

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

ERDENE:

**Environmental Research, Development and Education for the
New Economy**

A Proposition 301-Funded Project at Northern Arizona University
and Beyond

BUSINESS PLAN

**September, 2002
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Executive Summary

Northern Arizona University (NAU) is known for its leadership, expertise and collaborations in the environmental and natural resource sciences, technology and management. The Environmental Research, Development and Education for the New Economy (ERDENE) program is designed to accelerate Arizona's environmental business enterprises, to help better understand and manage our natural resources and to prepare Arizona's workforce for the many opportunities represented by these endeavors.

ERDENE builds on NAU's well-established leadership in environmental science and technology. More specifically, the program utilizes this position to stimulate new initiatives and to accelerate other promising enterprises having tangible economic returns.

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1.0 Core Vision/Project Description

1.1 Industry Overview

Northern Arizona University (NAU) has developed the Environmental Research, Development and Education for the New Economy (ERDENE) program around two major components: ecological restoration and applied research for sustainable development. Ecological restoration is a relatively new and expanding field of scientific study that is rapidly becoming integrated into natural resource use and management. Applied research for sustainable development focuses on enhancing Arizona's ability to preserve our rich environment while simultaneously building our economy. Economic opportunities directly and indirectly benefit our cities, rural communities and rural residents from sustainable utilization of resources such as energy, minerals, water, air, and ecosystems.

1.2 Mission and Goals

The April, 2001 Strategic Plan submitted to the Arizona Board of Regents states: "Northern Arizona University is a doctoral-intensive institution that has at its core undergraduate programs, significant research, and graduate programs to the doctoral level appropriate to its size and classification... Intimately linked to its undergraduate and graduate missions, the university's faculty, organized in departments, research centers and institutes, advances knowledge in traditional disciplines, in fields related to NAU's unique environment on the Colorado plateau, and in response to the needs of the state and region for solutions to real world problems."

The ERDENE project aligns with this mission by virtue of its intended outcomes in research, technology development, technology transfer, partnerships and workforce development.

1.3 Products or Services Provided

The unifying theme of ERDENE is the achievement of economic viability for new and expanding businesses using sustainable natural resource management practices.

ERDENE's "products", both tangible and intangible, emerge through a research and development cycle that incorporates education, creative thinking and testing.



ERDENE intends to use its TRIF funds much as a business incubator, to support research and pilot programs as they grow to fruition.

We will produce:

- A. Investment dollar leveraging
- B. A workforce prepared to contribute to environmental sustainability and resource management (practical use and conservation of natural resources)
- C. Innovative/patentable technologies

We will contribute to:

- A. Formation of spin-off companies
- B. Acceleration of Arizona's environmental business enterprises
- C. Economic development opportunities in partner communities
- D. Scientific knowledge in the areas of ecological restoration and sustainable resource management that will enable others to build on the foundations we establish.

1.4 Positioning

Through ERDENE, NAU will build on its leadership in ecological restoration and applied research for sustainable development. These Arizona-based activities are and will continue to be recognized nationally and internationally for their contributions to professional knowledge and more sustainable environments.

1.5 How Initiatives Will Be Accomplished

The ERDENE project is organized around project teams. It consists of five separate areas of activity, each with its own manager, coordinated through a central project director. The activity managers are experts in their designated fields and have extensive experience leading projects of this type. The central project director has broad administrative and technical experience. Working with the project managers, he ensures that project activities and outcomes are directed toward project goals approved by the Arizona Board of Regents in March, 2001.

2.0 The Market

ERDENE competes in several markets, among them:

- A. The \$21 billion market for grant support for research and development (R&D) in the environmental sciences and technology
- B. The national market of 261 doctoral/research universities that prospective students can choose to further their education in environmental studies.
- C. The markets for partnerships with government and private entities who need help with conceptualizing, planning and executing projects which enhance the sustainability of natural resources (such as water, air, and land) and "green products" that have been created, processed and delivered with minimal waste and net energy use.
- D. The national and international markets for innovative technologies e.g. renewable energy (solar, wind, hydrogen, biomass).

