and sustain aerospace related businesses to the State. It is imperative that companies have a skilled workforce as well as excellent school systems.

The need for a full spectrum Aerospace Engineering Department must be addressed. New Mexico State University has made a great start on an Aerospace Engineering program, but still needs support. A multi-institutional plan for aerospace education should be pursued where strengths from each school can be optimized. This is definitely a role for the State to facilitate and make happen. Without the appropriate education and training of students, professionals and technicians, the State will not be able to convince aerospace businesses to locate in New Mexico or remain here.

Other areas of State expertise include reconfigurable systems that cover a large effort in reconfigurable computing for space applications, such as the Field Programmable Gate Arrays (FPGA) and radiation hardened electronics for space applications. UNM has several experts who cover the areas of computer engineering, control systems, signal processing, optical and microwave systems (all integral components to any telecommunication system including space). Finally, UNM has an internationally-recognized effort in the area of plasma science with applications to space weather and communications.

Advisory Group Recommendation - Establish a public-private clearinghouse to disseminate information.

In addition to emphasizing the need for enhancing space education, the establishment of a public-private partnership should also be pursued. This type of arrangement could serve to unify, influence, and direct the development of the aerospace industry in New Mexico. This partnership could assess the industry's needs in order to grow the aerospace industry and develop a unified plan for business development and education programs for the State. A clearinghouse is also needed for private aerospace companies to participate in - and gain access to - funded research such as federal funds through Small Business Innovation Research (SBIR) program funds. This business model should include a mechanism that would quickly transfer space technology into the private and public sectors to facilitate TBED.

Many programs exist in the Aerospace sector. They are located at: Kirtland Air Force Base, Air Force Research Laboratories, Sandia National Laboratories, University of New Mexico, New Mexico State University, New Mexico Tech, Los Alamos National Laboratories, Holloman AFB, White Sands Missile Range, NASA White Sands Test Facility, Spaceport America, Space Development and Test Wing, Operationally Responsive Space Office, Eclipse Aviation, and other aerospace industry partners. The New Mexico Aerospace Capabilities Assessment lists the extensive aerospace capabilities available within the state from the federal laboratories, industry and universities.

Spaceport America

The New Mexico Spaceport Authority is preparing to build the world's first purpose-built inland, commercial spaceport, Spaceport America, in southern New Mexico beginning in 2009.

The complex will be capable of accommodating the activities of both vertical and horizontal takeoff space launch vehicles. It will serve as the base for pre-flight and post-flight activities with a modern spectators' center. It will be a catalyst for regional economic development opportunities and be a key component in the State's effort to attract space-related business here and create partnerships with third parties to develop support facilities for the Spaceport.

The U.S.-based Virgin Galactic, part of the Virgin Group founded by British entrepreneur Sir Richard Branson will be the Spaceport's anchor tenant. Virgin Galactic will locate its primary launch and operational activities and its worldwide headquarters in New Mexico. The Virgin Galactic connection coupled with our unique location advantages, expert technical support from White Sands Missile Range, and a long local heritage of space-related activity, all help New Mexico positioned itself as a pioneering leader of the new commercial space industry.

Spaceport America aims to become a world-class tourism destination. It has been designed as a sustainable development that will serve as an international model of environmentally sensitive

site design and construction. The Spaceport is intended as a catalyst for dramatic economic development and one of the primary objectives of the project is to attract space-related and other high-tech industry to the state, with the goal of creating R&D "clusters" in space commercialization, pharmaceuticals, and renewable energy sectors. Several private companies involved in space vehicle design, fabrication, testing and R&D have already signaled their intent to move or expand operations to New Mexico upon completion of the Spaceport, and dozens more, including governmental entities such as NASA and Kirtland AFB ORS, have expressed strong interest in doing the same.

Even in its infancy, the global commercial space transportation business is currently valued by the FAA at over $139 billion, and by welcoming the next phase of this emerging industry to the State of New Mexico, the region around Spaceport America has the potential to become this century's next world-class high tech cluster. According to an NMSU study, Spaceport America is estimated to generate more than 2,250 jobs and over $1.0 billion in related economic activity for New Mexico in the first five years of operation.

The economic impact from tourism associated with Spaceport America and related regional attractions will additionally facilitate the development of leisure and hospitality jobs and supporting infrastructure. Also worth noting is that even before becoming operational, Spaceport America will provide nearly $200 million dollars of investment in New Mexico and more than 500 construction jobs simply through the build out alone.

Spaceport America will be a diversified business with distinct lines of activity that act synergistically together and rely on the entire New Mexico aerospace industry to accomplish successfully.

Advisory Group Recommendation - Spaceport America should be a unifying link in a broad-based state aerospace industry strategy encompassing all state aerospace assets dedicated to driving economic activity in New Mexico.

Aerospace Industry Association statistics indicate that 60% of the aerospace industry workforce is 45 years old or older, highlighting the impending aerospace labor crisis as the scientists and engineers drawn to the profession during the 'Space competition and 'Cold War' retire. Education and workforce development are essential to Spaceport America's two-fold plan of inspiring the next generation of Americans to pursue studies in science, technology, engineering, and math (STEM), and of helping to create domestic high-tech, high wage career opportunities for New Mexican youth. In order to help supply the incoming businesses with a skilled, ready workforce, NMSA intends to partner with the foremost educational institutions in the state, including all three major research universities, UNM, NMSU, and NMT, on methods to bolster fledgling aerospace departments and to increase enrollment in STEM disciplines.

Advisory Group Recommendation - Strengthen and develop relevant aerospace and space science education programs.

(See Aerospace appendix for more detailed information.)

3.b. Bioscience and Health

Description

The bioscience and health cluster is perhaps the broadest and most inclusive of all the clusters discussed in this Plan in that it covers health sciences, genomics, and touches the energy and environmental sectors as well. Its relationship to nanotechnology is also expected to be significant in the years to come as each technology crosses the other's R&D boundaries. New Mexico's bioscience sector is characterized by a great diversity of capabilities and is poised to make significant contributions in a wide range of areas with the potential to dramatically impact bioeconomy industries. Some of those industries are: bioenergy, agriculture, animal health, personal healthcare (new drug discovery, neuroscience, cancer self-immunization technologies), biothreat reduction, and the development of new biologically inspired and assembled technical materials of unprecedented strength per unit mass.

BIOSCIENCE EMPLOYS 1.2 MILLION PEOPLE IN THE USA. IT HAS AN ANNUAL GROWTH RATE OF 2.9% IN RESEARCH, TESTING AND MEDICAL LABORATORIES, PROJECTED OUT TO 2014.

IN NEW MEXICO, BIOSCIENCE-RELATED JOBS PAY AN AVERAGE OF $51,700 COMPARED TO $30,000 IN THE REST OF THE PRIVATE SECTOR.

The sector has been growing due to major investments within the State's universities, research centers, and national laboratories. This growth and strength within New Mexico, will require focused investments for future acceleration and growth in our bioeconomy.

It has been shown that well placed strategic investments in research and development initiatives, e.g., university centers, leaders in key areas, and state-of-the-art infrastructure can evolve into new jobs and gains with five to ten times multipliers. The State of New Mexico has the opportunity to affect the outcome of bioscience and biotechnology research and development and therefore, the overall standing of the State in commercial investment and federal grants.

What follows are some opportunities for key investments for the State in: 1) Economic Development; 2) Energy, Environment and Water; and 3) Health initiatives. The portfolio represents a broad set of objectives with investment requirements in key infrastructure and personnel in the State's universities and major research centers. These investments should translate into further industrial collaborations and investments in the State, new business startups based on New Mexican-owned IP, improved health capabilities and establishment of the State in the bioenergy corridor.

On a national level, the bioscience sector remains strong. It currently employs 1.2 million people in the U.S. It has an annual growth rate of 2.9% in research, testing, and medical laboratories projected through 2014. Similarly, the drug and pharmaceutical industry projects an annual growth rate of 2.6% through 2014. In New Mexico, bioscience-related jobs are high-paying with an average salary of $51,700 compared to $30,000 in the rest of the private sector. Furthermore, the number of jobs grew 25% from 4,700 to 5,900 from 2001 to 2004.

