

# **Sustainability Initiative**

## **Arizona State University Technology and Research Initiative Fund (TRIF)**

### **Business Plan**

**Fiscal Years 2010–2011**

August 2009

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## Introduction — Business Plan for Fiscal Years 2010 and 2011

Arizona's quality of life, condition of the natural environment, and strength of the economy will increasingly depend on finding solutions to challenges of sustainability. These challenges include climate change, rapid urbanization, water quality and supply, biodiversity, social transformations, and energy supply and efficiency. ASU is committed to education, discovery, innovation, and outreach activities that will yield solutions to such challenges.

While the concept of sustainability was once associated exclusively with environmental advocacy, it has now become mainstream. Sustainability is rapidly becoming an academic discipline, a critical aspect of corporate competitiveness and profitability, and a platform for economic development policy. The Global Institute of Sustainability is ASU's primary vehicle for motivating, organizing, and assessing research in sustainability. Although the Institute itself is a relatively small unit, its mission is to work on a university-wide basis in support of teaching and research in sustainability science and to encourage ASU units to build bridges that connect scientists, policymakers, and business leaders on critical local and global challenges of sustainability.

Sustainability is a broad domain, including research investments in biodesign, engineering, public health, human evolution and social change, and life science. However, for purposes of focus and clarity, this document reports on past and proposed ASU TRIF investments in three areas that are involved in sustainability research:

- **Arizona Institute for Renewable Energy (AIRE)**, which oversees key investments intended to develop reliable, affordable, renewable energy sources and storage suitable for commercialization in the Southwest United States. (<http://aire.asu.edu>)
- **Decision Theater (DT or "the Theater")**, a policy informatics and visualization laboratory that studies how decisions for a more sustainable future are made, understood, and improved. (<http://dt.asu.edu/>)
- **Global Institute of Sustainability (GIOS)**, which catalyzes and advances interdisciplinary research on environmental, economic and social sustainability with a special focus on rapid urbanization. (<http://sustainability.asu.edu/>)

## Executive Summary

This document contains the business plans for proposed ASU TRIF FY10 investments in three discreet units that conduct sustainability research — Arizona Institute for Renewable Energy, Decision Theater, and GIOS. A total TRIF investment of \$1.9M is requested.

Conducting research and providing education on sustainability is an opportunity to “do good and do well” at the same time. In addition to the potential to mitigate serious threats to local and global environmental quality, research and development in sustainability has also become a significant opportunity for strengthening Arizona’s economy. The federal government, large philanthropies, and the private sector are increasing their funding commitment to technologies, processes, and policymaking in sustainability. As an example, the very backbone of the American Recovery and Reinvestment Act of 2009 (aka the “stimulus package”) is comprised of investments in research that will both create “green jobs” and reduce dependence on limited and vulnerable foreign sources of energy. The FY10 funding available for research, development, and implementation on sustainability topics from this Act alone exceeds \$75 billion. Thus, a TRIF investment in sustainability research at ASU will help the state to capitalize on this economic opportunity and, at the same time, educate current and future decision makers.

The majority of the FY10 TRIF funds requested for sustainability research, \$1.3M, are for renewable energy. This funding will attract talented researchers and lucrative investments to the state from companies already in or intending to enter this market. This mission is consonant with a growing push by the Arizona economic development community to make the state the “solar capital of the world.” Arizona clearly has the potential to achieve this goal due to the large amount of land suitable for concentrated solar power (19,300 miles<sup>2</sup>), existing engineering and biodesign talent, and abundance of sunshine (the highest of all the States with a resource potential of 7.5 kWh/m<sup>2</sup> per day). Indeed, research and development in “light inspired” energy, both to improve the efficiency and delivery of traditional technologies in solar power and to develop new, biomimetic approaches, are of great interest to private and public investors. Since the commercial viability of such technologies is heavily affected by public economic policies, ASU will also use TRIF funds to develop decision making data, models, and techniques that will enable Arizona’s leaders to make sound, scientifically based policy choices to enhance our economic prospects and, at the same time, create a more sustainable state.

The impacts of a successful TRIF FY 10 investment in sustainability science research at ASU will include, but are not limited to:

- Increased public, philanthropic, and private funding of ASU research in renewable energy, decision making, and climate adaptation by 15 percent annually
- Development and transfer of new technologies to the private sector
- Creation of well-paying “green jobs” in sustainability-related businesses
- Development of an Arizona work force with the knowledge, analytic capability, and technical skills to power a “green economy”
- Development of solutions to sustainability challenges such as water supply, rapid urbanization, land use, and biodiversity

# Arizona Institute for Renewable Energy

## Summary

AIRE was originally awarded TRIF funding in FY08. In December 2007, the Arizona Board of Regents (ABOR) approved funding for a Solar Energy Initiative at the University of Arizona (UA) and ASU. This plan illustrates how the two universities have defined their goals and approaches in distributing funding from the TRIF awards. Upon recommendation from the Arizona Solar Electric Roadmap, the two institutions agreed to coordinate efforts to unify research and development in the State of Arizona. The Arizona Research Institute for Solar Energy (AzRISE) at UA, and the Solar Power Laboratory under AIRE were established at the same time. In January 2009, Arizona State University reorganized their TRIF investments and AIRE became part of the sustainability component of the overall strategic plan. AIRE is dedicated to promoting the growth of renewable energy in the State of Arizona, and stimulating the resulting economic growth from the development of renewable energy industries in the state.

Research and development will be used to attract industry and intellectual capital to Arizona. It will trigger new startup efforts and will form a nucleus from which the renewable energy industry will grow. Economic and policy analyses are equally critical to renewable-energy-associated economic growth. Solar energy utilization for the utility-scale production of electricity does not follow conventional utility investment strategies since it does not require fuel purchases and thus, requires new financial analyses to predict investment costs and return on investment. Policy analysis is critical for guiding the prudent development of regulations that will stimulate economic growth in the state. Finally, education and outreach are critical to providing the trained work force that will attract new business to the state and will enable the installation of renewable energy for the consumer, the business, and the utility scales. AIRE is comprised of the Solar Power Laboratory, the Advanced Photovoltaics Center, the Center for Bioenergy and Photosynthesis, and the Center for Renewable Energy Electrochemistry. AIRE also serves as an umbrella for efforts in renewable energy infrastructure, testing, and policy. AIRE will actively engage with industry and in the development of renewable energy education programs.

## 1. Core Vision/Project Description

### 1.1. Overview of the Industry or Area Being Addressed by the Initiative

The Energy Policy Act of 2005 and U.S. Energy Independence and Security Act of 2007 support establishing infrastructure and commercialization of innovative technologies that meet security, environmental, and cost competitiveness goals. Major goals of these Acts are to reduce the Nation's reliance on fossil fuels and make significant progress toward a carbon-neutral renewable energy (RE) country. Several states have responded by building renewable energy portfolios that will provide up to 33% (CA) of the state's electricity from renewables by 2020. The twenty-two states that adopted RE standards are expected to support ~12,000 MW of existing capacity and result in ~52,000 MW of new capacity by 2020. The Arizona Corporation Commission responded by adopting aggressive Renewable Portfolio Standards (RPS) with targets of 4.5% distributed RE by 2012 and 15% by 2025. This policy projects the AZ renewable portfolio to be 2,000 MW by 2020. Successfully attaining these "green energy" targets will result in a more stimulated economy and a cleaner environment.

Power available from the sun in Arizona is the highest of all the states. Arizona's high solar resource potential of 7.5 kWh/m<sup>2</sup> per day plus the highest useable land area of 19,300 mi<sup>2</sup> in the

United States provide us with a potential concentrated solar power generation capacity of ~2.5 terawatts [NREL]. The entire U.S. power consumption in 2006 was ~4 TW. Realizing a respectable fraction of this potential capacity and achieving the RPS goals requires synergy among industry, academia, and policy makers. AIRE realizes the need for significant, long-term commitment to build infrastructure, commercialize products, innovate in new technologies, and train the new work force. There are approximately 122 renewable energy companies in Arizona with 50 specializing in solar energy [Source Guides]. Large corporations are beginning to form solar divisions (e.g. Honda Soltec Co, LTD). This interest is spurred to a large extent by the opportunity provided in the solar panel industry which is growing at over 35% per year and has a \$12B worldwide market for equipment. Worldwide, of the 46 Solar IPOs that have taken place since 1995, 75% of them occurred in the past three years [LUX Research]. Although the number of local solar energy companies is increasing with new startups and large corporations such as Abengoa Solar, the influx rate needs to be increased for AZ to become competitive domestically and internationally.

Arizona State University's historical strength in "light inspired" energy research (e.g. solar, bioenergy) as well as its development and technology spin-off capabilities, make it uniquely positioned to collaborate with industry in many ways. Faculty experienced in renewable energy-related science, technology, and policy can anticipate the technological needs, provide cutting-edge options, train future employees, and generate potentially revolutionary developments.

## **1.2. Mission, Goals, Values and Vision**

AIRE's mission is to research and develop reliable, affordable, renewable energy sources and storage suitable for commercialization in the southwestern United States

ASU has made the strategic decision to invest TRIF resources into renewable energy and supporting technology areas by forming AIRE and, most recently, the Solar Power Laboratory as part of the overall sustainability strategy at the university. Consistent with the TRIF goals, AIRE will accelerate ASU's participation in the renewable energy research enterprise, and must also be a key component in attaining educational and commercial global competitiveness in Arizona.

AIRE's vision is to establish a world-renowned, highly interdisciplinary environment and structure that develops and translates research into useful applications in renewable energy. Close synergy amongst academia, industry, power utilities, government, and policy makers will accelerate the creation and adoption of distributed renewable power resources integrated into the energy infrastructure, for example the electric grid. This technological and societal transformation will achieve an energy-secure, environmentally sound 21<sup>st</sup> century.

