

**ARIZONA UNIVERSITY SYSTEM
NORTHERN ARIZONA UNIVERSITY
TECHNOLOGY AND RESEARCH INITIATIVE FUND
(TRIF)**

Growing Biotechnology Initiative

BUSINESS PLAN

**Approved by Arizona Board of Regents
March 2007**

Executive Summary

Northern Arizona University (NAU) is positioning itself to be a strategic player in the biotechnology industry through research and development activities, technology transfer initiatives, and workforce training through established academic programs. Coupled with new and planned facilities, NAU is establishing an infrastructure to enhance the development of the biotechnology industry in Arizona. Building on an excellent and growing cadre of scholars in areas related to biomedicine, bioengineering and biotechnology, NAU will continue to provide a solid platform for launching a variety of bioscience initiatives. The outcomes of these endeavors will include several new start-up companies in northern Arizona, additional resources for biomedical and biotechnology-related research in Flagstaff aimed at attracting more high tech business to Flagstaff and northern Arizona, and a generation of graduates trained for the Innovation Economy workforce through hands-on experience with all facets of state-of-the-art molecular biology and biotechnology processes. NAU is uniquely positioned in Arizona to provide undergraduate and graduate education in the biosciences and biotechnology to rural populations, as well as to provide cutting edge research in its niche areas.

The Growing Biotechnology Initiative (GBI) focus directly connects research and development with practical applications such as the treatment and prevention of diseases. The GBI builds on existing strengths in programs such as the NIH-funded U54 cancer research grant. The Keim Genetics Laboratory has served as a centerpiece of our biotechnology operations, attracting national attention and millions of dollars in added funding. In addition, we are conducting research focused on emerging diseases, halophilic bacteria, musculoskeletal and cardiopulmonary rehabilitation, and endocrine disrupter chemicals. These ventures have already led to increased funding, several new businesses, patents and licenses and continue the effort to make NAU a biotechnology leader among its peer institutions.

GBI's research and development focus over the next five years will be on near and longer-term biotechnology platforms (i.e. cancer, neurosciences, bioengineering, infectious diseases, and diabetes) identified in the Flinn – Battelle report, "Arizona's Bioscience Roadmap" (Roadmap). These biotechnology platforms are areas of recognized strength or areas poised for significant development at NAU. GBI, through strategic investments in faculty research laboratory capabilities and technology transfer/commercialization partnerships, will seek to enhance the development of the biotechnology industry in Arizona. In addition, GBI will continue its efforts to educate and train undergraduate and graduate students to address critical Arizona workforce needs in the biosciences.

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The new Strategic Alliance for Bioscience Research and Education (SABRE), recently approved by Arizona Board of Regents, has as part of its task to increase the visibility of bioscience research at NAU. In this vein, SABRE helps elevate the profile of life sciences research at NAU and assists students into the biosciences at NAU. Another purpose of SABRE is to assist researchers find collaborators within and outside of NAU that contribute to the success of their research and teaching endeavors. Along with the Northern Arizona Technology and Business Incubator (NATBI), the Greater Flagstaff Economic Council (GFEC) and Arizona Technology Enterprises (AZTE), SABRE and the GBI have as their goal to increase the number of Biotech businesses in northern Arizona.

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1. Core Vision/Project Description

1.1 Industry Overview

Biomedicine, biotechnology, and bioengineering are among the most diverse and fastest growing industries in the U.S. and across the globe. Advances in the cellular and molecular life sciences over the last 10 years have led to the development of an industry with annual revenues exceeding \$30 billion and a total market value greater than \$200 billion. Since 1999 the biotechnology/biomedicine industry has attracted almost \$70 billion in investments to fuel the development of more than 350 new medicines and vaccines targeting more than 200 diseases. In 2001, the industry invested over \$15 billion in research and development, more than triple the amount spent in 1992. Employment in the biotechnology industry has been equally robust with more than 400,000 jobs in the U.S. alone attributable either directly or indirectly to the industry. From 2002 to today, at least 22 companies have moved to or expanded their presence in Arizona, yielding an increase of more than \$110 million and over 2000 jobs. In Flagstaff, several new companies have been developed and the major biotech business in the city has dramatically increased its output in the last three years.

States are increasingly looking to attract biotechnology companies to rapidly increase revenues, create new jobs, and provide a foundation for future economic growth. Incentives to increase the formation of biotechnology centers are now considered essential by many economic developers. In 2001, 41 states offered biotechnology incentives that not only included traditional R&D tax credit, but also provided substantial funding for incubator facilities, venture capital, and grant funds. Arizona was no exception as evidenced by its recent investment and success in attracting the International Genomics Consortium and the development of the Translational Genomics Research Institute (TGen). The advances in Arizona include a projected increase of over 50% in the number of bioscience firms and a more than 90% growth in bioscience jobs between now and 2011.

The future of biotechnology is very promising. Biotechnology patents in the U.S. are approaching 15,000 per year. Industrial and venture capital investments in R&D are also expanding despite the uncertainty in public stock markets. Biotech companies are strategically forming partnerships and making acquisitions to strengthen their position in the industry. Finally, biotechnology based products are finding their way to commercial markets at an increasing rate, bringing ever greater revenues to investors and benefits to society unimaginable to most people even a decade ago. The Flinn - Battelle report, "Arizona's Bioscience Roadmap" (Roadmap) stresses that investing in the biosciences will increase the diversity of jobs, increase economic stability, and increase the number of high-paying secure jobs in Arizona. For example,

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a report in 2005 by Battelle indicated that the average Arizona bioscience position pays nearly \$41,000, 15% more than the average private sector position.

1.2 Mission and Goals

Northern Arizona University (NAU) is positioned to be a strategic player in the biotechnology industry and our future efforts will specifically reflect the Roadmap. NAU TRIF funded Growing Biotechnology Initiative (GBI) will focus on near and longer term technology platforms in cancer, neurosciences, bioengineering, infectious diseases, and diabetes identified in the Roadmap. GBI will closely integrate research in these platform areas with nationally competitive undergraduate and graduate degree programs aimed at developing a highly skilled workforce to meet the demands of the rapidly developing bioscience industry. NAU's mission provides students, particularly undergraduates, with a wealth of opportunities to work side-by-side in the laboratory with nationally and internationally recognized scholars. The emphasis on undergraduate participation in research, along with the high productivity of NAU researchers in the broad bioscience arena, gives NAU a unique position in Arizona to provide cutting edge research, educate a workforce for the growing bioscience industry and contribute directly to the growth of the industry in northern Arizona and the state.

