UTAH AT THE BRINK:
UTHA’S FUTURE AND
THE ROLE OF RESEARCH UNIVERSITIES

A case statement by Utah State University and the University of Utah
Fellow Utahns:

The future of our great state is at risk. Around the world—in the U.S., Europe, and Asia—local governments are aggressively preparing for coming changes in the global economy. They recognize and value the very real links between scientific discovery, technology development, and economic growth.

R&D expenditures in the United States are at an all-time high (over $125 billion in FY2003). Our sister states—Arizona, Washington, Colorado and others—are already committing resources to ensure they vigorously compete for Federal research and development funds. Why? Because new technology-based businesses and job opportunities are the future of a thriving economy—a future that will only result with energetic research environments.

_Utah is at the brink of an economic decision. We must find the means to build bridges to a prosperous future—significantly increasing our capacity to compete in the new knowledge economy right now—or we will be left behind._

Those are challenging words, but they reflect the concern and commitment of Utah’s two public research universities. We pledge our willingness to join with others throughout this great state to promote technology-based economic development right here in Utah. By investing in our university research infrastructure, additional research funding will be received, more technologies will be developed, and Utah’s economy will be energized with new companies that promise a bright future for our children and grandchildren.

We all share a common goal to improve the lives and well-being of every Utahn. Let us begin now to explore every option and consider every way in which knowledge and discovery can partner with business and government. As Utahns, we stand at a brink; let us move forward together.

Sincerely,

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Today as never before, Utah stands at the brink. The very future of our state—its economic growth and the prosperity of its citizens—hangs in the balance. Competition for good jobs and scarce resources assails us from every region of the globe. Aggressive postures on research and development are the norm from North Carolina to Arizona. And the struggle for knowledge funding is already hinting at a world of haves and have-nots. These are factors that will only become more challenging in the months and years ahead.

A window of opportunity exists for us to meet this challenge, to tip the scale in favor of Utah and its citizens. To do so, we must commit to investments that prepare Utahns to participate in a knowledge-based economy.

A Reminder of What We’ve Accomplished

Utah has an enviable legacy of achievement in the face of daunting odds. To tame an arid desert we tapped the Colorado River (Central Utah Project, 1919). To connect a growing population we built a powerful network of state and national highways (1957, 1996). To welcome the world, we worked for thirty years to host the 2002 Olympic Winter Games. These investments required vision and sacrifice, but they set in motion patterns of action that benefit the lives of every Utahn even today.

Indeed, there are some who might well claim that Utahns can accomplish anything once they put their minds to it.

And such a time has come again. Utah is facing an increasingly competitive business environment, both regionally and globally. Gone are the days when competition was measured among communities in our state; now it is measured between states and nations. To create the advancements we need to grow and prosper, Utah must do as it has done in the past: invest in the infrastructure and education that will benefit both our present and our
future. We must do everything possible to maintain the quality of our highly educated workforce, while reinforcing our innate spirit of entrepreneurship.

The Milken Institute, a non-partisan think tank, recently noted that 50 percent of long-term economic growth occurs because of scientific and technological change, and that technology has doubled its share of economic activity in the past 20 years. The implication is clear: embracing technological development could be as vital to our state’s economy as developing our water resources was a century ago.

Fortunately, Utah’s state-assisted research universities have a strong tradition of supporting economic growth, both by providing human capital development and by maintaining a steady flow of innovative ideas feeding into Utah’s “technology pipeline.”

**There are Challenges to Face**

All is not well in Utah. To claim otherwise denies the honesty that made this state great. Our economy is only now recovering from its worst recession in nearly a half century. Continuing population growth and accompanying environmental issues raise questions that demand immediate and far-reaching answers; we must ensure a state where the quality of life is as good for our children as it is for us. And we struggle with the challenges of education—not only providing for a burgeoning primary and secondary population, but ensuring access to higher education for citizens from every economic stratum.

Even more critical is the lack of jobs awaiting Utah students. Each year, the University of Utah and Utah State University (along with our colleague, Brigham Young University) graduate thousands of men and women prepared to contribute to Utah’s economy in clean, productive high-tech industries. Unfortunately, Utah’s current job market cannot accommodate all its talented graduates; many of our best are lured away to jobs in more competitive markets around the world. If Utah is to retain its brightest children and serve as a beacon to the world, we must do a better job of preparing for tomorrow. We can do this by investing in the very research universities and citizens that have primed Utah’s economic pump for decades.

**What Future Awaits Us?**

High-tech businesses have had a major impact on Utah’s economic prosperity. At one time, high-tech companies in Utah numbered as many as 3,400, employing more than
60,000 people directly and some 133,000 in related services. Perhaps more telling, high-tech jobs in Utah paid about 77 percent higher than the state’s average wage. Higher wages equaled higher taxes; more companies meant more money for the state’s treasury. Indeed, high-tech employment currently constitutes 4.9 percent of the state total, but high-tech wages account for 8.4 percent of the state’s economy.

The future is clear: technology will compose the majority of sustained economic growth in the nation. Those states that can grow and attract high-tech firms will be the ones to succeed and thrive.

It’s worth noting that many Utah businesses pulsate with energy infused into them from university-based discoveries. Companies like Myriad Genetics, Theratech, Evans & Sutherland, Hyclone, WordPerfect and Iomega are just a few examples of companies whose establishment as international powerhouses relied on innovations coming from Utah’s research universities.

Unfortunately, some of these same Utah companies have now relocated outside of Utah, joining many other businesses whose innovative sparks were ignited here but who now heat the economies of other states and nations. We cannot blame organizations for taking advantage of global resources, but we must not allow this pattern to repeat itself. We must create an environment where emergent companies find the resources they need right here.

Utah’s state government has partnered effectively with higher education to enable universities to play a supportive role. For example, Utah led the nation in its Centers of Excellence Program. Its current efforts to attract new capital in its “Fund of Funds” and its support of industry-specific “ecosystems” are additional ways the state sustains new enterprises heavily reliant on Utah’s research universities. But more can and should be done.

**The Synergy We Need**

The government+higher education+industry partnerships suggested by prior programs are precursors of what policy experts describe as the “triple helix” of economic development. The components of this triple helix reinforce and strengthen one another, and stand united to benefit the state and its citizens. To enable technology-fed economic
development, the interplay between education, government, and industry must be robust; building this triple helix is the best way to create a prosperous future.

Utah’s research universities, for example, contribute to that robust interplay by identifying and encouraging promising technologies. However, they often lack the capital to prepare those technologies for success in the marketplace. Achieving market viability for new technology-based businesses is precisely where Utah’s government can cooperate with its universities to focus combined resources.

The government’s role in the economic triple helix is equally vital. Only the state can establish favorable tax policies, make selective investments, and protect the state’s resources. Companies being recruited to anchor new technology clusters expect to see state revenues invested in the state’s infrastructure, education system, and environment. Research universities can help illustrate that governmental commitment.

Finally, the role of industry is to follow the prompting of the “invisible hand” that economist Adam Smith says guides the market place. If the universities and state government do their jobs well, the advantages that Utah provides will attract and retain the businesses, entrepreneurs, financiers, and service providers needed for Utah’s economy to thrive.

Besting the Competition

Capturing additional Federal research grants is one example of what might be achieved by increasing Utah’s competitive environment. Such grants are a major financial artery for research universities and help foster the innovations that ultimately benefit the state. Together, Utah State University and the University of Utah brought more than $500 million in research funds to the state of Utah last year. Gaining access to Federal dollars is a highly competitive process, and—as a criterion for the awarding of grants—Federal agencies increasingly look at the full complement of economic infrastructure that supports petitioning institutions. It is therefore imperative for Utah to support university activities that develop synergistic clusters of high-tech companies.

Sadly, when it comes to state support for technology development Utah is being left behind. We once stood at the forefront of such support but sister states are now besting us. California, for example, is investing over a billion dollars in research university infrastructure. Arizona, facing more than a billion dollar deficit in 2003, committed over $400 million in high-tech and educational initiatives during the next 20 years. Michigan initiated
spending $1 billion on a “life science corridor” and created a statewide accelerator program that will take advantage of existing university-based incubators to advance technology-based start-ups. North Carolina dedicated $4.5 billion just for construction and renovations at the University of North Carolina. And the list could go on.

In the face of this national rush toward technology development, Utah cannot afford to remain idle. Rather, our comparative strengths, built up over a rich history of education research and service, should be put to work to increase Utah’s competitiveness. We must increase our capacity for research and development or we will continue to fall behind.

Utah stands at the brink. Implementing just seven objectives can alter our future and ensure a brighter tomorrow for all our posterity.

- Establish and strengthen research institutes in targeted technology areas.
- Increase incentives to attract and maintain research and development talent.
- Build and expand research facilities.
- Enhance business incubation at Utah’s research universities.
- Expand the state Centers of Excellence Program.
- Increase incentives and support for new ventures.
- Increase access to venture capital.

We all share a common goal to improve the lives and well-being of every Utahn. Let us work with one another to arrive at solutions both innovative and practical—solutions that are uniquely ours, based on a heritage of commitment to education and economic development that benefits all of us. We are at the brink; now is the time to press forward together.
Utah has a legacy of creating opportunities out of difficult challenges. Whether the challenge has been bringing water to the arid state, connecting Utah’s population with transportation infrastructure, or hosting one of the largest athletic and cultural events in the world, Utah’s leaders and citizens have met the challenge, invested resources, and created a more prosperous future. Utah’s challenge today—of global competition for jobs and resources—requires us to identify and commit to investments that will prepare the way for Utahns to participate in the rapidly evolving knowledge-based economy. As past investments have shown, Utah’s vision and investment today will dictate the state’s success tomorrow.

- 1919 – Colorado River Storage Compact; 1956 - Central Utah Project
- 1997 – Salt Lake Olympic Organizing Committee
- Now – Research, Technology, and Economic Development Infrastructure

**Investment in Growth and Sustainability: Colorado River Storage Compact, 1919; Central Utah Project, 1956**

When the Intermountain West began growing in the 1800s, the issue of water distribution was recognized as one of our most important challenges. In 1889 it was reported that “water is just now agitating all people in this region.” A report issued at the time indicated millions of people could be comfortably located in the arid West through the storage and distribution of water that went to waste. “Operations of such magnitude,
however, are not likely to be attempted by private resources. If it is to be accomplished in any other way than by gradual progress of successive generations, it must be undertaken by the Government.”

In 1919 Utah Governor Simon Bamberger urged government officials from the seven states located along the Colorado River to organize the League of the Southwest. This League sought equitable means for dividing the waters of the Colorado River and facilitating its usage. Under the League’s direction, the Colorado River Compact was created to divide the river in an orderly manner for agricultural uses, to secure dam sites for the storage of water, and to secure protection of life and property from floods.

Using seed funding from the League, Utah began petitioning the Federal government for assistance with water infrastructure. Utah’s efforts resulted in Congress authorizing the Central Utah Project (CUP) in 1946 and the Colorado River Storage Project (CRSP) in 1948. In 1956, CRSP (and the CUP, the largest single participating unit) was appropriated about $760 million for general Great Basin water infrastructure, along with participating projects in Utah.

The CUP stores and diverts water from the Colorado River for 200,000 acres of farmland and to provide supplemental water for an additional 239,000 acres. In addition, the CUP provides water for industrial and municipal uses along the Wasatch Front through a series of diversion and storage dams, aqueducts, and tunnels to the Bonneville Basin (Wasatch Front and areas south), where superior farm land is available and the bulk of the state’s population is located.

The Central Utah project made widespread development in Utah possible, by bringing water to the arid state. Still underway in Utah, it will provide water we need for farms, industry, and municipal use well into the future.¹

**Investment in Infrastructure: Highways, 1950s**

With the state population surging in the 1950s and 1960s, Utah was again at a critical crossroad, needing to connect Utah with states across the nation. In 1957, legislation sponsored by Senator Wallace F. Bennett of Utah aimed to add an additional 1,000 miles to the 40,000 mile Defense Highway System (later renamed the Interstate system). With this transportation addition, expansion and growth for Utah again became a reality.²

Since the establishment of the Interstate System, Utah’s transportation needs have continued to grow. In 1996 Governor Mike Leavitt introduced a 10-year transportation plan
that called for the state to spend more than $3 billion on highway construction over a 10-year period. This led to the Legislature placing $75 million in the base budget toward transportation, allowing $750 million to be raised through 2006 for highways.\(^3\) In 1996 the Highway Centennial Fund was also created and $110 million was committed by the state to improve highways and to pay for new highways and major reconstruction in Utah.\(^4\)

In 1997, Utah citizens voted to increase Utah’s gas tax by 5¢ per gallon as the state began the $1.59 billion reconstruction of I-15 in Salt Lake County and other major road projects, preparatory to Utah hosting the 2002 Olympic Winter Games.\(^5\)

By making thoughtful investments, Utah is working to ensure that the transportation infrastructure in Utah will enable long-term economic growth.\(^6\)

**Investment in Economy: Olympic Winter Games, 2002**

Another critical investment for Utah came in 1995 when the International Olympic Committee awarded the 2002 Olympic Winter Games to Salt Lake City. This defining moment provided Utah with the opportunity to strengthen its global standing and connection to the world.

Thirty years of preparation went into the making of Salt Lake’s bid for the Winter Games. From the 1960s through the 1990s, the state and the winter sports community demonstrated their commitment by building multi-million dollar winter-sports facilities with no guarantee the games would ever be held in Utah. This dedication and commitment paid off.\(^7\)

According to a 1995 IOC report, strong financing and overwhelming public support were two of the biggest strengths Utah had for hosting the 2002 Winter Games. The report stated: “There is great public awareness and enthusiasm for the bid, as well as good public support demonstrated by a 1989 referendum and by 25 surveys carried out in recent years.”

A stipulation agreement between the state and Salt Lake City was also cited as a major strength by the IOC. The agreement stated that if the City should fail to meet its contractual obligations, the state would assume any liabilities.\(^8\)

In 1997, the Utah State senate passed a bill designed to help the Salt Lake Organizing Committee secure the money needed to put on the 2002 Winter Games. The resolution ensured that the Salt Lake Organizing Committee (SLOC) would have access to up to $200 million dollars if needed.\(^9\)
More than $59 million had been pledged by taxpayers to fund various competition sites by 1995 and, in 2002, the Salt Lake Olympic Bid Committee raised approximately $3.2 million in private donations. In all, the bidding process cost $3.5 million each year.10

In 2002, the Olympic Winter Games fulfilled its promise, providing the state with a needed economic infusion of an estimated $1.3 billion, which helped cushion the early effects of the nationwide recession.

Olympic-related in-state spending included:
- Salt Lake Organizing Committee (SLOC) ....................................................$804 million
- Infrastructure investment .................................................................$326 million
- Visitor spending during the Winter Games ...........................................$117 million
- ISB’s spending to broadcast the Winter Games .................................$49 million
- Direct Federal funds to state government for Olympic operations ..........$17 million11

Additionally, the 2002 Olympic Winter Games provided a significant employment impact of over 35,000 job years. Says the Utah Foundation: “Statewide employment growth rates in 2001 and 2002 would be much lower were it not for the Games.”12

Investment in the Future: Research, Technology and Economic Development Infrastructure, Now

Major accomplishments in the state over the past sesqui-century have been no less than astounding. Once a barren desert, Utah today is a vibrant, flourishing region with one of the highest quality-of-life ratings in the country.13

To improve our current situation and to weather tomorrow’s storms, we must commit to an investment that is no less vital than our water infrastructure and no less visionary than hosting the world at the Winter Olympics. Strengthening our state’s research universities can help us do just that.
Research universities, as opposed to other universities, colleges, and places of higher learning in the state, are not only the educational flagships of Utah; they also provide more statewide practical, social and economic benefits than any other institution in the state. The three-fold mission of a research university—learning, discovery, and engagement—is unique. No other entity takes on the responsibility of providing affordable, state-of-the-art education, creating new knowledge, ideas and technology for worldwide benefits, and supplying practical assistance and service to all citizens of the state. From farming techniques, to financial counseling, to resources for disabled persons, research universities have lent willing hands and minds to help deal with nearly every issue of concern in Utah.

These ideas and services can do more than provide for our state’s practical needs; our research universities, the University of Utah and Utah State University, can provide the knowledge, expertise and human capital needed to create a launch-pad and landing-strip for high-tech companies.

To do this, we must act. We must facilitate the evolving role that research universities have in the state and invest the resources needed to make them as they are in other states: educational and economic centers.
Critical public issues in Utah show a significant need for the creation and expansion of Utah’s in-state industry strengths. Utah’s economy, still fragile during its recovery, needs an improvement in both the quantity and quality of available jobs. As the state continues to grow at a near record pace, the need for those high-paying jobs will significantly increase over the coming years. At the same time, higher education in the state must remain accessible for Utah’s students and competitive with neighboring states. These and other difficult public issues will require innovative thinking and practical solutions by the state’s citizens, business leaders, and policy makers.

Economic Issues

This past electoral season, Utah voters said that jobs and economic development were the second-most important public issue, behind only public education in perceived importance.¹ The recession of 2001-2003 marked the state’s worst economic slump since 1954. Not since World War II has Utah experienced back-to-back years of employment contraction.² Only now are signs beginning to show that Utah’s economic health is reaching a period of recovery.

No facet of the economy is more visible to the state’s constituents than the job market. Although the job market is beginning to strengthen, the Bureau of Economic and Business Research (BEBR) fears that a low-wage recovery will follow Utah’s high-wage recession. According to the Bureau, “Low-wage rates have long been a vulnerability of the Utah economy.”³ Average annual wages increased in 2003—at a rate of 1.4 percent to $30,537—but it was not enough to keep pace with current inflation rates.⁴
Job concerns for Utah citizens are compounded by increasing burdens on their existing incomes. The Utah Foundation reports “Utah’s state tax burden is...8th highest in the nation. This is partly the result of funding a public education system for Utah’s substantial student population.” For families with students attending college, recent dramatic increases in tuition have also required extra fiscal attention.