AIRE's goals are to:

- Discover and innovate evolutionary and revolutionary science and technology in renewable energy. There will be an increase in the number and size of R&D contracts resulting from consolidating and strengthening the renewable energy efforts at ASU. Building new laboratory capabilities and expanding the network of research collaborations are major efforts. Prominent faculty members are being recruited to further raise the visibility and distinction of ASU's energy programs. The renowned reputation of these programs will increasingly attract a larger number of higher quality students.
- Develop the local economy by providing technology solutions and transitioning them to partner companies and startups. A large part of this effort is cultivating relationships with

national and international companies to have them establish a significant economic presence in Arizona. ASU's faculty, intellectual property, and trained student work force are strong attractors. Public-private partnerships such as the TÜV/Photovoltaic Testing Laboratory (PTL), Tubes in the Desert, Heliae, and other joint ventures are critical. Increased emphasis needs to be put on identifying, harvesting, and maturing technologies that can be commercialized.

- Educate the next-generation work force and prepare citizens for a renewable energy society. Education and outreach programs are being established specifically in the areas of renewable energy to provide undergraduate and graduate curricula, including social, economic, and policy focuses. Developing programs to work with local high schools will involve students early and continue recruitment efforts.

## **2. Operational Strategies**

### **2.1. Development and Production**

Generating new discoveries, intellectual property, and products requires teaming in complementary areas of science, technology, and commercialization. Engineering, liberal arts and sciences, architecture, sustainability, policy centers, universities, and an extensive network of industrial and government laboratories are given the opportunity to collaborate through AIRE. This alliance will advance scientific, technological, intellectual property, and industry efforts to increase the competitiveness of Arizona's academic base and renewable energy industry.

#### **2.1.1. Development status**

AIRE was launched in spring 2007 through TRIF funding. Under AIRE the Solar Power Laboratory was launched through the TRIF Solar Initiative funds to coordinate and expand its solar activities. A team of prominent solar experts was recently recruited to run this laboratory (Section 2.3.1).

Many funded research proposals have been generated which leverage the extensive facilities of ASU and its partners. We are one of only four universities to receive five or more of the prestigious DOE Solar America Initiative awards, along with MIT, Stanford, and Penn State. AIRE researchers in the Center for Bioenergy and Photosynthesis achieved a very prominent success as the recipients of a large DOE EFRC award. Clearly ASU is gaining traction towards its goal of achieving excellence in renewable energy research.

Industry collaborations are increasing as well and plans are to expand them further by initiating an Industry Solar Lab (ISL) which will allow companies to access the planned measurement and solar cell fabrication facilities. A list is shown in the partnerships/collaborations section ([3.1.7](#)).

#### **2.1.2. Production process**

A coordinated, interdisciplinary group of ASU faculty, along with a large number of companies and government labs has been formed into a united team. AIRE, seeded by TRIF funds in spring 2007, established research centers in Advanced Photovoltaics, Bioenergy and Photosynthesis, Renewable Energy Electrochemistry, and the Polytechnic Energy Center. ABOR approval of AIRE and its associated centers was requested in August of 2007 and approved in January of 2008. A Strategic Research Group (SRG) proposal for photovoltaics was submitted to the Science Foundation Arizona (SFaz) in February of 2007, and awarded a \$500,000 planning grant in the summer of 2007. This SRG planning grant was the basis of a full

SRG proposal submitted in February of 2008, led by ASU with UA involvement (a similar proposal was simultaneously submitted by UA with ASU participation). These were combined under the SFaz Arizona Solar Technology Institute (ASTI), which recently awarded funding to joint teams of ASU, UA, and Northern Arizona University (NAU) faculty for solar testing, energy policy modeling, thin film photovoltaics, and storage.

Using separate funds provided by ABOR for the Solar Initiative, the Solar Power Laboratory was established, with its planned Industry Solar Laboratory (ISL) housed at the Flexible Display Center in ASU Research Park. This laboratory, combined with the Advanced Photovoltaics Center, the TÜV/PTL, and the Power Systems Energy Research Center provide a competitive advantage for Arizona's solar photovoltaics industry, attract investment and companies to the state, and increase revenue through sales of inexpensive solar power to neighboring states. The goals of ASU's Solar Power Laboratory are to improve solar cell efficiency to 50%, realize a cost reduction of more than 20% for thin-film solar cells, establish the world's best solar test laboratory, and offer technologies for the next-generation electric grid.

The key objectives for the Solar Power Laboratory and associated AIRE Photovoltaic-focused program are to:

- Develop the next generation of high-efficiency, multijunction (MJ) solar cells for space and terrestrial applications
- Use II/VI and III/V nanostructures to boost the efficiency and lower the cost of thin-film solar cells
- Development of low cost organic polymer and other organic/inorganic hybrid solar cells
- Establishment of an industrial laboratory for low cost Si module design in the ISL
- Develop test methods and algorithms for MJ solar cells and make the TÜV/Photovoltaic Testing Laboratory (PTL) the world's best equipped solar cell test laboratory
- Offer new technology for the future electric grid with large-scale distributed generation of solar electricity
- Commercialize technology through intellectual-property licensing and start-up companies, attracting venture capital and federal investment to Arizona
- Train the work force for Arizona's solar industry
- Make ASU/UA a National Center of Excellence in the area of the solar technology, attracting additional federal funding and the best talent to the state

### **2.1.3. Cost of development**

Development funds for AIRE are obtained from the Office of the Vice President for Research and Economic Affairs, College of Engineering, GIOS, SFaz, and ABOR with the TRIF support. Additionally, there are several external research contracts that contribute to the operation and growth of the renewable energy initiative. Additional construction and capital funds are needed to fully establish the Industry Solar Lab.

### **2.1.4. Labor requirements**

Faculty with expertise in biofuels, synthetic biology, electrochemistry, fuel cells, batteries, solar energy devices, solar cell testing, power systems, advanced materials, and system modeling and simulation are being recruited from around campus to participate in AIRE. Along with their participation they bring many students who will earn their degrees in renewable energy disciplines. Individual departments continue their efforts to screen and recruit leading students to their programs. AIRE is also engaged in student recruitment through its website, acting as a

point of contact for students interested in programs related to renewable energy. The pool of high quality faculty and student talent will increase as ASU gains national and international prominence in renewable energy.

## **2.2. Marketing and Promotion**

### **2.2.1. Strategy**

A key element for AIRE's success is national and international communication of its activities and successes. To gain support for this initiative our mission, goals, and progress need to be clearly articulated at all levels to the ASU community, city, county, and state governments, potential faculty and students, federal agencies, potential donors, research institutions, renewable energy industries, national labs, and Arizona residents. Reaching these groups requires a concerted effort among member researchers, university administrators, media outlets, and Arizona economic development offices. ASU is effective in communicating research results, major research awards, faculty profiles and accomplishments. AIRE will leverage their efforts to publicize the existence and impact of renewable energy initiatives. AIRE will frame its publicity to promote alignment with the goals of ASU's "New American University."

### **2.2.2. Method of promotion**

The methods used to promote AIRE will include a broad mix of approaches, including educational programs, media relations activities, direct mailings, websites, participation in trade shows and events, and printed materials. Technical venues such as workshops and conferences will be organized to augment scientific research publications. Course curricula in solar energy and sustainability will be developed to attract students into the field as well as a summer internship program.

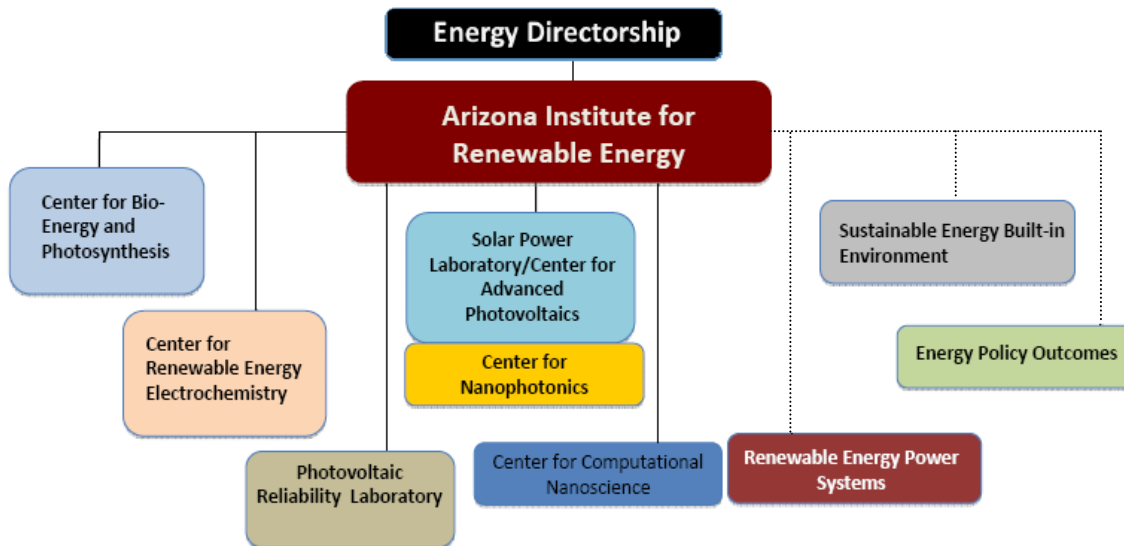
### **2.2.3. Advertising and promotion plans**

Plans are to develop and publicize AIRE-specific websites, literature, and press releases. This will be coordinated with university media organizations.