The unifying goal of the Growing Biotechnology Initiative (GBI) is to enhance the development of the biotechnology industry in Arizona. Achievement of this goal will help expand the state's economic base and provide applications that serve the citizens of Arizona and the world. GBI will strive to: (1) Increase NAU's core competencies in biomedicine, biotechnology and bioengineering; (2) Expand technology transfer activities including patents, licenses, business start-up companies, and strategic industry partnerships; (3) Increase the number and competitiveness of graduates to meet the workforce demands of bioindustry in Arizona and beyond; and (4) Attract new biotechnology businesses to Flagstaff and northern Arizona.

NAU takes a very broad view of bioscience and integrates its research and teaching programs across multiple disciplines. Strategically, NAU draws on the strength and expertise of its faculty to selectively pursue a number of R&D venues while simultaneously coupling its research capacity with a rigorous curriculum to produce highly competitive bachelors, masters, and doctoral graduates. The initial research activities funded under the Technology and Research Initiative Fund (TRIF) were largely focused on infectious diseases (e.g., plague, anthrax, Lyme's disease), genotoxicity (carcinogenicity) of heavy metals in the environment, development of new antibiotics and antiviral medicines, musculoskeletal exercise interventions to rehabilitate cardiac and pulmonary disease patients, and the application of molecular techniques to address environmental problems such as disruption of proper growth and

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development by environmental contaminants, climate change, and global warming. Many of these research activities will continue to be part of the GBI as they are identical to those technology platforms specified in the Roadmap. Others will be independent of GBI and seek other mechanisms for support.

From a workforce development perspective, NAU has over 2700 students in more than 70 undergraduate and graduate programs across four colleges and schools pursuing degrees in the biosciences or health professions. NAU's efforts for Growing Biotechnology are currently focused on two departments, Biological Sciences and Chemistry. We already have collaborative endeavors in place across these units. Centering our efforts on these areas has provided parameters and a focus for expending TRIF funds to the best advantage. On this selective and strategic basis, we can train a competitive workforce in biotechnology and biomedicine related fields. Our curriculum provides extensive hands-on training in molecular technologies, meeting directly the increasing demand for students with this specialized training. One of the goals of the GBI in FY 2007-2011 will be to broaden these collaborations across the university to include the Schools of Forestry, Engineering and Health Professions (and others as applicable) and academic institutions across the state and nation. We also intend to increase the number and productivity of collaborations with businesses in the region and state.

1.3 Products or Services Provided

The specific products and services we provide are highly diversified.

They include:

- Patentable technology (e.g. processes, devices and medicines)
- New knowledge for the bioindustry through publications and presentations, particularly as they apply to translatable research
- Opportunities for collaborative research and technology development
- Specific and strategic business partnerships including R&D services
- Training for students entering the workforce of the New Economy who are prepared to meet the demands of bioindustry
- A liaison between academics and the public for information and assistance through the Strategic Alliance for Bioscience Research and Education (SABRE).

We also contribute to:

- Partnerships with business and industry for technology commercialization through organizations such as the Greater Flagstaff Economic Council (GFEC)
- Collaborations with colleagues at other universities in R&D activities and in initiating business ideas, as with Arizona

Technology Enterprises (AZTE) housed at Arizona State University

- Aiding in establishment of start-up companies in collaboration with the Northern Arizona Business and Technology Incubator (NATBI)
- Scientific knowledge in areas ranging from cancer and biomedicine to environmental health and climate change
- Consultation with business, industry, and federal laboratories where there is mutual interest in particular projects where we have expertise and knowledge
- Aiding local economic councils to attract new biotech business to Flagstaff and northern Arizona.

1.4 Positioning

Northern Arizona University (NAU) is one of the fastest growing research universities in the United States. During the period 2000-2005 new research awards to NAU more than doubled to over \$55 million dollars. A major research area NAU continues to build upon is in the fields of bioscience, biomedicine, bioengineering and biotechnology. Research in these fields is under the sponsorship of numerous federal, state, and private agencies and organizations, and accounts for more than 20% of the current sponsored projects at NAU. As mentioned in Section 1.2, these already closely track the emphases listed in the Roadmap. Overall, the impact of externally sponsored bioscience research is seen across 13 academic departments, 22 research centers and institutes, and involving approximately 450 faculty, staff, graduate and undergraduate students (see Figure 1).

Bioscience related research is an integral part of the educational mission, experience, and degree programs at NAU. Of the nearly 20,000 students enrolled at NAU over 2,700 are pursuing more than 70 undergraduate and graduate degrees in the biosciences and health related professional programs. These programs of study are based mainly in the Colleges of Engineering and Natural Sciences and Social and Behavioral Sciences, and the Schools of Forestry and Health Professions. A major part of NAU's mission is to be a national leader in providing biomedical educational opportunities for under-represented students. Current funding from the National Institutes of Health, the National Science Foundation, Howard Hughes Medical Institute, the Flinn Foundation, Ottens Foundation, and the Beckman Corporation provide bioscience and biomedical research opportunities for NAU's more than 2,200 Hispanic and 1,300 Native American students. NAU also delivers numerous classes and health related degree and certificate programs through distance learning centers located at 30 sites across urban and rural Arizona.

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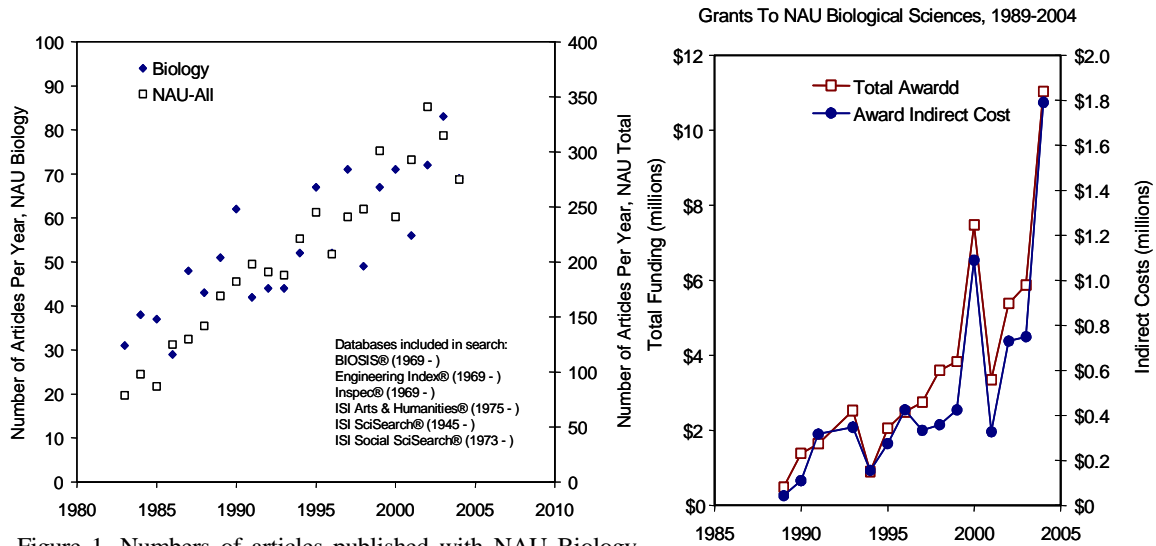


Figure 1. Numbers of articles published with NAU Biology (blue diamonds) or NAU (open squares) appearing as the institutional affiliation from 1983-2004. Databases included in the searches were BIOSIS, Engineering Index, Insect, ISI Arts&Humanities, ISI SciSearch, and ISI Social SciSearch .

