Strategic Plan

North Dakota

Experimental Program to Stimulate Competitive Research

RII 2008-2013

Foreword

The National Science Foundation awarded the state of North Dakota its most recent Research Infrastructure Improvement (RII) award — *North Dakota: Research Infrastructure and Partnerships for Discovery* — in September 2008. It provides $15 million over five years (2008-2013) to strengthen the State's capacity in two areas: **SUNRISE**: **SU**stainable e**N**ergy **R**esearch **I**nfrastructure and **S**upporting **E**ducation, and **FlexEM**: **Flex**ible **E**lectronics and **M**aterials.

The award is a cooperative agreement (EPS-0814442), and as such, requires that ND EPSCoR submit to the NSF a strategic plan that will guide the conduct, management and evaluation of the project over the five year award period. This document sets forth the States' preliminary plan for implementing the award.

The plan was precipitated by a strategic planning retreat held in Fargo, ND on January 29, 2009 (See Appendix B for Agenda and Participant List). Co-facilitated by Dr. Carl Batt, Liberty Hyde Distinguished Professor, Cornell University and Dr. Thomas Taylor, Roy A. Roberts Distinguished Professor, University of Kansas, the meeting was attended by more than 25 individuals, including NSF officials, university administrators, faculty and researchers, and ND EPSCoR staff.

The focal leaders of the programmatic elements—Transformative Research, Competitive Enhancements, Cyberinfrastructure, Broadening Participation, and Private Sector Partnerships — completed a planning template prior to the meeting. These templates were used to stimulate discussion. Likewise, these templates were also used by our external evaluator, Dr. Rose Shaw, as the basis for the project evaluation plan/logic model.

We are indebted to the NSF for this EPSCoR award and for the proactive engagement of the agency in its implementation. ND EPSCoR represents a partnership between the NSF and State of North Dakota to enhance and strengthen the competitiveness of the state's scientists and engineers to garner competitive federal mainstream research and education program awards.

ND EPSCoR is guided by a State Advisory Committee composed of members with diverse backgrounds from both the public and private sectors and from all regions of the state. Partner institutions include the North Dakota State University, the University of North Dakota, and the state's five tribal colleges.

Philip Boudjouk, Co-Chair, ND EPSCoR
North Dakota State University

Barry Milavetz, Co-Chair, ND EPSCoR
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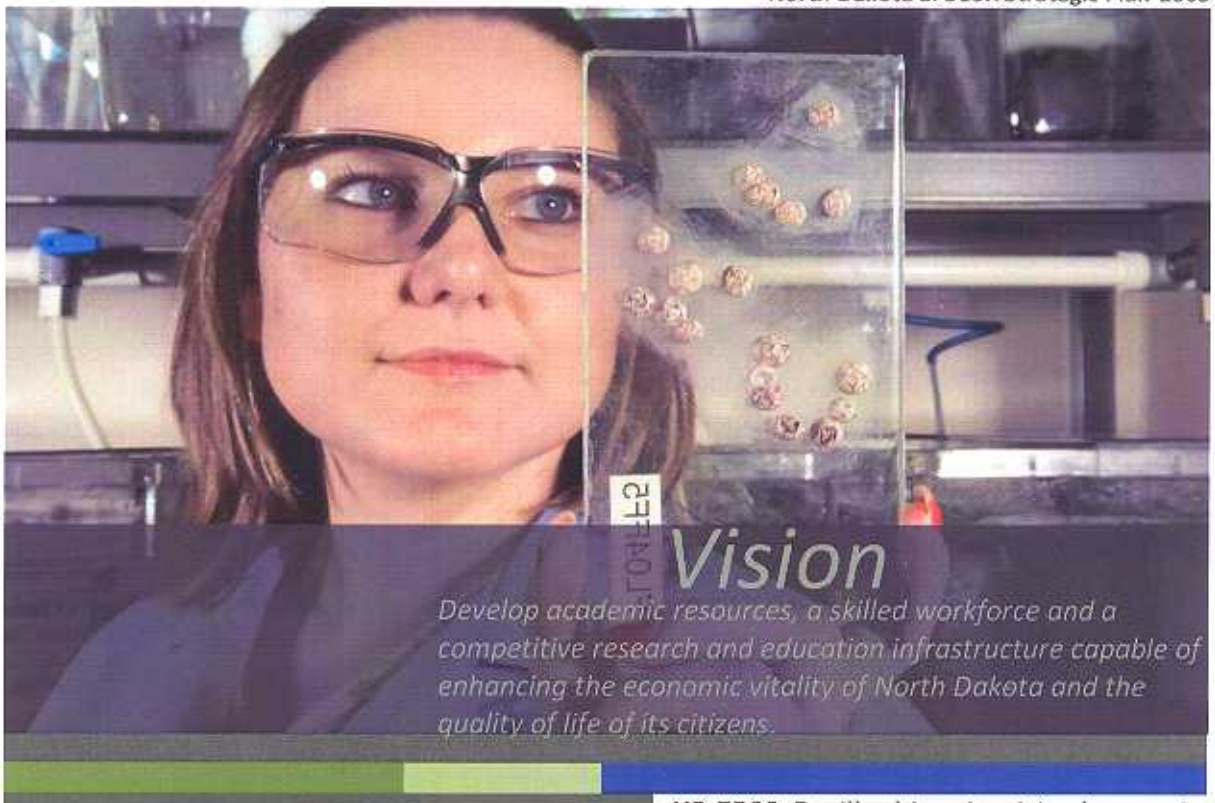
Executive Summary

Bringing together the people, tools and ideas to lay the foundation for a durable, competitive and cutting edge research infrastructure.