## **2.3. Project Management**

### **2.3.1. Description of the organizational setup to support the initiative**

AIRE was created primarily through TRIF funds administered by OVPREA at ASU, as well as program funds from GIOS, the Ira A. Fulton School of Engineering (FSE), and the College of Liberal Arts and Sciences (CLAS). As shown in the following figure, AIRE reports to a directorate comprised of the major stakeholders at ASU (OVPREA, GIOS, FSE, and CLAS). Under the AIRE umbrella are the Solar Power Lab, the Advanced Photovoltaics Center, the Center for Renewable Energy Electrochemistry, and the Center for Bioenergy and Photosynthesis, as well as emerging programs in Computational Nanoscience, Renewable Energy Power Systems, Sustainable Energy in the Built-in Environment, and Energy Policy Outcomes.



Organization chart: Arizona Institute for Renewable Energy

### 2.3.2. Advisory board

The AIRE Advisory Board membership is still being assembled, but consists of internationally recognized academic, government, and industry leaders. It also counts members of the individual centers comprising AIRE. The Advisory Board reviews the program and makes technical and managerial recommendations to the management team and task leaders. Teleconferences and communications on technology and commercialization-related topics are held on an ongoing basis.

The current AIRE Advisory Board includes:

- Dr. Frank Di Salvo, John A. Newman Professor, Cornell, Fuel Cells, MRSEC experience
- Dr. Larry Kazmerski, Director, National Center for PV, NREL, Photovoltaics
- Dr. David Eaglesham, CTO, First Solar Inc., Tempe AZ.

### 2.4. Sustainability

Long-term sustainability requires hiring high-caliber faculty, assisting them in developing external funding and retaining the highly productive ones. TRIF has provided seed funding for such activities. Some aspects of AIRE will become self-sustaining with external funding from government, private foundations, industry support, and eventually licensing revenues. Consolidation of the various Centers into AIRE provides strong teams that can compete for new DOE initiatives (ARPA-e, Hubs, and SAI) and NSF ERCs both of which have submissions and plans, respectively. AIRE’s chances of landing large programs such as these further improve by collaborating with industry partners. AIRE’s goal is to be self-sustaining by the end of TRIF FY12.

#### 2.4.1. Anticipated sponsored funding sources for ongoing support

ASU receives four years of funding from the ABOR TRIF Solar Initiative. AIRE builds on a strong funding productivity history of the various affiliated college faculty. Funding has come from NSF, DOD, DOE, NASA and dozens of companies. ASU has developed a track record of

performance with these agencies as evidenced by their continued and increasing support. Adding new, high-caliber, productive faculty in complementary areas of solar power research will further attract external funding.

Several research funding proposals have been generated that leverage the extensive facilities of ASU and its partners. Estimated external awards in FY09 are more than \$18.3M. We have submitted proposals for and are planning to pursue large block-funding programs such as:

- SETP — DOE Solar Energy Technologies Program.
  - Two prestigious grants from the DOE's Solar America Initiative (totaling \$2.44M) have recently been awarded to ASU for basic research into new materials for high efficiency and low cost solar cells. We are one of only four universities to receive more than one of these prestigious awards, along with MIT, Stanford and Penn State. Clearly ASU is gaining traction in solar energy research excellence.
- TPP — DOE Tech Partnership Program
  - Two more current grants from the DOE were obtained with industry partners BP and Amonix.
- DOE Photovoltaics Process and Product Development Award
  - This award is with another industry partner.
- EFRC — DOE Energy Frontiers Research Center
  - ASU submitted three EFRC proposals; one was funded for Artificial Photosynthesis, \$14.5M over 5 years.
- ERC — NSF Engineering Research Center
  - We will partner with the University of Delaware, MIT, and UA to submit a solar ERC proposal in July 2009. A second proposal in biofuels production is currently being prepared for submission in collaboration with the Biodesign Institute.

#### **2.4.2. Anticipated industrial support for AIRE**

Renewable energy company interest in AIRE is critical to its sustainability. Because of this, we have established both an Industrial Affiliates Program (IAP), and an Industry Solar Lab (ISL) which allows industry partners to have access for research and prototyping. Funding options such as Industrial Affiliates Program dues, facility access fees, and lab services will be offered. AIRE's Industrial Affiliates Program will provide many partnership opportunities to compete for grants and contracts from the sources shown here, as well as charging a small membership fee to help sustain operations.

In addition to membership fees, partnership with industry provides multiple opportunities for revenue generation helping to ensure the sustainability of the enterprise. These include: partnerships for multiple federal and state proposal opportunities where industrial collaboration is mandatory for a competitive advantage; licensing and royalty income through the commercialization of IP developed by AIRE researchers; and spin-off or startup companies established through industrial collaboration and the ensuing revenue sharing through joint ventures. Such partnerships with industry will result in substantial impact on the Arizona economy, in addition to the work force development resulting from the training of a renewable energy sector in the state.

#### **2.4.3. Timeline for transitioning away from TRIF support**

AIRE's goal is to fully transition away from TRIF support by FY12. The plan is to continue to grow the individual researcher programs, build the Industrial Affiliates Program, and compete for large national centers. Research funding details are provided in the financial section (4).

### **3. Goals/Metrics/Outcomes**

#### **3.1. Specific and Realistic Goals that are Clearly Measurable**

ASU's goals and objectives for the TRIF Renewable Energy programs embodied by AIRE are described in Section 1.2. The annual metrics summarized in the table are consistent with these goals.

##### **3.1.1. Return on investment (ROI)**

The FY09-FY11 financial table at the end of this document documents the expected return on investment for AIRE. In FY09, the expected awards from sponsored and non-sponsored sources are expected to be \$18.8M, which represents already a significant ROI on the initial investment already made in AIRE since 2007. The goal is to increase this to \$30M by FY11. A substantial portion of this income is expected to be industry-derived, through royalty and licensing revenue, partnerships in joint funding ventures, directly sponsored corporate research funding, and membership fees. Although this may seem ambitious, the current large-scale infusion of federal and industry funds into the renewable energy field over the next 5 years justifies such growth.

##### **3.1.2. Technology transfer**

Metrics for technology transfer will include the number of invention disclosures, filed patent applications, patents issued, number of start-up companies licensing ASU technology, and the number of licenses or options signed. Industry partnership will also play a role in tech transfer, through visiting scientists and joint IP development. Technology transfer will also be evaluated by the number of publications and conference presentations.

##### **3.1.3. Industry outreach**

The Greater Phoenix area is home to many companies in renewable-energy-related areas. There are ongoing activities to communicate our research activities and educational programs that benefit industry employees as well as the well-established lecture activities where industry is invited to present their work (e.g. IEEE Local Sections). Section 3.1.7. presents a list of formal research collaborations. One example of a major collaboration being formed in the solar industry is Abengoa Solar and APS. Abengoa has opened an office in Phoenix and plans to construct a 280 MW Solar Concentrator electric plant near Gila Bend. Partnering discussions with them have started. Other partnerships included the Heliae startup in bio-algae, and the Tubes in the Desert program in microbial biofuels.

##### **3.1.4. Work force contributions**

Metrics for work force contributions will be the number of post-doctoral appointments, post-doctoral researchers entering the work force, graduate students employed, graduate students entering the work force, undergraduate students involved and high school students involved.

### 3.1.5. Educational outreach

Metrics for educational outreach will be the number of workshops, conferences, seminars and new courses developed. These venues will seek to reach graduates, undergraduates, high schools and the general community.

Arizona State University's Electronic Systems Department at the Polytechnic campus was awarded a \$900,000 National Science Foundation (NSF) grant recently to develop alternative energy programs and courses in conjunction with community colleges in Arizona and Texas. Arizona-Texas Consortium for Alternative and Renewable Energy Technologies Advanced Technological Education (ATE) project will create industry internships, provide training to improve the skills of existing work force, offer professional development activities to teachers in grades 9-16, and serve as a nationwide and statewide public awareness vehicle.

The School of Sustainability (SOS) has expanded its curriculum by forming a new certificate degree program in Sustainable Technology and Management. Other new renewable energy courses are also being discussed.

### 3.1.6. Government agency/community outreach

AIRE's goal is to serve as the main point of contact between Arizona State University and the greater community in matters of renewable energy. Primary partners with AIRE in this outreach are the Science Foundation Arizona (SFAz), the Department of Commerce, the Arizona Corporation Commission, and the Greater Phoenix Economic Council. In addition, AIRE is seeking ties with community and professional organizations in the state with a focus on renewable energy, such as the Arizona Solar Energy Industry Association (AzSEIA).

### 3.1.7. Partnerships/collaborations

We have a strong collaboration with the University of Arizona through AzRISE and individual faculty in solar energy related research. AIRE also has substantial industry links. Below is a partial list of industrial partners currently associated with AIRE. Many are partners formally included in current and pending research programs. Individual faculty members have funded project partners in addition to the ones listed below.

AdValue Photonics Inc. (RP planned)	Nanoexa Corp. (RP planned)
Aerospace Corporation (RP planned)	National Renewable Energy Laboratory (RP)
All Optronics (RP planned)	Newport Corporation (RP, Fac/Eq)
AmberWave Systems Corporation (RP planned)	Nichia Corporation (RP, Fac/Eq)
Amonix (Fac/Eq)	Northstar (RP planned)
Arizona Public Service Company (APS) (RP, WF)	Phoenix Analysis and Design Technologies (PADT) (RP)
BP (RP)	Rogers Corporation, Durel Division (RP)
CYRO Industries (RP planned)	Salt River Project (RP, WF)
EMCORE Corporation (RP)	Sandia National Laboratories (RP, WF)
Global Solar Energy, Inc. (RP)	Sierra Solar Power, Inc. (RP planned)
Hernandez Electric (RP planned)	Spectrolab (RP, Fac/Eq)
Jet Propulsion Laboratory, California Institute of Technology (RP)	Xantrex, the Imperial (Calif.) Irrigation District (RP)

JOL Enterprises (RP planned)	Petro Algae (RP, TT)
Lockheed Martin Space Systems (RP planned)	Motorola (RP, Fac/Eq)
Micrel (RP)	

RP: Research Partnership  
 WF: Work force development  
 Fac/Eq: Facilities Equipment  
 TT: Tech transfer

### 3.2. Timeline for Achievement of Goals

#### 3.2.1. Return on investment (ROI)

FY09 external funding (awards) were \$18.3M (Section 3.1.1.) including the recent DOE EFRC. In addition to the individual investigator proposals, we will increase our bid efforts for major national Centers such as one or more DOE Hubs and NSF ERCs. The goal is to achieve an annual funding level of \$40M by the end of FY12 which will provide AIRE sufficient critical mass to be sustainable without TRIF funds.