Grants awarded to the department of Biological Sciences at Northern Arizona University (data from A. Miesch, OGCS, NAU).

Northern Arizona University research in the biosciences (including biomedicine and biotechnology) has been greatly enhanced through funding from the State of Arizona's TRIF program. TRIF funds have been used to develop the Growing Biotechnology Initiative, which includes a set of major interdisciplinary projects across a broad array of bioscience research. The overarching purpose of the Initiative is to attract highly trained biotech-oriented scientists and biotechnology firms to northern Arizona, to stimulate technology transfer in the biosciences, and to expand current research and teaching capabilities for the University, all of which closely relate to the goals in the Roadmap. Major research activities include studies related to new and emerging diseases, forensic genetics, antiviral and antibacterial drug development, and environmentally related cancer. After three years of operation the Growing Biotechnology Initiative has resulted in external funding of approximately \$17 million, 14 faculty patents, and more than 130 students involved in research projects. Numerous research partnerships have also been established with universities and organizations such as the University of Arizona, Arizona State University, Los Alamos and Livermore National Laboratories, the Centers for Disease Control, and the Federal Bureau of Investigation.

NAU currently has in place one new building, with two more being built that will add greatly to its bioscience capabilities. Combining this infrastructure with existing faculty and student expertise is a great starting point for launching the various pieces of our Growing Biotechnology Initiative. In addition, we have added personnel resources through a NIH U-54 cancer research grant, TRIF support, contracts and grants to the Keim Genetics Laboratory, and the

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leveraged funds that have been secured using TRIF funding as seed money, including the Environmental Genetics and Genomics (EnGGen) facility. Specifically, TRIF funding has allowed us to add four new bioscience faculty on the Flagstaff campus or in conjunction with TGen over the last three years.

1.5 How the Initiative will be Accomplished

The foundation for FY 07-11 is based on the successful practices of GBI over the last four years. Initially, GBI was built around four investigative teams, each with its own leader. These teams worked and continue to work in areas related to heavy metals and cancer, halophilic bacteria, emerging diseases such as hanta virus, and the area involving anthrax, plague and other possible weapons of bioterrorism. These projects have proven to be tremendously successful, leading to several patents, several businesses started or planned, and approximately 60 students trained per year for placement in high-paying biotechnology jobs in Arizona. They have also leveraged external funding of over \$12 million resulting in 20 publications and numerous scientific presentations.

GBI also focused on increasing its core competency and recruited and hired four new faculty at NAU or in collaboration with TGen. Their research focuses on microbiological bioremediation, bioinformatics in studying pathogen genomes, and molecular biophysics. In the short time that they have been associated with NAU, these researchers have performed research with NIH and NSF SBIR funding, have worked with upwards of 15 undergraduate and 4 graduate students, have established business and academic collaborations and planned or have in place several start-up companies.

Finally, through a series of minigrants throughout the University, GBI established a number of new initiatives to leverage external funding. In the three years that these awards have been made, the researchers associated with the TRIF GBI mini-grants have brought in over \$5 million in new funding, published over 60 manuscripts, and trained over 70 students in new techniques in their laboratories. In addition to their specific impact, the speed with which TRIF money translates into action with the seed grants is remarkable. Researchers who were awarded funds in 2004-2005 have already trained over 30 students in the lab, have presented or submitted 13 presentations, and have published or submitted four manuscripts, five grant applications and are in the process of submitting two patent applications. GBI funds have had an impact, and the impact has been nearly immediate. The real question is how we will move beyond these efforts and develop TRIF funds into greater economic benefit for the region and the state in the next five years.

Plan for the Next Five Years

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Growing Biotechnology Initiative (GBI) in FY07-11 will focus on near and longer term technology platforms in cancer, neurosciences, bioengineering, infectious diseases, and diabetes identified in the Roadmap. While support from TRIF will remain at approximately the same level, colleges and departments will take over the salaries of the new faculty hired in the last three years from TRIF funds. This will increase GBI's ability to expand research and development efforts and should greatly increase the specific biotechnology business-related productivity. While there have been numerous direct business-related successes (e.g., patents, licenses, new startup companies, etc.) that have resulted from TRIF-supported research, this is an area GBI will increase and expand its development activity. GBI proposes to provide two new types of funding for current and future NAU faculty that will lead directly to business development efforts.

First, GBI will provide a series of "Development Grants." These one-year grants of up to \$50,000 will specifically support faculty whose research has reached a point where it is leading to a product ready for development. These grants will be used to build prototype products, test the economic viability of products, or support other activities that will lead directly to business development for the department, university, and region. As a way of improving the inter-college collaboration, these grants would be likely to include not only researchers on the scientific side of the equation, but collaborators from the College of Business Administration, programs in Engineering or other areas with knowledge of how to further develop products or get them to the market. The review of these grants will be somewhat different than a typical scientific review. Since some, much, or most of the basic research would be completed on these projects, the scientific review, although important, would be the smaller portion of the review process. The major review would have to come from business and development entities. It is anticipated that review teams from outside NAU and even outside academia would determine the viability of these projects for funding.

The second "new" category of funding will be Large Equipment grants. The Roadmap and other similar reports consistently emphasize the shortage and need for new laboratory capabilities in Arizona. GBI has supported this kind of effort in the past which directly resulted in a nearly \$1M award from the National Science Foundation and more importantly a state-of-the-art capability for high performance genomics research. Therefore, we propose to have two grants each year for the specific purpose of purchasing one large piece of equipment of up to \$140,000. The equipment would have to be used in a collaborative manner among at least four faculty and be self supporting. The purchase of the equipment would require matching funds from the department or college housing the equipment in the form of support for maintenance, since these grants would be for one year. Some of the maintenance match would be likely to come from the use of the equipment to generate funds for the entity. This would require significant "leg-work" on the part of the research

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team, working with the administration to attain the match and with other investigators and government and business entities to show that a match could be provided. Review of these grant applications would be likely to include both academic (outside NAU) and business/government individuals. These reviewers would have to determine the viability of the application from both the scientific need for the equipment and the likelihood that its purchase would generate the funds necessary to provide support the laboratory.