Some positive news, however, is emerging. For instance, Utah’s job growth between September 2003 and September 2004 was 32,900 jobs, or about 3 percent, suggesting that the state is finally “shedding the shackles of recession.” Even during the recession, Utah’s economy continued to outperform the nation, says Utah’s Council of Economic Advisors. The Council attributes this to strong internal population growth; a young, well-educated workforce; a strong work ethic; and low business costs. A recent study echoes this sentiment. In September 2004, the Boyd Co., a corporate location consulting firm, released a study that placed Salt Lake City on a list of cities west of the Mississippi attractive to technology companies looking to flee the cost-prohibitive California market. The area offers a lower cost of living, strong intellectual capital, and strong work ethic. According to the study, these factors create a strong competitive advantage.

Current forecasts provide even more good news for Utah’s economy. All major forecast groups (Blue Chip, Global Insight, Zions Bank, State of Utah, BEBR, and Economy.com) predict positive changes for Utah.

Business leaders, public officials, and research universities must encourage Utah’s economic recovery by promoting needed economic and intellectual capital development.

**Growth and Sustainability Issues**

Throughout the Western states, growth continues to be one of the greatest challenges for state policy makers. States must accommodate a growing population, while maintaining quality of life and environmental conditions at the same time. In Utah, issues of growth and the environment were two of the ten most important issues for voters in November 2004’s election.
Population Growth

Utah is one of the youngest, fastest-growing states in the nation. The state’s official 2003 population was estimated to be 2.39 million, increasing 2 percent from 2002. Although the state continues to experience net in-migration, natural increase accounts for the majority of Utah’s population growth. According to Census 2000, Utah also continues to be the youngest state in the nation, with a median age of 27.1, compared to 35.3 nationally.¹⁰

Growth projections suggest coming challenges for Utah’s education system and job market. Beginning in 2004 and continuing for at least a decade, the 5-to-18-year-old population will increase significantly: Even with zero net migration to the state, Utah can expect an additional 169,600 students—an increase of 35 percent—by the year 2020. Salt Lake and Utah counties will be especially affected, with a projected 60 percent increase in the school age population from 2000 to 2030. This will result in more school-age persons per capita than any other state.¹¹

Not only does this trend have major implications for Utah’s public education and higher education systems, it will also affect the dynamics of Utah’s job market. The crest of Utah’s “Second Boom” (born 1978-1984) are now 20-to-26-years-old, and are leaving the education system and looking for jobs. The Third Boom will enter higher education between 2016 and 2025, and need jobs by 2030.

**To keep our best and brightest students within the state, high-quality jobs must be available.** Already, Utah’s current job market is strained with new entrants; from 1990 to 2000, Utah’s worker population grew by 41 percent—compared with 12 percent nationally.¹²

Environmental Sustainability

Utah’s population growth also brings challenges to the environment and to sustainability. The impact of more Utah residents requires innovative solutions to finite water, land, and air resources. These problems may best be solved by the efforts of research universities. The environment also has effects on Utah’s economy. Many of Utah’s natural resource industries (farming, mining, manufacture) are decreasing over time, which requires other industries—such as high-tech—to pick up the slack.
Higher Education Issues

Utah is known for its high quality, affordable higher education, but it must ensure the quality of education remains among the best in the nation. In spite of budget constraints forcing increases in tuition and low salaries for faculty, investments must be made to recruit and retain the best professors, researchers, and scientists and maintain Utah’s competitiveness in higher education. Public and private support from the state is critical, for without students, the state’s higher education system and intellectual capital resources will be significantly compromised.

According to Measuring Up 2004, a detailed report on the overall condition of higher education in each state, Utah has improved in the percentage of students scoring well on national math, science, and reading assessments. However, Utah has seen a decline in the chances of young adults enrolling in college. Utah has continued to keep public two-year colleges and public and private four-year institutions affordable, which is commendable in light of a nationwide declined in the affordability of college. According to the report:

- Utah performs well in preparing students for college. For example, two-thirds of secondary school students are taught by qualified teachers, which compares well with top states.

- However, over the past decade, the likelihood of 9th graders in Utah enrolling in college within four years has declined substantially, from 42 percent to 31 percent. Top states score 52 percent on this measure.

- Utah has held the line on the share of family income, after financial aid, needed to attend its public two-year colleges and its public and private four-year institutions, making Utah a best-performing state in this area.

- However, net college costs for low- and middle-income students to attend public two- or four-year colleges and universities still represent 25 percent of their annual family income. (Net college costs equal tuition, room, and board minus financial aid.)

Within the Utah System of Higher Education, projected enrollment increases may provide increased opportunity. Utah has the potential to capitalize on a major strength—a quality, affordable education—if the issue of lower participation in higher education can be remedied. In the coming years, Utah must maintain the competitiveness of its higher education institutions to ensure these students stay in-state to pursue their education and their careers.
**Infrastructure Issues**

Utah has spent billions of dollars developing quality physical infrastructure for the state. Transportation, especially I-15 reconstruction and TRAX, have had visible benefits to many Utah citizens, yet other infrastructure—such as power, water, sewer, and telephone would be propelled to the top of the public agenda if any of these were not sufficiently provided.

Utah’s technological infrastructure needs to be strengthened now; it is as vital as any public system we currently take for granted. Technology infrastructure, however, does not consist only of broadband Internet wiring and computer terminals. It also requires facilities, human capital, and money. Factors needed for an effective technological infrastructure include “at least one mega-success story” that can serve a synergistic purpose to the research university by helping encourage more start-ups; high-tech, well-educated talent; venture capital; an infrastructure of supporting law firms, Web designers, high-fiber Internet connections, and other business services; and a widely shared attitude of a visionary high-tech future.¹⁵

The research university, though, is at the center of any growing technology infrastructure.¹⁶ The success of regional economic in Silicon Valley, California, Route 128 in Massachusetts, and Research Triangle Park in North Carolina show that this is the case. By investing in research universities, the hub of our technological infrastructure, Utah can create the momentum needed to strengthen and develop our own regional economy.
High-tech businesses have had a major impact in determining Utah’s economic prosperity. High-tech companies in Utah have numbered as many as 3,400, employing more than 60,000 people.¹ This does not include the 133,000 individuals who work in the service industry, many of whom are involved with technology in some fashion.² Fifty percent of high-tech companies are professional, scientific and technical service organizations. Twenty-six percent provide information services, with nine percent focused on retail trade.³

The high-tech industry’s size is not the only reason for its importance to the Utah economy. High-tech jobs are largely responsible for increasing average wages in Utah and comprise a disproportionate amount of the state’s overall economy. High-tech jobs in Utah pay an average of more than $51,000—77 percent above the state’s average wage. While its employment makes up 4.9 percent of the state total, high-tech wages account for 8.4 percent of the state’s economy.⁴

In the past decade, the nationwide tech industry experienced dramatic gains and losses and has taken regional economies on an unpredictable roller coaster ride. Despite the tech sector’s short-term uncertainty, however, most economists are confident in the fact that, over time, the high-tech industry will comprise the majority of sustained economic growth in the nation, and those states that can grow and attract high-tech firms will be the ones to succeed.⁵

**Most economists are confident in the fact that, over time, the high-tech industry will comprise the majority of sustained economic growth in the nation, and those states that can grow and attract high-tech firms will be the ones to succeed.**
Utah’s High-Tech Beginning and Successes

During the 1980s, Utah was second only to the state of Washington in successful software development. A Salt Lake Tribune article reported that, “Some remember a time when Utah rolled off the tongue in any uttering of the nation’s high-tech hot spots along with California’s Silicon Valley and North Carolina’s Research Triangle.”

Consider these examples:

Novell, perhaps Utah’s brightest technology star, “invented the technology that enables personal computers to talk to one another, an innovation that changed the world.”

Established in Provo in 1983, Novell was a breakout leader in personal computer operating systems and early network solutions.

WordPerfect, also originally located in Utah Valley, led the word processing industry, and its main product was called a “life-changing technology.” With 4,000 employees and sales of more than $500 million in 1991, WordPerfect became a national business leader.

The founders of Novell and WordPerfect, Raymond Noorda and Alan Ashton, both graduated from the University of Utah.

Other businesses such as “Iomega Corp. and its once high-flying Zip drive called Utah home. Unisys Corp. and 3Com built a major presence in the state, and Intel and Micron Technology identified Utah as a site for significant expansion....”

Utah also played a role in major technology companies that don’t currently have a significant presence in Utah. Adobe Systems, the world leader in desktop publishing and digital imaging software, was co-founded by University of Utah alumnus John Warnock. Located in San Jose, CA, the company employs more than 3,700 and posted annual revenues of $1.2 billion in 2003. Another U of U alumnus, Ed Catmull, co-founded Pixar Animation Studios with Steve Jobs and serves as the company’s president. Located in Emeryville, California, Pixar employs more than 730 skilled personnel.

In the 1980s, the state, understanding the importance of developing strong competency in high-tech in the region, began forming strategic partnerships with businesses and universities. An example is the establishment of economic focus areas by the Utah state government, accompanied by representative industry organizations aligned with these focus areas, including the Utah Information Technologies Association (UITA), the Utah Life Sciences Association and others. While the state dedicated some limited resources to launch these industry groups, they quickly became industry-led and self-sustaining,
and have provided an effective means for Utah’s businesses to provide input to the government on an array of issues.

Another example of state investment in research and technology is the Utah Centers of Excellence Program, which is a state-sponsored program that funds late-stage research in order to develop new products, high-tech companies, and skilled jobs. Highlights of the program include:

- The cumulative state funding for the COEP between 1986 and 2001 was $33.7 million and the cumulative matching funds received was $356.1 million, resulting in a matching fund ratio of 10.6 to one.
- Over the entire life of the program, intellectual property created by faculty participating in the Centers of Excellence accounts for 170 patents, resulting in 197 license agreements.
- Since the inception of the program, 142 companies have been created and licensed proprietary technology from the program.
- Currently, companies that trace their origins to the COEP employ an estimated 1300 persons in the high technology sector of the economy. The wage for this workforce averages $68,000 per year.

Since its inception in 1986, the program has helped create thousands of high-tech jobs, assisted in the creation of spin-off companies, and through improving products and processes has helped hundreds of Utah’s high-technology companies experience tremendous growth.16

Utah’s stature in IT, however, waned in the 1990s. Novell and WordPerfect merged in an effort to fend off challenges to their technology by Microsoft Corp. The attempt failed. WordPerfect became part of Canada’s Corel Corp. Iomega moved its headquarters from Roy, Utah, to San Diego, California; neither Intel nor Micron has yet realized more than a fraction of their original expansion plans for Utah. And Novell, though
still located in Provo, has moved its headquarters to Massachusetts and has restructured several times, resulting in a series of layoffs.\textsuperscript{17}

Referring to Utah’s technology successes and failures, former Governor Mike Leavitt said, “While we have a rich history of innovation, let’s be honest about it. While the number of jobs that have been created are in the tens of millions out of Utah technologies, too few of them have been created [or remained] here.”\textsuperscript{18}

\textbf{Utah’s High-Tech Industry in the Dot-Com Era}

Many former employees of Utah’s early tech ventures invested their severance packages into other start-up companies, some of which became successful. These, along with a collection of Internet and health industry start-ups, kept Utah’s reputation in the tech sector alive. In 1998, Utah received national recognition when \textit{Newsweek} placed Salt Lake City in a class of 10 cities worldwide as “hot new tech cities,” described as “high fliers whose success at attracting and nurturing high-paying, high-tech jobs is dramatically changing their regions’ demeanor.” According to industry experts, the main element needed for such cities is the presence of a major research university. The article cited the value of the University of Utah, one of the first institutions to link up to the Internet’s predecessor.\textsuperscript{19}

High-tech interest was just as strong in Utah during the ‘90s. The Utah-Silicon Valley Alliance, championed by then-Governor Mike Leavitt, developed a strategy to lure California-based companies to Utah with the state’s cheaper real estate, skilled labor force, and access to major research universities. In reference to the Alliance, Gov. Leavitt said, “We are planting seeds now that will bear fruit later. We are creating more than just jobs. We are creating 21\textsuperscript{st} century careers so our children and grandchildren can flourish in the New Economy.”\textsuperscript{20}

\textbf{Utah Recession and the Falter of High-Tech}

“When high technology gets the sniffles, Utah’s economy gets pneumonia,” said Utah Technology Industry Council member Brad Bertoch.\textsuperscript{21} During the nationwide recession that can be traced to March 2001, that assessment proved especially true. According to the 2004 Economic Report to the Governor, the decline of high tech in Utah was listed as one of three major factors of overall economic decline in Utah, along with the national recession and the closing of the 2002 Olympics.\textsuperscript{22}
Utah’s technology sector lost almost 10,000 jobs between 2001 and 2003. That represents a 15 percent loss of typically high-wage jobs. Computer systems design, computer and peripheral equipment, aerospace and software publishing all have average salaries above $60,000. In one year (2002), nearly 4,700 jobs were lost in these four high-wage subsectors. According to the Utah Department of Workforce Services, “…It’s the loss of the higher spending power from tech workers that’s having a disproportionate influence on the economy. It’s the loss of that spending power that has reached into retail sales, car and clothing purchases and service industries, and that’s prolonging the economic downturn.”

Assistance from state government in promoting high-tech also has slowed, according to some. “We have not put together a strategic plan to focus on high technology,” Bertoch said. UTIC council member Suzanne Winters concurred: “Utah, five years ago, was ranked in the top five of high-tech business economic development programs. Today we’re not even in the top 20.”

The picture created by recent tech indicators seems bleak, but it is not the entire picture. Although there have been undisputed losses in the tech sector, most of those losses have been confined to the information technology industry, which is barely one-fourth of the entire Utah tech sector. In fact, in 2003 three technology industries were posting gains on the year: medical equipment and supply, engineering services, and scientific research. Many companies in these important growing industries have even closer ties to and reliance on Utah’s research universities.

**State Outlook: The Re-emergence of High-Tech**

According to economic experts, dramatic losses in the high-tech sector may be at an end. The 2004 Economic Report to the Governor says, “The rate at which high technology jobs are declining appears to be slowing,” while the Utah Information Technology Association (UITA) is yet more optimistic: “Utah’s IT industry may have taken a beating along with the rest of the country’s, yet it continues to grow steadily larger.” In a recent study UITA found that Utah’s overall IT industry increased 13 percent since 1999, and the number of IT jobs is increasing as well; the 57,442 IT employees in Utah is an increase of 34 percent since 1999. Also, according to investor relations specialist David Politis, recent increases in venture capital funding in the state provide additional evidence that Utah’s tech sector is rebounding.
Continued state investment in high-tech has helped Utah weather the recent recession and move toward a high-growth potential once again. For example, Utah is participating with other forward-looking states in bridging the venture capital gap. In 2003 the “Fund of Funds” was established by the Utah legislature. The Utah Capital Investment Corporation is authorized under the legislation to use $100 million in contingent tax credits to induce venture capital firms to establish and maintain a presence in the Utah market. Revenue from the tax credits will not be directly invested in ventures but will be available to banks and financial institutions under secured instruments to make investments to venture funds in the state. As much as $200 million dollars could become available under this program for investments in new Utah enterprises, but it could also attract a pool of over a billion dollars of existing venture capital assets to the state.30

Recently, the state’s reorganization under the Utah Technology Alliance resulted in the establishment of new “ecosystems,” including Web Services, Biotechnology, Medical Devices and Digital Media. This new structure emphasizes the state government’s perception that increased attention must be paid to Utah’s infrastructure needs.

Two of these ecosystems represent major existing industry sectors. Biotechnology and biomedicine are growing at a rapid pace throughout the nation and will be responsible for more than 3.5 million jobs in the U.S. by 2014. Utah stands to benefit disproportionately from that growth; according to the Milken Institute, biopharmaceutical employment in Utah grew at a significantly faster rate, 194 percent, between 1993 and 2003 that for the nation (28.1 percent).31 Biotechnology’s future is impressive, considering the following:

- Biopharmaceuticals are responsible for 2.7 million jobs and 2.1 percent of total employment in the nation. Each job in the industry creates another 5.7 jobs elsewhere in the economy, substantially above the average for all industries.

- The biopharmaceutical industry paid an average annual wage of $72,600 in 2003 and is among the most productive sectors in the U.S. economy with real output per worker of $157,300.

- Many state economies are highly dependent on the biopharmaceutical industry, including New Jersey, Massachusetts, Indiana, North Carolina, Connecticut, Pennsylvania, California, Utah, Maryland, New York, Rhode Island, Illinois, and Washington.32

Both Salt Lake City and Provo have established strong clusters in biomedical research and in biotech—with Provo hosting the second-fastest-growing cluster in the Southwest
Companies that comprise these important clusters include TheraTech, Myriad Genetics, Echelon Biosciences, and Applied Biosciences. Each of these companies had its beginning in a university-based Center of Excellence. For example:

- Myriad Genetics, created in 1991 from work done at the University of Utah, has grown to become a leading biopharmaceutical company in the medical industry. Myriad guides the development of new healthcare products that treat major diseases, leading to proprietary targets for human drug discovery. Myriad currently has a professional oncology product sales force of 100 people and recently formed a partnership with Abbott Laboratories. In 2004, Myriad reported sales of $34.3 million, up 25 percent from FY 2003, and recent sales indicate that this growth rate will continue into 2005.

- TheraTech, founded in 1985 on research conducted at The University of Utah, has made a name for itself in the biotech industry as a leader in the development of innovative products based on controlled release drug delivery technologies, such as patches and mild electric pulses. TheraTech has developed two transdermal products and is working on a wide range of drug delivery products.

- Idaho Technology, incorporated in 1990 on research conducted at The University of Utah, created a high-speed thermal-cycling instrument to match the speed of biochemical reactions. In 1999, the company began working with the U.S. Air Force to develop the world’s first Ruggedized Advanced Pathogen Identification Device to detect or study disease-causing organisms.

During the early nineties, while these companies were just emerging, Utah relied on its strong background in software development and computer connectivity to set the state’s economic pace. While our pre-eminence in information technologies has waned, the newer entrants to Utah’s high-tech showcase have more than made up for those losses. The question Utah is faced with today is, “Where will Utah’s resources need to be directed for economic success in the 2010s?” The answer to that question lies on the lab benches and in the computers of our state’s research universities.