2.1 Choices Available to Potential Customers

With regard to the markets specified above:

- A. All manner of institutions, public and private, universities and businesses, compete for R&D support. Universities have traditionally emphasized competing for grants from governmental (federal, state and local) entities and non-profit organizations. As with business organizations, these grantors want to invest in people and institutions that have a track record of success in the area of interest. NAU is a significant player in this marketplace. Two of our institutions (the Ecological Restoration Institute and the Merriam-Powell Center for Environmental Research) have received over \$12,000,000 in federal funding alone since 1997.
- B. Any entities wanting to invest public or private dollars in entrepreneurial or public service ventures want knowledgeable, affordable and experienced partners in order to maximize their investment. ERDENE project members live and do their research in Arizona -- in the same kind of habitats and economic situations that face those of their partners. We compete effectively because we understand the issues facing our customers, and have examined those issues thoroughly through years of research.
- C. Students, particularly graduate students, select the institutions they will attend based on the prominence of the faculty and their opportunities to become involved in leading-edge research. NAU's location in the Southwest, on the Colorado Plateau, its environmentally-oriented programs in sciences, engineering, public policy and the humanities and its nationally-prominent institutes such as ERI, CSE and Merriam-Powell allow NAU to compete successfully for the best and brightest students interested in these areas.

A notable example of a TRIF – sponsored initiative is the development of the Ecological Monitoring & Assessment Foundation. This collaboration between NAU and Babbitt Ranches, LLC creates the nation's largest ecological research facility comprising more than 700,000 acres on the Colorado Plateau. This enterprise will attract research scientists from many disciplines to northern Arizona. The direct benefit to the Arizona research economy is expected to exceed \$1 million in 2003 and grow to more than \$5 million in 2006 and beyond.

2.2 Market Size and Trends

Historically, the Federal government has been the largest source of research and design expenditures, with industry lagging well behind. Since 1980, however, when expenditures in both sectors were approximately even, this trend has begun reversing itself. In 2000, industry was funding about 68% of all R&D efforts with the federal government funding only 32% (Source: Science and Engineering Indicators – 2002 from <http://www.nsf.gov/sbe/seind02/c0/fig00-15.htm> ERDENE is building its track record of success with industry partnerships (see section 2.4 below).

2.3 Rivals and Competition

ERDENE competes in a regional but largely national and occasionally international marketplace. While more than 800 academic institutions compete for federal R&D funds, NAU's competition stems primarily from the 261 doctoral/research universities. NAU, however, is highly competitive for federal R&D funds as evidenced by a funding rate in the year 2000 (most recent data) of 50% compared to a national average of 17% for proposals submitted to the National Science Foundation's Division of Environmental Biology. Additionally, NAU and the Environmental Protection Agency have entered into a cooperative agreement to facilitate directed research projects. The doctoral/research universities also are primary competitors for students, particularly doctoral graduate students, who can choose from more than 130 programs in the ecological and environmental sciences. Examples of institutional competitors for environmental research and doctoral education include Stanford, Duke, University of Michigan, Utah State University, and the University of California, Davis.

2.4 Suppliers

ERDENE members have been successful in obtaining support from such diverse entities as the Ford Foundation, United States Forest Service, Aeromag Corporation, Arizona Public Service Company, National Park Service, and the Kaplan Foundation. We have established partnerships with, among others, the Navajo Nation, the Arizona State Lands Department, the Grand Canyon Wildlife Council, the Salt River Project, Arizona Motor Transport Association and the Coconino National Forest.

2.5 Alternatives to Traditional Approaches

While ERDENE members contribute to NAU's traditional degree programs, we also focus on professional development, short training sessions and innovative curriculum development. For example, the ERDENE Sustainable Energy Systems (SES) project is working with Sandia National Laboratory, Southwest Indian Polytechnic Institute, and several community colleges to develop curriculum that will enable the workforce to design, install, maintain and repair the next generation of energy systems. In addition to technical education and training, this program includes instruction on business planning and development. NAU also is developing a curriculum that will educate bachelor- and master's-level engineers on innovative, sustainable energy systems. This education will help Arizona companies do more with less energy, thus making them more profitable. SES is actively engaged in technology transfer to local industry as part of the curriculum. For example, in Spring 2002 a group of mechanical engineering students at NAU designed a new rotor blade for Southwest Windpower, Inc., as part of a senior capstone project. The rotor blade is being built and tested for use in Southwest's next generation AirX turbine.