There are national programs that address our energy health and that offer specific approaches to mitigating our energy dependence on liquid fuels. Our physical health is also impacted by pandemic diseases, and there is already considerable work being done on both a national and international level with significant federal funding. More is needed, however. The bioscience industry is considered a generally clean industry that fits well within the environment of New Mexico. It is also able to provide alternative approaches to ground water utilization through the use of nontraditional water supplies. This is a very important issue as we project a decrease in the Oglalla aquifer of 25% by 2030.

We have a number of large institutions offering strong programs and resources within this sector, including: research universities like UNM, NMSU, and NM Tech; two, state-of-the-art research institutions, NCGR and the MIND Institute; and our national laboratories, Sandia and Los Alamos. These institutions have created a wealth of research capability that is nationally and internationally recognized. Research involving genomics is driving efficient biofuel production and detection and therapeutic interventions for agriculture and public health applications. These institutions also conduct research in pandemic disease detection, modeling and mitigation; energy and water applications; and neural imaging and the understanding of brain functions.

Finally, the New Mexico Bioscience and Biotechnology Association (now NMBIO) has more than 100 participating companies, providing a strong base for connecting to the biomedical industry for commercialization of technologies developed within NM.

Advisory Group Recommendations -

Our recommendations for future investments in the bioscience and health sectors would follow our plans for growth in economic development, energy diversity, environmental (and water) protection; and public health.

1. In the areas of Energy, Environment, and Water, we fully support the alternative energy project to develop biofuels from microalgae through the construction and operation of pilot scale commercial demonstration algal biofuel process. The use of microalgae as a biofuel feedstock has the potential to make biofuels a viable replacement for significant quantities of fossil fuels, thereby supporting state initiatives and state laws, reducing American dependence on foreign oil, and reducing net global CO_2 emissions. It could also provide the State with a significant return on investment.

2. We recommend supporting the New Mexico Bioeconomy Infrastructure Initiative (NM-BII), to be led by the New Mexico Consortium and its Institute for Advanced Studies in close collaboration with the Biosciences Division of Los Alamos National Laboratory. We expect it to catalyze rapid economic development by leveraging existing innovation in the State by establishing a technical infrastructure focused exclusively on the needs of bioeconomy industries. This initiative would start by developing an economic agro-business "template" for rational alternative fuel infrastructure investment and the viability of investments in other biotechnology infrastructure.

3. We advocate for the creation of a New Mexico Center for Biotechnology Enterprises to assist with commercializing the new biotechnologies being created in the UNM Clinical and Translational Science Center and other components of the UNM Health Science

Center. This center will provide a significant initiative in improvement of healthcare technologies and development of new biotechnology commercial efforts within New Mexico.

4. In Public Health, we recommend the completion of construction and build-out of facilities for the New Mexico Center for Isotopes in Medicine (NMCIM – a consortium of UNM HSC, LANL, Lovelace Respiratory Center, and several companies) to position the State as a prime competitor for attracting the $1.0 billion plus radiopharmaceutical industry in the U.S. In partnership with private industry and the UNM Cancer Research and Treatment Center, the NMCIM would build-out a short-lived positron production facility (cyclotron), a state-of-the-art radiopharmacy, and a novel imaging and therapy suite that would directly benefit the health of New Mexicans and create jobs.

Other areas worth supporting are:

Genome New Mexico, which aims to enroll 20,000 New Mexicans in a bio-repository to carry out genome sequencing studies to identify causal variants associated with the top one hundred diseases and traits in New Mexico populations. Diagnostics and therapeutics would be developed with the goal of creating one or more personalized medicine companies in New Mexico. This project will provide solutions to the major healthcare problems of New Mexico's citizens, creating a vibrant biotechnology industry in the State, and substantially enriching the research ranking of our research universities.

The New Mexico Center for Research on Emerging Infectious Diseases to integrate and supplement the existing research strengths at the major research institutions in the State through investigation of environmental drivers of disease emergence; monitoring the evolution of designated populations of pre-pathogens; identifying and monitoring routes of pathogen introduction; and using data from the field studies to develop novel control strategies such as vaccines, antivirals, antifungals and antibiotics. The center would positively affect New Mexicans through improved health, increased security of the agricultural and recreation industries, increased federal funding of research, and enhanced technology transfer.
Finally, we would support further development of capabilities at the Mind Research Network (MRN), improving the diagnosis of mental illnesses, brain disorders, and brain injuries. This would require funding the recruitment of leaders in neurodiagnostic and neuroimaging fields who would help build upon MRN's core competencies of research and training, ultimately making New Mexico one of the largest neuroscience research hubs in the world as well as a leader in neurodiagnostic research.

The development of the collaborative virtual environment called Flatland under the program called Project Touch (Telehealth Outreach for Unified Community Health), which is developing visualization and virtual environment tools employing scenarios as virtual models to make learning of critical concepts relevant and translatable to real-life application. These simulation systems will allow medical personnel and teams to train within a virtual environment.

(See Bioscience appendix for more detailed information.)

3.c. Energy/Environment/Water

Introduction

Energy, Environment, and Water are inextricably tied together in this Plan and in our world. This is clearly demonstrated when you look at the production of fossil fuels, where more water is extracted from the ground than fuel and where the impact on our environment is significant. Renewable fuels also impact our flora and fauna as they often require enormous amounts of water. Our use of water affects our health as more than 90% of diseases are waterborne. It also affects our economic growth as business often competes with new residential users as communities expand. Finally, no environmental, energy, or water plan can survive the 21st century without conservation.

Addressing Rising Energy Costs

In the past, we have been able to compete because of our low labor costs, low cost of living, Federal government revenue, and a vast storehouse of energy reserves, among other factors.
Our future will be different. All costs will rise, especially those associated with energy and transportation. Growing our technology will become more expensive with each passing year. As we see this year, our budget surpluses from fossil fuels are not sustainable. We will switch from being an oil-exporting state to becoming an oil-importing state in 2015. The demands from our society for more energy, improved infrastructure, more evenly distributed healthcare and better social services will be impossible to meet unless we act now to grow our economy.

To address rising costs, we must develop economically competitive sources of renewable clean energy. Technologies emerging from our labs and universities have the potential to revolutionize the energy sector. Growing algae in the desert using our untapped sources of saline water could make New Mexico a major provider of transportation fuels for the country. Our immense solar resources, coupled with new technologies being developed in New Mexico could position us to be the most important state for solar energy. The New Mexico Green Grid Initiative can make New Mexico a national leader in implementing a Smart Grid with renewable energy. While we have the natural resources and scientific resources necessary to make this happen, we also need to provide the means to transition these possibilities into reality. Technology21 will do just that.

ON ENERGY: IF NO VIABLE ALTERNATIVES TO TRADITIONAL ENERGY PRODUCTION ARE FOUND, BY THE YEAR 2015, NEW MEXICO WILL CEASE BEING A NET EXPORTER OF ENERGY, BUT INSTEAD BE TRANSFORMED INTO A NET IMPORTER OF ENERGY.

ON WATER: OUR USE OF WATER AFFECTS OUR HEALTH AS MORE THAN 90% OF DISEASES ARE WATERBORNE.

ON THE ENVIRONMENT: WE ARE WORKING FOR A CLEAN ENERGY FUTURE IN WHICH GREENHOUSE GAS EMISSIONS ARE HALVED BY 2025.

New Mexico's Energy Present

New Mexico enjoys significant fossil fuel resources (coal, gas, and oil) along with strong potential for renewable energy including some of the highest quality wind and solar resources in the country. Additional renewable energy resources include geothermal and biomass along with the potential for hydrogen fuel cells and the hydrogen economy, and, to a lesser degree, hydro. In addition, New Mexico has large reserves of uranium ore. While there are no nuclear power plants in New Mexico, the Public Service Company of New Mexico (PNM) owns a share of the Palo Verde nuclear power plant in Arizona. In addition, a uranium enrichment plant is under construction in southeastern New Mexico.

New Mexico's Energy Future - Clean Energy and a Clean Environment

Governor Richardson is committed to building a clean energy future for our State. Our Congressional delegates are also leaders in promoting renewable alternative energy here, and in the entire USA. Home to two Department of Energy (DOE) national laboratories, several universities and additional public and private research facilities, New Mexico has substantial intellectual and research capabilities. We are engaged in developing innovative technologies in clean coal, biomass, solar, and carbon sequestration. We have the physical, political, intellectual, and financial resources to move New Mexico into a national leadership position in clean energy.