In addition, GBI proposes to continue the highly successful seed grant program. Seed grants have been successful in generating larger amounts of funding, training students, and increasing technology transfer in areas described in the Roadmap. They are also a source of quick turnaround in terms of the products they generate. These grants of up to \$25,000 will allow the faculty to conduct projects that will reflect the resources necessary to achieve success. Seed grants have been tremendously successful. Between GBI and ERDENE, which has a similar but not identical award category structure, a total award amount of \$1 million plus has been projected for FY07. The proposed breakdown of projects with approximate annual budgets is listed below:

Category	Funding Limit (\$)	Number Awards	Total Funds This Area (\$)
Equipment Grants	140,000	2	280,000
Development Grants	50,000	4	200,000
Small Seed Grants	25,000	8	200,000
Total			680,000

2. The Market

The market is reflected as follows:

- A student wishing to obtain undergraduate education with training prepares them for the 21st century biotechnology market.
- Graduate students looking for advanced training and the opportunity to conduct cutting-edge research.
- The funding (> \$20 billion/year) that is available for work in biotechnology and related areas.
- Partnerships and collaborations with other universities and businesses in the areas of research and development.
- Technology transfer and commercialization processes (e.g., patents, licenses, etc.).
- Developing and recruiting new biotech businesses to northern Arizona

2.1 Choices Available to Potential Customers

NAU provides services that make it highly attractive to its many customers. If we consider students as our primary customers, they have the potential at NAU to enter programs in numerous fields related to their area of interest in the biosciences. Students in Biology, Chemistry, Exercise Science, Health Professions (several departments) and several areas of Engineering and Social and Behavioral Sciences can enter programs preparing them for the bioscience industry. This diversity of degree options provides our students a wide variety of options to explore any area of biotechnology.

Graduate students who come to NAU are commonly reviewing institutions such as Stanford, Colorado State University, the University of New Mexico, University of California at Davis, and UCLA. Students seeking a graduate education evaluate, among other things, the stature and reputations of the faculty with whom they might work. They look for groups of people who share their interest in terms of an area of science or other discipline in which they want to make a career. With the TRIF supported GBI, NAU has enhanced its strengths in areas of particular focus to Arizona as defined in the Roadmap. These include: cancer, infectious diseases, neuroscience, bioengineering, and diabetes. Other related strengths include biochemistry, cell and molecular biology, microbiology, environmental chemistry, physiology and functional morphology, and ecology and evolutionary biology.

Biotechnology research at NAU supported by external organizations has increased significantly to more than \$10 million annually. The Growing Biotechnology Initiative has greatly contributed to that success by increasing faculty competitiveness through research support programs (e.g., seed grants). External funding has increased in dollar amount and number of sponsors and now comes from a wide variety of federal (USDA, USFS, NIH, NSF, NPS, DOE, USGS), state (ADEQ, AZGFD, ADCC), and foundation (Beckman, Howard Hughes, Dreyfuss, Flinn) sources. Further, these research contracts and grants support the training of a large number of undergraduate and graduate students. In some cases, these funds are specific to the development of new courses and curricula in biotechnology.

GBI has also enhanced the biotechnology infrastructure and hence Arizona's capabilities to develop biosciences as an economic platform. An outstanding example is the Environmental Genetics and Genomics (EnGGen) facility. The EnGGen facility at NAU is a university and regional resource center to provide for high-capacity, high-resolution DNA genotyping and sequencing training for a diverse user base from regional academic, government and private institutions. The facility is funded by a grant from the National Science Foundation, with GBI matching funds used to support a portion of the facility, a faculty position to provide training to new users and to help manage the facility. User fees began to pay for consumables and maintenance expenses once the facility became fully operational in summer 2005. The users already

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committed to the facility are studying plant evolution, ecological community genetics, conservation genetics, microbial diversity, molecular epidemiology and bioterrorism defense.

The EnGGen facility contributes to a number of the goals of the Biotechnology area of TRIF that coordinate extremely well with the direction of the Roadmap. The facility is a training facility and thus contributes to workforce development, substantially expanding the availability of biotechnology training in northern Arizona. It will also support NAU curricular activities by sponsoring workshops, laboratory courses and seminars for graduate, undergraduate and K-12 students. EnGen faculty also mentor students from diverse backgrounds through in-place programs including an NSF sponsored University Mentoring in Environmental Biology (UMEB) grant, the Hooper Undergraduate Research Award (HURA) program, and the Minority Student Development (MSD) program. In addition to contributing to workforce development, EnGen will also continue to increase external funding and help build collaborations. The existence of the facility and its high throughput capacity have already contributed to the success of several grant proposals including a large (~ \$5 million) collaborative grant to a number of NAU investigators studying genetic impacts at the scale of ecological communities. As the user base of the facility grows, its potential to bring in additional funding will expand throughout northern Arizona.

An area of emphasis for GBI is the development of business partnerships. To date, there have been 11 business partnerships established, exceeding the projections by almost two fold. As we make further progress with the GBI we expect this to greatly increase. We are a strategic partner of the Greater Flagstaff Economic Council (GFEC) and the Northern Arizona Business and Technology Incubator (NATBI). These partnerships have lead to seminars, GFEC members helping to review GBI mini-grant proposals for business possibilities, and a joint presence between SABRE and GFEC at the most recent Arizona Bio Expo. Further, the new Applied Research and Development building, currently being constructed on campus, has an 800 square foot laboratory space available for new business interests coming to Flagstaff. We are also engaged in numerous collaborative research activities with Arizona State University and the University of Arizona. For example, the NIH funded Native American Cancer Research Partnership is a joint effort with the Arizona Cancer Center at the University of Arizona. A second collaboration, pertaining to water quality and the possible effects of endocrine disrupters in the environment is a joint effort of NAU and Arizona State University. A third collaboration involves the University of Arizona, supported by the NIH, and is concerned with the effects of eccentric exercise on recovery in heart disease and osteoporosis patients. Furthermore, two NAU faculty are actively involved in TGen. Paul Keim is the director of pathogen genomics at TGen and Stephen Beckstrom-Sternberg has a joint appointment with NAU and TGen.

Finally, we are gaining momentum in furthering technology transfer. Prior to GBI technology transfer activity was very limited. However, in the first three years, GBI has contributed 14 patent applications and created or enhanced 3 startup companies. GBI anticipates that the new partnership with the Northern Arizona Technology and Business Incubator will greatly increase this activity. All of this increases the choices of our potential customers – students, businesses and intellectual property investors.