The Sustainable Water Resources Alliance, another ERDENE project, provides two-to-three day training courses on working within the Arizona Administrative Code to design and review decentralized wastewater systems – a critical need for our growing population. A graduate certificate in Conservation Ecology has emerged from the project, as have short courses such as Food Sustainability in the Southwest and Indigenous Mapping. It is ERDENE's goal to fill in the gaps in standard education sources as it relates to sustainable environments with whatever level and extent of training the market requires.

2.6 Estimated sales

ERDENE programs will increase revenues to Arizona companies in two basic areas. Development of new products will lead to new businesses and new business ventures within existing businesses. The rapidly growing and lucrative service industry will be supported through new companies and increased high-end graduates in science and engineering. Increased sales revenues will not be projected until 2004-2006. Important and specific other quantitative returns to the state are shown in Section 4.0.

3.0 Operational Strategies

3.1 Development and Production

3.1.1 Development Status

TRIF funding to date largely has been allocated to several initiatives to accelerate efforts already underway. This has allowed the projects to produce results in the short time since Proposition 301 funds have been available. This includes, among other things, acquisition of approximately \$5.6 million in external funding leveraged by 301 dollars, one patent application in renewable energy, one spin-off company (Environmental Engineering Consulting Company) and six business expansions principally in the renewable energy field, including Aeromag Corporation and Southwest Windpower, Inc.

3.1.2 Production Process

Research is conducted both within NAU's campus facilities and at private and public partner facilities. Production is carried out at facilities external to campus.

3.1.3 Cost of Development

Development of products and high-end services is supported by grants, contracts and TRIF resources. Although ERDENE is very successful in attracting external resources, the costs of infrastructure to facilitate technology transfer remain a significant impediment.

3.1.4 Labor Requirements

The ERDENE project requires the services of a variety of trained professionals -- research faculty, engineers, writers, technical staff and clerical staff. Approximately 42 full-time-equivalent (FTE) staff work are supported by TRIF. This number is expected to grow to approximately 50 by the fourth year. Over 75% of each year's proposed allocation is committed to professional staff. We recognize that it is imperative to attract and retain leading talent if we are to lead the nation and the world. A number of jobs have been created in other organizations through our many partnerships

3.1.5 Expenses and Capital Requirements

Operations and capital expenses for ERDENE projects are moderate. Approximately 20% of each year's funds have been committed to operations and computer or equipment acquisitions

3.2 Marketing and Promotion

3.2.1 Strategy

ERDENE's marketing and promotion strategy is to build a visible presence through both traditional research approaches and cultivating partnerships.

3.2.2 Method of Promotion

A. Traditional research approaches

1. Publishing articles in professional journals
2. Presenting at professional conferences
3. Sponsoring professional conferences
4. Serving on corporate and governmental advisory boards

B. Cultivating partnerships

1. Building on existing relationships with national, state and local governmental entities and Native American tribes.
2. Creating new relationships with various strategic community groups.
3. Establishing innovation development agreements with private sector partners.

3.2.3 Advertising and Promotion Plans

Sponsoring conferences as well as presenting at them brings visibility to ERDENE, NAU and Arizona. Publications and presentations not only increase visibility but identify authors/researchers as leaders in their fields. This exposure is invaluable when competing for grant awards, as well as for the best and brightest graduate students.

Community and governmental relationships also provide a mechanism for visibility and recognition.

In the period since TRIF funds were awarded to ERDENE, project members have sponsored four conferences and have published or presented more than forty papers. One of the projects was featured at the Global Summit on Environment and Sustainable Development in Johannesburg, South Africa in September, 2002.

3.3 Project Management

3.3.1 Organizational Structure

There are currently five subprojects in ERDENE, each with its own manager and area of expertise: Ecological Restoration, Environmental Change, Natural Resource Management, Sustainable Communities and Sustainable Energy. An administrator who sets general directions and budgets and monitors outcomes oversees the entire project.

3.3.2 Advisory Board or Other Oversight

Advisory boards or steering committees have been established to support all ERDENE initiatives. General oversight of all TRIF expenditures and reporting is provided through a university committee composed of senior project members.

3.3.3 Support Services Required

Access to legal counsel is essential. This is particularly pertinent as we move forward with business spin-offs.

3.4 Risks and Plans to Overcome Them

3.4.1 Legal Risks

Environmental science and technology innovation operate in an inherently legal and regulatory system. ERDENE leadership not only recognizes this fact, but also necessarily participates in the political (and, as necessary, legal) processes that influence opportunities for creative design and

development. Through active leadership in local, state, regional, national and international advisory bodies, we maintain contemporary perspectives on current and future legal influences on our R&D initiatives.