New Mexico can achieve a clean energy future by following the recommendations of New Mexico Climate Change Advisory Group (CCAG) on reductions in total Green House Gas (GHG) emissions. In defining what a clean energy future should be,
we adopt the CCAG definition of a clean energy future for New Mexico as one in which total GHG emissions are reduced from the year 2000 levels by 10% in 2020 and 75% in 2050.

A principle tenet in achieving these goals must be energy efficiency and conservation. Thus,
we recommend an aggressive statewide goal of 40% reduction in non-transportation energy use per capita from 2005 levels by 2025.

By maintaining strong environmental stewardship we can move to an integrated system of recycling and use of organic waste materials for energy production. Thus,
we recommend development of a recycling program in New Mexico with a goal of recycling 40% of all non-organic materials and producing energy from 40% of waste materials by 2030.

Clean Energy Production

In order for us to achieve a clean, sustainable energy future for New Mexico we must develop new sources of clean and renewable energy. New Mexico is, in fact, already energy independent in electrical power, as we produce more electricity than we consume. The new challenge for New Mexico is to transition to clean and renewable forms of energy.

Our first recommendation for clean energy production in New Mexico is to produce as much electricity by 2025 from clean and/or renewable sources as we presently use from fossil fuels.

Our second recommendation for clean energy in New Mexico is to develop and implement cost-effective storage of wind and solar energy with a capacity factor of 80% by 2030.

Our third recommendation for clean energy production in New Mexico is to develop and install economically viable carbon capture and sequestration technologies for 60% of the GHG emissions from our existing and new coal and natural gas-fired power plants by 2050.

Advisory Group Recommendation - Establish and fund the TICenter with a primary focus on achieving a clean energy future for New Mexico.

Transition from Fossil Fuels to Biofuels

New Mexico is a significant producer of transportation fuels, and as with electrical power, we are a net exporter of these fuels. Natural gas production in New Mexico is relatively flat and will become increasingly important to New Mexico's energy future during the transition to renewable fuels. This is particularly true since natural gas is a much cleaner fuel than coal, gasoline, or diesel. However, our oil production in the State is declining while total usage is increasing. Based on current trends, we estimate that New Mexico total usage will equal production in 2015. Thus, our challenge is to quickly transition to clean and renewable forms of fuels.

Our first recommendation for transportation fuels is to reduce our per capita usage of gasoline and diesel by at least 10% from 2005 levels by 2012 and 20% from present levels by 2020.

Our second recommendation for transportation fuels is to switch from petrodiesel to 100% use of biodiesel in New Mexico by 2030.

Achieving the goals laid out above requires the development of new technologies in energy production. On the Federal side, there is support for hydrogen fuel cell development. In 2007 the State created an Energy Innovation Fund designed to drive late-stage, precommercialization energy R&D into the commercial sector. This effort has been focused largely on algal biofuels, concentrating solar power, and conversion of dairy waste into electricity and could be expanded to include other areas such as hydrogen fuel cells, photovoltaic cells, and geothermal. This program has been highly successful - a state investment of $4M to date has resulted in venture capital investments of almost $50M. To drive the transition to a clean energy economy, we would recommend that the Energy Innovation Fund be significantly strengthened over the next five years to support the growth of new renewable alternative energy technology in the State and to strengthen the link between clean energy production and conservation.

Advisory Group Recommendation - Increase support for the Energy Innovation Fund with particular emphasis on supporting algal biofuel efforts in New Mexico.

The New Energy Economy in New Mexico

New Mexico possesses extraordinary potential for wind and solar power generation along with lesser potential for geothermal and biomass energy. If sufficient capital investments were made, New Mexico could export large amounts of renewable energy by 2025 (primarily in the form of electricity from wind and solar energy) to the primary markets of Arizona and California.

We recommend as a goal for a clean energy economy in 2025: Provide 1000 MW of renewable energy electrical power for export to other states by 2020 and 3500 MW of renewable energy electrical power for export to other states by 2040. By developing 3500 MW of exportable

renewable energy by 2040, New Mexico would be able to meet a significant part of the projected demands for import of renewable energy from other states in the West.

Green Grid

The New Mexico Green Grid Initiative is the first effort in the United States to take a full systems-integration approach to implementing the next-generation smart grid with renewable energy sources in moving towards energy independence for the Nation. While many efforts are underway to develop smart appliances and control systems, energy storage, renewable energy production, transmission and distribution, none of these efforts joins all aspects of what is required to implement a full, large-scale Green Grid system.

Technology development is crucial to the Green Grid Initiative as it provides the basis for clean energy export and clean and green manufacturing and enables the build out a full-scale Green Grid in New Mexico. This would provide an opportunity to grow New Mexico businesses and attract new businesses to the State to manufacture the equipment required for the Green Grid. This would result in the creation of high-paying, high-tech jobs for equipment manufacture and also for its installation and on-going operation. As we install additional electricity generation from solar, wind, and possibly geothermal and biomass, we would optimally position New Mexico to grow our economy by exporting clean energy to markets in the Southwest and West.

The ultimate goal of the New Mexico Green Grid Initiative is to transition New Mexico from a fossil fuel based economy to a clean energy economy with a focus on renewable energy. The impact of the New Mexico Green Grid Initiative will be national, by providing a flexible, scalable architecture that can be used in all 50 states. In this way, New Mexico will be a transformation leader in to a green economy and the prosperous future that brings.

Advisory Group Recommendation - Implement the New Mexico Green Grid Initiative as a primary initial focus of the TICenter.

New Mexico's Water Future

Water is a critical issue for the future of New Mexico. While we are primarily an agricultural state, demand for water is increasing as our urban areas are growing at about 1.6% per year. The drought of recent years, together with the long-term predictions of climate change, highlight the likelihood that the Southwest has enjoyed unusually high levels of precipitation during the last several decades. As a result, our interstate water compacts are based on what may be *higher-than-average* levels, and we are likely facing a serious and enduring water shortage in the near future as a result of these factors, our projected growth, and the impact of global climate change.

In addition to our water supplies, we also face quality issues with our water. Contamination of both surface and ground waters is an issue all across the State. This contamination ranges from high levels of total dissolved solids (TDS) that impact marine life (in particular endangered species) to high levels of arsenic in ground waters, to biological contamination due to organic wastes and effluents.

Research on water issues, including data collection, analysis, and modeling and simulation of water issues using the State supercomputer Encanto are vital components of addressing New

Mexico's water future. Development of new technologies to address those issues is of equal importance, if not even greater, importance.

Promoting conservation and the efficient use of water

At present, even during periods of average water supply, demand in many parts of the State would exceed supply if all water rights and permits were fully exercised. As New Mexico's population grows and demands for water increase, more conservation and efficient use of water will be necessary to meet the State's present and future needs for water. Thus, New Mexico's water conservation programs must be strengthened and adequately funded.

Water Quality

About 90% of New Mexico's population depends on ground water for drinking, and it is the only source of potable water in many areas of the state. Therefore, protection of ground water is important for public health and welfare. The quality of ground water in New Mexico varies widely. Mountain aquifers, recharged by recent rain and snow melt, often yield high quality water. A tremendous amount of fresh water resides in the basin-fill aquifers along the Rio Grande, stretching from Colorado to Texas. Ground water in New Mexico, however, often contains naturally occurring minerals that dissolve from the soil and rock that it has flowed through. Some ground water in the southern part of the state is too salty to be used for drinking. High levels of natural uranium, fluoride, and arsenic occur in various areas around the state. Because all water eventually moves through the entire water cycle, pollutants in the air, on land, or in surface water can reach any other part of the cycle, including ground water. The shallow sand-and-gravel aquifers of the river valleys are most vulnerable to contamination. Septic tanks are currently a major source of contamination in these aquifers.

Implementation Strategies

Advanced technical and scientific approaches to water resource management, supply assessment, measurement, alternative water supplies, enhanced water production and salvage, and water quality and treatment will be necessary to meet the present and future needs of the State. The resources of public and governmental research bodies can be harnessed to assist the State in meeting the present and future needs of New Mexico.