The research themes and strategy for the North Dakota EPSCoR RII program are the result of an 18-month planning process undertaken by ND EPSCoR and the universities in the North Dakota University System (NDUS). Our key research infrastructure elements, developed and informed by the State S&T vision, consist of a multifaceted program that includes:

- two major research initiatives, one in renewable energy (SUNRISE), the other in flexible electronics and materials (FlexEM);
- a series of programs to improve our ability to hire and retain outstanding chairs and faculty by supplementing start-up and retention packages;
- programs to increase faculty competitiveness via workshops on grant writing and project management, competitions for grants using an external merit review process, travel awards to international and national conferences, and visits to agency Program Directors;
- funds for collaborative projects that establish relationships with other universities including those in other countries;
- a plan to enhance the cyberinfrastructure at the research universities and other colleges in the NDUS system;
- a comprehensive set of programs designed to broaden participation of North Dakotans, particularly Native Americans, in STEM activities and careers; and
- programs that will continue to generate strong partnerships with the private sector.



Vision

Develop academic resources, a skilled workforce and a competitive research and education infrastructure capable of enhancing the economic vitality of North Dakota and the quality of life of its citizens.

- From 1986 to present, North Dakota invested $29.7M in EPSCoR; the cash return has been over $246.1M in merit-based research awards.
- From 2001 to 2005, total academic research expenditures have increased 77.4%, ranking ND fourth in the nation in percentage change.
- From 1986 to 2005, ND's share of NSF research funds has increased by 160%, ranking ND second in the nation in percentage change.
- North Dakota ranks 7th in the nation for University R&D/$1,000 of Gross State Product.
- ND EPSCoR has facilitated the recruitment of over 140 new faculty researchers to the state.
- A total of 22 EPSCoR-supported researchers have received prestigious NSF CAREER awards.

ND EPSCoR will achieve its vision by growing a competitive science and engineering base, sustaining a strong research and education infrastructure, and supporting excellence in:

- The education, development and support of a broadly diverse and inclusive STEM workforce wherein all people are inspired to reach their highest potential.
- Discovering and advancing critical scientific understandings that result in national recognition in the scientific community.
- Cultivating a diverse citizenry knowledgeable in science, proficient in the use of technology and engaged in the entrepreneurial opportunities that a strong science base offers.

Mission

Build a sustainable research and education enterprise in key areas important to the economic future of North Dakota.

The five key programmatic elements designed to accomplish our mission — described in the ND EPSCoR RII Plan EPS 0814442 — are shown here and more fully elaborated in this strategic plan.

The elements are structured and managed as vertically integrated activities with several points of contact between each element.

Implementation of the program will add to our strengths as well as address barriers to competitiveness. (See *Strategic Goals.*)

Transformative Research
- FlexEM
- SUNRISE

Competitive Enhancements
- New Faculty Startup Program
- Collaborative Research Support
- Graduate Student Assistantships
- Seed Grants

Cyberinfrastructure
- Network
- High Performance Computing
- Training

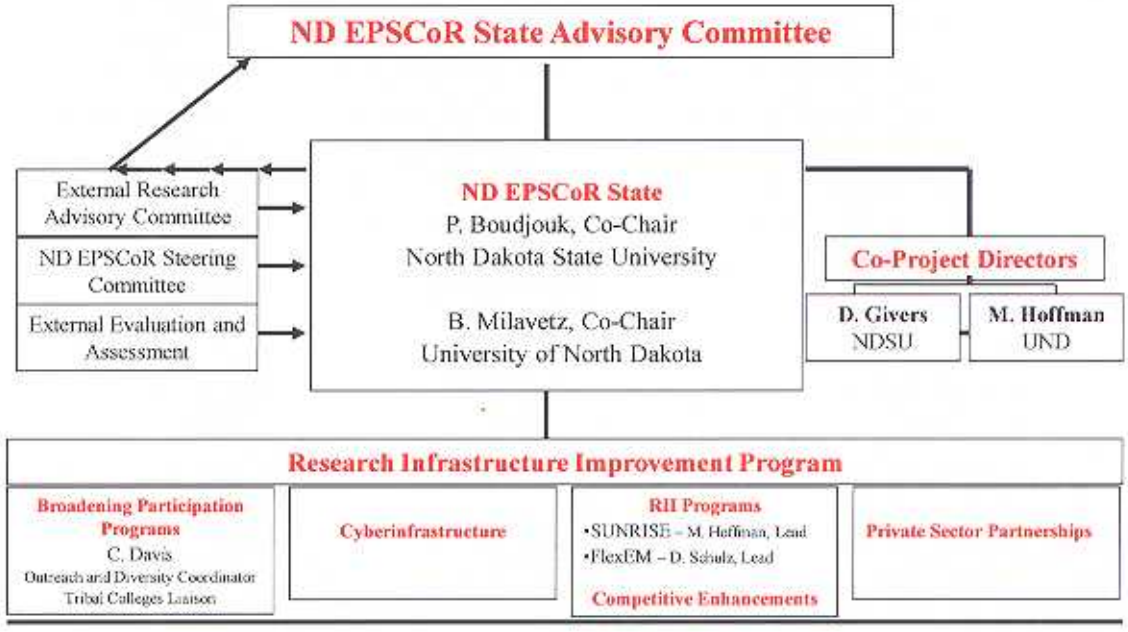
Broadening Participation
- Nurturing American Tribal Undergrad Res & Edu
- Women in Science & Engineering
- Faculty Lab & Research Exp
- Advanced Undergrad Res Awards