Despite the sometimes volatile nature of the tech sector, it remains a vital component of Utah’s growing economy. Overall, the majority of sustained economic growth nationwide will be in high-tech industries. Utah, which is in even greater need of high-wage jobs, must rely on the tech sector to create them. According to a recent article in Connect magazine,
“White-collar jobs that will be strong in the future will not be the standard high-tech jobs of the past. Rather, they’ll be high-concept and high-touch. Former programmers will become ‘IT designers,’ required to understand the bigger picture of business and relate to a larger group of people. The job becomes more of a synthesis of skills.”

Also, other industries—mining, farming, ranching, and manufacture—that have been the traditional mainstay of Utah’s economy, are predicted to continue declining over the coming years.

State Technology and Science Index: Utah’s Standing in High-Tech

The State Technology and Science Index was created by the Milken Institute as a benchmark assessment for states as a means to monitor high-tech economic progress. The index encompasses a comprehensive inventory of technology and science assets that can be leveraged by a state to promote economic development. The five equally weighted components of the index include:

1. Research & Development Inputs
2. Risk Capital and Entrepreneurial Infrastructure
3. Human Capital Investment
4. Technology and Science Workforce
5. Technology Concentration and Dynamism.

According to the Milken Institute, the single most important variable in explaining technology outcomes across states is the Risk Capital and Entrepreneurial Infrastructure composite. For 2004, rankings for western states were as follows:

California ................................................................. 2
Colorado .................................................................... 3
Washington ..................................................................6
**Utah** ................................................................. 9
New Mexico ............................................................ 14
Arizona ........................................................................ 17
Oregon ........................................................................ 19
Idaho ......................................................................... 30
Wyoming ................................................................. 41
Nevada ....................................................................... 43
Utah’s best placement was in technology concentration and dynamism, where it secured the highest number of *Inc* 500 companies per 10,000 business establishments. Utah is currently taking action to enhance its position in the future. Utah voters recently passed a constitutional amendment, which will permit universities to take ownership in private business exchange for intellectual property. Utah’s lowest ranking of 17 fell under Technology and Science Workforce Composite. This composite indicates the amount of research and development the scientific workforce converts into commercially viable products and services.

According to the Milken Institute, when skilled technical and science workers migrate from other regions to a geographic cluster or remain in a cluster after graduating from local institutions, localized growth is stimulated as they reinforce the initial advantages of the region. Regions that can retain their highly skilled technical and science workforce can attract new firm formation and sustain mature technology firms, eventually defining the region as a technology pole. Despite Utah’s high ranking on the overall index, the low score on the Technology and Science Workforce Composite is hurting Utah’s opportunity to become a true technology magnet. In states that offer both the relevant job opportunities and a vibrant, growth-oriented business environment such as California (3), Colorado (5), and Washington (7), the tech workforce is gathering intensity and attracting more and more firms to the region.40

*For state and local economic development, the message is this: the quality of scientists, engineers, physicists, system engineers and other creative technical workers that states train and retain, and attract from other locations, will profoundly impact a region’s future technology industry development.*41

Utah did score in the top ten of the index on the Technology Concentration & Dynamism Composite Index, which measures the degree to which a state’s economy is driven by the technology sector and the success of technology outcomes in that state. Just because technology is prevalent in a state does not necessarily mean that technology is growing in that state. With so many *Inc* 500 Companies, Utah has a high percentage of business births and many privately held companies begin in Utah, but we cannot retain these firms for the long-term. On the Technology Concentration & Dynamism Composite Index, Colorado ranked #2 with California at #4.
As Utah continues its economic recovery, many high-tech issues will need to be resolved.

- First, Utah’s diversity of high-tech industries needs to be recognized and celebrated. Though information technology has been the most visible industry, many other companies are emerging with promise of significant economic impact.

- Second, Utah continues to suffer from a low level of willing venture capital investors, which leads to an inability for research and technology to create commercial outcomes.

- Finally, Utah does not exhibit the same level of networking and partnership that commonly occurs in highly successful business clusters.

To help remedy these issues, methods and partnerships must be established to start-up and incubate potential successful businesses. Utah’s research universities are ready to help accomplish this, leading towards Utah’s next sustained economic boom.
Every Utahn needs and enjoys benefits of the state’s research universities—education, human capital development, social programs, innovation, and economic development. Key leaders from all facets of government, industry and media favor expanded support for university and technology research initiatives. From Governor Jon Huntsman, Jr., to Zions Bank President and CEO Scott Anderson, to both the Deseret Morning News and The Salt Lake Tribune, statewide support is strong for research universities.

**Government Support**

**Governor Jon Huntsman, Jr.**

*When you conclude, as I do...that the next 20 to 40 years of our economy of this country and indeed our state will be driven by biosciences, life and health sciences, nanotechnology and their implications for defense, communications and everything else, either we’re going to be part of that revolution or not.*

Platform Excerpts:

*Utah should continue to encourage innovation and creativity because it often leads to the formation of new companies, and ultimately jobs. As Governor, I would push for the following:*

- Streamline Utah’s technology transfer process at our research universities to make it effective for business creation in Utah....We need to encourage the commercialization
of our more innovative ideas…. A more collaborative approach will transform our technology transfer process into a driver for Utah’s economy.

- Support substantial funding for the Centers of Excellence Programs to incubate more start-up companies.

- Appoint a joint state/private task force to raise enough money to endow 30 new academic chairs at Utah’s colleges and universities. Each chair would fund the work of at least one professional researcher in areas deemed strategic to Utah’s economy.

- Consider state bond funding for development of a business accelerator in the University of Utah Research Park.

- Support the formation of another research park in Utah. This park should be a consortium of research universities, community colleges (training) and private sector.

- Support university endowments focused on targeted industries.²

Former Governor Olene Walker

Higher education is the engine of economic development. With the research programs at schools like the University of Utah and Utah State University, and the start-up businesses they influence, we have a great potential to transfer technology from research to business and back into research.³

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It is essential that we keep and grow high-technology companies here in the state. There is not a more educated and well trained workforce in the country…. Many of the great technologies of the world, like the television and network computing, were developed in Utah, and we must strive to build on this legacy.⁴

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We need more quality jobs, like those found in the tech industry, so that we can keep our most valuable resource–our families’ children–here in this state. To accelerate industry growth we need to find ways to...promote close cooperation between our schools and industry.⁵

*****
I have often said education is the fuel for economic development. That’s why one of the first things I asked [as governor] is, how can we get the research institutions and the private sectors working together to bring high quality jobs. Utah industry needs to keep up with the research coming out of our world-class universities. Everybody benefits when we work better with the universities.6

**Senator Bob Bennett (R-Utah)**

It is in our best economic interest to do all we can to encourage invention, innovation and investment.... Today, we are witnessing a revolution–the rise of a digital economy. This global medium will become the most important driver of business, economic and social change in this century.7

****

Now, the transformation of the white collar world into a high tech world, while not complete by any means, has caught up with the investment necessary to increase productivity. So we, as a nation, are increasing both blue collar and white collar productivity at a rate that is unprecedented in history, and that is what is driving the good times.8

**Former U.S. Senator E.J. “Jake” Garn (R-Utah)**

In an attempt to make ends meet today, some legislators would pull the footing out from under tomorrow; they would cut higher education, one of the most stable and therefore most stabilizing influences on our economic infrastructure. I look at the studies or just out the window and I see evidence of the effect that higher education–particularly our research universities–has on our lives.... While the state provides only a small portion of the earmarked funds for research, it provides crucial underlying support in the form of facilities and libraries. Without this support, the universities would be unable to attract top faculty or external funding. Without this support, we might as well be eating our own seed corn.... After 16 years on the Senate Appropriations Committee, I know the feel and weight of public purse strings. The constraints are real, and the times are indeed different and difficult. But neither of those excuses is good enough reason to just let higher education get by. We must not shortchange the future or our children.9
Jonnie Wilkinson, associate director of the state’s Office of Business Development

We’re not operating in a vacuum. We need a lot better cooperation among higher education and economic development along the Wasatch Front than we’ve done in the past, to create jobs.\(^\text{10}\)

Education Support

Michael T. Benson, president of Snow College, Ephraim, Utah

Investing in education is the wisest course any state can pursue because brains are now our most important natural resource…. Now, more than ever, our universities and colleges are in dire need of additional legislative support as we produce graduates who are better prepared to compete in today’s ever-demanding global job market.

But why am I, as president of a small, rural junior college in central Utah, advocating for increased investment into higher education in general and additional dollars for research space in particular? There are many reasons, not the least of which is that Snow College graduates—just like graduates of other smaller schools within our system—feed into these programs at our larger campuses throughout the state.

The cities on the winning end of the talent war...have two common denominators: They are in the top 10 for residents with college degrees and have the benefit of a research university in their area. Now is the time for Utah to invest even more in its institutions of higher education.\(^\text{11}\)

State Board of Regents Chair Nolan E. Karras

It is said we are in the “Information Age” or a “Knowledge-based economy.” Higher Education is the ‘knowledge factory.’ This is where new ideas are discovered and innovation fostered and then applied to real-life situations....Business partnerships promote the application of knowledge directly into the economy, [and] colleges and universities add significantly to the quality of life in their communities and the state as a whole. Sacrifice is...needed today to invest wisely in Utah’s future. But, it will pay great dividends in furthering Utah’s economic development.\(^\text{12}\)
Richard Kendell, commissioner of the Utah System of Higher Education

Research and development money...is such a vital part of [higher education] institutions and our economy. Science, technology and innovation will drive the economy into the future, and universities must be at the heart of the enterprise.¹³

Industry Support

Scott Anderson, president and CEO of Zions Bank

Scientific advancements...can have effects worldwide. But on a local level, university research and development plays an immediate and important role in the regional economy.... Research universities like the University of Utah and Utah State Univeristy, in particular, are cost-effective energy-efficient turbines generating talent that flows into the state economy.

In times of economic downturn, research universities are especially advantageous to a region. They are stable and enduring economic engines, constantly evolving as new ideas and industries emerge. They attract outside funds that flow into the state and help bolster the region’s economic growth and vitality.

In order for these schools to have the infrastructure and talent necessary to compete at the forefront of their fields, Utah’s legislature must provide them sufficient funding. Lawmakers ever-conscious of their role in bolstering Utah’s economy should evaluate research funding independent of general university allocations. The future of job growth and business expansion in the state depends on it.¹⁴

Curtis Brunson, president, Communications West, a division of L-3 Communications

We’re probably one of the largest acquirers of talent out of the University of Utah. We work very closely with them, we work with BYU, we work with Utah State and Weber State. They are our lifeblood. We could not survive without this kind of talent being pumped into our organization.¹⁵
Kelly K. Matthews, economist, Wells Fargo Bank

Now more than ever before, intellectual capital has become the source of business expansion and job creation. Certainly fertile soil and abundant mineral deposits remain important components of Utah’s economic base. There is little doubt, however, that the state’s future economic growth will be determined by our brains rather than our brawn and by the quality of our classrooms rather than the richness of our natural resources. Within the broad spectrum of educational opportunity, a prestigious, world-class research university is a vital lynchpin of the entire system.16

David Politis, president, Politis Communications

I love the fact that Utah’s technology economy, as well as the nation’s, appears to be on the road back to recovery.... I also love the fact that Utah has become a high-tech center. Not a Silicon Valley or a Seattle, nor a Research Triangle or Route 128. Rather it has become something different, something all its own.

Utah has a well-educated, multi-lingual, digitally aware and connected populace. This, plus ties to several institutions of higher education that are developing greater and greater educational results in areas of engineering, computer science, and applied science bode well for the state’s tech industry.17

Randy Rassmussen, chief operating officer, Idaho Technology, Inc.

Our first product was based on technology licensed from the University of Utah.... High-tech companies like ours cannot exist in isolation. They need interaction with outside experts to grow. The University of Utah is a great center of expertise in biotechnology. We are at the University of Utah’s Research Park to increase our interactions with the University. Most of Utah’s biotechnology industry is here in the park with us. Without the University of Utah, there would be no Utah biotechnology industry.18

Jack Sunderlage, former VP at Compaq, Vice Chair for UITA

[Lawmakers] hopefully will play a critical role to further establish our universities as “best is class” in certain areas. It is important to have our universities stand out in a few fields. In every major market, you have “best of class” universities whose research is spawning start-up companies in those fields.19
Media Support

Deseret Morning News

Utahns will reap big and long-lasting rewards from public expenditures in higher education, particularly if they keep the costs low for students and their families. Everyone who earns a college degree and stays in the state will end up helping the economy, by purchasing houses and other big-ticket items, and the state’s bottom line through taxes. Clearly, the state’s colleges and universities are... “the economic engine of the state”... because R&D is the basic engine that drives American industry and commerce. Tinkering with scientific research would be like using seeds for food instead of planting the next crop.20

*****

Private companies and universities may need to find more ways to work together on research so that both may benefit as the flow of Federal dollars begins to shrink. Without commitment to R&D, America could find itself as a second-rate entity in a high-tech world.21

The Salt Lake Tribune

By several standards, Utah’s research universities already are productive. Besides providing a highly educated work force, these specialized programs produce patents that fuel industry.

Utah legislators are not unique in the scrutiny of higher education costs and policies. What makes Utah different is its growing population and demand for excellent education, as well as progress already made toward greater efficiency. If the education system’s budget doesn’t keep up with demands for service now, its output, in both numbers of graduates and quality of education, will decline, and so will its abundant economic benefits.22

The Daily Herald (Provo)

There’s no denying that education needs to be a priority in Utah. The state’s economic success depends upon providing Utah [students] with the best possible education.23

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As legislators craft the state budget, they should not see the colleges as expenses to be controlled. Rather, they should see them as investments in Utah’s future.24

The Standard Examiner (Ogden)

State funding has dwindled, and relatively meager tuition increases during the past few years have not kept pace.... In short, faculty strength must be maintained...if the school’s degrees are to mean anything in the job market.25

*****

Utah desperately needs new business. But we’re at a severe disadvantage. The state, it appears, views incentives to attract business to the state as an expense; it should be viewing those expenditures as an investment for our future.... High-paying, highly skilled jobs are precisely the kind Utah needs and should be chasing.... When the U.S. economic engine starts to rev again, if the state doesn’t begin to put its money where its mouth is, we could lose out on more companies—companies with the kinds of jobs we desperately need to make Utah’s economy grow.26
Research universities have become an essential component of states’ economic strategies. In addition to performing the vital traditional role of education and adding to our collective ability to solve practical problems, research universities drive technology development and fuel regional and global economic growth.

**Research Universities Create Innovation & Technology**

Throughout history, research universities have produced much of the world’s basic and practical knowledge. Newton’s Laws, electricity, chemistry, the periodic table, quantum physics, genetics, and information technology are examples of areas that were advanced in large part by institutional research.\(^1\) Says Arizona State University President Michael Crow: “A necessary element for the development of these bodies of scientific knowledge was the presence of academic scientists who were motivated by the quest to push back the frontiers of knowledge.”\(^2\)

Indeed, university-based research has resulted in much more than just academic publications. Results have led directly to technologies and innovations that enable faster and more reliable transportation, more effective communication, healthier living, and other benefits that are now considered essential parts of daily life. Additionally, each of these activities has incrementally improved a thousand times over as a result of continued research advances, both large and small.

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<td>▪ Numerical controlled machine tools</td>
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<td>▪ Online information services</td>
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<td>▪ Advances in medicine</td>
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Again, ASU President Michael Crow:

*While each industry has its own story to tell, it is clear that all such industries could not have developed, or may not even have come into existence, without the presence of significant public investments in universities and complimentary organizations. These areas of knowledge have transformed not only our possibilities for industry, but also our understanding of human potential, our vision of our place in the world, and our expectations for the improvement of humanity and its surroundings.*

Fortunately, university-based research continues to improve the human condition. A large percentage of research projects aim to solve specific and practical problems and yield solutions that may otherwise be unattainable. These solutions have become more important than ever.

Not only have research advances improved the way we live, they have fundamentally changed the worldwide economy. Intangible information and technology now are worth more than many tangible resources and manufactured goods.

In the national economy, rapid growth has been and will continue to be in the high-technology sector. According to the Milken Institute, a non-partisan economic think tank:

- Scientific and technological change accounts for over 50 percent of long-term economic growth.
- High-tech has doubled its share of the U.S. economy over the past 20 years.
- Since the 1990-91 recession, growth in the high-tech sector has been four times as large as in the aggregate economy.

Without technological change, “the per capita growth rate of an economy will inexorably tend toward zero.” In much the same way that the manufacturing capacity of a region shaped its economic success in the early- to mid-1900s, its technological capacity will determine the extent of its growth and development in the 21st century.

Specialized knowledge is becoming a necessity, and creating that capacity requires investment. “Without sufficient research infrastructure and top-notch talent (e.g., research capacity), no university can serve as the hub for knowledge-based economic growth.” With that investment, though, comes great opportunity. According to industry experts, “investments in knowledge infrastructure offer transformational opportunities that rework the very nature of a region’s economy and its contribution to the global economy.”
Research Universities Fuel the Economy

Despite fluctuations in the economy, high-tech and knowledge-based industries will continue to earn the lion’s share of growth in the coming decades. Regions that want to be engaged in the next sustained wave of progress and economic development must be strongly invested in creating high-tech capacity.

At the heart of a region’s technological capacity lies the research university. As a developer of human capital and marketable innovation, the research university creates an environment that serves as an effective launch pad for emerging innovations and an attractive landing strip for relocating and expanding companies.

Business & Technology Creation

New high-tech companies are understandably based on new technology, and no institution creates that technology as consistently as research universities. According to one survey, approximately 10 percent of new products and processes depend on recent academic research.8

It is not the jobs created by the initial phase of university RD&E investments that matter. What matters is the creation of a new source of job creation. By spawning new technical fields and firms that can advance the commercialization of these fields, university RD&E investments serve as the seed corn of knowledge-based economic growth.9

Historically, research universities were not very active in the commercial sector, but since the passage of the Bayh-Dole act in 1980, which allowed universities to hold patents for their developed technology, the climate has changed. For example, the volume of university technology transfer through patenting and licensing has more than doubled in just the past six years.10 The intersection of academia and business has proved profitable for universities, researchers, companies, and the general economy as researchers have searched more diligently for knowledge and technology with practical, marketable applications.
Today, major research universities are pairing new technologies with market entry techniques. This process, known as technology transfer, includes a variety of activities. Kirchhoff (2002) points out:

*The glue that holds [new business] clusters together is the effort universities are putting into mechanisms to promote commercialization of the inventions that emerge from their laboratories. Such mechanisms include campus incubators where new firms can obtain low overhead space that includes low cost shared services; professional sabbaticals to develop inventions into commercial products or services; development of science parks; assistance with patent applications; and even university-created venture capital funds poised to provide the early, start-up stage capital that is so scarce in the private sector.*

Since the passage of the Bayh-Dole Act, American universities have:

- Spun off more than 2,578 firms to commercialize innovations born of research, 79 percent of which remain in the state where the initial research was conducted
- Created 280,000 jobs in the process
- Contributed $40 billion annually to the American economy.