Advisory Group Recommendation - Support the Water Innovation Fund

The Water Innovation Fund is being established to drive innovation of clean water technologies in New Mexico. We expect that the State will benefit through the increased production of usable water here, including: efficient use of produced water; cost-effective desalination; increased precipitation through weather modification; improved techniques for cleaning up water; improved water conservation technologies; reduction of evaporative losses of water; providing technologies to deal with community water issues and meeting the water needs of the state in a manner that retains our agricultural use of water while also allowing urban development.

(See Energy, Environment, and Water appendix for more detailed information.)

3.d. Information Technology

Description

Scientific supercomputing is rapidly becoming an essential element of innovation and competitiveness. Computer-based methods and the solutions they bring now play a central role in all areas of economic development, education, and research. In fact, the states that choose to move their science and technology forward rely heavily on computational analysis, modeling, and simulation to stay competitive. Supercomputing is also essential to New Mexico's success in the education field. To grow our students' science skills, we must offer them 21st century tools that will enable them to pursue their career ambitions in a highly information-intense world.

By setting up the New Mexico Computing Applications Center (NMCAC or the 'Center'), we have catapulted the State into the top rankings of states with supercomputing capabilities. (In fact, New Mexico now has the fastest non-Federal computer in the world.) The Center will provide a nationwide fabric of scientists and institutions - including leading-edge industrial partners - that will work together (in New Mexico) on issues important to our State and the Nation.

The vision of the Center is to create high-paying jobs and new job opportunities while training and equipping New Mexico's youth to be more competitive for those jobs. This is the only supercomputing center in the country (or the world) whose focus is primarily on driving economic and workforce development.

The Center will be a magnet for business growth. It will elevate our business profile both nationally and internationally. By setting up remote 'gateways' throughout the State, the NMCAC will extend computing capabilities along with 3-D stereo visualization and high-definition video conferencing collaboration across New Mexico. These gateways, which will be set up at universities and colleges (ultimately 40), will enable long distance learning, telehealth, and economic development.

In education, it will connect classrooms and create economies of scale by combining classrooms electronically, thereby allowing small numbers of students around the State to join together and take courses that might not have been possible had the supercomputer not connected the virtual classrooms. Finally, it will also support our educational initiatives while attracting more students into science and technology, thus positioning New Mexico at the forefront of the Knowledge Economy.

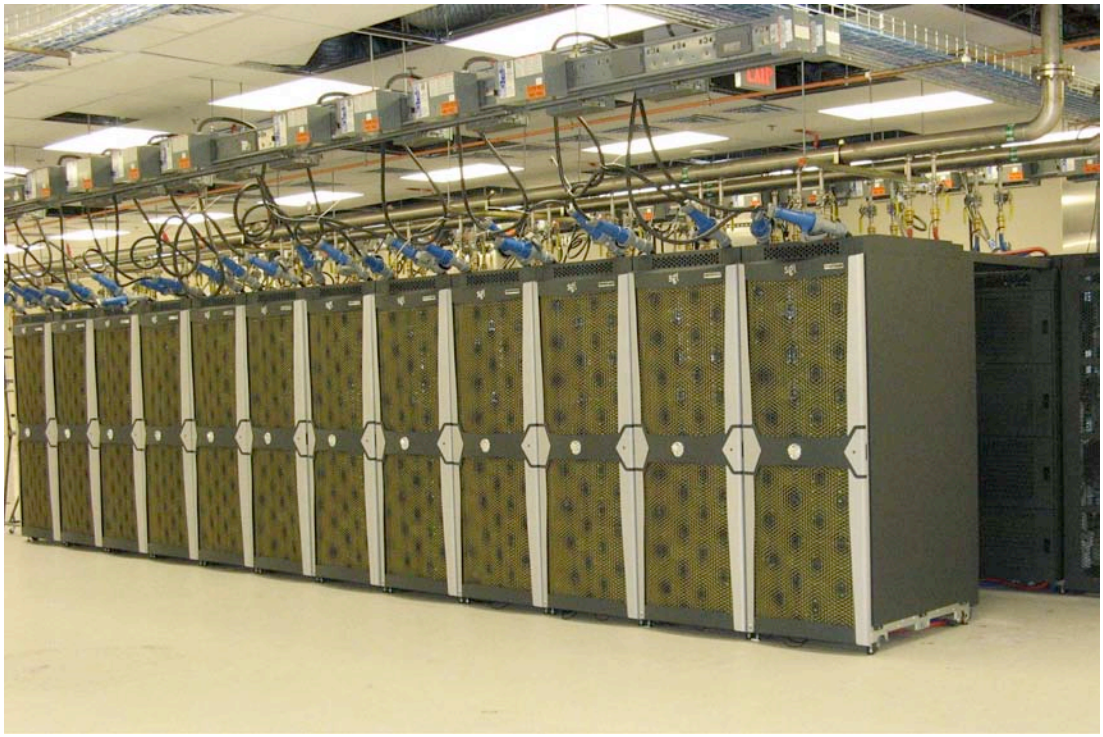
ESTABLISHMENT OF THE NEW MEXICO COMPUTING APPLICATIONS CENTER PROVIDES A PARTNERSHIP BETWEEN SCIENTISTS, INSTITUTIONS, AND INDUSTRY IN THE STATE.

IT WILL CREATE HIGH PAYING JOBS AND NEW JOB OPPORTUNITIES WHILE TRAINING AND EQUIPPING NEW MEXICO'S YOUTH TO BE MORE COMPETITIVE FOR THOSE JOBS.

THE CENTER WILL HAVE A POSITIVE IMPACT ON RURAL NEW MEXICO BY EXTENDING CAPABILITIES THAT WILL IMPACT EDUCATION, HEALTHCARE, AND ECONOMIC DEVELOPMENT.

The establishment of the New Mexico Computing Applications Center provides an engine of growth to drive science and high-tech industry in New Mexico. Our state is ideally suited for such a facility due to the existing world-class expertise in scientific computing that exists at our universities, national laboratories and industry. With an initial State investment of $14M, a 172 Teraflop Altix ICE supercomputer was procured from SGI and Intel in November 2007, at which time it was the third fastest computer in the world. The investment requested from the State over 6 years will provide the basis for self-sustaining operation of the Center, thus moving New Mexico to a position of national importance in commercial applications of supercomputing.

Advisory Group Recommendation - Complete the 6-year funding request to bring the NMCAC up to its full capabilities.



Encanto, the NMCAC Supercomputer

Areas of Economic Growth

A complete market analysis was carried out in conjunction with the University of New Mexico's Anderson School of Business to identify those areas of strength in which New Mexico could compete favorably in high performance computing on a national and international scale. To be considered a target area, it must meet the criteria of having potential paying customers, complex problems requiring supercomputing and a current or developing New Mexico capability.

The three primary focus areas will be on the energy; health, medical, and bio med/tech; and the digital and film media industry. These were chosen for their robust market dynamics and for the resident professional expertise in the state. Secondary markets for the NMCAC reflects needs and strengths in the State of New Mexico. The energy and environment market sector and in

particular alternative energy, oil and gas, water, and electricity transmission hold promise for a high performance computing resource. Other potential markets include nanomaterials, remote sensing networks, and the financial investment sector. In the following sections, we provide some representative examples of high performance computing applications within three of the primary focus areas of the NMCAC: renewable energy, digital media, and genomics.

Renewable Energy

Algal Biofuels

Efforts are underway in New Mexico to determine the economic viability of bio-diesel produced from algae as a major new fuel source for the country. Algae is of interest as it has up to 100 times higher oil yield per acre than any other crop. New Mexico has the assets for growing algae on a large scale: large amounts of unused, flat land; high degree of sunshine; and large, deep saline aquifers. Making bio-diesel from algae competitive with petrodiesel will require genetic engineering of the algae strains. The most efficient way to engineer the algae is through computer modeling of changes to the genetic structures responsible for stimulating algae growth and the amount of oil contained in algal cells. If successful, this could lead to a new multi-$B clean energy industry in New Mexico.

Green Grid

The goal of the Green Grid initiative is to develop and successfully demonstrate the next generation of commercially scalable electric grid using renewable energy sources such as solar and wind. Modeling and simulation will be central to designing, optimizing and ultimately operating the Green Grid. The State of New Mexico is uniquely poised to tap the expertise of national laboratories and state universities as well as the resources such as the New Mexico Computing Applications Center (NMCAC) to lead these efforts. High performance computing will address critical issues in the areas of modeling renewable energy storage and production, determining optimal routing of transmission lines, simulating electrical use by the consumer, and optimizing innovative control and communication systems.