Private-sector Partnerships
- Product Design Center
- Students in Tech Transfer
- Faculty in Tech Transfer
- Plus Experience

Management

ND EPSCoR's strategic plan is guided by its Statewide EPSCoR Advisory Committee. The Committee consists of: 1) the Governor (or representative); 2) the Chancellor of the State Board of Higher Education; 3) four members of the current legislature; 4) the Vice Presidents for Research from North Dakota State University (NDSU) and University of North Dakota (UND); 5) two leading members of the regional business community; 6) the Tribal Colleges Liaison; 7) two leading members of the national academic research community, 8) two graduate students in STEM areas, one each UND, and NDSU; and, 9) one Project Co-Director from each campus. The two Vice Presidents for Research — Drs. Philip Boudjouk, NDSU, and Barry Milavetz, UND — serve as Co-Chairs of this committee.

ND EPSCoR Organizational Chart



Management

The Statewide Advisory Committee formalizes its relationship to the ND EPSCoR management team by facilitating the incorporation of the State S&T vision into ND EPSCoR operations. Its major roles are to ensure ND EPSCoR's fidelity to State initiatives in S&T and human resource development and to continue to be a catalyst for integrating relevant academic research into State S&T plans and priorities. Strong state government support has been key to ND EPSCoR's success leading to steadily growing budgets to fund its infrastructure programs and activities. ND EPSCoR has also benefited greatly from the advice of business community representatives on the Committee in tech transfer matters and training students for industry.

As prescribed by the ND EPSCoR by-laws, day-to-day management is carried out by the ND EPSCoR Steering Committee, comprised of the Vice President for Research at NDSU (Boudjouk) and UND (Milavetz); two Co-Project Directors (Givers, NDSU and Hoffman, UND); an Outreach and Diversity Coordinator (Davis); and campus research leaders (Hoffman – SUNRISE, and Schulz – FlexEM).

External Research Advisory Group	Advisory group composed of leading researchers and national leaders in technology based economic development, confers with State Advisory Committee on vital and emerging trends on the international and national scenes.
ND EPSCoR Steering Committee	Establishes policies, criteria and procedures to ensure that ND EPSCoR goals and objectives are met and ensures that all EPSCoR programs are aligned with the State S&T vision. Members include the Vice Presidents for Research at NDSU and UND; two Co-Project Directors; an Outreach and Diversity Coordinator; and campus research leaders.
External Evaluation and Assessment	External evaluation will be carried out by Dr. Rose Shaw, President of Metrica. A nationally recognized evaluator, Dr. Shaw has developed ND EPSCoR's evaluation and assessment plan based on recognized qualitative and quantitative formative and summative evaluation methods.

Strategic Goals

The five key elements — **Transformative Research, Competitive Enhancements, Cyberinfrastructure, Broadening Participation, and Private Sector Partnerships** — are the foundation upon which the strategic goals are established.

Implementation of the RII will add to ND's strengths, principally by addressing the challenges our researchers face as they strive to become more competitive. EPSCoR participants will develop a new, more competitive platform for research composed of state-of-the-art equipment and additional intellectual capital in the form of new faculty, post docs and graduate students. The result will be collaborative scientists and engineers who will be able to compete more effectively for research grants leading to major centers or satellites to existing centers. Our plan to upgrade our cyberinfrastructure will impact our S&T efforts across the research community. We will remove barriers of limited connectivity, low computing power, marginal data visualization capabilities, and the absence of know-how and resources to be engaged in relevant virtual organizations. Existing programs will be leveraged and new initiatives launched to bring more females and underrepresented groups, Native Americans in particular, into the STEM pipeline. Finally, the formation of partnerships is an essential enabling mechanism for our researchers and innovators, and as such, an important component of the ND EPSCoR RII.