2.2 Market Size and Trends

The funding for various research and development projects that fall under the Growing Biotechnology Initiative comes from a variety of sources, as detailed elsewhere in this plan. New funding for projects under this initiative will more likely come from industry and possibly venture capital sources than from the federal government. Some of these funds are competitive proposals, while others are of a defined contract nature in terms of specific targeted projects that are mission oriented

GBI believes, and industry data support the claim, that one of the areas that will receive added attention in the upcoming years involves research and development in a broad spectrum of topics tied to biotechnology. These areas will range from drug development to bioterrorism on the one hand, and from agriculture to environmental issues on the other hand. We feel we are well positioned to take advantage of the upcoming trends. These funds have also helped and will continue to help NAU investigators and students perform projects that lead to increasingly significant amounts of funding in the areas of biotechnology. These funds have come to NAU from the NIH, NSF, various private granting agencies such as the American Heart Association and American Lung Association, and federal appropriations for ventures such as improving homeland security and forest restoration. With the help of TRIF funding, funds have increased to NAU from these and other sources, and they are expected to dramatically increase again in the next five years.

2.3 Rivals and Competition

If we consider our customers as students needing an education, we have competition, primarily within Arizona, for excellent undergraduates. At the graduate level, our competition is with more than 260 research universities in the US. Students evaluating opportunities for undergraduate training often prefer institutions that offer small class sizes, a priority for NAU. These students are also attracted to opportunities to do research as undergraduates, something for which we are a national leader – more than 120 undergraduates in Biological Sciences and Chemistry are intimately involved each year in research endeavors in our various laboratories. In addition, both departments offer specialized courses in research methods – projects that were funded by grants from the National Science Foundation.

Northern Arizona University competes at several levels. We compete with a number of institutions, as noted above, with regard to matriculation of the best undergraduate and graduate students. It is clearly the case that for graduate students we are in a position where TRIF support can be used to attract and retain the best graduate students for our programs. We are currently using TRIF funds to leverage additional external dollars that will increase the number of stipends available to graduate applicants. NAU is highly placed among institutions of higher learning in its attraction to ethnic minority students, especially those of Native American and Hispanic descent. Several grants are already in place, funded by NIH and NSF, to help us attract those students into biomedical careers. These have been successful and many of the students work in projects also funded by TRIF. Therefore, the TRIF funds have increased our ability to compete in the recruitment and training of these students, as well as the advantaged students, who often enter these programs.

On another plane we compete for funds to conduct our research and development activity. We have, as noted in the next section, a significantly higher than average rate of success with regard to competitive funding from various federal and state agencies, as well as with foundations. We are moving into new territory in terms of seeking better ties with industry, partnerships that we feel ready to establish. Given our selective attention to particular areas of research in terms of the Growing Biotechnology Initiative we will be targeting particular industry groups in our attempts to establish these partnerships. We have made great advances in our competitiveness in some areas highlighted in the Roadmap, such as infectious diseases and cancer, and are striving to be increasingly competitive in other areas as well.

2.4 Suppliers

Students come to NAU from a variety of places. Within Arizona we obviously compete with the University of Arizona and Arizona State University for undergraduates. We have stepped up our recruitment efforts with particular emphases on biotechnology, microbiology, and preprofessional programs. We also target selected areas outside Arizona with regard to recruitment of undergraduates. At the graduate level we find that our strong reputation is the best recruiting tool. In today's world the web page(s) for our Departments of Biological Sciences and Chemistry/Biochemistry are the chief entry point for students who want to explore our biotechnology offerings and look for potential graduate mentors.

Our external support, as noted earlier is from a wide variety of entities. We continue to explore new possibilities in terms of locating resources that match with the particular projects on which we are working. With the assistance of the Office of Grants and Contract Services, we are quite successful in the granting process. Whereas the national averages with the NIH and NSF are

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about 18-20% in terms of successful, funded applications, in our departments, we are successful about 40-45% of the time with these applications. One of our goals is to continue to increase external funding, with a primary focus on areas related to biomedicine and biotechnology. To that end, our funding in these areas has more than doubled since the start of TRIF. With the addition of 4 new faculty in areas pertaining to biotechnology and biomedicine we should see significant increases in external funding in areas related to biotechnology.

Though the Federal Government has traditionally been the primary supplier of funds for research and development activities, many other sources are available. We are making more contacts with a variety of non-governmental organizations (NGOs) and potential business partners. In addition, we have an established track record in terms of competing successfully for funds from a number of different foundations, such as the American Heart Association and the Alzheimer's Research Foundation. In our program it has also proven fruitful to work in partnership with organizations like the Arizona Biomedical Research Commission and the Arizona Department of Environmental Quality.

2.5 Alternatives to Traditional Approaches

This matter can be examined from two perspectives. On one hand, our approaches will be, for the most part, a traditional pathway of discovery → research → development. On the other hand, we are engaging in many activities that would be considered non-traditional. The work in the Keim Genetics Lab is unique and pioneering in terms of the system of markers that they have and are developing for typing strains of various pathogens. The work on heavy metals and cancer is rather unique to our part of the western US. The research on the musculoskeletal effects of eccentric cycling is truly revolutionary and may yield significant positive notoriety for NAU, as well as patent and licensing possibilities. Efforts on biotechnology aspects of agriculture and climate change are also relatively non-traditional. We will be expanding these types of efforts in the next five years to better explore the non-traditional pathways to turn some of the outstanding basic research performed at NAU into viable products that generate funds for NAU, Flagstaff, and Arizona. The inclusion of the Northern Arizona Technology and Business Incubator (NATBI) into the new Applied Research and Development building, scheduled for completion in early 2007, is one example of such a non-traditional approach. This entity will be housed in the new building, with a laboratory space specific for business and academic collaboration. The outcome of these collaborations is very likely to be increased patent and biotech business activity in northern Arizona that would not likely have taken place otherwise.

2.6 Estimated Sales

This item is only just beginning to be applicable to the Growing Biotechnology Initiative. Some business partnerships have been established, exclusive

licensing agreements are in place, and start-up companies are formulated. We are starting to have a better picture of expectations in this area. We estimate that several of these sales-producing outcomes can be in place during the last year of the first five-year plan, and we will know a great deal more as time progresses. This, too, is a reason for the Development Grants proposed by having research faculty, whose expertise is not in bringing products to market, collaborate with experts in this area, this should increase development and sales.

3. Operational Strategies

3.1 Development and Production

3.1.1 Development Status

The current funding from TRIF has enabled us to launch more than 25 different and exciting initiatives in terms of Growing Biotechnology. At the core we had four principal projects, all with significant funding and all with high likelihood of achieving significant new external funding for extending these projects. These have generally been very successful in their missions, with a great deal of return on investment from the standpoint of external funds generated. Several new patents and licenses have also resulted. Across the University we also have over 20 projects, each of which received \$10,000 - \$30,000 in funding during FY02-05. These projects have proven to be a remarkably good investment providing intellectual property, numerous grants, and many students trained as outcomes. In FY 05, four larger individual grants to support equipment purchases and the hiring of postdoctoral research associates were awarded. These were designed to add to the impact of the small seed grants as the initial larger grants were phased out. We are thus moving forward with both the larger projects and the smaller grants to be awarded each year. To facilitate growth in other emerging areas it is our plan to have the larger grants rotated after two years to other individuals. It is our expectation that by that time these larger projects will have been successful in achieving sufficient external funding through grants or partnerships with industry and that they will be self-sustaining. Further, the Development Grants, as described above, should have a positive impact on product development.