Digital Media

New Mexico has made an important commitment to expanding the digital media industry. What started as incentives for the film industry has expanded to include an acknowledgment that film is a small part of a much larger and growing media industry. It is also an industry that matches the State's strengths in arts and technology. Many of the opportunities (and a strategy for seizing them) are incorporated in the Governor's Media Industry Strategic Plan (MISP).

The State has attracted several major companies to locate here, and each of them supports digital efforts in post-production and animation. In addition, many smaller companies in the interactive game, simulation, and animation are either here or in the process of moving here. One characteristic of the digital media industry is the need for high performance computing. New Mexico has a long history of involvement with simulation, primarily through Sandia, Los Alamos, and White Sands Missile Range. The field is undergoing revolutionary changes due to the advances in commodity graphics hardware. Simulations that formerly required expensive specialized workstations now use commodity graphics cards whose designs are based on the

demands of interactive game users. Consequently, the simulation and game industries have merged, and we see the National Labs being heavily involved in game development.

Advisory Group Finding: Education must be part of any IT planning for digital media.

Unlike the film industry where programs such as the Film Crew Training Program (supported by the State at community colleges like CNM, SFCC) can train people from scratch, the media industry needs a highly educated pool to draw from. Most will be college graduates. Educational programs that will produce the necessary workforce will have to start with K-12.

Healthcare

Within the next ten years, the medical profession will see a revolution with the advent of personalized medicine. This will be based on the ability to carry out sequencing of the genome of individual patients. At present, the cost to sequence an individual is a few tens of $K and takes a few weeks, but within a few years that is expected to come down to under $1K and to be done in a few hours. When that is possible, doctors will be able to determine a patient's genetic susceptibility to a whole range of diseases as well as the response of the patient to different drugs. This will allow doctors to be proactive in early detection of cancer and other diseases, as well as the ability to tailor prescriptions to the body chemistry of each patient.

One of the greatest challenges in developing personalized medicine is the ability to analyze the extremely large data sets that result from sequencing the DNA of patients. Each person contains about 30,000 genes with about 3 billion base pairs of amino acids. Variations in the type and location of the amino acids in the DNA determines what a person looks like, their genetic disposition to disease, and their response to drugs. High performance computing is essential in analyzing and decoding the information in the genes. The intellectual property associated with knowledge of which genes are expressed in cancer, learning disabilities, and other health problems that can be genetically based will be a significant economic driver in health care. New Mexico is well positioned with work at the national laboratories, the National Center for Genomics Research in Santa Fe, and the NMCAC to develop the intellectual property for personalized medicine.

Homeland Security

The area of homeland security is one of intrinsic interest in New Mexico, given that this is one of the primary missions of our national defense laboratories. It is also a promising area for economic growth in New Mexico. While some aspects of homeland security fall under bioscience (biothreats) and other areas, much of homeland security issues are connected with information technology:

- Detection of chemical, biological, radiological, nuclear, and explosive threats
- Detection of networks (physical, social, …)
- Remote sensing of infrastructures (buried structures, …)
- Secure Border Initiative
- Protection of networks (cyber, electric grid, …)
- Protection of infrastructures (perimeter security, cyber systems, …)

The Information Technology aspects of homeland security issues fall generally into two categories:

- Development and testing of electronic sensors
- Computer modeling and simulation

In the first category, significant work is being carried out at Los Alamos and Sandia National Laboratories, Air Force Research Laboratory at Kirtland Air Base, White Sands Missile Range, New Mexico Tech, New Mexico State University, and a number of R&D businesses in New Mexico.

In the second category, significant work is being carried out at Los Alamos and Sandia National Laboratories, and New Mexico Tech.

New Mexico is in a relatively unique position to benefit from homeland security initiatives. New Mexico is one of only four states that share a border with Mexico, we have two national security laboratories, two R&D military installations, Fort Bliss (a test center for Future Combat Systems), and a number of military R&D businesses. As a result, we are in a prime position to translate late-stage military R&D into the commercial sector.

A large variety of data from satellites, networks of sensors, highly specialized detectors, the internet, human intelligence, and other sources result in massive, heterogeneous data sets that need to be analyzed to determine both natural and engineered threats. New Mexico is optimally positioned to develop the capabilities required for this type of analysis with the presence of the national laboratories, military R&D bases, the NMCAC, and R&D businesses in New Mexico.

(See Information Technology appendix for more detailed information.)

3.e. Nanotechnology

Description

Many economists, strategists and policy makers predict that nanotechnology and other small technologies will be the basis for the next economic revolution. These technologies present current and potential commercial solutions for numerous industries — so much so, it is difficult to find even one industrial segment that nanotechnology will not soon impact.

New Mexico could be a world leader, modeling how to leverage nanotechnology and small tech-led economic development. Our State has already undergone a formative period in which we built our infrastructure and developed our investment capacity. We now have world-class scientific and engineering knowledge and research centers. Yet despite many strong efforts, other states and international regions are recognized leaders in the field of nanotechnology. The next step is for New Mexico to leverage its strength to create opportunities in nanotechnology while keeping in mind the weaknesses in our State and the threats of competition from others.

New Mexico is uniquely positioned to take a leading role in nanotechnology and indeed in all small technologies. We are recognized for our world-class scientific and engineering knowledge and as a leading research center, including the Microsystems and Engineering Sciences Application complex at Sandia National Laboratories and the Center for Integrated Nanotechnologies at Sandia and Los Alamos National Laboratories. Largely because of these capabilities, New Mexico is ranked third nationally in R&D intensity in nanotechnology. While these and our nanotech efforts at our universities and businesses are strengths, our weakness is due to the overall loose coordination and disparate missions of the R&D organizations in New Mexico.

New Mexico is in a period where the infrastructural and investment capacity development has been building itself out. This growth has gradually filled in gaps, but not in a coordinated manner. The New Mexico Science & Technology Planning Task Force's Nanotechnology Group is proposing the following solutions, institutions, and programs. Combined with our existing organizations, these efforts will put us in a strong position to effectively leverage our potential:

NEW MEXICO IS UNIQUELY POSITIONED TO PLAY A LEADING ROLE IN NANOTECHNOLOGY AND INDEED IN ALL SMALL TECHNOLOGIES.

WE ARE RECOGNIZED FOR OUR WORLD-CLASS SCIENTIFIC AND ENGINEERING KNOWLEDGE AND AS A LEADING RESEARCH CENTER.

THE NEXT STEP IS FOR NEW MEXICO TO LEVERAGE ITS STRENGTH TO CREATE OPPORTUNITIES IN NANOTECHNOLOGY WHILE KEEPING IN MIND THE WEAKNESSES IN OUR STATE AND THE THREATS OF COMPETITION FROM OTHERS.

Advisory Group Recommendation - Establish a State-Level Innovation Center, Infrastructure, and Funding

CINT core facility at Sandia National Laboratories

It's vital that the State establish a New Mexico State Technology Innovation Center that oversees our science & technology investments, multi-technology strategy, high technology workforce development and overall science-based economic development coordination. This Center should have oversight over New Mexico State Technology Development programs for businesses and grand challenges; the coordination, collaboration on science and technology marketing and communication - within and without - the State and serve as the agent for the bundling of intellectual property from among the State's Research universities.

Advisory Group Recommendation - Establish a State-supported Small Tech Institute

A Small Tech Institute, linked to a New Mexico nano initiative would work with and through the Technology Innovation Center (as mentioned above). Such an institute would carry out New Mexico specific activities assisting New Mexican Small Tech public awareness, marketing, investment, partnering, commercialization, and workforce development stakeholders to improve statewide communication, collaboration, and networking. It would serve as a place for networking and product development, matchmaking with New Mexican biotechnology, energy, water and environment, and computing technology communities. Additionally, it would connect New Mexico's micro-nano interests with the larger worldwide networks of Small Tech researchers and commercial enterprises to accelerate matchmaking, partnering and investment. It would also initiate and maintain a public awareness and education campaign to inform and build excitement among New Mexico's citizenry about the importance of the Small Technology Revolution. Finally, it would market to and assist in recruiting a workforce from among the public and the State's education institutions and be an agent to help commercialize small technologies from research universities. In order to fulfill this mandate it would require a State-funded endowment for Small Tech economic development.