1. Enhance research infrastructure through strategic investments in research areas critical to ND's economic future.
2. Provide competitive enhancements to increase faculty capacity and competitiveness.
3. Expand cyber-enabled communication, discovery and innovation.
4. Diversify and strengthen our research and education enterprise through targeted programs to broaden the STEM pipeline.
5. Form university-private sector partnerships to help translate new knowledge into opportunities for the residents of North Dakota.

Key Elements of Strategic Plan

ND EPSCoR's strategic plan contains specific strategies and presents a detailed plan to: 1) promote synergistic research activities between UND and NDSU; (2) evaluate the impact of seed funding; and (3) facilitate a mutually beneficial, long-term partnership with ND's five tribal colleges.

- **Synergistic Research Activities**: As described throughout this plan, the SUNRISE and FlexEM programs are integrated across the state's two major research institutions (NDSU and UND). Representation of both institutions is apparent in the more than 25 and 20 faculty who are part of SUNRISE and FlexEM, respectively. Due to the nature of the infrastructure needed to support these programs, the center of activities lies within NDSU and UND for FlexEM and SUNRISE respectively. Working from these origins, the programs have continued to build linkages between the two campuses and we plan to increase current partnerships with the five tribal colleges. Moving forward we will continually integrate the various ND institutions supported in part by an investment in the cyberinfrastructure that links us. Equally important, our commitment to broadening the participation in our research and education activities will further network our institutions. Looking toward the future, we will invest in research opportunities that leverage the collective expertise of the faculty at UND, NDSU and the five tribal colleges.

- **Seed Funding:** ND EPSCoR will hold competitions for single investigator seed grants to PIs who are early career for them to obtain the preliminary results important to successful grant applications. Seed funds will also be available to established PIs planning to make a significant change in the direction of their research. Typical grants will be $20K a year for two years with second-year funding contingent upon submission of a proposal to NSF. The program will be rigorous, using NSF guidelines and will include external review by a minimum of three referees. Through seed funding we will explore new research opportunities and where appropriate direct resources to target future directions of the ND EPSCoR program beyond the current portfolio of energy and flexible electronics.

- **Tribal Colleges Integration:** For nearly a decade, ND's two research universities—NDSU and UND —have successfully collaborated with the state's five tribal colleges (Turtle Mountain Community College; Fort Berthold Community College; Cankdeska Cikana Community College; United Tribes Technical College; and Sitting Bull College) on the NATURE initiative. NATURE is designed to build the pathway from K-12, to the tribal colleges, to baccalaureate institutions, and eventually to graduate schools for American Indians in the pursuit of careers in STEM. Through this ND EPSCoR award, we will seize an opportunity to further solidify our partnership and collaboration by: 1) creating a strong alliance between North Dakota EPSCoR management and the North Dakota tribal colleges; (2) implementing research and education capacity building at the ND tribal colleges for high school and college students (3) providing professional development for STEM teachers and Tribal College faculty by engaging them in activities at three levels of STEM education; and (4) collecting nationally-relevant data to advance STEM student initiatives. Dr. Carol Davis, an enrolled member of the Turtle Mountain Band of Chippewa, who directs the ND NATURE program, has been appointed ND EPSCoR Tribal Colleges Liaison. She serves on the State Committee and works closely with the ND EPSCoR co-Project Directors. As the focus of ND EPSCoR's diversity plan centers on increasing the number of Native American students in STEM, we are committed to growing, and sustaining our partnership with the state's Tribal Colleges.

Transformative Research

Research being developed by our EPSCoR program seeks not just to generate knowledge but to generate knowledge that will be transformative in terms of leveraging existing resources and creating new opportunities for economic development in our State. We have a highly educated workforce, which leverages our capabilities of moving from our traditional agrarian base to high tech industries and capitalizes on the growing opportunities in the green and the 'postsilicon' economies.

The two RII areas targeted are of critical economic importance to North Dakota: renewable energy and flexible electronic materials. These are two efforts are represented by the following programs:

- **SU**stainable e**N**ergy **R**esearch Infrastructure and **S**upporting **E**ducation (SUNRISE) will elucidate fundamental aspects of heterogeneous catalysis, especially at the nanoscale, that are relevant to developing alternative transportation fuels and chemical feedstocks.
- **Flex**ible **E**lectronic **M**aterials (FlexEM) will endeavor to discover new materials and deposition processes for the development of printed routes to electronic materials.

While distinct in focus and plans, the SUNRISE and FlexEM programs are integrated across the state's two major research institutions (NDSU and UND). Representation of both institutions is apparent in the more than 25 and 20 faculty who are part of SUNRISE and FlexEM, respectively. The nature of these two distinct programs is reflected in their relative center of operations on the two campuses; however, the ND EPSCoR provides considerable infrastructure and facilitates active and productive communication between the SUNRISE and FlexEM leadership and the participating faculty, staff and students. Both SUNRISE and FlexEM are evolving in structure and function — both moving toward having a greater impact in the private sector as the fundamental body of knowledge in sustainable energy and flexible electronics reaches a critical mass. Each program will be the driver for economic opportunities in the private sector. The inputs, outputs and annual outcomes of SUNRISE and FlexEM are described in the Appendix 1-A and 2-A, respectively.