3.1.2 Production Processes

Not yet applicable

3.1.3 Cost of Development

The costs for development involve equipment, consumables (supplies), and personnel (see 3.1.4). We are using a combination of funds for the equipment

and consumables, successfully combining funding from TRIF with other resources such as external grants, foundation funds, and state funds. It is exactly this sort of synergy in terms of putting the pieces of the funding puzzle together that we believe was the intent of ABOR when this mechanism for funding research was established after passage of the Proposition 301 ballot initiative. To further help with this cost, we are proposing the development grants as well as the large equipment grants. Both of these avenues of funding will provide assistance to faculty with ideas ready for development, but without another funding mechanism.

3.1.4 Labor Requirements

Each of the many laboratories involved in the ongoing research under this initiative have a number of personnel – ranging from laboratories with 3-5 individuals to some with more than 20 people working on various projects. Because we are quite successful in terms of leveraging funds from TRIF for personnel, we have not committed significant funds from the initiative to personnel. We do have 4 post-doctoral/technician positions, 6 graduate students, and 8-10 undergraduate students supported by TRIF funds. This funding (in the ERE) includes tuition reimbursement for graduate research assistants. In addition, as described, we have hired new established investigators. These new hires are specific to biotechnology with a clear intent to have both research and training missions high on the agendas of those we select for these positions. With the area growing, there will be a need to hire a 1.0 FTE staff position at the Administrative Assistant level as well as a 0.25 FTE director for GBI.

3.1.5 Expenses and Capital Requirements

As noted in 3.1.3, we have used a significant portion of the TRIF funds for what might be termed one-time expenses, purchases of equipment needed for specific projects and buying consumables that we use up on a continuing basis. This is continued in this proposal and will further enhance not only the research capabilities of the faculty, but will also help aid in the development efforts central to TRIF funding. In general, we have supplied the necessary infrastructure support for our TRIF Growing Biotechnology Initiative from existing funds. This infrastructure support includes clerical and accounting assistance, computer resources, and general maintenance of laboratories and equipment, but as mentioned above, this will not be sufficient in the next five year period and necessitates the 1.25 positions requested.

3.2 Marketing and Promotion

3.2.1 Strategy

Our marketing strategy to attract good students involves enhanced recruitment at the undergraduate level. This will include visits to target schools by those who are actually involved with the various research projects. It will also involve one-to-one student contacts between our undergraduates who are conducting research in these various laboratories and prospective students who have expressed interest in areas related to biotechnology. Other opportunities that arise will also be used. For example, 10 NAU faculty, most of whom have been involved in TRIF-funded projects recently served as Grand Award Judges at the International Science and Engineering Fair. Efforts such as this serve not only as potential individual contacts, but help get the name of NAU biotechnology in the minds of potential students. At the graduate level we rely on our varied contacts through colleagues at other institutions and via professional meetings. We also use our web pages to advertise our areas of skill and expertise. The many publications from our faculty and students, across a broad spectrum of areas related to biotechnology, enhance both our reputation and our visibility.

A second area in which we will be seeking to be more active concerns the cultivation of partnerships with business and industry. We have begun to move down this pathway in our collaborations with GFEC in attracting biotechnology businesses to NAU, with NATBI in helping advance current and future business ideas in northern Arizona, and we expect that SABRE will be a major conduit between the research and business community that will help market biotechnology at NAU. This has already been done with a collaborative effort between GFEC and SABRE in having an informational booth at the most recent AZ Bio Expo in April in Phoenix. In addition to these duties, one of the primary purposes of SABRE will be to communicate (e.g. AZ Bio Expo) the successes realized as a focus of TRIF funding in Biotech.

3.2.2 Method of Promotion

Our efforts to promote what we do will take on several forms. One of these, traditional research approaches will entail:

- Publishing articles in professional refereed journals,
- Submission of contract reports to appropriate funding agencies,
- Working with science writers and public relations personnel to enhance the public's general knowledge of the importance of biotechnology in today's world,
- Sponsoring professional conferences,
- Serving as consultants to and on the advisory boards of corporations, and
- Serving on government advisory panels.

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A second area where we will endeavor to promote our Growing Biotechnology Initiative will be through cultivation of business partnerships and public outreach via:

- Building on already established relationships with local, state, national, and tribal Governments. As outlined above, some of these efforts have already taken place.
- Outreach to important community groups in business and education,
- Establishing new partnerships with local business and fostering the development of start-up companies by working with the local economic developers, and
- Striving, where possible, to help the public understand the impact of modern biotechnology developments via such avenues as workshops and newspaper articles. This will be an increasing duty of SABRE over the next five years.

3.2.3 Advertising and Promotion Plans

We have already begun to act upon the various points made in 3.2.2 concerning our methods of promotion. Several conferences have been held on campus in the past years. More than 80 publications have appeared from our work or are in press in professional journals. These publications serve as an advertisement vehicle through their visibility with professional colleagues and they aid in recruitment in terms of students seeing what we have to offer, and the fact that both undergraduate and graduate students are co-authors on published articles. Further, faculty and students at professional meetings have made some 20+ presentations during this past year related to the work they are conducting with TRIF funding under the Growing Biotechnology Initiative. Several of our TRIF Project Managers have received statewide and national attention for their research work, making our entire program much more visible in the process.

The new Strategic Alliance for Bioscience Research and Education (SABRE), recently approved by ABOR, has as part of its task to increase the visibility of bioscience research at NAU. In this vein, SABRE has sponsored research and business seminars on campus, had exhibits at the recent TGen grand opening and the AZ Bio Expo. This helps improve the perception of research in the life sciences at NAU and helps recruit students into the biosciences at NAU. Another purpose of SABRE is to help researchers within and outside of NAU find collaborators that contribute to the success of their research and teaching endeavors. We anticipate continuing these and similar efforts to increase the visibility of biotechnology activities at NAU.

3.3 Project Management

3.3.1 Organizational Structure

The Growing Biotechnology Initiative (GBI) is one of five major initiatives at NAU supported by TRIF. GBI will be lead by a Project Coordinator (0.25 FTE) (faculty member with biotechnology expertise) with assistance from an administrative assistant (1.0 FTE). The Project Director (PD) will provide the administrative leadership and insure that deliverables are being met, reports completed, and budgets balanced. The PD will also oversee all funded activity to insure compliance with NAU's TRIF program and seek to further the development of biosciences at NAU. The PD will be the GBI liaison to SABRE, NATBI, GFEC, and other internal and external organizations.