Multiple and diverse lines of business, ranging from biotechnology to semiconductors, software and aerospace to plastics, paper to steel and automobiles, rely heavily on scientific research; such research provides the knowledge infrastructure crucial to the success of much privately funded research, and to economic development.

Research universities are also fertile ground for the “spillover effect,” which suggests that the “tacit knowledge generated by the R&D process at one firm may spill over to, and be subsequently exploited for, economic gain by other firms.” University-based research often exhibits the same spillover effects and helps spawn new firms from tacit knowledge created at the institution.

A study for the U.S. Small Business Administration investigated whether R&D activities at research universities have a significant effect on the formation on new local firms. The report stated that “just like business firms, research universities form local innovative activity centers, from which both knowledge spillovers and growth in specialized markets generate higher rates of new firm formations in one or more industries.” They also discovered that these effects endured for at least five years after initial R&D spending.
A region with a research university surrounded by a cluster of small- to medium-sized start-up companies can also create the ideal conditions for attracting larger, high-tech firms.

**Business Recruitment**

The Milken Institute conducted a study of variables that influence the location and development of regional high-tech industries. Each factor was rated on its effectiveness in helping to establish a regional high-tech cluster in the different stages of economic development. The institute found that:

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**Research centers and institutions are undisputedly the most important factor in incubating high-tech industries. A side effect of the technical capability and scientific research activities of these institutions is the training and education of the skilled labor that will be critical to the expansion and reinforcement of regional high-tech industries.**¹⁵

When knowledge is produced by a research institution, the benefits not only accrue to the producer, they often “spill-over” to the local economy. Therefore, universities with specialties in highly tacit—or experiential—knowledge, create a geographic incentive for companies based on that area of knowledge.

**Human Capital**

One of the most important contributions a research university can make to the economic development of a region is skills development through the graduation of high-quality,
technically savvy alumni. Just as manufacturing companies rely on resources of copper, steel, or wood, high-tech companies locate where their major resource—skilled and competent employees—can be found in ample supply.

Research universities help develop a highly skilled workforce equipped with the knowledge necessary to operate a high-tech economy. “Research universities graduate and attract college graduates to their local areas to provide the educated workforce needed to support the clustering of new firms.” Unlike manufacturing industries that use up their resources, however, the use of human capital only adds to the region’s wealth by creating a higher-paid workforce with greater discretionary income to spend on goods and services provided by other sectors of the economy.

In addition to creating and enhancing a skilled workforce, research universities are instrumental in ensuring that those workers remain in the region. “It is interesting that the attraction [by research universities] of post-graduate, professional business, and engineering students has been found to lead to their long-term relocation.”

**National examples of University-Instigated Economic Growth**

Across the country, regions in close proximity to research universities are becoming technologic and economic leaders. Although they vary in size and specialty, most of these areas provide a significant economic boost to their state.

**Silicon Valley, California**

Silicon Valley represents the archetype of high-tech economic growth instigated by university knowledge. As early as the 1930s, the seeds of high-tech entrepreneurialism were already being sown in Silicon Valley when Stanford electronics professor Fred Terman encouraged two of his students, David Hewlett and William Packard, to commercialize their audio-oscillator research. Located at Stanford Research Park, Hewlett-Packard quickly grew...
into a successful company and created the blueprint for other companies in the Park, and later in the 30-by-10 mile strip of land in Santa Clara County that became Silicon Valley.\textsuperscript{19} In close proximity to Stanford University and the University of California-Berkeley, IT-related companies sprang up along Highway 101 between San Francisco and San Jose. Those companies eventually numbered more than 4,000 and currently generate more than $200 billion in annual revenue.\textsuperscript{20}

Among the different organizations that were instrumental in the process of creating the technology powerhouse, the Stanford Research Institute (SRI) played the most significant role. Because of its commercialization efforts, most of the first Silicon Valley companies were formed by university faculty or alumni or were based on university-centered technology. Other companies were also drawn to the synergistic atmosphere that the university-based companies had already created. Close collaboration with the research universities, along with government incentives and the pleasant California climate, made the perfect foundation for the most successful local economy in the world.

\textit{Consider the numbers: In 1996, more than half of the $100 billion gross domestic products of the Silicon Valley economy came from companies started by Stanford graduates and faculty. In 1998, Silicon Valley attracted $4.7 billion in venture capital; had 15 percent of area workforce in research and development; and was the home of more than 40 percent of the wealthiest individuals in technology.}\textsuperscript{21}

According to the Milken Institute, “Policymakers from Kuala Lumpur to Jerusalem are busy trying to clone Silicon Valley.” Although the Institute holds that such a grand task is impossible, “those regions that come closest to duplicating Silicon Valley will be the leading technology centers in the early stages of the 21\textsuperscript{st} century.”\textsuperscript{22}

The Milken Institute created a composite measure of technology production centers in the United States. The Institute calls cities with high-tech production “tech-poles,” (see Figure 1; next page) because of the gravitational-like pull they exert on technology activities.\textsuperscript{23}
Figure 1: Milken Institute Tech Poles

Not surprisingly, the San Jose metro tech-pole is unparalleled, with a tech-pole index more than three times the second-place metro area. Virtually all tech poles—which are calculated by combining the location quotient with its share of national high-tech output—are located in close proximity to one or more major research universities.

Route 128, Massachusetts

Other regions of the country have experienced success in following the university-based economic model. The 60-mile stretch of Route 128 between Boston and Cambridge has become a high-tech mecca for some of the largest companies in the country, thanks to its university anchors, Harvard University and the Massachusetts Institute of Technology (MIT). More than 1,000 MIT-related companies such as Raytheon, Gillette, Thermo Electron, Lotus Development, and Bose are headquartered in Massachusetts. Those and other MIT-related firms represent at least 5 percent of the state’s employment.25

According to Business Week:

*If the companies founded by MIT alumni formed an independent nation, it would be the 24th-largest economy in the world, somewhere between*
South Africa and Thailand. Viewed another way, as of 1994 MIT-related companies employed a total of 733,000 people, or 1 out of every 170 jobs in the U.S. About 150 new MIT-related companies are founded each year.26

Other Regional Economies

Research Triangle in North Carolina, flanked by Duke University, the University of North Carolina-Chapel Hill, and North Carolina State University, is another example of a successful university tech center. Geographically, it is the largest research park in the world, with more than 35,000 workers earning $1.2 billion in salaries annually.27 Other regions are also creating successful university-based tech centers. For example, the University of Rochester and the Rochester Institute of Technology's strength in optic research has translated into a high concentration of imaging companies located in that area.28 The University of California-San Diego is a high-tech center for software and biotechnology companies in southern California.29 Robert Dynes, President of UC, says:

UC faculty and graduate students produce an average of three new inventions every single day. These are the inventions that lead to new products, new companies, new jobs and entire new industries for California. For instance, UC faculty and alumni have founded 1 in 4 biotechnology firms in California, and 85 percent of California biotech companies employ scientists and engineers with advanced degrees from UC.30

Austin, Texas, has become a rival to Silicon Valley for software and semiconductor companies, thanks in large part to the University of Texas-Austin, the flagship of Texas’ public university system.31 According to one report, higher education in Texas has fueled the state’s economy with nearly $25 billion a year and has contributed more than 600 high-tech companies in the Austin area and Dallas.32

Though the most-often cited examples of university-related business clusters are located around very prestigious universities, the most rapid high-tech growth is occurring around smaller clusters, especially in the western United States. Milken’s tech-pole measures show that Albuquerque, New Mexico, and Boise and Pocatello, Idaho, are experiencing rapid high-tech expansion, with growth rates of more than 10 percent annually. These cities have been successful in attracting large high-tech firms to their areas, including Intel, Micron Technologies, and Hewlett-Packard. Each of these high-growth cities is home to a research university.33
Research universities support students

Although research universities are the most important factor in creating a successful high-tech economy, economic development is not a university’s primary mission. The first role of the university is to educate. Strong research activity, however, is just as important to the integrity of higher education as it is to economic development. Bartlett (2003) says:

*The two responsibilities [of teaching and research] are in many ways complementary, and the ability of the researcher to integrate his or her students into the collective enterprise of research adds an important dynamic to the best schools.*

This research/teaching dynamic provides valuable opportunities for students to grow skills and competencies unavailable in traditional classroom environments. One study of students who had participated in undergraduate research projects identified more than 40 benefits gained from their experiences. Benefits mentioned in this and other studies are quite diverse. Students who conduct research are able to more firmly grasp the
concepts of the field they are studying, as well as other academic subjects, such as writing, statistics, and computer skills.36

Students who work with faculty on research projects also hone numerous cognitive skills, including analytical and critical thinking abilities, organizations skills, experience working with deadlines, public speaking skills, and the ability to form thoughtful questions. Perhaps the most poignant benefits of student research, however, are those that occur at the personal level. Student participants reported increased enthusiasm for the learning process, relationships with faculty mentors, consideration of ethics, emotional maturity, and self-confidence.

On the macro level, there are also many educational benefits of student interaction with faculty researchers. According to one study, universities with undergraduate research programs tend to have more students go on to pursue Ph.D. degrees.37 Students listed preparation for graduate school, and even the decision to attend graduate school, as a benefit of being exposed to the research process. Research also has been found to be a source of scientific talent, attracting more students to science and engineering fields, especially those from under-represented groups.38

Table 3: Selected Benefits of Undergraduate Research as Reported by Students

<table>
<thead>
<tr>
<th>Ability to analyze data</th>
<th>Increased comfort in statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to develop clear research ideas</td>
<td>Improved writing ability</td>
</tr>
<tr>
<td>Improvement in math skills</td>
<td>Opportunity to manage and troubleshoot</td>
</tr>
<tr>
<td>Ability to ask effective research questions</td>
<td>Influence on decision to attend graduate school</td>
</tr>
<tr>
<td>Improved teamwork skills</td>
<td>Application of ethical principles to actual research situations</td>
</tr>
<tr>
<td>Improved time management skills</td>
<td>Development of a one-to-one relationship with a professor</td>
</tr>
<tr>
<td>Development of leadership skills</td>
<td>Improved interpersonal communication skills</td>
</tr>
<tr>
<td>Ability to cope effectively with deadlines</td>
<td>Increased self-confidence</td>
</tr>
</tbody>
</table>
The educational aims of the research university serve to reinforce its economic value. By investing in the quality of students’ education experience, the community receives an enhanced output of human capital. More high-information and high-tech experts are created, as well as more potential entrepreneurs of high-tech companies. The Boyer Commission on Research Universities reported: “To an overwhelming degree, [research universities] have furnished the cultural, intellectual, economic, and political leadership of the nation.” 39
Because research universities are valuable to local, regional, and global economies, national public officials and industry leaders have widely recognized those benefits and have invested in improving the nation’s research capacity. Over the past decade federal research funding has grown at record rates, and national senators and representatives have extolled the importance of investing in science, technology, and university research. Industry leaders have also supported university research and partnerships, with a $10 billion investment since 2000.

**Federal Support for Research Universities**

*Federal Research Funding*

Over the past decade, Federal funding for research has grown substantially. John Marburger, Director of the Office of Science and Technology policy, stated: “....the President provides an unprecedented level of investment in Federal R&D, marking the first time in history that a President has requested an R&D budget greater than $100 billion. At $112 billion in FY2002, up 8 percent overall from last year, this is the largest request increase for R&D in over a decade.”

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**Federal Obligations for Academic R&D**

<table>
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<th>Year</th>
<th>Obligations (in thousands)</th>
</tr>
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<td>$17,290,384</td>
</tr>
<tr>
<td>2001</td>
<td>$19,385,740</td>
</tr>
</tbody>
</table>

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1. John Marburger, Director of the Office of Science and Technology policy, stated: “....the President provides an unprecedented level of investment in Federal R&D, marking the first time in history that a President has requested an R&D budget greater than $100 billion. At $112 billion in FY2002, up 8 percent overall from last year, this is the largest request increase for R&D in over a decade.”
The National Institutes of Health, the nation’s largest sponsor of research, recorded the most substantial funding increases, with many of its program budgets doubling between 1998 and 2003.²

Major public investment in the National Institutes of Health (NIH), which has seen its budget double in the last 5 years to nearly $27 billion for FY02 alone, has enabled the United States to both create a science and technology base in biotechnology and leverage substantial private investment in product and process applications.³

The National Science Foundation, which pays for 40 percent of all non-medical research projects at academic institutions, has been promised similar gains.⁴

Thanks to increases in Federal research spending, most universities across the country have been able to post significant gains in their overall research expenditures. This money has been used to increase the nation’s overall research activity and innovation productivity.
A more conservative growth pattern, however, is anticipated in the coming years for Federal research spending. Despite the slower growth in funding for future Federal research, overall, many programs have experienced dramatically increased funding. For example, research spending at the Department of Homeland Security is scheduled to rise by 15 percent in 2005.

No matter the level of Federal research funding, it is vital to maintain a foothold of research grants and contracts in diverse disciplines. Research grants are a major artery of university livelihood and regional economic health. Austere predictions of research funding should only steel a state’s resolve to be more competitive in securing those research grants from diverse sources.

Budget forecasts also indicate that strong partnerships with industry are more important than ever. Relationships with industry partners can help diversify research funding.

**Legislative and Agency Support for Research Universities**

United States legislators and other government officials, recognizing the benefits of research universities to their home states and districts, have worked to ensure strong Federal funding for research. The following are selected remarks about the value of investments in science, technology, and university research:

**U.S. Representative Sherwood Boehlert (R-NY):**

*Our research universities are such a vital national resource and I hope to ensure that they continue to play a significant role in our nation’s scientific endeavors.*

**U.S. Senator Kit Bond (R-MO):**

*Science in Missouri is extremely important. In this century, we’re going to lead the way in developing life sciences breakthroughs that will not only contribute to improved human health, but a cleaner environment and help hungry people around the world.*
U.S. Senator Pete Domenici (R-NM):

Basic research is the engine that makes our national defense, homeland security, and economic security possible.⁹

U.S. Senator Kay Bailey Hutchison (R-TX):

The [research] money coming into our state means better students and faculty at our universities, greater opportunity within our communities, and more diverse industries for our state.

We need the engineers to come from our Texas universities. We want to attract the great minds and we want to keep them there. It also creates role models and mentors for our young people to also go into science and engineering.¹⁰

U.S. Senator Joseph Lieberman (D-CT)

Innovation comes from our universities, laboratories and private businesses, not from the government. But a government that neglects innovation neglects the economic future of America…. For innovation touches every corner of our economy. Technological advancements enable workers and companies do what they do better, faster and more efficiently…. Government can spark innovation by directly supporting basic and applied research.¹¹

U.S. Senator Patty Murray (D-WA):

Increased funding for research programs will lead to better products and to bigger markets for Washington…. Especially now, we must do all we can to support industries which will provide jobs and economic growth.¹²

U.S. Senator Pat Roberts (R-KS):

I believe strongly in the need for science and technology research as a tool to improve quality of life for all Americans. And after September 11, this research is not only vital for thriving in an economically competitive world, it must be vigorously pursued…. Research
is important. Every Federal and state dollar spent today will pay economic and social dividends many times over in coming years.... A renewed commitment today to our institutions of higher education and especially to science, engineering and technology research is a commitment to our nation’s future.

If you do not have the basic research or the basic infrastructure to support that research, you do not go ahead with the technology you need to keep the best and brightest at home and provide employment opportunities. It’s as simple as that.13

**U.S. Senator Rick Santorum (R-PA):**

America is not going to be an economy that’s going to survive on using existing technology. We’re going to survive and we’re going to grow by creating new technology and being at the forefront. We can’t be a follower; we have to be a leader.14

**U.S. Senator James Sensenbrenner (R-WI):**

Basic science research is the engine of increased productivity for the American economy. Basic science research means more exports which means more jobs for the people of Wisconsin.15

**U.S. Representative Lamar Smith (R-TX):**

I think a focus on science is the smart thing. Science is the future, and high-tech jobs are the backbone of our economy.16

**U.S. Representative Zach Wamp (R-TN):**

For the dollars we invest at the Federal level, we get enormous benefits that far outweigh the investment.... Academia is actually the laboratories of ideas out there. It’s competitiveness, new breakthroughs.17
U.S. Senator Ron Wyden (D-OR):

There is nothing more important to me...than my work to help revive Oregon’s flagging economy. I believe research universities are the sparkplugs of economic activity. With adequate research funding we can build a strong economy for Oregon for the 21st century. 