The Industry Solar Laboratory is currently under construction at the Macro Technology Works facility, and it is anticipated that the laboratory will be complete by early 2010. The number of industrial partners will increase per year as the capabilities of the facility come online. We will leverage the industrial affiliates to partner with AIRE to pursue major government R&D programs to grow the research base and accelerate technology transfer to industry.

#### 3.2.2. Work force contributions

The plan is to complete three or more faculty hires in FY10 to AIRE associated departments and colleges. Research labs and offices for the new hires will be constructed in the next two years. Staffing of research faculty, postdoctoral associates and students will be concurrent with the lab development activity. Training of new graduate and undergraduate students will ramp up with time as well.

A renewable energy curriculum will be developed in partnership with industry and the other universities to develop the renewable energy work force necessary to make Arizona competitive in the global energy market. An interdisciplinary graduate degree in renewable energy will be established between ASU and the U of A. One support mechanism for funding this is an NSF IGERT (Interdisciplinary Graduate Education and Research Training) program, which has been submitted for funding in FY09. Undergraduates in the affiliated departments will have the option of attaining a degree with a certificate of specialization in renewable energy, planned for FY10. ASU Polytechnic already has a technology degree with solar emphasis and we will roll out this model to other departments. This will necessitate establishing additional courses. The NSF education award at Polytechnic will be used to develop two year Associates and four year technology degrees. This curriculum is mainly to train students in skills such as Solar system installation and other related services.

#### 3.2.3. Technology transfer and partnerships

Communicating faculty and staff developments and raising the awareness of the important and growing field of solar energy is important to forming new industry and government partnerships. These will be accomplished by hosting yearly conferences on AIRE research and activities as

well as by informational briefings to targeted state, federal, and industry organizations. The number of keynote speeches, technical presentations and papers has been increasing steadily and will continue because of the high researcher quality and improved capabilities of AIRE.

IP development is an ongoing effort and will increase as educational and research plans mature. The number of graduate and undergraduate students in the Renewable Energy Program will grow and thus provide opportunities for employment in the private sector. Providing a centralized Industry Solar Lab will offer companies a close look at SPI to identify promising technologies and talent. The opportunity for technology company spin-offs will increase as IP generation increases, and visibility with our industrial partners will follow in growth.

### **3.3. Early Proof of Performance**

#### **3.3.1. Research**

Performance has already been demonstrated with several major grants awarded (Section 3.1.1.). A major success was the establishment of a DOE Energy Frontiers Research Center on Artificial Photosynthesis at ASU.

#### **3.3.2. Organizational**

The Solar Power Laboratory structure was formed and a team from the University of Delaware was successfully hired as its core faculty/staff and has been leading the effort since January 2009. The Centers for Renewable Energy Electrochemistry, Bioenergy and Photosynthesis, and the Applied Photovoltaics Center have all received ABOR approval and are well established. AIRE itself received ABOR approval in January 2008, and has since organized seminars, workshops and conferences. The industrial partners program both through the Affiliates Program and the Industrial Collaboration Lab are maturing and will be fully developed in FY10.

# Decision Theater

## Summary

DT is evolving its strategy aimed at “better decision making for a sustainable future.” The Decision Theater team is combining a systems-based approach and the physical “systems scoping” capability of the Theater with a growing group of strategic research collaborators at ASU and beyond. DT intends to increase its national visibility, engage in critical policy issues, and develop novel research programs in order to provide long-term ROI.

## 1. Core Vision/Project Description

### 1.1. Overview of Industry or Area Being Addressed by the Initiative

DT is both an idea and a place. It is a unique world-class laboratory that studies how decisions for a more sustainable future are made, understood, and improved. As a collaborative decision-making facility, leaders can examine and address the most challenging scientific, economic, and policy issues we face today. It is a place for developing the most innovative approaches for a sustainable future and sharing these visions through direct engagement with ASU faculty, students, and staff. While DT, “the place,” is located at ASU and is part of GIOS, DT, “the idea,” is an evolving knowledge base, human network, and action mandate that can be taken anywhere around the globe and shared using the most open, collaborative, and IT-enabled means available.

DT executes its mission in three strategic areas:

- Pioneering Research Laboratory and Unique Facility
  - DT is a research facility (a decision-making laboratory) and partner for exploring, understanding, and progressing knowledge on making decisions for a sustainable future. DT explores and applies decision-making frameworks, creates decision making environments and utilizes a unique suite of analytical and visualization tools and facilities. The Theater partners with researchers, business and community leaders, and policy makers in this pursuit.
- Direct Application to Real-world Challenges
  - DT works directly with partners and clients to find solutions to real-world challenges in fields such as energy efficiency, water planning, urban development, public health, education, and national security. The Decision Theater applies a collaborative decision process and uses its unique visualization and analytical capabilities to bridge the gap between complex scientific knowledge and the explicit needs of decision makers.
- Leadership and Education
  - The Theater is a center where decision-makers gather to engage with today’s most challenging issues. Through leadership summits, publications, planning exercises, and educational courses, DT exports the knowledge gained here with a growing group of collaborators. Students, faculty, and partners use DT as a unique venue to develop courses and exchange information, bridging system science with real-world challenges.

### 1.2. Mission, Goals, Values and Vision

The vision for DT is to aim to become a world-class research laboratory and application center focused on better decision making in complex arenas. The Theater targets emerging issues of sustainability and helps decision-makers at all levels address these challenges by making the most informed and scientifically robust decisions possible for a sustainable future.

DT's mission offers a unique research laboratory and facility at ASU to support and enable decisions that are informed by systems science and empower key decision makers, especially with regard to how they can help create a sustainable future.

DT Values:

- Combine a Place and an Idea
  - A strengthened focus is the Decision Theater as a world-class laboratory that explores how to define, support, and enable better decisions for a sustainable future. As a physical laboratory, DT can bring together collaborators and decision-makers to explore decision-making and sustainability challenges. As an idea and a mandate for better decisions, DT can extend its reach beyond the confines of the physical theater through publications or results and sharing new methods and direct engagement and partnerships with other global institutions, enterprises, and projects.
- A “Decision First” Approach
  - Overall success focuses on increasingly better decisions made by systems-science informed decision-makers. In many cases, decision-makers’ needs and the actual decisions that must be supported by systems science only come into play late in the decision-making process. A decision-first approach makes successful decisions the overarching goal that presides over the strategic process — from interactions with key participants to defining important issues and aspects to critical analyses.
- A Connected and Collaborative Facility
  - A facility in which a growing set of partners can navigate through and across complex systems, define areas requiring deeper analysis, and apply robust decision-making frameworks to today’s sustainability challenges.
- Sustainability Informatics
  - DT will provide the best information and the pertinent decision-making frameworks to decision-makers in a collaborative process, to enable them to make informed and effective decisions about sustainability challenges. The Theater gets the right people and the right information in the right way at the right time.

Decision Theater Goals for 2010 and Beyond:

- Have demonstrable impact on the field of decision-making in the area of sustainability.
- Develop methodologies that extend beyond the DT facility for use in numerous regions.
- Be an integral part of research and application partnerships and collaborations at ASU, in the local, national, and global scales.
- Create ROI and financial self-sufficiency via a mixed revenue model: grants and contracts, workshops and forums, and applications.

## **2. Operational Strategies**

### **2.1. Development and Production**

#### **2.1.1. Business development status**

A major component of DT's efforts is to promote our applications and projects to the public and private sector in order to develop new relationships, collaborations and project opportunities. Each staff member at DT is involved in these outreach and demonstration efforts at the rate of 3–5 presentations, outreach efforts, and client meetings a week. As such, business development is a vital part of DT's program of work. The key metrics to return on investment of business development activities is in the number of proposals written, the number of awarded projects, and the number of new partnerships/collaborations developed. Other valuable activities include the investment return to the university community through support of VIP presentations, strategic workshops for large initiatives, publicity and media coverage, and student engagement.

Targeted segments for business development:

- Resource Intelligence in Renewable Energy and Water
- Sustainable and Resilient Cities
- Critical Infrastructure, Homeland Security and Emergency Preparedness
- Green Technology, Sustainability Business and Innovation
- Participate with key ASU research groups/centers on new initiatives

Current DT Industry Collaborators:

- Arizona Department of Health Services
- Arizona Public Service
- City of Phoenix
- City of Mesa
- Discovery Triangle
- Greater Phoenix Economic Council
- Maricopa County Department of Public Health
- National Oceanic and Atmospheric Administration
- Professional Supply, Inc
- Salt River Project
- Brightsource Solar Power

The Theater has established relationships and secured funding for targeted projects from the above collaborators that will benefit our region in the areas of energy and health planning. Specifically, DT and its collaborators are working together to create new capabilities and capacity through modeling, simulations, and structured collaboration exercises to plan for local and global sustainability challenges. These coordinated efforts are being developed into portable tools and processes for work force training and development in Arizona, as well as nationally. For example, DT's pandemic flu tabletop exercises are being considered by the Department of Homeland Security (DHS) as a method for training DHS stakeholders across the county. In addition, DT's current collaborations are providing a platform for disparate groups to develop new tools and processes for renewable energy, potentially leading to new education programs, the creation of new jobs, and reducing energy use across the state.