3.4.2 Regulatory Problems

The many disciplines within environmental science and technology operate in a highly regulated structure. This structure presents barriers, but also provides opportunities. ERDENE and its many partners are quite knowledgeable about this regulatory environment, and constantly seek to utilize it rather than to view it as a problem. A very recent example is the important role of the Ecological Restoration Institute in identifying and stimulating business opportunities created by the high-profile need for new forest management practices.

3.4.3 Political Risks

Minimal, yet we are very mindful of the often-erroneous perception that environmental sustainability, wise resource management and economic growth are competing rather than complementary goals.

3.4.4 Business Risks (supply and demand)

3.4.5 Competitive Risks

3.5 Sustainability

We anticipate a complete turnover of projects funded with Proposition 301 funding in five years at the outside. We have selected projects that needed dollars to help them get going, but we expect them to either become self-sustaining or to cease operation within five years of their initial proposition 301 funding.

4.0 Goals/Metrics/Outcomes

4.1 Measurable Goals		4.2 Timeline for Achievement of Goals				
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
4.1.1	Returns on Investment					
	Leveraged Federal and State Funds	\$ 5,525,000	\$ 1,194,000	\$ 4,275,000	\$ 5,699,000	\$ 6,508,000
	Leveraged Industrial Dollars	\$75,000	\$ 116,000	\$ 100,000	\$ 133,000	\$ 152,000
	Leveraged Other Dollars (Foundations, Private, etc.	\$ 183,333	\$ 308,000	\$ 200,000	\$ 267,000	\$ 304,000
	Arizona Economic Losses Avoided		\$1,600,000	\$4,700,000	\$5,100,000	\$5,600,000
	Other Qualitative Returns including presentations & publications	10	63	18	24	27
4.1.2	Technology Transfer					
	Patent Applications generated and/or Patents Received	1	0	1	1	2
	Spin-off Companies Generated	1	1	1	1	2
	Products Generated & in the Marketplace	0	1	0	0	0
	Business Expansions	6	0	6	8	8
	Sponsored conferences or workshops	4	6	5	7	8
4.1.3	Companies Identifying the University as a Reason for Relocating	0	0	0	0	0
4.1.4	Work Force Contributions					
	Graduate Students in Pipeline or Graduated	39	60	40	53	61
	Post-Doctoral Students in Pipeline or Graduated	3	12	3	4	5
	High-end Baccalaureates Produced in Specific Disciplines	51	16	55	73	84
	Certificates Granted	0	0	5	7	8
	Continuing Education Professionals	20	25	30	40	46
4.1.5	Specific Curriculum Innovations					
	New Programs -- full-time students	5	0	6	8	3
	New Courses -- full-time students	7	3	10	13	15
	Revised programs and courses	6	4	6	8	3
	New programs -- practicing professionals	2	0	2	3	3
4.1.6	Specific Collaborations					
	Community College	2	3	3	4	5
	Tri-University	3	1	3	4	5
	Industry/Private Sector	15	18	18	24	27
	Community-based (including Tribal)	21	28	30	40	46
	Regional, National, International	3	16	10	13	15

4.3 Early Proof of Performance

Note outcomes above.

5.0 Pro Forma Financials

5.1 Cash flow statement

Not Applicable

5.2 Income statement (resources and planned expenditures)

See below

5.3 Funding request, including sources

See below

	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>	<u>FY 2006</u>
OPERATING BUDGET REQUEST:					
FTE Positions.....	42.25	42.25	42.25	50.50	52.00
Personal Services.....	908,368	1,292,127	1,096,679	1,526,063	1,644,866
ERE @ 19.5%.....	150,455	237,190	213,852	297,582	320,749
All Other Operating.....	212,735	269,625	229,469	236,355	394,385
TOTAL OPERATING BUDGET REQUEST....	1,271,558	1,798,942	1,540,000	2,060,000	2,360,000
CAPITAL BUDGET REQUEST:					
Building Renovation.....					
Debt Service.....	-	-	-	-	-
TOTAL CAPITAL PROJECT REQUEST.....	-	-	-	-	-
GRAND TOTAL.....	1,271,558	1,798,942	1,540,000	2,060,000	2,360,000