Research and the U.S. Commission on National Security/21st Century

The bi-partisan Hart-Rudman Commission on National Security to 2025 was established to redefine national security and to do so in a more comprehensive fashion than any other similar effort since 1947. The third phase of the commission report points out that one of the primary threats to our national security is the failure to invest in science, math, and engineering education:

*In this Commission’s view, the inadequacies of our systems of research and education pose a greater threat to U.S. national security over the next quarter century than any potential conventional war that we might imagine. American national leadership must understand these deficiencies as threats to national security. If we do not invest heavily and wisely in rebuilding these two core strengths, America will be incapable of maintaining its global position long into the 21st century.*

The Commission believes the fact that the nation’s scientific and technological prowess is falling relative to other nations is a serious threat:

*Our systems of basic scientific research and education are in serious crisis, while other countries are redoubling their efforts. In the next quarter century, we will likely see ourselves surpassed, and in relative decline, unless we make a conscious national commitment to maintain our edge.*

There is also, however, opportunity in today’s technological climate. Says the Commission:

*We also face unprecedented opportunity. The world is entering an era of dramatic progress in bioscience and materials science as well as information technology and scientific instrumentation.*
and materials science as well as information technology and scientific instrumentation. Brought together and accelerated by nanoscience, these rapidly developing research fields will transform our understanding of the world and our capacity to manipulate it. The United States can remain the world’s technological leader if it makes the commitment to do so.²¹

Hart-Rudman Commissioner Newt Gingrich expounded on opportunities in science, technology, and the economy, and how research universities bring them together:

*My sense of the scale of the scientific revolution in the next 25 years is...if you are not in a position to have people who are first rate, you’re just not going to be in the game. And so I would argue...every state...ought to be looking at what does it cost us to sustain a first-rate capability in science.... [In] Georgia for example, despite the fact that for a long time it was relatively poor and very agrarian, the existence of Georgia Tech and the Georgia Tech research facilities around the state really made a difference and is now really paying off in North Atlanta. And I think that kind of approach is one I would recommend to every single state in the country.*²²

**Alan Greenspan**

Alan Greenspan, chair of the Federal Reserve through an unprecedented four presidencies, is one of the foremost experts on the strength and nature of the U.S. economy. Greenspan is a champion of the research university, citing it as a primary component and catalyst of the country’s economy and its transition into the information age.

Greenspan has noted that the United States economy is rapidly changing. “With the rapid adoption of information technology,” he says, “the share of output that is conceptual rather than physical continues to grow.” Much of this transformation, says Greenspan, is due to new innovation, especially in technology. He says: “Indeed, it is the proliferation of information technology throughout the economy that makes the current period appear so different from preceding decades.... As a result, information technologies have begun to alter significantly how we do business and create economic value, often in ways that were not foreseeable even a decade ago.”²³

According to Greenspan, research universities are necessary to facilitate these sweeping economic changes on both the macro and micro levels, because they are uniquely
positioned to respond to new demands on human capital, technology innovation, and business development. He says:

The advent of the twenty-first century will certainly bring new challenges for our society and for our education system.... We can be certain that our institutions of higher education will remain at the center of the endeavor to comprehend those profound changes and to seize the opportunities to direct them toward ever-rising standards of living and quality of life.24

Throughout history, the nation’s education systems, and research universities specifically, have helped its students gain the skills needed to operate in a changing economy. “The scale and scope of higher education in America was being shaped by the recognition that research—the creation of knowledge—complemented teaching and training—the diffusion of knowledge.” This has been the case throughout the nation’s development.25

Today’s economy is demanding an even higher standard: “Workers must be equipped not simply with technical know-how but also with the ability to create, analyze, and transform information and to interact effectively with others.”26 With the current conditions of an ever-changing economy, and two-thirds of high school graduates enrolling in college, with many adults reentering education, “our institutions of higher learning increasingly bear an important responsibility for ensuring that our society is prepared for the demands of rapid economic change,” says Greenspan.27

Universities must also accommodate rapid economic change on the technological front. Again, Alan Greenspan:

In a global environment in which prospects for economic growth now depend importantly on a country’s capacity to develop and apply new technologies, our universities are envied around the world. The payoffs—in terms of the flow of expertise, new products, and startup companies, for example—have been impressive.28

One of the greatest payoffs of research universities, according to Greenspan, is the tech cluster, or what he calls “significant centers of commercial innovation and entrepreneurship.”29 In these clusters, “creative ideas flow freely between local academic scholars and those in industry. State support, both for the university system and for small business, has been an important element in the vitality of these centers,” Greenspan says.30
Greenspan also stresses the importance of state support for research universities. At the 92nd Annual Meeting of the National Governor’s Association, Greenspan gave advice to state executives about operating in the new economy:

*States with more flexible labor markets, skilled work forces, and a reputation for supporting innovation and entrepreneurship will be prime locations for firms at the cutting edge of technology…. Your leadership as policymakers will be a key element in promoting an environment in which you join with others in business, labor, and education to realize the potential that technological change has for bringing substantial and lasting benefits to our economy.*

**Industry Support for Research Universities**

Since 2000, industry has sponsored more than $10 billion in university research and development. Even after the dot-com meltdown and nationwide recession, industry investment in research has barely slowed and is expected to increase dramatically over the coming years. As more partnerships between business and universities develop, the pace of industry investment accelerates. Already, nationwide industry R&D expenditures for universities have nearly surpassed all R&D expenditures by state and local government.

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**Industry-financed Academic R&D Expenditures**

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<tr>
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<td>$2,213,929</td>
</tr>
<tr>
<td>2002</td>
<td>$2,188,111</td>
</tr>
</tbody>
</table>
Noting the benefits of research partnerships with universities, leading industry professionals and stakeholders have voiced their support for technology innovation, basic research, and support for higher education.

**Microsoft / Bill Gates**

Former Washington governors Daniel J. Evans (R) and Booth Gardner (D) recall an instance in 2002 when Microsoft Corp. Chairman Bill Gates was asked after a speech, “What is the most important single thing that can be done to assure a prosperous economic future?”

Gates’ reply: “Support your local university.”³³

Microsoft is one notable example of a high-tech company that is eagerly creating partnerships with university talent. Bill Gates has repeatedly emphasized the importance of research universities and the partnerships forged between them and industry.

A few examples from Bill Gates:

**[Aug. 2, 2004]** Our commitment to higher education has been and will continue to be broad and strong. Academic institutions worldwide remain at the forefront of software innovation, driven by the possibilities of pure research and a limitless imagination…. Together, we’re exploring new research frontiers of innovation that will transform computing and create a better future for people around the world.³⁴

**[July 28, 2003]** The research and technologies coming out of university computer science, engineering and research facilities are truly amazing, which is why we continue to be so excited about our collaboration and investment with academia. And, like our academic partners, we are optimistic that the answers to the toughest computing questions are just beginning to take shape through new breakthroughs.³⁵

**[July 28, 2003]** One thing that university research is fantastic for is that each different university, or groups within a university, can go off and take a new approach. We want to make sure that we’re a collaborator, helping out, providing tools, providing what we know, and then seeing which of the approaches are making the advances, and making sure that we, along with
other companies like startups, can take that and make sure it has the impact in the marketplace that it should have.36

Microsoft has recently backed up Gates’ words by establishing several formal university research partnerships, including programs to identify, recognize, and support exceptional computer researchers; programs that will work with universities to simplify code generation, optimization and program analysis issues; summits for the exchange of ideas among faculty researchers; and other research pursuits.37

Top management at Microsoft also supports research partnerships with universities. Douglas Leland, worldwide director of the Microsoft Research University Relations group, says, “Our success as an industry depends on the tremendously talented people who graduate every year from universities. The relationship between industry and academia fuels a cycle of innovation, a ‘virtuous cycle,’ and we see it as a corporate imperative to engage in and nurture this cycle.”38

Anne Craib, director of international trade, Semiconductor Industry Association

If you have a decrease in funding for universities, by definition what you’re doing is lowering the quality of facilities and professors and basic infrastructure to educate your future engineers or technicians.39

Business and Finance Magazine

In recent decades increasing attention at both local and national levels has been given to the subject of technology transfer. In the US, collaboration between industry and universities has led to some impressive results with universities such as Stanford leading the field. Indeed, most of the world’s leading high-technology clusters are centered around such universities.40

Raymond Gilmartin, CEO of Merck & Co.

Markets will not tolerate slower-moving regions that do not continue to innovate—and create environments conducive to innovations.41
William R. Hambrecht, president, W.R. Hambrecht & Co., LLC

The competitive challenge for the future is likely to come not just from low-cost producers, but from low-cost innovators. Because the innovator club is growing, the United States must look to the fundamentals to sustain a competitive environment; support for basic research that creates the seedcorn for innovation, an assured talent pool, and the legal, regulatory, and accounting rules that can incent (or impede) industry investment in innovation.42

Mark Hanny, IBM vice president

Companies must be prepared for disruption, and universities must devote sufficient resources and investment to getting ahead of the curve of this new era. IT must be an integral part of any company’s new planning process. As such, we need a deeper partnership between academia and business to ensure that the students of today are qualified for the IT jobs of tomorrow.43

Joint Resolution of the Semiconductor Industry Association board of directors

Funding for fundamental research in physical sciences and engineering performed at America’s research universities is the single most important public-policy issue facing the industry today because of the long-term implications for both technology and workforce.44

Ross Perot, founder of EDS and former U.S. presidential candidate

A significant factor impeding the productive capacity of the US is the lack of resources devoted to research. Germany and Japan are far ahead of us on non-defense research, and probably even farther ahead in applying it to productive purposes. The U.S. needs to place a greater emphasis on research that adds to our quality of life and has commercial value as well. The Federal government could facilitate this effort by [budgetary] spending priorities and changes in the tax laws to encourage private research.45
Casey Porto, technology transfer expert and consultant, Case Western University

Any company that partners with the universities in these research areas is already leveraging millions and millions of dollars of state money. That is about as much risk mitigation as you can have in research.... When the company is spun out, it sounds like it's a new, risky endeavor, but the fact is the investors or the entrepreneurs spinning out the company at that point are leveraging all this Federal money that's gone into that research for years. That's why it's attractive for investors and entrepreneurs to start companies based on university technology. It didn't just get discovered yesterday. It's usually after many, many people have worked many years and spent millions of dollars.46

Willem P. Roelandts, president and chief executive officer, Xilinx Inc.

Unless governments step in and restimulate the long-term research in universities, I believe we are not going to see the rate of innovation we have seen in previous years.... The government should work through universities to stimulate research. That is an area where the government can really play an important role.47

David Tennenhouse, Intel Corp.'s director of research

Despite all that industry labs are doing to advance electronic devices, university research remains the key to future progress.... There is great science being done at universities.48
States throughout the country have also chosen to aggressively invest in their local research universities. Arizona’s Proposition 301—a $1 billion investment in high-tech, research, and education—is just one example of a neighboring state’s farsighted investment. In just a few years, money from Proposition 301 has spurred millions of dollars in new federal grants, added new faculty members and programs of study to the state universities, and created dozens of new research partnerships and ventures. Other recent examples abound of state governments placing top priority on their research capacity. Many of those states, including California, Georgia, Illinois, Michigan, New York, North Carolina, Ohio, and Virginia, are making commitments in the billions of dollars.

Case Study: Arizona and Proposition 301

In 2000, Arizona’s legislature and voters took a major step in promoting the state’s high-tech economy when it passed Proposition 301, which has been called “the most substantial public investment in Arizona’s economic future since the Central Arizona Project brought water into the state.” Proposition 301 is a bill that changed Arizona’s relationship with its public universities and total education system. By treating research capacity not as an obligation but as an investment, the state committed to its research universities $45 million annually over 20 years for high-tech economic and educational initiatives.

Arizona State University (ASU) president Michael Crow crystallized a vision for a new type of university, a “New American University,” that could bring new educational and economic benefits to Arizona. He wrote, “I [propose] a new model for an American research university,...one that does not just engage in community service but rather takes on major responsibility for the economic, social and cultural health of its community.”
According to Crow, this fresh direction for ASU encompasses many new imperatives, including: consideration of its socioeconomic setting; establishment as a force in the community; research inquiry with practical applications; examination of societal relevance; and global engagement. The most important of these, however, is the promotion of entrepreneurial opportunities. Crow wrote:

*As we move—fiscally, psychologically, emotionally—away from the paradigm that Arizona State University is not only an agency of the state government, we must move towards a paradigm that casts the university as an enterprise responsible for its own fate, an enterprise which the state government charters and empowers, and in which it invests.*

ASU is advancing the entrepreneurial potential of teaching and research. ASU faculty members engage in path-breaking research, developing new learning tools and new products with commercial application, all of which have the capacity to generate new revenues for the university and state. “ASU must capitalize on its knowledge content and intellectual property, expediting the transfer of knowledge and technology developed in our classrooms and laboratories to the commercial sector,” states Crow.

Based on this paradigm, Arizona legislators and citizens realized that research universities were positioned to address numerous public issues in the state, including growth, diversity, economic diversification, and environmental sustainability. According to the Morrison Institute for Public Policy, recognition emerged that:

- Universities are knowledge factories
- Arizona’s knowledge business depends on the state’s universities for their future leaders and inventors
- The quality and the competitiveness of metropolitan regions increasingly stems from new economic activities at their universities.

Even though, like most states at the beginning of the recession, Arizona’s budget was looming close to the red, state legislators came to believe a major investment in education was needed. Proposition 301, as approved by voters in November 2000, called for a six-tenths of a percent sales tax increase to support K-12 education, public university science and technology research, and community college workforce development programs.

Proposition 301 funding for public universities is “dedicated to expanding cutting-edge research and education in science and technology as a means to foster sustained...
economic growth in Arizona.” The funding is used to increase research capacity in six key areas: biosciences/biotechnology, information science, advanced materials, manufacturing, access and workforce development, and technology transfer.7

Funding in FY02-03 was used for new hires, seed funding for external grants, new entrepreneurial ventures, additional research programs, and skills development. Additionally, a large portion was applied to one “mega-project,” the Arizona Biodesign Institute (AzBio), which will be home to expanded biotechnology, nanotechnology, and information technology research programs.8

<table>
<thead>
<tr>
<th>NEW MONEY</th>
<th>NEW PROGRAMS</th>
<th>NEW VENTURES</th>
<th>NEW SKILLS</th>
<th>NEW TALENT</th>
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<tr>
<td>• $7.3 million in Federal awards</td>
<td>• 6 new courses in Bio, IT and Nano</td>
<td>• 13 new research collaborations with industry &amp; national labs</td>
<td>• 48 new post-doctoral students in pipeline</td>
<td>• Internationally renowned research scientist and business executive hired</td>
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<td>• $1.3 million in industrial contracts and donations</td>
<td>• A manufacturing research roadmap in collaboration with industry</td>
<td>• 1 new industry-university research consortium under development</td>
<td>• 19 new post-doctoral students entering workforce</td>
<td>to lead AzBiodesign</td>
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<td>• $400,000 in new products to ASU</td>
<td>• 6 proof-of-concept grants to faculty</td>
<td>• 6 new software packages distributed</td>
<td>• 120 new graduate students in pipeline</td>
<td>• 5 new senior tenured faculty successfully recruited</td>
</tr>
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<td>• $92,000 in value of new startups to ASU</td>
<td>• 13 technology transfer portal inquiries from industry</td>
<td>• 3 new products in marketplace</td>
<td>• 33 graduate students earning degrees and entering workforce</td>
<td>• 22 research faculty hired</td>
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<tr>
<td></td>
<td></td>
<td>• 3 new companies started</td>
<td>• 84 undergraduate students with research experience</td>
<td>• 24 post-doctoral research associates hired</td>
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<td></td>
<td>• 20 licenses/options signed</td>
<td>• 10 more graduates in Computer Science and Engineering</td>
<td>• 4 visiting scientists appointed</td>
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<td>• 17 patents approved and 106 patent applications filed</td>
<td>• 227 high school students completing software design material</td>
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<tr>
<td></td>
<td></td>
<td>• 91 inventions disclosed</td>
<td>• 88 internships in industry of Software Factory</td>
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<td>• 6 business plans written</td>
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Other support by the state legislature has also been given to Arizona’s research universities. The Arizona Research Infrastructure Bill, passed in June 2003, gave an additional $400 million in state funding for research facilities throughout the state. This gave Arizona State University the resources to build five new research-intensive buildings, thus tripling ASU’s total research space.  

Although it may take decades to fully realize the benefits of this visionary investment, there are already some indications of success. In just the past two years, Arizona has increased its ranking in the Milken Institute State Technology and Science Index. The Morrison Institute for Public Policy created measures to analyze the benefits of Proposition 301, called the CAT index, which will monitor connections, attention, and talent created by Arizona universities beginning in 2004.  

Arizona’s officials are confident in the potential of Proposition 301. “Leveraged with other public and private funding sources, Proposition 301 monies offer the state an extraordinary opportunity to stride ahead in the international race for brainpower, innovation, and competitiveness.”

**Other Recent State Investments in Research**

**Alabama**

$20 million: Center for transportation technology (2002)

Auburn University received a $20 million state fund match for $20 million in Federal money. The funds were used to construct a 194,000sf center for transportation technology on campus. The center will house researchers developing analytical approaches to highway design and construction, traffic modeling and vehicle safety.