SUNRISE: Transformative Research

The ND SUNRISE program will elucidate fundamental aspects of heterogeneous catalysis, especially at the nanoscale, that are relevant to developing alternative transportation fuels and chemical feedstocks. (See Appendix 1-A .)

SUNRISE breakthroughs in the previous RII have matured to funding by mission-directed agencies and industrial partners, and it is expected that research performed in this RII will move SUNRISE to the level of a sustainable center in basic and applied research. The scientific basis for the development of heterogeneous catalysts for crop oils will form the foundation for proposal submissions from SUNRISE to such programs as the NSF Chemical Bonding Centers (CBC) competitions and to the Integrative Graduate Education and Research Traineeship (IGERT) program during this grant period.

Because of successes in the previous RII, attention will now be focused primarily on crop oils, although opportunities for advancing the understanding of nanoscale heterogeneous catalysts that may prove more useful for coal or fuel cells will also be explored. Heterogeneous catalysts, particularly on nanoscale supports, will be studied to gain knowledge about the electronic structure, surface morphology and defects, effects of doping and functionalization, redox properties, and finite size (e.g., nanodimensionality) effects.

Thrust Areas

SUNRISE conceives and executes RD&C activities in three sustainable energy focus areas:

- Renewable Fuels, Chemicals and Polymers
- Sustainable Coal Utilization
- Harvesting Energy from Diffuse Sources

Anticipated Outcomes

We anticipate the following outcomes during the first three years:

- Increased intellectual capacity through at least two new faculty (chemistry and chemical engineering)
- Enhanced research infrastructure as result of new capital equipment purchases and faculty hires
- Increased support for large scale program development
- Active efforts in five critical areas of research: (1) Novel catalysts for hydrocarbon generation; (2) Novel catalytic cracking of crop oils; (3) Nanocatalysts for fuel cells; (4) Cyclopalladation catalysts; and (5) Catalytic reaction mechanisms

Catalysts that show potential for the synthesis of preferred organic compounds that can be exploited to produce fuels, chemicals, and polymer monomeric feedstocks will be of particular interest. Emphasis will be placed on studies of transition metal (e.g., Co, Pd, Pt) catalysts, which preliminary studies by SUNRISE researchers and others have shown to be very promising. SUNRISE researchers have a diverse spectrum of talents and experience necessary — from feedstock origins (plant science) through theoretical/computational and experimental chemistry (organic, analytical, physical chemistry), to applied science and engineering (chemical, combustion, and process engineering) — to make substantial advances in our knowledge and expertise in these research areas. SUNRISE studies are organized into five broad, multidisciplinary projects. The majority of studies will be experimental, although complementary computational electronic structure studies of the catalysts and catalyzed reactions will be undertaken. ***The overarching goals of the studies are to develop understanding and methodology for the de novo design of new heterogeneous catalysts.***

FlexEM: Transformative Research

The development of new materials and processes for electronic devices has been driven by the integrated circuit (IC) industry since the dawn of the computer era. After several decades of "Moore's Law"-type innovation, future miniaturization may be stymied by materials (i.e., pin-hole free dielectric materials as thin as a few atomic layers) and processing (i.e., lithography) limitations. By comparison, the nascent field of flexible electronics is not driven by the smallest possible circuit dimension, but instead by cost and form factor. Nominal circuit features as large as 10 μm will enable flexible electronic technologies such as RFID, e-paper, photovoltaics, and health monitoring devices.

The goal of FlexEM is to discover new materials and deposition processes that will revolutionize the field of flexible electronics. (See Appendix 2-A)

The FlexEM team is not a continuation of the previously supported SPIN program, but is a rational derivative spawned from the successes of that group. The transition of effort from SPIN to FlexEM is logical given a common thread: the development of printed routes to electronic materials. Over the next 3-5 years we anticipate a concerted effort to better define our capabilities and unique attributes that make us competitive in the field of flexible electronics.

In this effort we will distinguish ourselves and chart a course to sustainability in the field. Our competitive advantage lies in four core capabilities:

(1) Combinatorial materials research laboratory;
(2) Synthesis of new polymers;
(3) Si6 synthon and safe handling of liquid silanes; and
(4) Multi-scale modeling based design of nanocomposite coatings.

Looking forward, we anticipate supporting at least two new faculty hires to help build our intellectual capital in the area of flexible electronics. We will also make decisions as the viability of some areas including efforts in conjugated organic polymers. Overall we will look to better refine program elements and seek international collaborations in areas that will strengthen our capabilities.

Thrust Areas

FlexEM conceives and executes RD&C activities in three thrust areas:

- Barriers for Flexible Electronics
- Conjugated Organic Polymers
- Materials from Liquid Silanes

Anticipated Outcomes

We anticipate the following outcomes during the first three years:

- Adding at least two new faculty
- Enhanced research capacity especially in the area of processing novel polymeric materials
- Defining our unique skill set that will set us apart from the competition
- Research efforts in the following areas: (1) Characterization and modeling of barriers for flexible electronics; (2) Novel dithienopyrrole materials and resulting films (3) Novel liquid silane materials and processing.