Given the above considerations, we propose that an initiative be launched in the area of nanoscience and nanotechnology transfer to accelerate the development of reliable, cost effective efficient and renewable energy. The State of New Mexico would establish an initiative for Nanotechnology for Efficient and Renewable Energy (NEARE) that will leverage the large

federal investment in S&T made at New Mexico's federal laboratories Sandia, Los Alamos, and the AFRL, and the state's investment in S&T at its institutions of higher education. The focus of the initiative would be on nanomaterials to achieve greater efficiencies and performance. The development and insertion of cutting edge science and technology would enable a constellation of efficient solutions to the nations energy problems, that will also capture the attention of industry in photovoltaics, solid state lighting, refrigeration and insulation, electricity transmission, and electrical energy storage. The initiative will result in thousands of new jobs for the state.

Some specific projects of the Small Tech Institute could include:

1) The creation of a state initiative in Nanotechnology for Efficient and Renewable Energy (NEARE), that would leverage federal investments in S&T in NM based on a nascent state industrial presence in photovoltaics, solid state lighting, refrigeration, and other nanomaterials for energy applications. The goal would be to help transfer emerging technology to large and small businesses in the state, spurring economic development and the growth of high-wage jobs. This aligns with the Governor's energy focus, harnesses expertise at the labs and universities that is not available in other states.

2) A project called *Frontera Del Sol* focusing on commercial solutions for the taxing problems associated with border, energy, environmental, and economic security issues.

3) A grand challenge to leverage New Mexico assets to develop a far-reaching Small Tech professional and technical workforce development infrastructure with specific goals oriented to dramatically increasing the diversity of the STEM workforce by 2020.

4) A Federal Technology Transfer Program to provide matching grants for Federally-Funded R&D Center scientists to assist businesses with technology development,

5) The creation of a state supported small business development fund to act as an incentive to innovative start-up firms to locate all portions of their operations in New Mexico. This fund, much like the New Mexico Small Business Assistance Program, would provide funding for prototyping helping firms cross "the Valley of Death".

6) The creation of an Innovation Access Incentive Program to act as an incentive to innovative start-up firms to take risks in product development that they might otherwise shun due to cost of accessing federal facilities and technical expertise.

7) The creation of an evergreen funding mechanism for the Administrative/ Management, Marketing/Sales and Production jobs that are created to insure these jobs are also retained in the state over time.

(See Nanotechnology appendix for more detailed information.)

4. Economic Development

Overview

If implemented successfully, the Science and Technology Plan will compliment the efforts of economic developers across the entire State, many of whom have been pursuing their own separate programs of technology-based economic development.

More often than not their efforts have been company or industry-related rather than technology related. Their recruiting efforts have been based on assessments of local resources, local infrastructure and local community needs. Whenever the New Mexico Department of Economic Development (EDD) was involved, the view expanded to include the entire State and its infrastructure/resources. The EDD's Office of Science and Technology has worked closely with the Office of the Governor, and in particular, the Governor's Science Advisor, to develop this S&T Plan. Our efforts were supported by several other State departments, the two federal labs, military testing facilities, the three State research universities and countless private sector volunteers who served on advisory committees.

There can be no doubt that the coming decades will see rapid growth in technology-based economic development, both here and throughout the world. Much of this growth will be dictated by necessity as we are compelled to adapt to new market and environmental conditions. These conditions will demand a move from more traditional paths to those supporting newer technologies. Many of the economic decisions we will make will be defensive in nature and based on the acceptance of ever-dwindling resources and increased competition. Others will be proactive like formulating strategies that marry conservation with marketplace realities to affect a healthier and more robust economic future.

There are those who doubt that commerce can become 'green,' but it has no other logical alternative, as the demands of our world would seem to dictate. Others doubt that healthcare advances can be integrated into a national healthcare system for the benefit of all Americans, but we all know they must. The truth is that new technology empowers optimism even among opposing groups by presenting new alternatives and ways to solve persistent problems. It can inspire whole generations as it did with the manned space program and lead them to careers in the sciences. It can also help states and countries make difficult transitions from agrarian or manufacturing economies to knowledge-based ones.

"New Mexico is fortunate to have ample human capital and natural resources, diversity of thought and culture, an enviable concentration of research institutions, a vibrant private sector and the ability and willingness to adapt to change."
Cabinet Secretary Fred Mondragón

To move us forward towards creating more technology-based economic development we need a technology innovation center that can mobilize all segments of the science and technology community.

Here in New Mexico, we are fortunate to have ample human capital and natural resources, diversity of thought and culture, an enviable concentration of research institutions and the ability and willingness to change.

From an economic development point of view, these are all the important and necessary ingredients for success. We are pleased to support the Executive Recommendations in this Plan and stand ready to implement them.

Technology as a Driver for Clean, Green Growth

Our planet is under siege by climatic forces and by our rapid consumption of our most precious resources. Our environmental and economic futures depend on finding new technology solutions to the nation's most pressing problems of climate change, water shortages, and fossil fuel dependency. A clean and green economic future also relies on our ability to develop new businesses in areas such as aerospace, biotechnology, information technology, and nanotechnology. We must grow our base of technology jobs, expand new technology-driven company start-ups, and recruit more out-of-state firms. This is vital if we are to firm up and diversify our economic base and provide a bright and sustainable future for all New Mexicans. To expand our clean and green economic base, we must dedicate a relatively small but consistent portion of our budget to move our discoveries from the laboratory to the people. This requires a commitment to creating a Technology Innovation Center (the core of Technology21) that will support or coordinate promising *commercializable* technologies in four areas: energy, water, supercomputing, and clean and green technology innovation. Similar centers have been created by other states for the same purposes, and the vast majority of them have profited from the economy of scale and coordination that these centers have provided.

The Federal R&D Investment in New Mexico

Our science and technology advantage over other states has been our unique Federal government relationship with our national laboratories. With over $6.0 billion in annual revenue derived from the Federal government to operate its many facilities here, we are fortunate but also vulnerable to Washington's changing priorities. New policy decisions could lead to base closures or substantial reductions of missions for the national laboratories.

To avoid such losses and the subsequent economic impact on New Mexico, we must forge stronger and more flexible relationships with the labs that focus on commercial technology transfer and retaining Intellectual Property (IP) and human capital. We must draw on our scientific resources to provide solutions to energy problems and to produce the clean and green technologies needed to create better-paying jobs in rural and urban New Mexico. Technology21 provides the means for us to most effectively meet those challenges.

Advisory Group Recommendation - Establish and fund the Technology Innovation Center (TICenter)

The TICenter is the essential element in a strategy to bring all sectors of the S&T community together - a place where programs, activities and grants can be monitored, coordinated and supported. It is also a place where a State-sponsored Technology Development Fund could be

administered and directed towards commercializable technologies; to support market pull and help emerging technologies prosper with the State's help. The TICenter would be the State's 'voice of technology,' promoting and cross-promoting New Mexico's R&D and companies. It would be the principal liaison between all State Departments, community-based technology programs, federal labs and private sector companies and multipliers. Absent a positive decision on this recommendation, the State will not have the necessary resources to oversee or implement the other recommendations. That is why we strongly support the TICenter initiative.

5. Education and Workforce Development

Education

Education is the key to the 21st century, both in terms of economic prosperity and personal achievement. Today's new economy is knowledge-based, entrepreneurial, and globally competitive to an extent that was almost unimaginable even a decade ago. Addressing our challenges in per-capita income, health care, and crime is dependent on a high level of achievement in education. Yet New Mexico students lag significantly in many measures of K-20 academic success, thus imperiling our prospects.

New Mexico is faced with a potential 'Catch 22' situation. Currently there are not enough specialized technology workers to satisfy the demand for them. This means we cannot attract new high-tech companies to New Mexico to create more and better paying jobs without having the necessary base of skilled workers. Conversely, until we grow the high-tech job market, we cannot interest students in investing the time and effort requited to go into STEM (Science, Technology, Engineering, and Mathematics) careers.

At the heart of this issue is having a talented and highly-trained set of teachers who have the abilities to effectively teach students in STEM subjects while inspiring them to work towards STEM careers. A vital part of the equation is educating parents about the importance of their children performing well in math and science.