GBI will focus its efforts on five major technology platforms – cancer, neuroscience, infectious diseases, bioengineering, and diabetes. Funded research that will support these platforms will be selected on a competitive basis using outside reviewers. All TRIF supported grant activity will fit into one or more of these platforms and address specific metrics specified in the business plan. The overall goal will be to help implement Arizona's bioscience Roadmap.

3.3.2 Advisory Board or Other Oversight

An Advisory Committee (approximately 6-8 members) will be developed with membership from NAU senior administration (e.g., Deans) and external business and academic leaders in the bioscience arena. The GBI Project Director will serve in an ex officio capacity on the Advisory Committees. The Advisory Committee will set the overall direction for GBI, provide funding recommendations, and assist the PD in achieving GBI's stated goals. NAU's TRIF Oversight Board will also review the GBI and an annual assessment will be completed by an external evaluator. A new Research and Development Advisory Board will be formed to oversee the next 5 years' TRIF initiatives in GBI and Environmental areas. This board will consist of two deans, two faculty, and five people from off campus, with expertise in environmental biotechnology areas. The members are as follows: Laura Huenneke, Dean of the College of Engineering and Natural Sciences, David Patton, Dean of the Consortium of Professional Schools, Thomas Whitham, Regents' Professor, Biology, Barry Gold, Packard Foundation, David LaRoche, Environmental Protection Agency, Edwin Lewis, Professor of Chemistry and Biochemistry, Michael Bittner, Translational Genomics Research Institute, Mary O'Connell, Professor of Agronomy and Horticulture, New Mexico State University, Will Ott, Northern Arizona Technology and Business Incubator, Stephanie McKinney, Greater Flagstaff Economic Council.

3.3.3 Support Services Required

To accomplish GBI goals, several types of support will be necessary. The Office of the Vice-Provost for Research & Graduate Studies (VPR&GS) will oversee and administer the grant selection process using external reviewers. The VPR&GS will make all final decisions on grant funding. Other support (financial and programmatic monitoring, technology transfer, contract management, etc.) will also be provided through the VPR&GS. In addition, as we develop contacts with industry we will work closely with business and economic leaders (GFEC, NATBI, Arizona Technology Council, Flinn Foundation, Arizona Dept. of Commerce) and seek their advice to insure we are closely aligned with the Roadmap. Lastly, we will have regular access to Arizona Technology Enterprises and NAU legal counsel to aid in preparing documents such as those involved in patents, licensure agreements, and codifying partnerships with business and industry.

3.4 Risks and Plans to Overcome Them

3.4.1 Legal Risks

Legal risks are anticipated to primarily be related to litigation associated with technology transfer activities and specific contractual agreements with private industry. Additional risks would also be evident if research included laboratory animals and human subjects. Current policies are in place through the Arizona Board of Regents (ABOR) to address technology transfer issues. Research conducted with private organizations is carefully negotiated in advance by NAU's Office of Grants and Contracts following ABOR and State of Arizona policies. NAU policies relating to animals and human subjects stringently follow federal guidelines and regulations.

3.4.2 Regulatory Problems

The research, development, and commercialization of biotechnology products is tightly controlled by numerous federal agencies, policies, and guidelines. As a university we comply with all federal and state laws regarding biohazardous materials, animal use and care, radiation safety, scientific conduct, and the use of select agents. NAU has in place federally mandated oversight committees to provide for public safety and insure compliance with all regulations. NAU has also recently hired a new Biosafety Officer who works with the oversight committees as well as the university industrial hygienist and others to insure compliance in all laboratory areas.

3.4.3 Political Risks

NAU maintains the highest degree of integrity in its research and teaching programs. We strive to work in close partnerships with governmental leaders, businesses, and public officials. Where an extra degree of sensitivity is present, (e.g, biohazardous materials) we maintain several extra layers of

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security. There is much to be gained by being an active participant institution in aiding our national initiatives in areas such as bioterrorism, cancer research, and maintaining a safe and non-toxic environment.

3.4.4 Business Risks

In the initiation of any business there are tremendous risks and some of these risks apply to academic institutions as well. The major difference, though, is that academics are the backbone of NAU and any university. Our major products are training students for the future, discovering new knowledge and applying that knowledge. New businesses are important as are technology transfer and commercialization opportunities and it is anticipated that the next five years will see dramatic increases in those arenas, as have been seen in the last five years. There will, though, be the traditional products that NAU has always produced such as leveraged grant funding that brings a great deal of money into the state and is responsible for many jobs in the Flagstaff region. Therefore, while risks exist, they are minimized by the ability of our researchers to continue with and expand their current excellent efforts.

3.4.5 Competitive Risks

Our faculty has proven to be competitive with the other institutions in the region and the nation who have similar levels of research. Further, the incoming college students in Arizona have shown a strong interest the biosciences. Therefore, we do not anticipate any shortage of research opportunities or students interested in the biosciences and biotechnology in the next five years or for the foreseeable future.

3.5 Sustainability

3.5.1 Anticipated funding sources for ongoing support

Several areas of the Business Plan have addressed funding sustainability directly or indirectly. TRIF support has been tremendously helpful to the researchers who have received it. The investment of TRIF dollars has resulted in several millions of dollars in external funding as a result of this support. More importantly, the TRIF support has increased the competitiveness of our faculty researchers and they are better positioned to get new funding from agencies such as the NIH and NSF, as well as from state, local and private funding sources. Further, as NAU continues to develop its core competency in biotechnology, it will increase as a priority for the university gaining an increased number of students and faculty as the demand increases over time. Additionally, two of the new grant opportunities outlined in this Plan are directly linked to future support from business and government agencies. Seeking and securing support (including technology transfer and commercialization revenue) from business and industry will be major activity for GBI in an effort to establish a diversified portfolio of support.

Finally, the equipment grants will lead to self-supporting laboratories that will recover operating and maintenance costs directly from their use.

3.5.2 Timeline for transitioning away from TRIF support

The initial projects supported by TRIF GBI have already been transitioned away from that support and those investigators have successfully secured support for much of their continuing research and development efforts. This support has come from federal agencies as well as business ventures. As this successful attainment of grants and contracts, as well as new products, grows, it is anticipated that cost returns to the university such as increased indirect costs, license fees and sales from products will help support R&D efforts at the university to a much greater extent than has previously been the case. While it is not planned that all of this support will be able to be transitioned within the next five years, we do anticipate some turnover. By the same token, in order to advance as fast as we plan in the face of less than optimal support at numerous levels (See Battelle report, February 2005), this funding will be critical to help support new researchers as they join NAU and others who have new ideas for research and development ideas that will increase the capability of the university.