Competitive Enhancements

The ability of our EPSCoR faculty to compete on a national and international level is in part a function of the array of talent that we can attract and retain in the State. Resources allocated to our faculty help to make them more competitive.

Competitive enhancements are embedded in our vertically integrated RII strategy to:

- improve our ability to hire and retain outstanding chairs and faculty by supplementing start-up and retention packages through our New Faculty Start-Up program.
- support collaborative research programs through seed investments that bring together faculty in interdisciplinary efforts and that result in competitiveness for large-scale national awards.
- provide faculty with additional graduate students through graduate Student Research Assistantships (GSRA) and Doctoral Dissertation Assistantships (DDA) programs.

We anticipate over the initial three years to provide 45 start-up packages (75 over the five years) and to provide 45 GSRA and DDAs to promising faculty in our EPSCoR program. These investments are critical to building our competitive status in the nation and around the world. New faculty hires over the past five years supported by the EPSCoR program has resulted in more than 75 scientists and engineers being added to our ranks. These investments will have an impact — our goal is to increase competitive funding for the FlexEM and SUNRISE programs to $10M each. Beginning in 2010, ND EPSCoR will host a S&T colloquium in the State Capitol to highlight the importance of STEM activities to the North Dakota workforce and economy. Finally we will support the creation or renovation of 200,000 sq feet of net assignable research space in North Dakota.

Thrust Areas

Major "competitive enhancement" thrust areas include:

- New Faculty Start-Ups
- Collaborative Research Support
- Graduate Research Assistantships
- Seed Grants

Anticipated Outcomes

We anticipate the following outcomes:

- 45 new faculty supported in the first three years with awards averaging $90K
- A total of 75 new faculty added to the ND campuses over a five year period
- Training for 45 graduate students in STEM

ND's investment in its EPSCoR program has provided an 8.2:1 return on investment from 1986-2006.

Cyberinfrastructure

The distance between our EPSCoR institutions represents a physical challenge to integrating our various activities. Opportunities however exist by investing in the cyberinfrastructure that will revolutionize the way we communicate and collaborate. ND's plan is coincident with NSF's Cyberinfrastructure Vision for 21st Century Discovery: *"to provide cyberinfrastructure that is human centered, world class, supportive of broadened participation in science and engineering, sustainable, and stable but extensible."* Cyber enabled discovery is dependent upon physical and infrastructure and fostering interdisciplinary research collaborations.

Our state strategy is to continue to improve and upgrade desktop connectivity and provide training workshops for faculty, students and staff in the use of cyberinfrastructure. Specifically this will entail:

- Purchasing and installing (2008-2010) desk top state-of-the-art broadband (10 gbps) network (world-wide) capability.
- Providing staff (two full time managers and four graduate research assistants for high performance computing centers) to embed CI in our research community.
- Co-sponsoring statewide CI events (K-20 plus tribal colleges) focusing on how to access strategic CI facilities, i.e., those located on the TeraGrid, and its scientific applications.

Key Strategies

The RII will enhance cyberinfrastructure by:

- Increasing broadband access
- Installing CAVE visualization to allow faster, more accurate data interpretation
- Hiring staff for computer center support, provide training
- co-sponsoring statewide K-20 tribal college cyber infrastructure events

Anticipated Outcomes

We anticipate the following cyber-related outcomes:

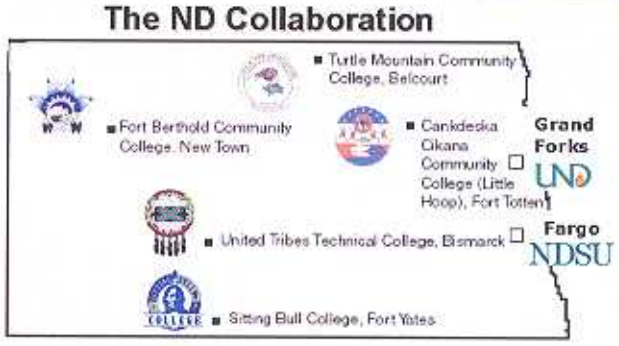
- A new 3D CAVE system
- Installation of almost 1000 new Gb connections
- Two annual workshops
- Support for at least one new CI manager each year.

ND EPSCoR cash commitment will staff and support activities to embed CI in our research community. CI user support in the form of full time CI Project Managers (one at NDSU, one at UND) and four graduate assistants (two at each university) who will provide support for high performance computing, e.g., assist users to develop programs and/or scripts necessary to deploy applications; help scientists to use installed scientific applications and to troubleshoot problems ; keep up to date with advances in scientific computing and parallel computing; oversee CI workforce development and training programs, help implement virtual organizations, provide pertinent web design and maintenance, organize CI users groups and supervise graduate assistants in research areas.