The S&T Plan that is laid out in this document cannot succeed in promoting high-tech workforce development without the State having a strong and solid base of students that are well prepared in technical areas. Thus, in developing the S&T Plan, we have been working closely with educators, state leaders, educational organizations, economic development groups, and the New Mexico Departments of Economic Development and Workforce Development to ensure that the State S&T Plan and efforts underway to improve STEM education are fully aligned.

What is called for is a liberation of New Mexicans from a lifetime of lower-wage jobs with questionable futures by offering them a pathway to meaningful employment through continuing education and vocational training. A number of efforts are underway to achieve this: IDEAL-NM (Innovative Digital Education and Learning in New Mexico); New Mexico Project 2012; Project GUTS (Growing Up Thinking Scientifically), STEM education efforts of the New Mexico Computing Applications Center, and others.

EDUCATION IS THE FOUNDATION FOR IMPROVING THE STANDARD OF LIVING OF NEW MEXICANS. STRONG SCIENCE AND MATH EDUCATION IS ESSENTIAL TO ACHIEVING HIGH-TECH BASED ECONOMIC DEVELOPMENT AND THE HIGHER-PAYING JOBS IN THE HIGH-TECH SECTOR.

NEW MEXICO CAN SIGNIFICANTLY IMPROVE OUR STUDENT'S PERFORMANCE BY IMPLEMENTING THE PLANS LAID OUT BY OUR PUBLIC AND HIGHER EDUCATION DEPARTMENTS. WE CONCLUDE THAT THOSE EFFORTS ARE ESSENTIAL IN ACHIEVING THE GOALS OF THE STATE S&T PLAN.

IDEAL New Mexico

New Mexico is the first state in the nation to create a statewide eLearning system that from its inception encompasses all aspects of learning from traditional public and higher education environments to teacher professional development, continuing education and workforce education. IDEAL-NM provides eLearning services to New Mexico P-12 schools, higher education institutions, and government agencies. It reduces geographic and capacity barriers to educational opportunity while increasing the digital literacy skills students need to participate in a global economy.

New Mexico Project 2012

The goal of New Mexico Project 2012 is simple yet dramatic: that in five years New Mexico K-12 students will be among the nation's leaders in math and science achievement. While recognizing that this is a very ambitious goal, we believe it is a strong motivating force for positive change.

The strategic components of NM2012 are to: (1) increase student interest, participation, and achievement in math and science; (2) raise public support and awareness of the importance of science and math to New Mexico's economic health and security; and (3) to establish effective collaborations with internal and external partners.

The seven components of NM Project 2012 are:

- Increase the number of highly-prepared math and science teachers graduating from college
- Expand professional learning opportunities for K-12 math and science teachers
- Align the strategies used for teaching math and science to focus on inquiry-based learning, problem solving ability, and writing and literacy acquisition;
- Provide quality distance-learning opportunities for New Mexico's students via IDEAL-NM, the NMCAC, and related projects
- Draw on the extensive math and science expertise of New Mexico's very large community of engineers, mathematicians, and scientists to assist teachers
- Build a statewide STEM2 education community of students, parents, teachers, school administrators, institutions of higher education, state and local governments, and the business community to insure that New Mexico's young people are well prepared
- Create an effective public awareness campaign promoting math and science education

Education Working Group

The education working group identified a number of goals and strategies that should be implemented in conjunction with the State S&T Plan. While there is strong alignment between these goals and strategies with those of the New Mexico Project 2012 Plan, there was additional focus on the role of higher education in preparing students for a high-tech workplace and providing for the high-tech jobs needed to retain our students in New Mexico. Thus, the goals and strategies of the education working group are included here to amplify on some of the recommendations made by the Math and Science Advisory Council in formulating the Project 2012 Plan.

Goal I: Build coalition of business, industry, and government installations and labs to take ownership and provide coherence in statewide advancement of STEM education and workforce development.

- *Strategy 1: Create P-20 Council, including industry, business, national labs, education, etc. (chaired by Gov and top 10 CEOs in the state)*
- *Strategy 2: Create an HED STEM Bureau in collaboration with Governor's Office and P-20 Council*

Goal II: Build a seamless and coherent P-20 strategy that provides P-12 students increased access to STEM education

- *Strategy 1: Create statewide programs based on successful STEM programs that bring additional P-12 students onto campuses, national labs and businesses to prepare them for entering STEM fields.*
- *Strategy 2: Recruit and retain diverse faculty (women, minorities, faculty with disabilities) into Higher Education faculty and researcher positions. STEM HED staff representing increased diversity (STEM Bureau)*
- *Strategy 3: Double number of teachers certified in STEM fields with advanced preparation in the science, technology, engineering, and mathematics disciplines (program with salary supplements and scholarships for (pre-service teacher education*
- *Strategy 4: Provide opportunities for in-service teachers to increase knowledge and qualifications for teaching STEM subjects. (in-service strategies). Work collaboratively with PED k-12 math/science plan*
- *Strategy 5: Develop five5 STEM high school academies in diverse regions of the state with academic focus in strategic areas such as aerospace, nanotechnology, digital arts, robotics, energy, bioinformatics, etc.*
- *Strategy 6: Collaborate with P-12 to align curricula between P-12 system and higher education and enrich both institutions*
- *Strategy 7: Focus on role of school counselors in guiding students to STEM fields (prestige, opportunities, higher expectations—bring counselors to university campuses for STEM workshops/showcases)*

Goal III: Provide additional state funds for higher education STEM efforts

- *Strategy 1: Fund strategic hires of women and minority faculty in STEM fields to provide role models to increase recruitment and retention of diverse students*
- *Strategy 2: Increase by 50% funding for number of GRAs and fellowships for graduate students majoring in STEM fields*
- *Strategy 3: Increase by 50% scholarships for undergraduate students to major in STEM fields including Science or math teaching credentials*
- *Strategy 4: Match R&D—joint public-private partnerships between higher ed and industry*
- *Strategy 5: Provide matching funds for federal grants (NSF, NIH, DOE, ED, etc.)*
- *Strategy 6: Providing funding for mentored research opportunities for undergraduates*

Goal IV: Increase capital investments in identified NM areas of strength

- *Strategy 1: Increase facilities development for critical areas of scientific research*
- *Strategy 2: Fund Equipment upgrade and purchase in strategic STEM areas*

Workforce Development

Workforce development goes hand in hand with education. We need to both graduate students who are qualified for the high-tech jobs that will provide for a rewarding career and lifestyle while we also provide the high-tech jobs in New Mexico needed to keep our talented graduates in the state. This "Catch 22" situation is exacerbated by the challenges that we face in improving student performance and growing and attracting high-tech businesses to New Mexico.

Portrait of New Mexico

The New Mexico workforce system is faced by many challenges. New Mexico is a state marked by a high degree of poverty. According to the 2007 Kids Count report, New Mexico ranks 47th in the nation for the percent of children living in poverty (income below $19,806 for a family of two adults and two children). In 2007, the New Mexico department of public education reported that approximately 59% of New Mexico's students were classified as low-income and qualified for free and reduced price meals. The effect of these statistics on New Mexicans has a lasting and dramatic impact on the access to and achievement in education and success in the work place. A large percentage of New Mexico students lag significantly in most measures of academic success, thus imperiling both their individual prospects and those of the state. According to the 2007 "The Emerging Policy Triangle: Economic Development, Workforce Development and Education" report, New Mexico is ranked 44th in the nation for public high school graduation rates. The state is ranked 47th in the nation for overall results on a career pathway pipeline, the transition and completion rates from 9th grade to completion of college. 28% of New Mexican adults ages 25 to 34 have an associates degree or higher.

Education and Workforce Development Reform

New Mexico has made great strides in implementing systemic education and workforce development reform. Paramount to these reform efforts is collaboration among state agencies and key stakeholders. In 2003 the New Mexico departments of higher education and public education were created. In 2004, the Governor's Workforce Coordination and Oversight Committee was established. Members of this committee include seven New Mexico agency heads, several private-sector representatives, public-sector leaders, representative from labor organizations and representatives of the New Mexico State Legislature.

During the 2007 legislative session, the New Mexico State Legislature passed the High School Redesign Act. This act increases opportunities and expectations at the middle and high school levels to align with national policy recommendations for college and career success.