$35 million, biomedical research facility (2001)

Gov. Don Siegelman agreed to provide $35 million from a state economic development fund to support a $90 million biomedical research facility at the University of Alabama-Birmingham. He also announced formation of the Alabama Research Alliance, a state, business and research university partnership designed to boost the state’s research investment.
Californians voted in November to publicly fund a $3 billion stem cell research initiative. Taxpayers’ money will be used to underwrite research to use embryonic stem cells to develop cures for Alzheimer’s disease and other illnesses. Under the plan, the research will be financed by a state bond issue over 10 years.14

University of California-Davis recently dedicated a $95 million Genome and Biomedical Center, funded by the Whitaker Foundation and the state’s Garamendi legislation (the Garamendi law allows California universities to take out a construction loan and pay it off using the overhead charges to research grants). The Center will house the UC-Davis Genome Center, the Department of Biomedical Engineering, and a revitalized pharmacology and toxicology department in the School of Medicine.15

California recently began a $300 million initiative to create new centers for biomedicine, nanotechnology, and telecommunications. Each center will receive $100 million in state funds over the next four years, and each is expected to raise twice that amount on its own, making the total potential investment worth $900 million. Former Californian Gov. Gray Davis (D) described this investment as “the most ambitious scientific research initiative ever undertaken” by the state.16

Proposition 47 (approved by voters November 2002) provided $13.05 billion in bonds, issued and repaid by California for the construction and modernization of elementary, secondary and higher education facilities. Of that, $1.65 billion was reserved for college campuses. The governor and legislature selected the projects to be paid for by the bond dollars and some of this funding went toward the completion of a new science building at California State University-Long Beach that will contain state-of-the-art teaching and research laboratories for chemists, biochemists and biologists.17

UC-Davis constructed a $39.6 million Plant and Environmental Sciences Building with half the funding provided by state bonds and the other half through university funds.18

**Florida**

$20 million, Centers of Excellence program (2004)

Governor Jeb Bush (R) recommended $20 million in the FY04-05 budget for a Centers of Excellence program in Florida, designed to foster innovative, cutting-edge technology research at Florida’s colleges and universities.19

$10 million, biotechnology center (2003)

With a $10 million grant from the state, the University of Florida’s Center of Excellence for Regenerative Health Biotechnology was created to stimulate promising research, facilitate commercialization of treatments that provide cures for human diseases, and create new companies and high-wage jobs for Florida.20

$180 million, research center (2002)

A new $180-million addition to the H. Lee Moffitt Center, the Vincent A. Stabile Research Building, which was completed in April 2003, will add 350,000 square feet of research space that can be used as a recruitment tool and help the University of South Florida gain national recognition as a Carnegie Research 1 university. The new research center has three floors of research laboratories and provides Moffitt with research and clinical areas as well as a conference center and auditorium.21

**Georgia**

$1.05 billion, Georgia Research Initiative and building program (2004)

Vowing not to raise Georgians’ taxes next year, Gov. Sonny Perdue unveiled a budget that slashes spending across state government by $800 million. The Republican governor
still found $5 million for the Medical College of Georgia Research Initiative and the money to give teachers and state workers a modest pay raise, keep hospitals and state parks open and borrow $1 billion for a building program aimed at speeding the state’s economic recovery.22

$200 million, Georgia Research Alliance (1990-2002)

Since 1990 Georgia has invested $200 million in the Georgia Research Alliance, matched by $50 million from the private sector. This resulted in an additional $500 million from the Federal government in increased grants and contracts awarded competitively based on the increased merit and achievement of the research enterprise built at the six research universities in the state. The total enterprise has doubled since 1990, from $400 million annually to over $800 million. Venture capital has tripled, patents awarded have tripled and industry relationships with university researchers have more than quadrupled.23

Illinois

$2 billion, VentureTech technology program (2000)

Gov. Ryan’s VentureTech program is a $2 billion, five-year program launched in 2000 to invest state resources in technology. The program is funding projects like the construction of research facilities at Northwestern University’s Chicago campus and the University of Illinois at Chicago. VentureTech has also funded the following “bricks and mortar” investments:

- Rare Isotope Accelerator Science Center at Argonne - $16.6 million
- Center for Nanofabrication and Molecular Self-Assembly - $5 million
- Argonne Nanoscale Center - $19 million in FY02 and FY03
- Thomas M. Siebel Center for Computer Sciences - $80 million funded by state and private donations
- UI National Center for Supercomputing Applications - $30 million - $2.5 million annually
- Fermi Accelerator Research – $2.5 million
- Advanced Photon Source - $3 million annually
- UI Microelectronics Laboratory
- University of Illinois Tech Incubator - $10 million
- UI Medical School - $93 million
- Chicago Tech Park Expansion - $17 million
- UI Medical Resonance Imaging - $10 million
- UI Chemical Sciences - $70 million
- Northwestern University Biomedical Research Building - the state’s $30 million investment has already secured an additional $90 million in private investment and is expected to yield $76 million annually in federal research grants
- SIU Cancer Institute - $17 million
- University of Chicago Juvenile Diabetes Center - $13.4 million
- Illinois Institute of Technology Biomedical Research Center - $12 million

$123 million, high-tech research facilities (2002)

Gov. George Ryan’s VentureTech program provided $123 million to the University of Illinois to develop three high-tech research facilities on its Urbana-Champaign campus: $67.5 million for the Post Genomic Institute, $27 million for the National Center for Supercomputing Applications, and $18 million to expand the Micro and Nanotechnology Laboratory. The money is separate from the state’s higher education budget and was included in the state budget for the 2002 fiscal year.

Construction of the buildings, which will occupy nearly 230,000 square feet, began in 2002 and is expected to be completed within the next two years. Gov. Ryan’s office estimates the project will create 1,500 construction jobs.
Massachusetts

$10 million, engineering research center (2004)

Collaboration between the University of Massachusetts-Amherst campus, three other universities, and various companies including Raytheon Co. of Waltham, will create a new engineering research center with a $17 million grant from the National Science Foundation. With contributions from the state and from business the project is now funded at $40 million.26

Michigan

$1 billion, life sciences corridor (2002)

In May 1999, the University of Michigan committed $200 million for the establishment of a life sciences institute; by 2002 the University of Michigan spent about $700 million on new life sciences research facilities including a Life Sciences Institute Building, a 236,000 square foot state-of-the-art research laboratory building. Construction costs were $96 million. The University of Michigan is also investing $220 million for a new Biomedical Science Research Building. The state has committed $1 billion to develop its Michigan Life Sciences Corridor over the next 20 years.27

Minnesota

$250 million proposed, biosciences initiative (2004)

Governor Tim Pawlenty will ask the Minnesota Legislature to fund his ambitious biosciences initiative this year, with the governor’s biotech advisory council recently recommending $250 million to grow the state’s biotech industry. The biosciences initiative includes $117 million to help develop facilities in the Twin Cities and Rochester to support biotech growth (including $32 million for a bio-fuels research facility at the University of Minnesota); $70 million for biotech research funding for a new biosciences research partnership with the Mayo Clinic and the University of Minnesota; and $50 million in endowed professorships for the University of Minnesota.28
Missouri

$350 million, higher education facilities (2004)

Missouri colleges and universities will benefit, with total costs per project and state’s contribution, from a $350 million bond proposal now before the State Senate.29

$190 million, research center (2003)

State House Speaker Catherine Hanaway (R) and Senate President Pro Tem Peter Kinder (R) gathered support for a bond issue that will raise $190.4 million to renovate buildings and build new research centers at each of the four University of Missouri campuses to increase the state’s investment in life sciences research.30

$31 million, life sciences building (2002)

Gov. Bob Holden seeks to provide $31 million in state funds for a life sciences building that business leaders hope will boost Kansas City into the top ranks of bioresearch centers in the nation. The building would house the university’s schools of Pharmacy and Nursing and cutting-edge laboratory and research facilities, university officials said. Holden said he would release $1.7 million immediately, which will allow the university to seek an architect to design the project. Even in tough economic times, he said, the state must make investments that will make Missouri a leader in research and development of new products.31

Nebraska

Science center (2002)

Creighton University Medical Center is squeezing a six-story science center between buildings. It also is renovating existing space into a neuroscience lab that can be used only by NIH-funded scientists. Creighton currently has tax-exempt financing in place and has received oral commitments to substantially cover the costs of the new building.32
New Jersey

$300 million, technology infrastructure (2004)

Since 1998, over $300 million in state funds have been granted for technology infrastructure and inter-institutional connectivity including: scientific and other equipment, technology-based economic development initiatives, recruiting of renowned faculty, and programs in targeted high-tech disciplines.33

Innovation Zones (2004)

Governor James E. McGreevey this year unveiled plans for the creation of Innovation Zones. The Innovation Zone concept is the state’s latest initiative that builds upon Economic Development Administration’s past successes in strengthening university, business, and government collaborations. This proposal, designed to spur collaboration between universities and business community, will target financial and other state resources to provide funding and technical support that encourages universities and private businesses to collaborate on projects, encourages businesses to locate in the defined zones, and attracts more Federal and other research dollars to businesses and universities located in the zones. It will seek to attract scientists, students, and entrepreneurs with the goal of creating a technology environment where people live, work, and learn.34

$518 million, research building program (2002)

The University of Medicine and Dentistry of New Jersey embarked on a $518 million building program to house new research, classroom and clinical space. In 1998, the university began a major push to improve its research capabilities, including programs in cancer, cardiovascular disease, neuroscience and injury caused by trauma.

The University has already completed the International Center for Public Health, a $78 million facility in Newark, with the help of the New Jersey Economic Development Authority (EDA). The EDA financing and real estate capabilities are being used for the project. The State of New Jersey provided an $18 million appropriation to the EDA for site acquisition, relocation, design and improvement costs. The EDA sold $46 million in low-interest long-term bonds for the project, and the balance is being funded through
grants and loans obtained by UMDNJ and University Heights Science Park. A new $37 million behavioral health science building will open in Newark next spring, and UMDNJ is building a new $45 million research tower for molecular biology in Piscataway.\textsuperscript{35}

$95 million, research buildings (2002)

The University of Medicine and Dentistry of New Jersey broke ground for a $100 million seven-story cancer center in Newark that will include a hospital complex along with cancer research labs. It is also tripling the size of its cancer facility in New Brunswick with a $71 million 150,000-square foot building. In addition, the university’s Cancer Institute of New Jersey will receive $20 million in financing from the state’s tobacco settlement fund. The buildings are to be financed through $95 million in state bonding authorized earlier and an additional $280 million in bonds underwritten by the University. The University will finance the rest of the construction with gifts to the University and other internal funds.\textsuperscript{36}

New Mexico

$21 million, public education facilities (2004)

The University of New Mexico will receive $21 million from the recently passed Bond Measure B and plans to use it as follows:

- $8 million to plan, design, construct and equip an expanded anatomy teaching laboratory at the Health Sciences Center
- $2 million for patient care equipment at the Health Sciences Center
- $4 million to help plan, design, construct and equip the $30 million Centennial Engineering Center at the School of Engineering on the main campus
- $3 million to renovate existing buildings on the main campus
- $200,000 to install equipment for a computer technology “clean room” on the main campus.

In all UNM will receive $550,000 for its Valencia branch campus and $3.2 million for its branch campuses in Los Alamos, Gallup and Taos from Bond Measure B.\textsuperscript{37}
New York

$1.2 billion, high-tech and biotech development (2001)

The New York State Legislature approved Gen*NY*sis, a $225 million fund created to promote the biotechnology industry. Gen*NY*sis’ budget is part of a $1.2 billion capital program to expand businesses and create new high-tech and biotech businesses in the state. During September 2002 Gov. Pataki announced three major Gen*NY*sis investments:

- The University at Albany will build a $45 million, 125,000-square-foot Center for Excellence in Cancer Genomics at its East Campus, the hub of the school’s biotechnology efforts. Much of the work at the new center will be devoted to understanding metastasis, or the spread of cancerous cells.

- $403 million microchip research and development facility called International Sematech North at the University of Albany this fall, will make the region “a worldwide leader in high-tech and biotech research and economic development.”

- The state will provide $48 million to support a $71.5 million partnership between industry and university groups on Long Island to bolster biotechnology and educational and research programs.

- Rensselaer Polytechnic Institute (RPI) will receive $22.5 million from the state to create a Center for Bioengineering and Medicine. The research center will be housed in RPI’s Center for Biotechnology and Interdisciplinary Studies, an $80 million 218,000-square-foot facility currently being built on RPI’s Troy campus.38

$50 million, University of Rochester Medical Center research and central New York Biotechnology Research Center (2002)

The $30 million pledged to the University of Rochester (UR) Medical Center by Gov. Pataki will mean new tenants for the Rochester Technology Park and seed money for start-up biotechnology companies. Part of the grant—about $20 million—also will pay for completing construction and equipment purchases at the medical center’s new research buildings, which UR officials described as essential for the recruitment of scientists and technicians. UR officials estimate the $30 million—the largest single contribution to the medical center’s research efforts—will create 3,500 jobs at the medical center, related vendors and spin-off companies and in construction. It is also projected to help produce
$45 million in venture capital and royalties. UR will use about $5 million to support a partnership with Rochester Technology Park in Gates. The venture, University Technology Partners Inc., will help commercialize UR research discoveries. About $5 million will be used to lease tech park space for start-ups created from UR biomedical research, said Mark Scheuerman, president and chief executive of UTP.

Governor Pataki announced that state taxpayers will supply $20 million of the $35 million needed to build the first phase of a proposed 240,000 square-foot Central New York Biotechnology Research Center. The biotech center, jointly run by SUNY Upstate Medical University and the SUNY College of Environmental Science and Forestry, will eventually grow to encompass three buildings and cost $80 million. The first phase will be 80,000 square feet on less than an acre leased from the Syracuse Veterans Affairs Medical Center and will cost $35 million. Officials touted the center as a boon for the local economy, initially generating 250 jobs with the possibility that it will create 1,000 jobs once all three phases of the complex are complete. Groundbreaking for the first phase is anticipated to take place in about 18 months.39

North Carolina

$4.5 billion, UNC buildings and renovations (2001)

The legislature of North Carolina voted for $5.1 billion in bonds with $4.5 billion going to the University of North Carolina for new buildings and renovations. The measure passed in every county of the state with an overall 73 percent positive vote. The vote came after an intensive study of need, and a lot of support from the NC Citizens for Business and Industry who raised the money for a lobbying campaign. Several major projects have bid successfully for funding, including the B.B. Dougherty Renovation at Appalachian State ($1.3 million), Film Archives Building at the North Carolina School of the Arts ($2.2 million), Central Utilities Plant at North Carolina State University ($15.9 million), and Health Sciences Library Renovation at UNC-Chapel Hill ($12 million).40

$24 million, nanotechnology research building (2002)

NC State University’s Centennial Campus in Raleigh will soon break ground for a new building devoted entirely to nanotechnology R&D. The building will be 80,000 square feet and will cost $24 million.41
Ohio

$1.1 billion, Third Frontier Project (2002-Present)

In 2002 Governor Bob Taft unveiled Ohio’s Third Frontier Project (TFP), the state’s largest-ever commitment to expanding high-tech research, innovations and company formation. The 10-year, $1.1 billion initiative has built world-class research facilities, supported early stage capital formation, the development of new products, and has funded advanced manufacturing technologies to increase productivity in existing industries.42 Under the initiative, various programs were instigated to foster collaboration among Ohio’s higher education institutions, non-profit research organizations, and local companies to ensure the state’s successful economic future. These programs include:

- Wright Centers of Innovation–approximately $40 million in grants were awarded in FY2004 from the Ohio Department of Development to support collaborations between Ohio higher education institutions, non-profit research organizations, and Ohio companies in order to accelerate the pace of commercialization in Ohio.

- Wright Projects–approximately $10 million43 in grants were awarded in FY 2004 from the Ohio Department of Development to support specifically defined near term commercialization projects at Ohio higher education institutions and non-profit research organizations who are conducting research into areas of advanced materials, power and propulsion, information technology and instruments, controls and electronics.

- Biomedical Research and Technology Transfer Partnership Program–grants to conduct research leading to commercialization and long-term improvements to the health of the citizens of Ohio.

- Third Frontier Fuel Cell Program–grants to support growth of the fuel cell industry in Ohio with focus on technical and cost barriers to commercialization and adapting fuel cell components produced in Ohio for use in fuel cell systems.

- Product Development Pilot Program–grants to support product development assistance, including design, engineering, financing, marketing and management, to small and medium-sized Ohio manufactures.

- The Innovation Ohio Loan Fund–created in 2003 with initial capitalization of $50 million to assist companies in Ohio develop next generation products and services.

- The Third Frontier Network–over 1,600 miles of dedicated high-speed fiber-optic network for linking Ohio’s colleges and universities, elementary, middle and high schools, and state and local governments, medical research centers, federal research centers.44
The following monetary awards were made in 2004 as part of the TFP:

- The University of Cincinnati’s Genome Research Institute received $68 million in federal, non-profit and industrial funding.

- The Biomedical Structural, Functional and Molecular Imaging Enterprise, located at The Ohio State University in Columbus, received $6 million from the National Institute of Health.

- The Power Partnership of Ohio, located at Case Western University in Cleveland, received $6 million in federal grants, as well as a $780,000 National Science Foundation education grant.

- Columbus-based LeadScope received a $2 million award from the National Institute of Standards and Technology (NIST.)

- The Cardiovascular Bioengineering Enterprise, located at The Ohio State University in Columbus, secured $10 million in federal funding.45

Oklahoma


The Tulsa area could become another growth area for the biotech industry. That possibility was helped with the passage of Tulsa County’s Vision 2025 proposal last year. Vision 2025 projects under consideration to receive part of the proposed $99 million funding package for higher education include a research and medical clinic at OU-Tulsa. That project could produce skilled graduates for the biotech industry as well as generate more spin-off companies in the Tulsa area. The expansion of biotechnology research in Oklahoma commands a high price tag but the end results are worth the investment, officials say. According to one report, for every $1 invested in health research, the state gets back $5.46

$38 million, national weather center (2002)

The Oklahoma legislature appropriated $38 million to establish a national weather center at the University of Oklahoma in Norman and state-of-the art bioterrorism research facilities at Oklahoma State University in Stillwater. The Federal government
set aside funds to match the state’s investment including $19 million for the OU weather center. OSU is expected to receive a sizable portion of the $20 billion the Bush Administration and Congress are expected to allocate for bioterrorism research. “This legislation will pay enormous long term benefits to the state of Oklahoma,” Governor Frank Keating said. “Establishing these facilities at our two comprehensive universities will enable Oklahoma to establish itself as the premier center in the United States for weather and bioterrorism related research. These projects will provide students with an educational environment second to none and will have a tremendous impact on both the public and private sector.”

Oregon

$18 million, research park science building (2004)

The University of Oregon plans to build its new science building in the Riverfront Research Park and make it a multi-use center combining nanotechnology research and a “high-tech extension service” to help develop new businesses from UO discoveries. The building could be as large as 60,000 square feet and cost in the neighborhood of $18 million.

$20 million, nanotechnology initiative (2004)

The Oregon legislature has allocated $20 million for construction and $1 million for operations for the Oregon Nanoscience and Microtechnologies Institute (ONAMI) initiative. The UO will receive $9.5 million of the construction funding and $475,000 of the operating money when bonds for the project are sold in early 2005.