In 2010 and beyond, DT will also significantly boost its research activities through active participation in collaborative and trans-disciplinary research proposals.

Current DT Academic Collaborators:

- BioMedical Informatics, ASU
- Central Arizona Phoenix Long Term Ecological Research
- Consortium for Science, Policy Outcomes
- Decision Center for a Desert City
- Global Institute of Sustainability
- Office of the Vice President for Research and Economic Affairs
- W.P. Carey School of Business
- University of Arizona

DT aims to develop broad academic engagement through a variety of entry points including:

- Co-development of new research efforts and integration of DT into existing research programs. DT is a party to a number of significant grant opportunities. DT will work to further refine the unique added value of the DT in research efforts and make it easier for faculty at ASU and other institutions to write the DT into their explorations and support their success.
- DT will develop its own novel research efforts and link them to faculty. By taking a leadership role in decision-making and sustainability efforts, DT can create a platform for engagement for existing and new faculty who wish to move into this growing arena.
- Work with department deans, chairs, and directors to develop resource pathways for new faculty to work with the DT.

To achieve our business development goals, the Theater aims to develop effective grant writing and proposal support mechanisms by leveraging the experience of ASU's proposal preparation techniques.

### **2.1.2. Production process**

DT has defined "value adds" that can be integral to every proposal. These include:

- Providing a unique research platform for exploring and improving decision-making in complex contexts (i.e. the ability to explore and modify decision making environments, decision-making frameworks and decision-support systems and tools)
- Applying facilitated interactions between decision-makers and expert communities. Providing expert facilitators and group decision applications for group collaboration and creating consensus building activities
- Hosting structured decision-making exercises through workshops and summits (e.g. curriculum planning, tabletop exercises, educational training)
- Structuring decision-making exercises to address critical issues and performing alternative analyses
- Offering multiple points of entry to projects for stakeholders, evaluators, observers, planners, etc.
- Facilitating group meetings to plan projects and collect data
- Creating visualizations and/or models and simulations from data
- Attracting domain experts to participate and collaborate on projects
- Offering simultaneous multi-media integration through streaming video, video conference, teleconference, multi-screen displays, multiple laptop inputs to display
- Providing access to visual GIS applications and imagery through a database-driven process
- Offering engagement opportunities for students

- Using DT facilities and technology to run experiments

### **2.1.3. Cost of development**

In 2009, DT focused on maintaining its current technology and searching for inexpensive deployments of alternative technologies. 2010 will include a strategic effort to develop industry partnerships and funding sources to update DT technology, with one focus on increasing DT's capability to share project outputs beyond the confines of the DT building. The benefits of an additional capital investment in the Theater include:

- Increasing capabilities for expanding training programs and services
- Maintaining cutting-edge technology and ability to be used as a resource in attracting new AZ investments
- Attracting high-level collaborators by including off-site participation using innovative technology
- Providing state of the art computing to advance industry partnerships
- Increasing connectivity and scope of DT activities via internet-enabled technologies

DT's current strategy promotes a more flexible platform for the Decision Lab concept — encouraging faculty to port platforms into the DT for research and development. There has been an increased focus on commercial and open source software such as Google Earth, PowerSim, GroupSystems, and GeoDa as well as an effort to move DT to more web-enabled technologies.

### **2.1.4. Labor requirements**

For 2010, DT has streamlined its staff in line with the objectives of increased research capability and greater community decision-making support and leadership. The staff is organized according to three primary areas: operations, research and development, and decision-support and policy leadership. While removing two positions in the FY09-FY10 transition, a new position has been created that focuses directly on the convening and community decision-support dimensions of DT. The reorganization maximizes operational and economic efficiency at the Theater. DT also includes a growing cohort of ASU and external faculty partners who actively engage on projects and proposals. In addition to increasing research program success, the streamlining supports direct engagement and development of activities with external businesses and leading community partners. Examples include: supporting the development of new education and job models in the energy efficiency and renewable power sector with Professional Supply, Inc.; developing analytical and decision-support tools with APS, SRP, Brightsource, and other businesses; and supporting Arizona's response to the H1N1 flu outbreak in collaboration with local, state, and federal health officials and community leaders.

## **2.2. Marketing and Promotion**

### **2.2.1. Strategy**

Marketing to an internal audience involves promoting DT as an accessible and research-critical "decision lab" — a compelling environment to explore new ideas, showcase research, and host seminars and symposia. Marketing to an external audience involves promoting the Theater as collaborative space with a sustainability focus that enables action on "real-world" challenges. We target cities, non-profits, planning agencies, city, state, and federal agencies, businesses,

and professional trade associations that have deep interest (as well as limited experience) in using decision lab interactive tools in decision-making.

### 2.2.2. Method of promotion

DT promotes best when we market our potential, technology, and “idea” to a captive audience. We do this on an ongoing basis with monthly tours. We plan to extend this into webinars, teleconferences, and workshops for internal and external groups. To the internal audience, we plan to launch the “Decision Theater Challenge” which ties into the broader 100 Challenges campaign for ASU. To the external audience, we will plan and market mini-events that can be structured using our decision-support tools. In doing so, we can better explain DT strengths and value proposition, identify key pathways to engage DT, and leverage the DT brand for other university funding and success.

### 2.2.3. Advertising and promotion plans

The Decision Theater marketing strategy is to develop a recognizable and solid DT brand through research and project activities demonstrating DT “value adds,” developing key relationships and collaborations to expand capabilities, executing targeted promotional activities to attract new investments, and using mixed media outlets to broaden the scope of the DT audience.

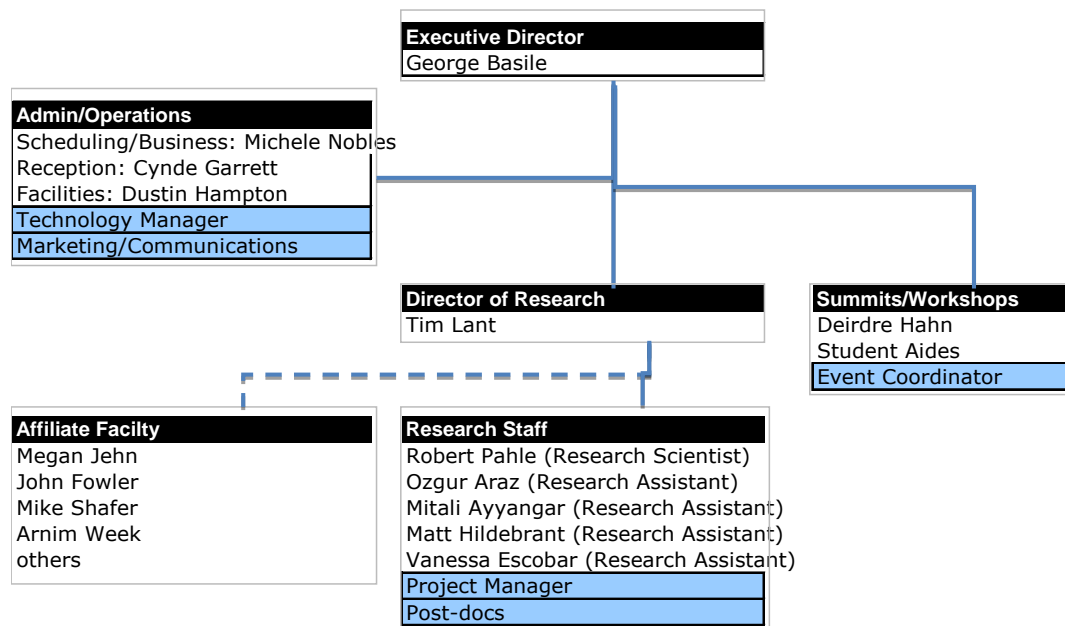
<b>Tactic</b>	<b>Activities and Outputs</b>
1. Demonstrate DT Value Add	Developed annual decision-informatics conference
	Hosted two promotional workshops/summits for energy/health planning and training
2. Developing key collaborations	List and invite top 10 industry prospects to DT
	Solicit advice/counsel with 5 key leaders in energy and health planning for projects and research
	Establish DT as critical partner for industry/government
3. Targeted promotion activities	10 DT-produced or DT-related peer-reviewed publications
	10 conference presentations and white papers
	40+ DT citations in external press
4. Use mixed media to broaden reach	New Media — blog, podcasts, online video, micro-sites created
	Transitional Media — online news, radio, local publications
	Web Site — redesigned to include all marketing tools

## 2.3. Project Management

### 2.3.1. Description of the organizational setup to support the initiative

The Decision Theater is organizationally placed within GIOS and supported, via advisory oversight, by the Office of the Vice President for Research and Economic Affairs at ASU. This allows for integration of the Decision Theater into cross-cutting, university-wide initiatives. The linkage to GIOS provides an additional benefit of supporting project development, grant writing,

communications, and linkage to internal and external collaborations in the broad arena of sustainability.



Organization Chart: Decision Theater  
Blue= to be added per project needs

### 2.3.2. Advisory board or other oversight

Decision Theater is in the process of developing an appropriate internal and external advisory board given its evolved strategic foci. The Theater is currently advised on strategic program and managerial issues by a senior advisory team, including: Dan Stanzione, Director, High Performance Computing Center; Rick Shangraw, Vice President, Office of Research and Economic Affairs; Jon Fink, Director, GIOS; and Rob Melnick, Executive Dean, GIOS. DT strategy and activity will also be reviewed by the DT Board of Advisors, which will include industry and academic leaders from a variety of relevant sectors. DT management meets with internal (ASU) advisors on a monthly or more frequent basis.