In the summer of 2007, the New Mexico Department of Workforce Solutions (DWS) was developed through the integration of the state's Department of Labor and Office of Workforce Training and Development.

In the fall of 2007, the DWS received a WIRED (Workforce Innovation for Regional Economic Development) grant from the United States Department of Labor. The New Mexico WIRED project provides additional linkages among workforce development, economic development and education entities. Many of the partners involved in the New Mexico WIRED project represent workforce development, economic development and educational entities focused on the

development of a "green collar" workforce in the following industries: advanced manufacturing, green building, clean and renewable energies, aerospace, micro-electronics and optics. Key activities of the project are dependent upon cross entity collaboration. In early 2008, the New Mexico department of workforce solutions was selected to participate in the shared youth vision mentee/mentor program by the United States Department of Labor.

Throughout his tenure, Governor Richardson has recognized that connecting education to local and global economies is necessary to ensure a healthy workforce and a stable economic future for New Mexico. He has directed all of the state's workforce partners to come together to plan for a better economy, create good jobs and the opportunity for well-paying careers for New Mexicans of all walks of life. With the support from the Carl D. Perkins Vocational and Technical Federal Fund, industry recognized certifications aligned to the career clusters increased from 91 to 148 in the 2006 - 2007 school year. In addition, 12 high schools in 11 of the state's 89 school districts are participants in the High Schools That Work (HSTW) program that focuses on continuous school improvement and increasing career and technical opportunities by incorporating ten key instructional practices including career-technical studies.

Advisory Group Recommendation - Implement the recommendations of the New Mexico Project 2012 strategic plan.

Advisory Group Recommendation - Coordinate the efforts in economic development, education, and workforce development to maximize the creation of high-tech jobs for New Mexicans.

(See the Education and Workforce Development appendices for additional information.)

6. Recommendations

Given the challenges and opportunities that lay ahead of us, it is the opinion of the Working Groups that one single initiative be adopted and become the foundation of the State's S&T five-year Plan. While there are several other activities and recommendations, all are enabled by the:

Establishment of a Technology Innovation Center (TICenter)

The TICenter is the essential element in a strategy to bring all sectors of the S&T community together - a place where programs, activities and grants can be monitored, coordinated and supported. It is also a place where a State-sponsored Technology Development Fund could be administered and directed towards commercializable technologies; to support market pull and help emerging technologies prosper with the State's help. The TICenter would be the State's 'voice of technology,' promoting and cross promoting New Mexico's R&D and companies. It would be the principal liaison between all State Departments, community-based technology programs, federal labs and private sector companies and multipliers. Absent a positive decision on this recommendation, the State will not have the necessary resources to oversee or implement the other recommendations.

More specifically, legislation is requested to remove the Technology Research Collaborative (TRC) from statute and create the Technology Innovation Center (TICenter). This change will result in improving our ability to transition basic research supported by Federal funding at the universities and laboratories into the commercial sector. The TRC was focused primarily on technology push from the universities and laboratories in which one seeks to find a business application for new technology that is developed. The TICenter will have a primary focus on market pull in which technology development is driven by identified needs in the market place. Experience in other states has shown this approach to be much more effective in leveraging Federal Research and Development (R&D) investments into the commercial sector.

The TICenter will have reporting responsibility to the Department of Economic Development, the Governor's Office (through the Governor's Science Advisor) and the State Legislature. It will have an executive board with the Chair appointed by the Governor. The TICenter will also have the authority to hire an executive director and other personnel as appropriate. It will also appoint a technical advisory committee of subject matter experts to aid it in responding most effectively to opportunities.

The New Mexico TICenter would be responsible for developing a business plan, metrics, and performance assessment process that will ensure accountability and return on the state's investment. It will have the ability to contract for R&D services, provide funding for technology development, create initiatives to respond to market opportunities, form partnerships with any combination of public and private organizations, and create and commercialize new intellectual property. This full range of capabilities is critical in addressing the pressing needs that exist in New Mexico to make technology-based economic development a driving force in improving the quality of life for all citizens of New Mexico.

Initiatives that would fall within the scope of Technology21 are:

- New Mexico Computing Applications Center (NMCAC). Complete the effort started in FY08 to bring the Supercomputing Center fully on line with major business partners. Provide support for targeted areas in economic and workforce development. Support education and telehealth goals. Locate core facility in Albuquerque and implement 20 gateways in combination rural/urban New Mexico. Oversight by the Department of Information Technology and the Economic Development Department.

- The creation of a technology development effort. This would support the development of targeted technologies in the five cluster areas defined in this plan. Those efforts could be individual projects that are aligned with state interests and have good prospects for return on investment to specific initiatives such as a biotech or nanotech center. The State Legislature would have to review and approve large projects such as centers that involve significant state funding over several years.

- On-going Energy Innovation Fund program. Grow funding over several years to support innovation in energy technologies that are important to New Mexico and offer prospect of significant return on investment. Will drive New Mexico efforts to achieve a clean and sustainable energy future in which clean energy is an important economic factor. Model on program created in FY08, but make it an on-going effort. Oversight by Energy, Minerals, and Natural Resources Division.

- On-going Water Innovation Fund program. Support innovation in water technologies that are important to New Mexico. Providing novel means of conserving water and developing new sources of usable water is essential if New Mexico is to grow. Model on energy innovation program created in FY08, and make it an on-going effort. Oversight by the Office of the State Engineer.

Other initiatives that could be included within the scope of Technology21 are:

- Improve environment for workforce development through active private/public sector programs such as supporting STEM education and the development of new commercially-relevant training programs/curricula.

- Support high technology associations by having the Technology21 Center work with the associations in fulfilling the S&T Plan and working with the New Mexico Partnership in representing and advocating for their industries and the State.

- Review all State incentives and tax policies to attract high-technology companies coupled with a concerted effort to attract 2-3 of the major venture capital companies to New Mexico through a series of planned, carefully coordinated events.

- Establish a special High Technology Advisory Group comprised of membership from both legislative houses for the purpose of information exchange with the Governor's Science Advisor and the Technology21 Center.

7. Summary

The State Science and Technology Roadmap has taken over 18 months to complete. Over 100 people representing the academic, scientific, business, government and non-profit communities from all parts of the State worked on it. The outcome of this effort concluded that meeting the needs identified in the S&T Plan can be met by implementing the following recommendation:

Establish and fund the State of New Mexico Technology Innovation Center

Technology21 is a roadmap that charts a course for economic and technological development that is integrated with educational and workforce development initiatives. It builds on the experiences of other states' plans, but is specific to New Mexico.

Creating the Technology Innovation Center (TICenter) and providing sufficient funding to leverage the remarkable Federal investments in Research and Development in New Mexico is the most direct way to drive the technology-based economic development that will create high-paying high-tech jobs for New Mexicans across the state. These jobs are essential in addressing the significant issues that New Mexico faces in low per-capita income, health care, and crime.

Achieving the goals of the State S&T Roadmap requires a highly skilled and prepared workforce. We are not currently producing the number of graduating students with the necessary skills. To ensure the success of the S&T Roadmap requires a committed effort to improve the performance of our students in STEM disciplines. While New Mexico has made progress in the last several years and is a national leader in setting standards for our students, we need to focus on improving the math and science skills of our students. A number of efforts are underway to do just that and the most promising approach is the comprehensive one laid out in the New Mexico Project 2012 Strategic Plan. Implementing the recommendations of that Plan would dramatically further our ability to drive technology-based economic development across New Mexico.

Implementing the recommendations of the S&T Roadmap will position us to recover more quickly from the current national economic crisis and to be in a position of strong economic growth in the future. It provides a highly effective way for the state to address the important issue of the rising cost of energy and of using our technology base to drive clean and green growth. It contains all the elements required for success.

Following a two-year effort to asses what is required to address the pressing need for more better-paying jobs for New Mexicans, we conclude that:

The State S&T Roadmap provides
a highly effective way to grow New Mexico's economy.

Technology21

Innovation and Technology in the 21st Century
Creating Better Jobs For New Mexicans

A Science and Technology Roadmap for New Mexico's Future: Appendices

New Mexico Governor Bill Richardson's Office
and
New Mexico Economic Development Department

January 2009

[Access the full text at the NM EPSCoR Website under "Research--Publications"]
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