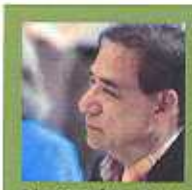
The ND borne costs (for the CI plan) will be about $2M over the five years of the grant. This plan is in line with the State's CI plan that incorporates not only campus upgrades in computing power and staffing, but completes the connectivity to the Northern Tier Network. In North Dakota, as true elsewhere, the number of quality jobs in IT far exceeds the number of qualified applicants. Also we will compete for additional cyberinfrastructure resources such as those available through NSF and NSF EPSCoR. Details of the cyberinfrastructure are presented in the Appendix.

Broadening Participation

ND EPSCoR is fortunate to have opportunities within our own communities to broaden the participation of women and underrepresented groups in STEM activities. Our broadening participation is based upon strong and mutually respectful relationships that exist between NDSU, UND and the tribal colleges. Scattered across the State are the five tribal colleges — Turtle Mountain Community College; Fort Berthold Community College; Cankdeska Cikana Community College; United Tribes Technical College; and Sitting Bull College. These institutions, along with NDSU and UND cover a wide swath of the State and serve a very diverse community.



Collectively, our demographics include 94.6% Caucasian, 4.1% American Indian, and 1.3% all others (US Census 2000). We will invest in STEM education across the State, and, to broaden participation, we will focus on women and Native Americans. ND EPSCoR works collaboratively with two programs, Nurturing American Tribal Undergraduate Research and Education (NATURE) and Women In Science and Engineering (WISE) that serve the particular needs of Native Americans and women, respectively. These two programs, while diverse in the audiences that they impact, have a common goal of engaging individuals and promoting their interest in STEM activities. (See Appendix for projected inputs, outputs and annual outcomes.)



Nurturing American Tribal Undergraduate Research and Education (NATURE): A culturally relevant program that incorporates Native science where appropriate. NATURE provides a STEM education pathway for American Indian high school and tribal college students. This collaborative model engages North Dakota university professors with STEM teachers and faculty from reservation high schools and tribal colleges. With an emphasis on hands-on learning, NATURE provides Native American students with hands-on summer experiences.

Women in Science and Engineering: WISE will provide supplemental funding to women faculty, both new hires and current, for upgraded lab equipment, additional graduate students and postdoctoral researchers. We expect to support 20 women faculty by providing them with the resources and enhancing their ability to better compete on a national and international level. This investment will be in the form of supplemental funding to women faculty, both new hires and current, for upgraded lab equipment.

Anticipated Outcomes

We anticipate the following outcomes during the first three years:

- Increase in the number of NATURE participants by 30%
- Increase in the number of NATURE students enrolled in baccalaureate degree programs from 10 to 15
- Graduate three NATURE students with a MS or PhD
- Support up to 20 women faculty

Private Sector Partnerships

The scientific discoveries of the ND EPSCoR program have the potential to impact the intellectual foundations of sustainable energy and flexible electronics and be a driver for economic development. To accomplish these goals, partnerships with the private sector are critical. Special emphasis is placed on university – private sector partnerships through the following programs:

- **Product Design Center (PDC).** Seed funding for bridging the gap between a discovery arising from basic research and a technical innovation with a commercial market.
- **Students in Technology Transfer and Research (STTAR) and Faculty In Technology Transfer (FITT).** Support students and faculty to work with regional industries that provide two-thirds of the cost of company projects.
- **The Plus Experience (TPE).** TPE, a private sector-driven program in the pilot stages, is designed to fill "training gaps" identified by our regional industrial partners. While satisfied with the education supplied by our institutions, several partners have identified training gaps, which if filled, would add value to our graduates. These gaps are costly for companies, especially small ones, to cover.

The private sector is committed to supporting TPE with funding, curricula, and instructional staff. Knowing that this program improves North Dakota's ability to attract companies, the ND Legislature added $150K to the ND EPSCoR budget to begin TPE. Sample curricula for TPE are programming in MS Sharepoint, MATLAB, and Rational Rose for Software Engineering. The budget is $450K ($150K a year for 3 years) from the ND cash commitment.

Key Strategies

The RII will be used to:

- Bring in needed experts to advise researchers on how to enhance commercial potential
- Implement the recommendations of the experts
- Support costs of protecting intellectual property and early stage marketing
- Provide training as needed

Anticipated Outcomes

We anticipate the following outcomes during the first three years:

- Support the creation of at least four new start-up companies in the emerging areas of energy and flexible electronics
- Increase the number of patent applications from 60 to 75

The private sector partnerships are investments of EPSCoR resources that are meant to promote a much greater return in the private sector beyond just the discovery of new knowledge. The State of North Dakota has seen dramatic increases in the growth of small entrepreneurial firms around our academic institutions. An example is Alien Technology which provides UHF Radio Frequency Identification (RFID) products and services to customers in retail, consumer goods, manufacturing, defense, transportation and logistics, pharmaceuticals and other industries. Their RFID manufacturing facility is located adjacent to the NDSU campus. The outcome of our scientific discoveries and investment in programs such as PDC and STTAR includes high paying jobs for our graduates and a continuing improvement in the quality of life in our communities. Over the next three years we propose to invest over $270,000 in these programs. We anticipate significant outcomes each year and these are detailed in the Appendix.