## 2.4. Sustainability

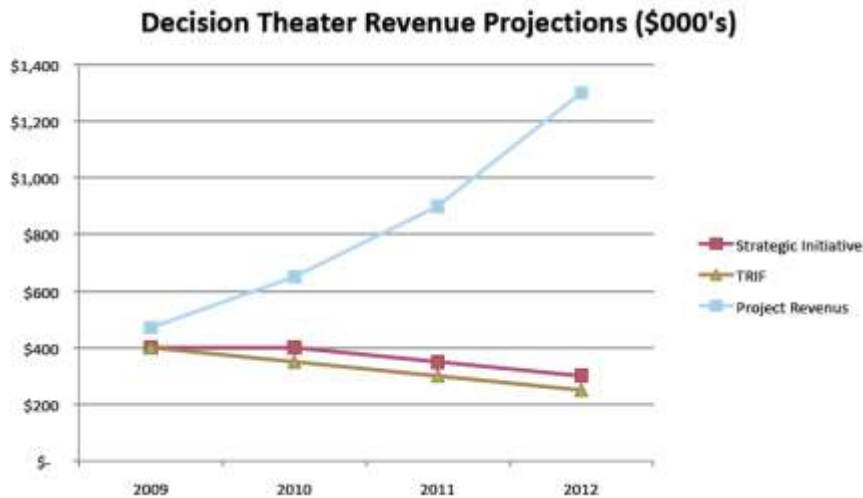
### 2.4.1. Anticipated funding sources for ongoing support

The goal is to have a balanced activity portfolio of research, consulting, summits, and facility use. We anticipate this will lead to a balanced funding portfolio of federal agencies, state and local organizations, private foundations, and business. DT’s current efforts in urban preparedness, such as pandemic flu planning, and resource intelligence, such as water and renewable energy planning, positions the Theater to increasingly access growing resources and key partnerships in these arenas.

### 2.4.2. Timeline for transitioning away from TRIF support

Since 2007, the Decision Theater has reduced its TRIF support by 60% (2007 \$1M; 2009 \$400k). In summer 2008, DT hired a new executive director and evolved its strategic plan to

include a stronger research focus. Below is a graph to illustrate our mixed revenue model with anticipated increased direct return for sponsored projects with decreased reliance on TRIF funds.



### 3. Goals/Metrics/Outcomes

#### 3.1. Specific and Realistic Goals that are Clearly Measurable

##### 3.1.1. Return on investment (ROI)

DT is the partner on five major grant proposals, the co-PI on eight grant proposals, and has several key non-government proposals in process. Entering 2010, DT is partnering on over \$16 Million in grant and project proposals (total potential award). Total DT 2010 direct grant award goal is at least \$700K.

##### 3.1.2. Technology transfer

Historically, DT has not aimed at developing IP, but has focused on bridging university knowledge development by supporting community, governmental, and business leaders in making scientifically informed decisions. Moving into 2010, the Theater is positioned to develop new decision support tools and their applications, which reflect potentially unique knowledge on decision-making environments and decision-making frameworks. In addition, the DT is positioned to support technology development in areas such as renewable power and physical decision support aids.

##### 3.1.3. Industry outreach (research initiatives only)

The Theater is increasingly interacting with industry partners. Through the Science Foundation's Solar Technology Institute, and in partnership with the School of Engineering and the W.P. Carey School of Business (Siedman Institute), DT is working with a variety of regional utilities and renewable power businesses to further the use of renewable-energy technologies and development of a state-wide renewable energy industry. DT also works directly with the water planning community and water-related businesses exploring issues related to climate change. In

partnership with the ASU-led Sustainability Consortium, the DT is exploring its value as a research partner for life-cycle analysis, modeling and decision-support for global supply chains. The Consortium includes a wide range of retail businesses and their suppliers.

### 3.1.4. Work force contributions

The Decision Theater is a rich and unique resource for ASU (and its partners') students. DT is increasing its capability to engage in high-value education opportunities, including research, student project engagement and course work. The Theater employs eight students including graduate and undergraduate students. These students are given the opportunity to work on research and projects throughout their experience at DT. One to two students will graduate each year and take with them real-world, hands on experiences that they may take into their careers following graduation. Our goal is to include students in all activities at DT, from tours and presentations, to applied project work and research. They have taken part in efforts that range from water planning to school-district strategy to investigations of air pollution movements to neurological mapping. Aligned with the goals of the New American University, students find themselves at the front end of visits with foreign dignitaries and local community members alike. Students associated with DT have an opportunity to create crosscutting and novel research and educational opportunities of their own. They are exposed to a diverse array of topics and social sectors (governmental, business, community, etc.). DT is utilized as a teaching platform for 8 ASU courses and for over 160 ASU MBA students whose training includes an emphasis in sustainability.

In addition, the Decision Theater will offer professional development and training opportunities by translating completed projects into educational curriculum. Through targeted workshops and seminars, we anticipate reaching over 150 professionals in Arizona and the Southwest region in the areas of water management and business administration. DT will deliver hands-on activities to facilitate resource planning. In 2010, we anticipate hosting up to 10 ASU classes to engage in hands-on planning exercises, and are planning to host 2 graduate courses in the fall and spring semesters. Expected direct instruction is estimated to reach over 100 students.

### 3.1.5. Partnerships/collaborations (including university-wide impacts)

Decision Theater is actively working to establish partnerships and collaborations in several key areas with the objective of DT to become a world-class laboratory for the exploration of the interface between decision-making and sustainability, and the creation of high-value outputs, from new decision-making methodologies to specific case examples of better decisions and associated policies. A number of integrated areas require research that addresses decision-making for a sustainable future. DT is currently developing partnerships at all levels, from within ASU to globally, to conduct such research. The goal is to create several formal collaboration/agreements. Examples of collaborators include:

Arizona Department of Health Services	National Oceanic and Atmospheric Administration
Homeland Security Studies & Analysis [Institute]	Professional Supply, Inc (PSI)
Arizona Public Service (APS)	Salt River Project (SRP)
City of Phoenix	Brightsource Solar Power
City of Mesa	CHIR, BioMedical Informatics, ASU
Discovery Triangle	Central Arizona Phoenix Long Term Eco. Research
Greater Phoenix Economic Council	Consortium for Science, Policy Outcomes

### 3.2. Timeline for Achievement of Goals

We plan to achieve the DT goals by the end of FY2011.

### 3.3. Early Proof of Performance

#### 3.3.1. Return on investment (ROI)

An FY 09 TRIF investment supported the Decision Theater in developing events and projects that provided targeted training and education for professionals and students. Below are examples of successful Decision Theater events in FY 09 as a result of this support from TRIF:

Activity	Description	Participants	ROI
<b>Educational Outreach Events</b>			
Certified Public Manager: DT Class in Water Planning	During an 8-hour class, participants practiced communication skills, and developed planning skills for regional water sustainability.	35 water resource and city planning professionals	<ul style="list-style-type: none"> <li>• \$8k project funding</li> <li>• Professional development for work force</li> <li>• research proposals ~\$200k</li> </ul>
MIT's Terrascope Program	Using DT's applications, undergraduate MIT students learned water planning skills for an arid region during 4-hour seminar	40 MIT undergraduate students	<ul style="list-style-type: none"> <li>• \$5k project funding</li> <li>• Skills development for future work force</li> <li>• research proposals ~\$100k</li> </ul>
<b>Educational Outreach Total</b>		<b>75 students and professionals</b>	<b>\$13k project funding \$300k grant proposals</b>

Activity	Description	Participants	ROI
<b>Government/Community Events</b>			
Pandemic Flu Planning Policy Exercises	Pandemic Influenza tabletop exercises with Arizona State Health Department and Arizona Department of Education	50 health and educational professionals from across the state	<ul style="list-style-type: none"> <li>• \$75k project funding</li> <li>• \$2.5m grant proposals</li> <li>• Professional development</li> <li>• Work force training</li> </ul>
CJDATS: National Institute of Health/National Institute of Drug Addiction study	Investigating effectiveness of organizational design, implementation strategy, and informatics	12 partnerships spanning the probation and criminal justice practitioner communities throughout Arizona and the United States	<ul style="list-style-type: none"> <li>• \$12k project funding</li> <li>• \$2.5 m grant proposal</li> <li>• Study to inform work force development and leadership training</li> </ul>
SmartAZ/RenewSim	Research in new solar energy generation and its impact to electric infrastructure; extended regional job generation, benefits of solar investment	6 research collaboration partnerships that include ASU institutes, SFAZ, and APS	<ul style="list-style-type: none"> <li>• \$200k project funding for three years</li> <li>• Estimate 30–40 new jobs produced in solar field</li> </ul>
NSF-CNH, Urban Vulnerability to Climate	Support process and model to analyze the	4 new research partnerships with ASU	\$15k project funding

Change	advantages and disadvantages of various renewable energy policies	and other universities	
<b>Government/Community Total</b>		<b>50 professions trained</b> <b>16 research partners</b>	<b>\$287 project funding</b> <b>30 potential future jobs</b>
<b>Summits/Workshop Events</b>			
Decision Theater / DCDC – AWI Climate Workshops	Support a series of workshops to identify key needs of water planners for integrating down-scaled climate model results into their planning decisions	45 professional water managers from across AZ	<ul style="list-style-type: none"> <li>• \$20k project funding</li> <li>• \$50k research grants</li> </ul>
National Oceanic and Atmosphere Administration Summit	Planning Integrated Research for Decision Support for Climate	35 participants from ASU and NOAA	<ul style="list-style-type: none"> <li>• \$5k project funding</li> <li>• Opportunity for joint research proposals</li> </ul>
Greater Phoenix Economic Council Arizona Economic Summit	Topics included examine long range economic planning and work force development for Phoenix	20 senior corporate and government leaders from AZ 700 online participants from 3 countries	<ul style="list-style-type: none"> <li>• \$3k project funding</li> <li>• Potential work force development through legislative budget planning</li> </ul>
ASU Pandemic Flu Conference	DT is co-host for four day conference to include global health experts in planning research and applications for pan flu	60 health expert participants from around the world	<ul style="list-style-type: none"> <li>• Potential for improved pandemic flu planning policy and research</li> <li>• Identify gaps in health policy</li> <li>• Potential for joint research proposals</li> </ul>
<b>Summit/Workshop Totals</b>		<b>860 people educated, participating or trained</b>	<ul style="list-style-type: none"> <li>• <b>\$28k project funds</b></li> <li>• <b>Great potential for additional funding</b></li> <li>• <b>Improve policy</b></li> </ul>

Funding from TRIF supports ongoing grant and project proposal development. Decision Theater is targeting project funding opportunities that will have an impact on economic development for the region which includes work force and professional training opportunities, as well as impacts on policy in health and energy.