South Carolina

$500 million, economic development package (2004)

South Carolina unveiled a $500 million technology-based economic development package that targets life sciences, commits state funds to venture capital and facility and infrastructure improvements at the state’s three research universities.
$25 million, engineering education center (2002)

BMW announced a $10 million endowment for Clemson University to create a graduate engineering education center in Greenville. The gift is the largest cash donation in Clemson’s history. BMW’s $10 million pledge will endow the academic programs, and S.C. Governor Jim Hodges said that the state will give $25 million to build and equip a state-of-the-art research facility. The recently conceived graduate center for automotive research is expected to attract at least 50 new students. The center would provide both the academic and research support needed by BMW, its suppliers and the state’s rapidly growing automotive industry.51

Tennessee

$40 million proposed, research park lab space (2002)

Memphis is in the process of building a $40 million, 160,000-square-foot lab building that will represent phase one of the UT-Baptist Research Park. When complete, the UT-Baptist Research Park will consist of 1.2 million square feet of research space. The Tennessee Department of Economic and Community Development announced a grant of $750,000 to Memphis to begin the infrastructure work necessary to build the biotech research park. Tennessee Industrial Infrastructure Program (TIIP) funds are to be used for infrastructure improvements or for job-specific workforce training for Tennessee industry. The current goal is to raise $32 million from public and private sources over the next two years.52

Virginia

$900.5 million, research infrastructure (2002)

Virginia voters approved legislation that allows the Commonwealth to sell bonds to pay for capital projects at public colleges, museums, and other educational facilities. The University of Virginia (UVA) will get $68.3 million in projects from passage of the bond referendum, including more than $24 million toward a 183,000-square-foot medical research building that would provide lab space for research in cancer, infectious diseases, allergies and immunology. Another $7 million would help UVA build a 100,000-square-foot research facility for the engineering school’s material science engineering department and the Center for Nanoscopic Materials Design. George Mason University expects their share of the bond to go toward both a performing arts facility and research facility.53
**Washington**

$750 million proposed, biotechnology initiative (2004)

In his State of the State address, Gov. Locke promoted the Bio 21 initiative—a plan to invest as much as $750 million in public money over the next 15 years to nurture Washington’s infant biotechnology industry. He hopes to lay the foundations of such a strategy before he leaves office in 2005. Over several months, Locke has gathered the state’s top research institutions and corporations to put together a biotechnology initiative that is turning into one of the most ambitious industry-fostering plans the state has attempted. Under the plan, the state’s top research institutions could vie for competitive, peer-reviewed state grants, with preference given to researchers who team up to speed progress. Venture capitalists and corporations like Microsoft and Amgen would be involved early.54

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<td>$1.65 billion for higher education facilities (2002)</td>
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<td>$19.8 million for plant and environmental sciences building, (2002)</td>
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<td>Florida</td>
<td>$20 million, Centers of Excellence program (2004)</td>
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<td>$10 million, biotechnology center (2003)</td>
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<td>$180 million, research center (2002)</td>
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<td>Georgia</td>
<td>$1.05 billion, Georgia Research Initiative and building program (2004)</td>
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<td>$200 million, Georgia Research Alliance (1990-2002)</td>
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<td>Illinois</td>
<td>$2 billion, VentureTech technology program (2000)</td>
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<td>$123 million, high-tech research facilities (2002)</td>
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<td>Massachusetts</td>
<td>$10 million, engineering research center (2004)</td>
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<td>Michigan</td>
<td>$1 billion, life sciences corridor (2002)</td>
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<td>State</td>
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<td>Minnesota</td>
<td>$250 million proposed, biosciences initiative (2004)</td>
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<td>Missouri</td>
<td>$350 million, higher education facilities (2004)</td>
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<td>$190 million, research center (2003)</td>
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<td>$31 million, life sciences building (2002)</td>
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<td>New Jersey</td>
<td>$300 million, technology infrastructure (2004)</td>
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<td>$518 million, research building program (2002)</td>
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<td>$95 million, research buildings (2002)</td>
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<td>$21 million, public education facilities (2004)</td>
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<td>New York</td>
<td>$1.2 billion, high-tech and biotech development (2001)</td>
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<td>$50 million, University of Rochester Medical Center research and central New York Biotechnology Research Center (2002)</td>
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<td>North Carolina</td>
<td>$4.5 billion, UNC buildings and renovations (2001)</td>
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<td>$24 million, nanotechnology research building (2002)</td>
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<td>Ohio</td>
<td>$1.1 billion, Third Frontier Project (2002-Present)</td>
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<td>$38 million, national weather center (2002)</td>
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<td>Oregon</td>
<td>$18 million, research park science building (2004)</td>
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<td>$20 million, nanotechnology initiative (2004)</td>
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<td>South Carolina</td>
<td>$500 million, economic development package (2004)</td>
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<td>$25 million, engineering education center (2002)</td>
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<td>Tennessee</td>
<td>$40 million proposed, research park &amp; lab space (2002)</td>
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<td>Virginia</td>
<td>$900.5 million, research infrastructure (2002)</td>
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The contributions of higher education have always been valued in Utah. Advanced learning was a key tenet of Utah’s first immigrants. “We should be a people of profound learning,” said Brigham Young, L.D.S. church president and first territorial governor. Public education was as important to the settlers as tilling land, sowing crops, and building houses. During Utah’s early years, the University of Utah and Utah State University had a large role in advancing the state’s intellectual capital, industry, and development. Where, a century ago, the state’s research universities were vital for their contributions in agriculture, mining, and military training, they are now a fundamental part of regional economic development.

The University of Deseret was established just two years after the pioneers’ arrival in the Salt Lake Valley; it was, in fact, founded even before the state became a state! The first classes of the University were small, and funding was a continuing challenge for the frontier community, yet enthusiasm for the institution never diminished. After many years of struggle and growth, the University of Deseret eventually became the University of Utah.

In 1886, the Agricultural College of Utah was established as the forerunner of Utah State University. Over time, the University of Utah and Utah State University have grown up with the state, providing both different and similar functions that have substantially enhanced the state’s well-being.

**Establishment and Mission of Utah’s Research Universities**

**The University of Utah**

The first classes taught at University of Utah (then the University of Deseret) were held in private homes or wherever suitable space could be found. Funds to pay for teachers and
supplies came from private donations. The urge for an institution of higher learning in Utah was strong, but the economic foundation needed to be built. Classes were suspended after two years, until the state’s investment in higher education began in earnest.

During the early years of the University, even under trying economic conditions and uncertainty about location, the University produced a number of benefits to the state, including graduates of note in many fields. These included Heber M. Wells, the first governor after Utah achieved statehood; Heber J. Grant, president of the L.D.S. church; Don Carlos Young, a famous architect; Richard W. Young, who would rise to the rank of General in the U.S. Army; B. H. Roberts, the famous historian; and Orson F. Whitney, a Mormon scholar and historian.

In 1892, the University of Deseret became the University of Utah, and that decade the state legislature appropriated $200,000 (nearly $3 million in 2004 dollars) to create facilities for the new campus, to be located on the Salt Lake Valley’s east bench. Over the next half century, the University focused on education—both for the development of teachers for Utah’s public schools, and also for other knowledge and skills that would benefit its students. Although education was the primary initial role of the University of Utah, many other services were provided to the state, including the state’s first library; training for the state’s military during both World Wars; thousands of faculty, staff, support and construction jobs; and major development of the state’s mining, business, and medical industries.

Utah State University

Utah State University’s beginnings can be traced to the mid-nineteenth century. President Abraham Lincoln signed the Morrill Act in 1862, which provided for a grant of land from the Federal government to the several states and territories. The subsequent sale of the land would provide an endowment to establish colleges that would, in the words of the act, support and maintain institutions:

...where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal education of the industrial classes in the several pursuits and professions of life.
The Morrill Act was one of the first large-scale investments in intellectual capital because it was focused on developing an entire society of learned individuals. Utah State University was designed to be a school for all people, an institution intended to create a state of “citizen scholars” and a competent, well-educated workforce.

_Though rightly centered on the home campus in Logan, the interests of Utah State University have historically stretched far beyond its institutional center. As part of the Land-Grant system—and as home to the Utah Agricultural Experiment Station—the University was founded with the idea that it would take its discoveries from the campus to the people._

Though not explicitly stated in its mandate, Utah State University—originally called Utah State Agricultural College—required intensive research programs from its inception. Research took place primarily through the Agricultural Experiment Station, the most important component of the University at the time, that was established to deal with challenges associated with the most prominent industry in the state. Jeremiah W. Sanborn was recruited from the University of Missouri to head the Experiment Station, and he directed many research activities aimed at developing efficient agriculture methods that could be used to improve agricultural productivity.

An especially important area of agricultural research was dry farming, which involves a specific set of techniques for raising crops in Utah’s semi-arid climate. John A. Widtsoe and L. A. Merrill investigated dry farming practices in the state and developed the first systematic presentation of the principles in the nation. In 1903, the legislature appropriated $12,500 for the establishment and maintenance of six experimental dry farms of 40 acres each in different parts of the state. These farms did much to stimulate the growth of dry farming, greatly influencing the agricultural industry of the state, which, at the height of the industry, accounted for as many as 30,000 farms. Today, nearly half of Utah’s 2 million acres of cultivated land still utilize the dry farming practices developed by Widtsoe and Merrill.

To further extend Utah State University research findings and benefits to the entire state, the Cooperative Extension program was created. The beginnings of the Extension Service came when the Experiment Station obtained money to hold a “Farmer’s Encampment” in each county in Utah—bringing the research work of the College to its rural constituency. In 1891, the Experiment Station expanded its role further by placing one of its employees, L.M. Winsor, in Vernal. Essentially the first county agent in the western United States, he was called to Washington to help launch a federally backed
county agent and extension program under the Smith-Lever Act. Utah State had placed county agents in all counties by 1922, and since then has expanded their roles to teaching in rural areas. These programs proved successful in providing needed benefits to the state.\textsuperscript{10}

Due to commitments to the experiment station, extension division, and outreach programs, the college attracted thousands of students from rural Utah and surrounding states. The “AC,” as it was labeled, literally fulfilled its mission by claiming “the state is our campus.”\textsuperscript{11}

The Evolving Role of Utah’s Research Universities

The University of Utah

By the mid-1900s, the University of Utah, recognizing that the future would be a high-tech one, had already taken steps to insure that it would be at the forefront of the rapidly expanding world of research and development of computers, medical devices, and other industries. These steps included the intertwined activities of increasing the University’s research capacity, as well as creating an incubator and attractor of technology and business development.

The last half of the twentieth century brought great advances for the U. By 1970, the University’s regular and auxiliary faculties were among the nation’s most prolific researchers. The University had made research connections worldwide and ranked among the top 25 American colleges and universities in funded research. Some of the University of Utah’s great research achievements included:

- Dr. Willem Kolff, the pioneer of artificial organs and limbs, made the University of Utah a household name when the artificial heart he developed was implanted in Dr. Barney Clark, a Seattle dentist.

- Evans and Sutherland, an early resident of Research Park, became the world leader in computer simulators for aerospace.

- The University of Utah Hospital became a world leader in treatment of burns and other trauma. The U of U Health Sciences Center also achieved prominence in cancer research through its Huntsman Cancer Institute.\textsuperscript{12}

The University of Utah became one of the first in higher education to recognize that the profound results being created at the institution could be used to generate additional
practical and economic benefits for the state and beyond. In 1968, the University became just the sixth university in the United States to initiate a technology transfer program. And, in 1970 the University acquired land immediately adjacent to the campus and developed a research park to house high-tech companies, many of which grew out of faculty research. By 1980, income from patents and commercial licenses on inventions from the University’s faculty had significantly increased.

To create the many benefits yielded by the state, the University of Utah required the support of the entire state.

A review of the past of the University of Utah reveals how the attainment of its present maturity and prestige was the result of the vision and foresight of [those] devoted to the principles and ideals of public higher education [and] who have met the various crises with the positive conviction that no outside contrary influence could be permitted to impede or divert the educational purposes for which the institution was founded and maintained, In those who have labored for it, the University of Utah has its richest heritage.13

**Utah State University**

According to one historian, “the change from College to University was a process—and the official name change was a mid-point in that process. From a primary emphasis on technically oriented undergraduate education in 1940, by 1965 Utah State’s commitments to graduate education and research were major in virtually every academic area.”14 At that time, Utah State University found it necessary to more fully engage in the research process because that was the drive of the faculty and the need of its students and the citizens of the state. In order for Utahns to compete in the global economy, Utah State recognized that technological and research skills were necessary components of a college education. This created significant expansion of the University research in the last half of the twentieth century, in both campus facilities and programs.

*It is the phenomenal growth of the research programs that has both spurred new construction and altered complexity. In the ten years from 1968 to 1978, outside funding for University-conducted research rose from $2.8 million to almost $18 million. [From] 1978 to 1988 it more than tripled again. New programs have accelerated the trend.*15
USU sponsored research awards have continued to grow dramatically, reaching $162 million in 2003.

Although agriculture remained a mainstay of Utah State University research, other programs, necessitated by the needs of the state’s students, grew as well. One of Utah State’s traditional roles became training public education teachers for the state. Thousands of teachers have been taught and prepared at Utah State. The College of Engineering developed a major role in irrigation, civil, electrical and mechanical engineering, and also moved into the forefront of space research. Natural Resources became a strong focus at USU, focusing on the sustainability of Utah’s precious land and water resources.

Like the University of Utah, Utah State has also focused on maximizing the benefits of its research. In 1986, Utah State established its research park. Now called Innovation Campus, the park has become an economic hub of northern Utah. According to one historian, Innovation Campus has brought the role of Utah State University full circle:

*Where the first scientific experiments on the application of water to crops and vegetables were conducted by the Experiment Station at the turn of the century, the first buildings of the University’s new Research Park are rising. In 1900 the contributions the College could make to a country where most people lived on farms or in small towns were contributions to agriculture. Today, while contributions to agriculture and agribusiness continue, the spin offs of other research are in the fields of high technology, and the acres that saw wooden sluices and measuring weirs now see Research Park businesses.*

Throughout their history, neither the University of Utah nor Utah State University have forgotten their mandates to serve Utah’s students as well as its citizens. This charter has necessitated a variety of tactics: from housing the region’s only public library, to imparting agricultural knowledge to the state’s farmers. Today, these two major universities have evolved to best serve the needs of the state, by creating an innovative, collaborative atmosphere that satisfies the intellectual and economic appetites of Utah’s citizens.
Today, with more than 50,000 students between them, the University of Utah and Utah State University have come a long way from single-building campuses and their early curricula. Both institutions are vigorously pursuing multifaceted missions of learning, discovery, and engagement. With students, faculty, and a host of stakeholders taking part in that mission, Utah now ranks 11 in the United States for the proportion of higher education degrees to number of residents. Although both universities have contributed greatly in higher education and research, new prospects of fulfillment in economic development have yet to be fully realized.

Utah’s Research Universities

The University of Utah today is an academic powerhouse, offering more than 160 degree programs to its 28,000 undergraduate and graduate students. Several of its programs are ranked in the top 50 nationwide, including business, chemical and fuels engineering, and computing. As the third-largest employer in the state, the University has more than 18,000 people on its monthly payroll and annually distributes more than $850 million in salaries and benefits.

Utah State University also is a nationally prominent institution with many highly recognized degree programs, including agriculture, education, engineering, and natural resources. Utah State offers more than 200 majors to its 24,000 students and has significantly increased important research opportunities available to them. The University drives northern Utah’s economy, providing more than 5,800 jobs to Utahns in the area. In June, Consumer’s Digest rated Utah State as the sixth-best-value university in the United States for cost in relation to educational quality, and was ranked second in affordability by the National Center for Public Policy and Higher Education.

Both universities’ research programs have been very successful. In July 2004, then Governor Olene Walker, along with Utah State President Kermit Hall and University of Utah President Michael Young, announced the generation of $500 million in joint
research revenues from the two universities. That represents the largest amount ever garnered by the state. A large majority of this funding comes from the Federal government and private industry, while the state provides less than one-tenth of total research funding for the universities. State funding is often used as seed money to attract the larger Federal grants.\textsuperscript{5}

FY04 research funding for the University of Utah and Utah State University achieved double digit percentage gains from the previous year, and doubled amounts compared to a decade ago.\textsuperscript{6} Not only does this substantial growth of research funding support cutting-edge knowledge being developed by university faculty and staff, but much of it is spent within the state, which in turn boosts the overall economy. Every dollar invested in research infrastructure—buildings and equipment—results in a $10 return in research grants and other economic benefits to Utah.\textsuperscript{7}

Increased research funding in Utah has stemmed from strong research programs that both the University of Utah and Utah State University have developed. Although the success of research programs is often measured by the money they bring in, they have also created valuable opportunities for students and needed services for the state. Research discoveries also result in the creation of technologies around which new businesses can be built.

\textbf{Research at the University of Utah}

The University of Utah’s research accomplishments place it squarely in the top 15 percent of America’s nearly 200 research institutions, creating many benefits for the state in terms of research outcomes, economic development, and human capital development.\textsuperscript{8} For example, more than two-thirds of Utah’s doctors and pharmacists have received all or part of their training at the University of Utah, and more than three-quarters of U of U engineering and MBA graduates stay in the state to pursue their careers. Two of the University of Utah’s greatest strengths are in the areas of biomedicine and computers.\textsuperscript{9}
Biomedical and Genetics Research: Creating Worldwide Results

The University of Utah’s biomedical and genetics research programs are among some of the strongest in the nation. The U’s dominance in this field is bolstered by a host of centers, institutes and programs, including a state-of-the-art medical school, world-renowned scientists, and one of the largest cancer study centers in the world. Work by these U of U professionals has generated countless medical, scientific, and practical outcomes. For example, University of Utah genetics researchers did the following—and much more—in 2003:

- Found a new drug that can make the anticancer drug interleukin-2 more effective and less toxic in patients with melanoma or kidney cancer.

- Discovered how the enzyme PKC gamma influences cells in a developing embryo to move to either the right or left side of the body—a discovery that also has implications for how cancer cells spread or metastasize in cancer patients.

- Helped lead an international research team that discovered how children are protected from two of the deadliest forms of malaria when they carry a gene that lets them produce high levels of nitric oxide.

- Led a study showing that people have longer life spans if they also have longer telomeres, which are the ends of chromosomes that grow shorter during aging.

- Helped conduct a multi-center clinical trial that found premature births can be reduced by up to one-third if the expectant mother received weekly injections of a form of the hormone progesterone called hydroxyprogesterone caproate.

- Participated in a study that tested a new generation of cardiac pacemakers and combined pacemaker-defibrillator devices on congestive heart failure patients nationwide. The trial showed significant reductions in the risk of death among patients who used the implanted devices as opposed to medication.

- Showed that by administering the neurotransmitter GABA to aging monkeys, their old brain cells briefly were made to act young again. The study is an early step toward the goal of helping elderly people by reversing age-related declines in vision, hearing, memory and other skills.¹⁰

To maintain its prominence in genetics research, the University of Utah continues to grow its programs. One example is the Brain Institute at the University of Utah, a major effort to unite
various fields of study, utilize the university’s research strengths and advance understanding in one of science’s last frontiers. An ambitious plan calls for raising more than $100 million for a new interdisciplinary research building and to finance the institute’s first five years of research into the brain and brain disorders by an estimated 200-300 faculty and staff.