4. Goals/Metrics/Outcomes

4.1 Measurable Goals

The following table provides a picture of our current goals, metrics, and outcomes. These are primarily based on the outstanding progress that we have had with the first three years of TRIF funding. It is also important to note that some of these categories are increased levels of their outcomes. Therefore, even though the values might not increase, these numbers are all increases.

METRICS (\$ in millions)	FY 07 Proj	FY 08 Proj	FY 09 Proj	FY 10 Proj	FY 11 Proj
<u>Return on Investment</u>					
Increased External Funding - Federal	\$2.5	\$2.8	\$3.1	\$3.4	\$3.7
Increased External Funding - Other-Private	\$0.3	\$0.5	\$0.5	\$1.0	\$1.0
Increased Number of Scholarly Publications	20	30	30	40	40
<u>Technology Transfer</u>					

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Patents Generated	2	2	2	2	2
Products Generated and in the Marketplace	1	2	1	2	2
Business Expansions	1	1	1	1	1
Technology Transfer: startup companies created	0	1	0	0	1
Industry Partnerships	1	1	2	1	2
<u>Economic Development</u>					
Incubation/Formation of Biotech Concerns in Flagstaff/Northern Arizona	0	0	1	1	2
<u>Work Force Contributions</u>					
Graduate/Postdoc Students in Pipeline	10	20	20	25	30
Undergraduate Students with Research Experience	70	80	100	110	125
M.S./PhD Graduate Increases	3	3	3	3	3
<u>Specific Collaborations</u>					
New Research Collaborations	2	2	5	5	7

4.1.1 Return on investment

TRIF funds will be leveraged through the acquisition of new external contracts and grants supported by federal (e.g., National Institutes of Health), state (e.g., Arizona Biomedical Research Commission), and private (e.g., Howard Hughes Foundation) organizations. GBI predicts that \$14 M in new funds will be leveraged as a result of seed grants to faculty. Return on investment will also be manifested in the development and distribution of new knowledge. In a given year, it is difficult to predict the proportion coming from federal, state/local and corporate/private funding sources. Typically, federal sources account for the majority (>75%) of the funding. That will be detailed in the annual reports during this period. GBI anticipates a strong increase in the number of scholarly publications and discoveries from TRIF-funded research.

4.1.2 Technology transfer

The number of new industry partnerships, patents, license agreements, products developed, businesses expanded, and start up companies will

constitute metrics for technology transfer. This will be an area of emphasis for GBI in FY 07-11 and many of the proposed grant programs will contribute to increasing technology transfer. At this point, predicting the average dollar income from each license is very difficult based on a lack of sufficient previous experience in this area from NAU.

4.1.3 Companies relocating

GBI will continue a close relationship with the Greater Flagstaff Economic Council (GFEC). Both GBI and GFEC recognize the importance of university research, development, and education/training in recruiting new companies to a community. GFEC has established biotechnology as one of three major initiatives in Flagstaff.

4.1.4 Workforce contributions

A major area of emphasis for GBI is recruiting students into the bioscience pipeline, providing a high quality education experience, and integrating teaching and research. GBI will offer unparalleled opportunities for undergraduates to acquire research skills by working directly in laboratories. Similarly, graduate students will have access to top bioscience faculty in the development and completion of their research. Both undergraduate and graduate students upon completion of their degree programs at NAU will be fully prepared to enter the biotechnology workforce.

4.1.5 Specific curriculum innovations

GBI will facilitate the development of new curricula through the seed grant program. Support from specific programs will be sought to continue the development and implementation of innovate courses, training activities, and laboratory experiences. Programs at the National Science Foundation, National Institutes of Health, as well as several private foundations provide an opportunity to secure support for innovation in the classroom and teaching laboratory.

4.1.6 Partnerships/collaborations

Strategically, this metric may be the most important of all those listed. In today's world of scarce resources, partnerships and collaborations are the "way to get things done". GBI will strive to continue to facilitate partnerships with industry, business, universities, national laboratories, and state/federal agencies. GBI through SABRE will also seek cross disciplinary research programs that integrate across bioscience, biotechnology, and biomedicine. GBI will specifically aim to increase partnerships with Arizona State University and the University of Arizona in an effort to build bioscience capacity in Arizona.

4.2 Timeline for achievement of goals

The metrics identified in the previous table will be achieved during FY 07-11. Some changes will undoubtedly occur but the numbers presented are sound estimates based on past experience and current assessments.

4.3 Early proof of performance

4.3.1 Implementation goals for the first three years

Since GBI has been successfully in place since FY 01, there is no anticipated start up time. The goals, metrics, and outcomes will stand as proof of performance. Technology transfer activities will take more time simply due to the processes involved in licensing and commercialization.

4.3.2 Special efforts to produce rapid results

The grant program outlined in the proposal will be effective in producing rapid results. The size and duration of the faculty-based grants are sufficient to see early results. The solicitation and award process is well established and will move quickly once budgets are in place. The partnerships with NATBI and AzTE will be critical to technology transfer efforts.

5. Pro Forma Financials

5.1 Cash Flow Statement

n/a

5.2 Income Statement

n/a

5.3 Funding Request

	FY 2002 Actual	FY 2003 Actual	FY 2004 Actual	FY 2005 Actual	FY 2006 Actual	FY 2007 Budget	FY 2008 Budget	FY 2009 Budget	FY 2010 Budget	FY 2011 Budget	TOTAL
Carry Forward	\$ 0	\$ 363,216	\$ 510,270	\$ 18,410	\$353,276	\$ 341,247	\$ -	\$ -	\$ -	\$ -	
New TRIF Revenue	967,002	1,123,132	817,501	768,000	807,951	913,880	913,880	913,880	913,880	913,880	\$ 9,051,435
TOTAL REVENUE	<u>967,002</u>	<u>1,486,348</u>	<u>1,327,771</u>	<u>786,410</u>	<u>1,161,227</u>	<u>1,255,127</u>	<u>913,880</u>	<u>913,880</u>	<u>913,880</u>	<u>913,880</u>	
Personal Services	\$ 216,402	\$ 377,561	\$ 706,203	\$ 696,382	\$ 345,031	\$ 866,035	\$ 630,577	\$ 630,577	\$ 630,577	\$ 630,577	\$ 5,887,493
Operating	387,384	598,517	603,157	67,366	474,949	389,092	283,303	283,303	283,303	283,303	\$ 3,163,942
TOTAL EXPENDITURES	\$ 603,786	\$ 976,078	\$ 1,309,360	\$ 763,748	\$ 819,980	\$ 1,255,127	\$ 913,880	\$ 913,880	\$ 913,880	\$ 913,880	\$ 9,370,019
ROI	2.3:1	6.4:1	4.2:1	1.8:1	6.2:1	2.2:1	3.6:1	3.9:1	4.8:1	5.1:1	