As of May 2009 the Decision Theater had over \$3 million of research grant and projects in consideration for FY2010 and 2011. Total proposal budget for ASU is over \$15 million on these projects. Below are examples of pending grant proposals and projects that include Decision Theater participation.

Activity	Description	Participants	Potential ROI
<b>Educational Outreach Events</b>			
MacArthur Foundation Sustainability Masters degree and PIRE Sustainable Cities graduate education grants:	New professional Masters degree in international development supported by MacArthur Foundation	20-30 graduate students	<ul style="list-style-type: none"> <li>• \$50k DT project funds</li> <li>• \$2m ASU funding</li> <li>• 20 graduates/year</li> </ul>
<b>Educational Outreach Total</b>			<ul style="list-style-type: none"> <li>• <b>\$50k project funding</b></li> <li>• <b>\$2m ASU funding</b></li> <li>• <b>20 graduates/year</b></li> </ul>

<b>Government/Community Events</b>			
Center for Health Informatics Research and DT joint proposal for a RO1 CDC Grant	Evaluate behavioral health community for Maricopa County for mental illnesses and drug abuse	Thousands of individuals in Maricopa County receiving behavioral health services	<ul style="list-style-type: none"> <li>• \$150k DT project funds</li> <li>• \$2.5m ASU funding</li> <li>• Supports behavioral health patient care in AZ</li> </ul>
NIH Challenge Grant Submission on Data Privacy	Protection of online health information	Thousands of health care providers sharing online patient data	<ul style="list-style-type: none"> <li>• \$350k DT project funds</li> <li>• \$1m ASU funding</li> <li>• Supports professional training in health privacy</li> </ul>
NIH Challenge Grant Submission on Adolescent Smoking	Adaptive Health Behaviors: Adolescent Substance Uses within Networks	Health care providers for substance abuse programs	<ul style="list-style-type: none"> <li>• \$750k DT project funds</li> <li>• \$1m ASU funding</li> </ul>
Point of Dispensation for pandemic flu planning in Arizona	Follow on planning and tabletop exercises for pandemic flu planning in Arizona	AZ population receiving pandemic flu health care	<ul style="list-style-type: none"> <li>• \$75k DT project funds</li> <li>• Impacts AZ population for access to medicine during a pandemic</li> </ul>
Federal Transportation Administration	Transit-Oriented Design and community participation research	Urban Communities impacted by transit-oriented design planning	<ul style="list-style-type: none"> <li>• \$79k DT project funds</li> <li>• 150 Community participation opportunity</li> </ul>
Discovery Triangle and Green Phoenix	Planning for sustainable community and long-term physical and economic development in the "Discovery Triangle" area between Phoenix, Scottsdale, Tempe	Businesses and communities within Tempe, Phx, Scottsdale area	<ul style="list-style-type: none"> <li>• Future work force development</li> <li>• Future business development</li> <li>• PR/Outreach</li> </ul>
<b>Government/Community Total</b>			<ul style="list-style-type: none"> <li>• <b>\$1.4m DT project funds</b></li> <li>• <b>\$4.5m ASU funding</b></li> <li>• <b>potential future jobs and economic development opportunities</b></li> </ul>
<b>Activity</b>	<b>Description</b>	<b>Participants</b>	<b>Potential ROI</b>
<b>Summits/Workshop Events</b>			
Professional Supply, Inc Energy Reduction Curriculum Development	Three part workshop to take PSI business model of energy reduction and develop a trans-disciplinary certificate program at ASU.	20-50 students a year will receive hands on training in sustainability skills	\$15k+ DT funding. Work force ROI: Potential for 25-50 students a year to be rapidly trained with unique and highly marketable work force skills.
<b>Summit/Workshop Totals</b>			<ul style="list-style-type: none"> <li>• <b>\$15k project funds</b></li> <li>• <b>Great potential for additional funding</b></li> <li>• <b>25-50 students trained each year</b></li> </ul>

# Global Institute of Sustainability

## Summary

With a very modest amount of TRIF money, GIOS has promoted research initiatives in several other ASU units. These investments have focused on proposal development and seed funding for a small number of high-priority, high potential ROI projects. Return on investment will be determined through the success in external funding for research proposals being supported with GIOS TRIF funding as detailed in this report.

### 1. Core Vision/Project Description

Sustainability is a broad field of intellectual pursuit where environmental goals, economic feasibility and social impact are simultaneously balanced and optimized. The goal of developing sustainable solutions to today's challenges directly impacts numerous economic outcomes but is not always directly tied to any single industry.

GIOS was established to catalyze and advance interdisciplinary research on environmental, economic, and social sustainability, especially as it relates to urban areas. The Institute brings scientists, social scientists, engineers, and government and industry leaders together to share knowledge and develop solutions to real-world problems.

As limited TRIF funds were made available to GIOS, the decision was made to make strategic investments to strengthen the competitiveness of research proposals and as seed funding for a small number of high-priority, high-potential ROI projects, rather than to use the funding to initiate new research projects themselves.

### 2. Operational Strategies

#### 2.1. Development and Production

Research conducted under GIOS spans from well-established and well-funded projects — such as the Central Arizona Phoenix Long Term Ecological Research Project (which has been funded at a level of ~\$800K per year since 1998) — to new initiatives being pursued by faculty in the School of Sustainability and across the ASU campus. Within GIOS, TRIF funding is being used to develop new research proposals and in a few cases, to initiate new programs that align with the goals of the Institute.

For new proposal development, the process begins by pulling together relevant faculty from across the University to develop the intellectual framework to pursue research and educational programs related to sustainability. The material for each proposal is pulled together and augmented partly with support from research support staff within GIOS.

Student recruitment for research projects pulls primarily upon students enrolled in the School of Sustainability. The active student recruitment for both undergraduate and graduate students to the School of Sustainability uses highlights of current research projects in promotional and recruiting materials.

#### 2.2. Marketing and Promotion

Primary marketing is to students for recruiting to research projects through the School of Sustainability. GIOS also has a strong communications group which actively promotes GIOS research through a number of media outlets and through maintenance of the GIOS website.

Advancing GIOS sustainability activities to local governments and businesses occurs in two important ways: through the Sustainable Cities Network and by coordination with OVPREA. The Sustainable Cities Network was launched in February 2009 with GIOS serving as a convener of local government agencies to serve as a vehicle for sharing knowledge and to foster partnerships, identify best sustainability practices, provide training and information, and bridge research at ASU and real-world challenges of implementing sustainability.

The GIOS staff works with the Associate Vice President for Economic Affairs, Todd Hardy, to link ASU sustainability research and practice with corporations. While this effort is primarily limited by capacity at GIOS to respond to opportunities, several new and important initiatives have been started in FY09 and GIOS will continue to advance corporate sustainability in coordination with OVPREA.

### **2.3. Project Management**

Allocation of the GIOS TRIF funds are decided upon by a committee of four persons including Jon Fink, Director of GIOS; Rob Melnick, Executive Dean of GIOS; Matt Fraser, Co-Director of Research Development for GIOS; and Dan Childers, Co-Director of Research Development for GIOS. Review of the appropriate use of allocated funds is conducted by the same persons to ensure appropriate use of funds.

### **2.4. Sustainability**

A majority of funds allocated from the GIOS TRIF fund are geared toward development or advancement of research proposals. This ensures that programs are not initiated that cannot be sustained. For most investments, once the project proposal is completed, the GIOS TRIF support is terminated with the goal that external support can be garnered.

There are two exceptions to this general statement: support for the Variable Atmosphere Laboratory (VAL) and the Urban Genomics program. These larger-scale programs each could potentially be funded at a level of ~\$100M and support is designed to develop critical intellectual content to pursue external funding. For VAL, two workshop proposals have already been funded by NSF and technical proposals are being developed for NSF Major Research Instrumentation Program, the Earth Sciences Instrumentation and Facilities Program and the Atmospheric Sciences Mid-Sized Infrastructure Opportunity. For Urban Genomics, the TRIF funding is being used to initiate the project with the goal of pursuing external funding from any variety of sources: Department of State, USAID and NGOs including the International Rescue Committee by the end of FY10.

Beyond individual projects, GIOS is working to develop a profile as a resource center for local businesses and government agencies to provide sustainability solutions. As mentioned above, GIOS convenes the Sustainable Cities Network and responds to local companies as capacity permits. The most advanced current involvement of this type is between the City of Phoenix and GIOS which jointly developed the "Green Phoenix" concept to drive investment of ARRA funds to promote a more sustainable Phoenix. Working together, GIOS and City of Phoenix personnel are continuing to advance this approach to ensure future revenue for GIOS as a local resource for companies and agencies seeking sustainable solutions.

### 3. Goals/Metrics/Outcomes

#### 3.1. Specific and Realistic Goals that are Clearly Measurable

Return on investment (ROI), work force contributions, educational, corporate, government and community outreach and partnerships are all dependent on the individual investments made with the GIOS TRIF money and each will be discussed separately.