The University of Utah also focuses on engaging the public through outreach programs aimed at sharing the results and importance of their research. For example, the Genetic Science Learning Center was created to help teachers, students and others understand how their lives and society are influenced by genetics. The center’s engaging, interactive website covers everything from the basics of DNA to in-depth explorations of genetic disorders, cloning, stem cell research and gene therapy. ScientificAmerican.com has honored the website as one of the five best biology sites on the Internet. During 2002-2003, Learning Center courses and workshops reached over 1,500 educational institutions worldwide.

Computational Research: Launching New Technologic and Economic Frontiers

The University of Utah has been a leader in computing and imaging research since the beginning of the field of study. The U’s distinguished alumni in the computer field include John Warnock, cofounder and board chairman of Adobe Systems; Alan Kay, developer of the personal computer and a participant in the early design of ARPANet, the forerunner of the Internet; Nolan Bushnell, father of the video game industry and founder of Atari; Ed Catmull, cofounder and president of Pixar Animation Studios; Jim Clark, cofounder of Silicon Graphics and Netscape; and Raymond J. Noorda, founder, former president, and CEO of Novell.

The University of Utah’s computing research strength is maintained in several research centers, including the Scientific Computing and Imaging Institute, a leader in engineering and research in scientific computing, scientific visualization and imaging. The institute has solved computational and imaging problems in areas such as medicine, geophysics, chemical engineering, molecular dynamics, aerospace fluid mechanics, combustion and atmospheric dispersion.
Research at Utah State University

Research at Utah State University involves and supports students, attracts external funding, leads to knowledge and technologies, and solves practical problems in the state, the nation, and the world. USU faculty and student researchers are improving education, services and the economy. Accomplishments in research at Utah State are especially pronounced in the areas of space, land and water, and human services.

Space Research: An Opportunity in Education

Utah State University is designated not only as a land-grant university but also as one of the first space-grant universities in the nation. Space research at Utah State includes many programs within the College of Engineering, the College of Science and the College of Agriculture, working in conjunction with the Space Dynamics Laboratory (SDL), which is one of only ten University Affiliated Research Centers in the nation for sensors and supporting technologies.

SDL applies basic research to the technology challenges presented in the military and science arenas, developing revolutionary solutions that are changing the way the world collects and uses data. SDL, the largest research center at USU, generated about $70 million in research contracts in 2004. Researchers at SDL have enabled significant advances in data compression and quality, developed real-time reconnaissance data visualization equipment, and created thousands of successful sensors and subsystems for over 400 space-borne and aircraft-based payloads.13

Some of SDL’s current projects include the following:

- A series of satellite-based projects aimed at providing a better understanding of the weather that will allow more accurate weather forecasts and early storm warnings.

- Research by the Center for Atmospheric and Space Sciences that studies atmosphere in relation to Global Positioning Systems. The ionosphere specifically can foul up GPS coordinates by tens of meters.

- LADA, an agricultural growth chamber in which cosmonauts grow vegetables. It is currently operating aboard the International Space Station.

One of the most important contributions the space research program has made is the creation of research opportunities for Utah State’s undergraduates. USU has sponsored a number of projects that are almost totally student-developed: For example, Get-Away-
Specials, which are self-contained experiments sent into space on the Shuttle, have been created entirely by students. In large part because of this student research, Utah State University has earned the distinguished honor of having sent more experiments into space than any university in the world.

Land and Water Research: Creating Solutions to Fundamental Problems

Utah State University was founded in 1888 as an agricultural college, but the global environment has dramatically changed since then. While agricultural production, processing, and distribution remains vital, Utah State’s research mission has expanded considerably to address earth conservation, biotechnology, food safety detection, and cures for diseases. Research about Utah’s natural resources also has evolved to best serve the needs of the state.

Current initiatives in land and water research include the following:

- The Utah State University Water Initiative, an interdisciplinary partnership across the multiple colleges and departments involved with water sciences and engineering at Utah State University, designed to focus the intellectual leadership of the university on integrated water planning that is critical for the Intermountain West.

- Integrated Water and Coastal Resources Management Indefinite Quantity Contract (Water IQC), part of a $2 billion initiative to provide capacity to respond rapidly to requests for services aimed at helping carry out the integrated water and coastal resources management aspects of USAID development assistance programs.

- “Agrosecurity,” and homeland security more broadly, to devise solutions for the United State vulnerability to naturally occurring events and acts of terrorism. Agrosecurity issues are based on gaining a better understanding of potential threats related to plant and animal production, marketing, and processing. Homeland security efforts include the detection and elimination of harmful pathogens.

- Genomics, Proteomics, and Bioinformatics, which involves the study of cellular DNA, protein, and computational methods of these studies. Research in these areas will give scientists a better understanding of how biomolecular processes work, and how they can be used for public health and economic benefits.

Land and water research at Utah State has resulted in practical benefits for the state for over a century, and it has also created innovative technologies.
Utah State University’s College of Education and Human Services is another example of excellence in learning, discovery, and engagement, including economic development. One of the largest colleges of education in the nation, Utah State’s College of Education and Human Services lists the following among its recent accolades:

- Ranked by *U.S. News and World Report* in the top tier of prestigious graduate schools of education in the U.S. for the past five years—and most recently ranked 38th in a field of over 1100 schools.

- Ranked fourth in the nation among colleges of education in external research dollars generated—$181 million over the past ten years and $25 million in 2003-04.

- Top producer of early childhood, elementary, and special education teachers.14

Utah State University houses many of the nation’s most prominent education and human services facilities and programs, including the Emma Eccles Jones Center for Early Childhood Education, the Edith Bowen Laboratory School, the Center for the School of the Future, and the Center for Persons with Disabilities.

The Center for Persons with Disabilities is one of 61 University Centers for Excellence in Developmental Disabilities, Education, Research, and Services located at major universities throughout the United States. These programs provide leadership to support independence of people with disabilities. For over 30 years, the CPD has focused major efforts on the needs of Utah and of rural and underserved populations nationwide. The CPD generates over $16 million annually. It houses over 70 projects, including the Early Intervention Research Institute, the Reed F. Warren Biomedical Laboratories, the Mountain Plains Regional Resource Center, the Utah Assistive Technology Program, and WebAIM (research on accessible Internet technologies).15

Another example of research, technology, and outreach is the National Center for Hearing Assessment and Management (NCHAM), which addresses the most common birth defect in babies—hearing loss. NCHAM conducts cutting-edge research to improve screening methods and equipment for testing the hearing of newborns, applies new knowledge about the genetics of hearing loss to screening programs, extends the lessons learned in hospital-based newborn hearing screening to early childhood programs, and determines how screening impacts families. The center works with all hospitals in Utah, and hundreds of other hospitals across the United States and in many other countries.
Both the University of Utah and Utah State University research produces knowledge outcomes for the world, economic benefits for the state, and services for the community. University research results are becoming even more vital as the seedcorn for future businesses and economic growth.

University Research and Economic Development

On their own, the results of the University of Utah and Utah State University’s research are impressive; when combined with the resources needed to create practical outcomes and technology commercialization, university research is potentially revolutionary for the economic vitality of the state. Evidences of the economic benefits created by the University of Utah and Utah State University are already apparent. They are seen in the growth of patents, licensing, and royalties generated by university technology, and they are manifest in the companies being created from some of those inventions and ideas.

The University of Utah

The University of Utah has utilized the economic strength of research longer than almost any other institution in the nation. In 1968, the U became just the sixth university in the United States to initiate a technology transfer program. Today, University technologies create thousands of jobs and generate hundreds of millions in investment each year. More than 90 percent of the jobs and 77 percent of the investments remain in Utah.16

Almost 60 new companies have started from University of Utah technology in the past decade alone, the vast majority of which have stayed in Utah. Some of the companies generated with the help of the U’s Technology Transfer Office include:

- **Evans & Sutherland**: One of the oldest university spin-offs, it was co-founded in 1968 by David Evans, who also started the U’s computer science program. Known for flight simulators and other virtual reality products, the company generated $84 million in revenue last year.

- **Myriad Genetics**: Founded by former U geneticist Mark Skolnick, the company focuses on identifying disease-causing genes and producing medicines through alliances with pharmaceutical companies. Myriad uses genetic technology licensed from the University.
- **Iomed Inc.**: Iomed produces non-invasive drug delivery systems, including a product that delivers medication through the skin using a mild electric charge instead of a needle. Founded in 1974, Iomed is based on engineering and bioengineering research at the U.

- **Sarcos Inc.**: Sarcos has licensed many technologies from the University and is involved in robotic systems for industry and entertainment, artificial limbs and other medical devices, and various mechanical and electronic microsystems.

- **TerraTek Inc.**: An engineering company founded in 1969, the company provides research testing and equipment for the oil and gas industry.

- **TheraTech**: Founded in 1985, the company is a leader in the development of innovative products based on controlled release drug delivery technologies, such as patches and mild electric pulses.¹⁷

Many of these companies are located at the University of Utah Research Park, which lies adjacent to campus on 320 acres of ancient Lake Bonneville shoreline. The park houses 44 companies, 37 academic departments and approximately 6,300 employees in 35 buildings. Research Park companies have added more than 4,700 jobs to the state’s economy, and the annual in-state productivity of park residents exceeds $600 million. The park provides a special environment for entrepreneurial growth. It is a reservoir of practical research and business opportunities for university faculty and both graduate and undergraduate students.¹⁸

The University of Utah has engaged in other initiatives to bring the results of university research to the consumer market. Technology to Market (T2M) is an alliance of the University and other public and private organizations designed to create a non-profit business accelerator for high-tech companies. The alliance provides start-up businesses with capital, management, advisors, and other consolidated resources. Also, the Lassonde New Venture Development Center teaches Utah students skills needed to assess business opportunities associated with scientific discoveries and innovations emerging from University of Utah labs. Coached by experienced entrepreneurs, Lassonde Center students work with scientists and inventors to understand possible applications for a discovery and define the true market value.¹⁹

*Utah State University*

New ideas and technologies initiated by Utah State University researchers also have created profitable products and businesses. Nearly 60 companies had their beginnings in
USU research. These companies generate more than $300 million in taxable revenues, employ 2,000 people, and help create an infrastructure of high-tech businesses throughout the state. Overall, Utah State University research has influenced the creation of more than 10,000 jobs and has brought millions of dollars into the state. Some examples of companies started from USU technology include:

- **HyClone Laboratories**: A worldwide leader in fetal bovine serum production and other media-related product, the company employs over 500 people in Utah and 700 worldwide.

- **Campbell Scientific**: Campbell has produced and sold over 100,000 dataloggers throughout the world and has about 200 employees at its headquarters in Logan, Utah.

- **Wescor**: Wescor develops, manufactures, and markets high quality instrumentation and other products for medicine, science, and industry. The company employs more than 50 scientific, engineering, design, business, marketing, and sales professionals in Logan, Utah.

The use of Utah State research for economic development is reflected at its research park, now known as Innovation Campus. Established in 1986, the campus is home to some 50 companies with about 2,000 employees. The average annual salary of non-students employed at Innovation Campus is $65,000, which is 25 percent higher than the area’s median family income. Efforts by Innovation Campus to create a high-tech hub in rural Utah have been nationally recognized by the U.S. Department of Commerce, which awarded it one of seven “Excellence in Economic Development” awards. This spring, Innovation Campus won the 2004 national award for “Rural Economic Development.”

Innovation Campus is increasing its vital role in the region, and in the coming years, it will do it on a much larger scale. With fourteen existing buildings and three more under construction, Innovation Campus is growing rapidly as a center of research and economic activity in Cache Valley; it may well employ as many people as Utah State University (currently the valley’s largest employer) in the coming decades. Innovation Campus’ recently-completed master plan will guide growth at the campus over the next 40 years to bring it from its current 38 acres to over 150 acres by full build-out.

**Research Partnerships and Programs**

The University of Utah and Utah State University have taken steps to create research partnerships aimed at sharing resources to attract funding, create better outcomes, and
more efficiently benefit the state. More than 100 faculty members at the U and USU have created partnerships in their research and entrepreneurial efforts.

**Partnership in Human DNA Research**

Utah’s two research universities are working to reduce the burden of conditions of aging one of the nation’s largest health and economic concerns. These efforts will position the state as a leader in medicine, public health, and biotechnology, and will build a foundation for sustained economic growth over the coming years.

Recently the University of Utah and the Huntsman Cancer Institute (HCI) applied for a new joint grant from the National Cancer Institute and the National Institute on Aging to create the Utah Program on Aging and Cancer (UPAC). This program combines the usually disparate areas of cancer research and research on the elderly to build new in-roads into geriatric cancer studies.

The UU-HCI UPAC project leaders have invited participation from researchers from the USU Center for Epidemiologic Studies to augment its extensive cancer research. As one of the largest long-term aging studies, the Cache County cohort provides a unique resource for UPAC researchers and will support Utah’s continued position as a leader in cancer research.

**Partnership in Infectious Disease Studies**

Utah State University and the University of Utah are partnering together in cancer and infectious disease studies to win large Federal grants and establish our state as a principal player in cancer, viral and biodefense research. By jointly applying for selected grants, Utah’s research universities are able to combine their effectiveness as both a medical and genetics powerhouse and as a leader for therapies of viral diseases.

Partnering together, the University of Utah and Utah State University have applied for Federal funding for new magnetic resonance imaging (MRI) equipment. The University of Utah applied for a grant from the National Cancer Institute that would fund a Core Facility for MRI of small animals, and Utah State enhanced the need by combining its support. The U and USU also are collaborating with Colorado to become a Regional Center of Excellence in biodefense research.
Through these partnerships, the University of Utah and Utah State University will gain an advantage in research competition, allowing them to win even more multi-million dollar Federal grants that will lead to marketable technologies, companies, and jobs.

Other Partnerships

Other recent examples of collaborations between the U and USU include:

- Dr. Ray Reutzel of Utah State University and Jan Dole, Emily Swan, and John Hosp of the University of Utah are working together to develop, deliver, and evaluate Utah’s reading First Grant, a $42 million project.

- USU’s Dr. Karl White and John C. Carey M.D. of the U of U School of Medicine are collaborating on a $22 million NIH project studying hearing loss in infants and young children.

- Mathematics researchers Dr. Lajos Horvath (University of Utah) and Dr. Piotr Kokoszka have been long-time colleagues; together they have published 18 papers and have received two NATO grants and one NSF grant.

- Dr. Sarah Rule (USU) and Dr. Jan Day work together on statewide preparation of early childhood specialists and K-12 teachers in vision and hearing impairments.

- Utah State University has had a relationship with the University of Utah on the student-involved Unity IV rocket project since 1991.

The University of Utah and Utah State University have become world-renowned in their research efforts in biomedicine, genetics, computation, space, land and water, and education and human services. After decades of development, these prolific research programs are now nearing potential payoffs. If Utah policymakers act decisively, Utah’s research outcomes may become the state’s economic windfall.
inds of change are stirring in the national economy. In the past few years, issues of high-technology, globalization, recession, and recovery have changed the way we think about and do business, and have clearly shown that states wishing to be competitive in the new economy must stay abreast of the changes—or fall behind. Utah, too, is at the tipping point. We must choose now—between stagnation and investment—and set the path for Utah’s economic future.

The goal, of course, is clear: continuing economic prosperity. But the path to long-term economic prosperity in Utah still awaits an action plan. It is not that the path is vague. Urban planner and economics professor Richard Florida argues compellingly in his book *The Rise of the Creative Class* that major research universities are a basic infrastructure component for a state’s competitive advantage in the future—more important than canals, railroads and freeway systems that drove growth in past periods of prosperity.

An important recent analysis, the Employers’ Education Coalition report, distinguishes Utah’s Research 1 institutions as significantly, and importantly, different than other institutions in Utah because their economic return-on-investment is critically different than those institutions. Simply put, the state’s Research 1 universities already bring home close to a half billion federal dollars each year for the citizens of Utah.

It should be clear that merely planting a research university in the middle of a desert will not lead to knowledge-based economic growth. The strategies that university, policy and business leaders employ, can affect how well a region can appropriate the returns from university RD&E investments.
Utah’s future is not stalled; in fact, this is a time for optimism. But now also is a time to make decisions. Utah has the proven university firepower to champion its economic future and to make the state competitive with any other in the nation. Utah’s business leaders are working hard to ensure a prosperous economic future for the citizens of the state, and they are leading the call to action at this important time. The business community has promised to share the investment bill because it, perhaps most directly, will share the payoffs down the road. But the entire state will share in the profits of this investment.

And the word “share” is key to the conversation. Long-term economic growth means that prosperity will be shared with all of Utah’s citizens. We must make this investment now to ensure that Utah wins its fair share of tomorrow’s job wars.
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19 Office of the Vice President for Research.
Utah boasts two public universities that rank among the elite in terms of research, funding, and doctorates awarded. These institutions—The University of Utah and Utah State University—are designated by the Carnegie Foundation for the Advancement of Teaching as “Doctoral/Research Universities-Extensive.” No other public universities or colleges in Utah have attained that ranking.

In general, a Doctoral/Research university (often called a Research 1 university) is deeply engaged in the process of education and discovery using research as its locus. Doctoral/Research universities receive considerable amounts of federal and other grant money for research, and award a significant number of doctorates. Students at research universities are taught by scholars who work at the cutting edge, thus exposing the students to the latest findings in their academic fields.

Doctoral/Research universities like the University of Utah and Utah State University not only offer a wide range of baccalaureate programs, but—as part of their Carnegie qualification—also award 50 or more doctoral degrees per year across at least 15 disciplines.

Of nearly 4,000 U.S. institutions of higher education, only 151 public and private universities fall into the highest category of “Doctoral/Research Universities-Extensive.” The University of Utah and Utah State University are among just 102 public universities in that category nationwide.

There is little doubt, however, that the state’s future economic growth will be determined by our brains rather than our brawn and by the quality of our classrooms rather than the richness of our natural resources.

–Kelly Matthews, economist, Wells Fargo Bank