FY 09 Expenditures:

- Support for VAL Workshop: \$10K
  - The second workshop on the Variable Atmosphere Lab will be held in early June in Washington DC. This location was chosen for the second workshop to allow greater participation of representatives from potential funding agencies including USDA, DOE, NASA, NOAA and NSF. The support for ASU faculty to travel to the workshop was not included as part of the proposal for the second workshop, so GIOS decided to support travel of ASU faculty to show the breadth and strength of research at ASU to potential funding donors. The expected return on investment includes the \$28,840 already allocated by NSF for the workshop plus increased likelihood of funding for the VAL proposals that Prof. Jon Harrison is working on including the NSF Major Research Instrumentation Program, the Earth Sciences Instrumentation and Facilities Program and the Atmospheric Sciences Mid-Sized Infrastructure Opportunity. While limits to the various NSF programs vary, VAL itself is estimated as a \$50–100M project. Very minimal support will continue in FY10.
- Solar Implementation Feasibility Program: \$12.5K
  - A major component of our efforts to advance sustainability in Phoenix is promoting the “Green Phoenix” concept as a guide to direct infrastructure investments along the light rail corridor. Working with the City of Phoenix, GIOS and ASU have made a number of contacts with officials at DOE, Housing and Urban Development, and the Department of Education promoting this agenda. One key component of Green Phoenix is the installation of solar photovoltaics. Prior to installation, an assessment of the suitable locations with suitable roofing surfaces is required. Prof. Harvey Bryan will lead a team of students in conducting this assessment and feasibility study. The key to the return on investment is the potential for access to significant money from the ARRA program in partnership with the City of Phoenix. Working with the City of Phoenix, GIOS has developed a concept for investing ARRA funding to promote sustainability along a 10-mile segment of the light rail line in the City of Phoenix. This concept has been approved by the Phoenix City Council and GIOS is currently working with the City of Phoenix on a \$53M proposal to the DOE Energy Efficiency and Conservation Block Grant Discretionary Grant program which has \$456M of funding available. As envisioned and if fully funded, approximately \$7M will flow to ASU to conduct monitoring and evaluation of sustainability projects with the majority of funding to the City of Phoenix for installation of solar energy capacity, mitigation of the urban heat island, and community redevelopment. The advantage of this approach is the simultaneous impact of economic advancement and work force development through application of ARRA funds to infrastructure improvement in conjunction with the City of Phoenix. Exact economic benefit and job creation will be determined by the City of Phoenix. This effort will continue in FY10.
- Decision Center for a Desert City (DCDC) Proposal Support: \$6K

- DCDC is an exemplar research project bringing together leading researchers and local stakeholders to address the decision process on future water allocation under uncertain future climate scenarios. Supported at a level of \$7.2M (\$6.7M initial funding plus a \$500K supplement), DCDC is preparing for a renewal proposal submission in July 2009. To support this renewal application, GIOS has committed \$5K to summer faculty salary support to be distributed by the project PIs, Profs. Pat Gober and Chuck Redman. The return on investment will be determined based on the preparation of a strong renewal application for this program, which is expected to range from \$5–7M.
- Technical Writing Support: \$10K
  - Recently, the limiting factor for promoting research strategies is having capacity to portray ideas in a concise, coherent written summary. To assist, GIOS interviewed a number of technical writers to have on call to respond to opportunities as needed. This capacity has been used to support collaborative initiatives with the Vice President for Global Engagement (Vietnam, UAE initiatives) and the Decision Theater (NIH Challenge Grant), as well as GIOS research projects (Green Mountain Coffee Roasters proposal, CAREER proposal for Prof. Hallie Eakin). The return on investment can be calculated based on the value of proposals for which we do not have internal capacity that are enabled by this mechanism.
- AzSMART Support: \$25K
  - GIOS, working with OVPREA, the Fulton School of Engineering, the W. P. Carey School of Business and UA, submitted a proposal for \$3.3M to SFaz on developing a Solar Market Analysis and Research Tool (AzSMART). As SFaz requires industry participation, APS, SRP, TEP, ViaSol and BrightSource were all involved in this project. While the project was recommended for support, SFaz funding was cut by the State of Arizona. To continue interest in the project, GIOS committed \$25K to initiate and accelerate efforts in this valuable project and the rate of return can be determined based on progress towards getting AzSMART funded. This will continue in FY10.
- Proposal Development Travel: \$11K
  - Travel by GIOS personnel to pursue funding opportunities has been supported with TRIF money including: a trip to Seattle by Prof. Matt Fraser to work on the STC preproposal at UW; a trip to Washington, DC, by Prof. Dan Childers to promote GIOS research to funding organizations and on Capitol Hill; a trip to the UK and UAE by Prof. Jon Fink to promote collaborative efforts on sustainable urban development. Rate of return is difficult to define: while the STC preproposal developed in Seattle was not selected by NSF, we used the contacts developed with Prof. Marina Alberti as part of the PIRE preproposal submitted in February 2009. Contact with partners in the UK lead to the UK Consulate in Los Angeles applying for £20K to support a joint ASU/UK research conference.
- Variable Atmosphere Laboratory Prototype Development: \$20K
  - Advancing the VAL concept through workshops and presentations is building support for the major investment that would be required for developing this user facility. A preliminary estimate of the full cost of a functional VAL is between \$50M and \$100M. The next logical step is the technical design of a prototype for a single individual cell of the laboratory by an architectural firm. The expected cost of \$20K has been committed by GIOS to Prof. Jon Harrison to get this prototype ready before the next VAL workshop in August 2009. The expected return on investment includes advancing the next major VAL funding opportunities including proposals to the NSF Major Research Instrumentation Program,

the Earth Sciences Instrumentation and Facilities Program and the Atmospheric Sciences Mid-Sized Infrastructure Opportunity.

Intended FY10 Investments:

- Urban Genome Research Initiative: \$35K
  - Linking urban planning, development theory, and human interaction with the built environment and geophysical data sets would allow a more holistic approach to understanding how cities evolve and the role of policy in building sustainable cities. Most importantly, this novel approach would allow more detailed investigation of human interactions and can address topics of environmental justice, hazards, crisis response and poverty, with the goal of providing technical guidance to NGO and other emergency response organizations. Support from TRIF will initiate the project with the goal of pursuing external funding from any variety of sources: Department of State, USAID and NGOs including the International Rescue Committee.
  
- Solar Engineering Research Center Proposal: \$25K
  - OVPREA recently gave the green light for an ERC proposal on solar energy lead by Christiana Honsberg and Stuart Bowen. GIOS has offered to support initial work on proposal development, which may include travel (to build partnerships with industry and other universities), outside consulting (from experts familiar with the NSF ERC program to define the preproposal) and technical support (including writing and/or graphics preparation). A budget of \$15K has been reserved for this purpose and return on this investment will be tied to a strong ERC preproposal. The value of the ERC is estimated at \$20M (\$4M per year for 5 years).
  
- Solar Implementation Feasibility Program: \$12.5K
  - This continuation of the assessment of solar potential is a continuation from FY09.
  
- AzSMART Support: \$25K
  - Beyond initiation of the AzSMART proposal, there is very significant potential for exporting this approach to other regions. GIOS will support this technology transfer and potential licensing of the approach in FY10
  
- 100 Cities Support: \$12.5K
  - One of ASU's most prolific — and well funded — research scientists, Phil Christiansen, has been working on various projects and proposals that use remote sensing as a tool for studying the trajectory of urban environments. The “100 cities” project will be submitted for additional external funding during FY 10. Discussions with Steve Hipskind, Chief of the NASA Ames Research Center's Earth Science Division, and Pete Worden, Director of the NASA Ames Research Center, have identified an opportunity within NASA for a 3–5 year observational campaign at the \$5–10M funding level that we will target and pursue.

## Sustainability FY 2010/11 Performance Measures/Deliverables

<b>Sustainability</b>	<b>FY10</b>	<b>FY11</b>
<b>PERFORMANCE MEASURES/IMPACT</b>	<b>Proj</b>	<b>Proj</b>
<b>Return on Investment</b> (\$ amounts in millions)		
Federal and non-federal awards	32.20	40.00
Royalty income	0.10	0.30
Foundation funding	1.50	2.50
<b>Return Total</b>	<b>33.80</b>	<b>42.80</b>
<b>Work Force Contributions</b>		
Post-doctoral appointments	29	35
Post-doctoral researchers leaving to enter the workforce	13	18
Graduate students employed	114	142
Graduate students earning degrees and entering the workforce	43	60
Undergraduate students involved	77	87
<b>Partnerships/Collaborations</b>		
The number of research grants/contracts involving funding from non-government entities	24	33
The number of research grants/contracts involving subcontracts to non-ASU researchers	21	27

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#### 4. Pro Forma Financials

##### 4.1 TRIF Funding Request: Resources and Planned Expenditures

<b>Sustainability</b>	<b>FY10</b>	<b>FY11</b>
	<b>Rev Budget</b>	<b>Rev Budget</b>
<b>REVENUE</b>		
Carry Forward		
New TRIF Revenue	1,900,000	1,900,000
<b>TOTAL REVENUE</b>	<b>\$1,900,000</b>	<b>\$1,900,000</b>
<b>OPERATING BUDGET</b>		
Personal Services	775,200	775,200
Employee Related Expenses	182,400	182,400
Operating Expenses	562,400	562,400
<b>Total Operating Budget</b>	<b>\$1,520,000</b>	<b>\$1,520,000</b>
<b>CAPITAL BUDGET</b>		
Building Renovation	380,000	380,000
Debt Service		
<b>Total Capital Budget</b>	<b>380,000</b>	<b>380,000</b>
<b>TOTAL EXPENDITURES</b>	<b>\$1,900,000</b>	<b>\$1,900,000</b>
<b>Return On Investment</b>	<b>17.8:1</b>	<b>22.5:1</b>

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