"Agridata, Inc. has grown to four full-time and 15 part-time employees over the past year. The students we've employed through the STTAR program are a contributing factor to our success, and many are still employed at our company. We thank you for the opportunity to be part of the program."

David A. Hagert, President, Agridata, Inc. Grand Forks, ND

Conclusion

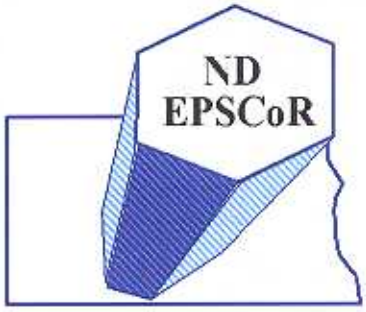
As noted, ND's RII will bring together the people, tools, and ideas to lay the foundation for a durable, competitive and cutting edge research infrastructure. The primary objective is to build the infrastructure to support nationally-competitive research in *renewable energy* and *flexible electronics and materials* — two areas of critical importance to North Dakota. New knowledge generated by this work will lead to greater understanding of issues at the core of problems in energy and microelectronics. Building on the successes of the SUNRISE and SPIN thrusts in the current (2005-2008) RII, and leveraging prior investments made by NSF and DOE, this RII will advance ND EPSCoR goals by strengthening academic research overall and making the state nationally competitive in several key areas. By fostering innovation in renewable energy, i.e., continuing SUNRISE, and flexible electronics and materials with a new program, FlexEM, ND EPSCoR will further stimulate North Dakota's economy. With major investments in cyberinfrastructure, integrating research and education, and implementing a comprehensive human resource development plan, ND EPSCoR will contribute to diversifying the science and technology workforce.

Forming partnerships, an essential enabling mechanism for our researchers and innovators, is an important component of the ND EPSCoR RII. Our major research themes, SUNRISE and FlexEM, will be benchmarked on their partnership forming activities in addition to more conventional measures of productivity. Collaborations, fostered by targeted seed grants, will encourage individual Principal Investigators to form productive linkages to colleagues at other universities. Special emphasis is placed on university-private sector partnerships in the form of 1) seed funding for bridging the gap between a discovery arising from basic research and a technical innovation with a commercial market; and, 2) support for students and faculty to work with regional industries, who provide two-thirds of the cost, on company projects.

As noted, the major underrepresented groups in North Dakota are Native Americans and women. Nurturing American Tribal Undergraduate Research and Education (NATURE) is a multifaceted program that greatly increases the involvement of our five Tribal Colleges in STEM education and research. The ND EPSCoR program also administers Women In Science and Engineering (WISE) to provide supplemental funding to women faculty for lab upgrades and additional research staff. ND EPSCoR also appropriates funding for Women in Science, Mathematics, Engineering and Technology (WISMET) a networking group that provides mentoring for women undergraduate/graduate students and women faculty.

The State has demonstrated strong and steadily increasing support of the ND EPSCoR S&T Plans over the last 25 years in the form of a line item in the State's Higher Education budget reaching the current level of $2.83M/yr. The Governor, the Chancellor of Higher Education, and four members of the State Legislature serve, with others, on the ND EPSCoR State Advisory Committee. Their engagement with ND EPSCoR over the years has led to the level of support this program has enjoyed. The involvement on the research university campus continues in the proposed program with commitments to four new tenure track faculty slots for the FlexEM and SUNRISE initiatives. At least 50 new faculty will be hired in the broader STEM areas at UND and NDSU.

Our comprehensive management plan (inclusive of plans to sustain this work), evaluation and assessment, and a communications plan will ensure efficient stewardship, value, and accountability to our stakeholders.



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Experimental Program to Stimulate Competitive Research

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Appendices

Appendix A

Appendix 1-A. SUNRISE

Outcome 1: Expand Research Capabilities through New Faculty Positions

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
New Chem Eng Faculty	Faculty hired	0	1	1	1	1	1
New Chem Faculty	Faculty hired	0	0	1	1	1	1
Seed grant proposals from new faculty	# of small proposals submitted – all agencies	0	1	2	2	1	2
Career grant proposals	# of NSF career grant proposals submitted	0	0	2	2*	1*	1
Federal grant proposals	# of Federal grant proposals submitted**	0	1	3	5	6	7
Peer-review publications from new research	# of peer-review publications submitted	0	0	0	1	2	3
Student training	# of grad, u/g, post-doc trainees supported	0	1	3	6	8	10

* if not successful in prior years

** excludes NSF career proposals; includes all as PI, co-PI, or major participant

Outcome 2: Facilitate SUNRISE Sustainability Activities

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Major research proposals	# of >$1 million proposals submitted by SUNRISE researchers	4	5	5	5	5	5
Highly collaborative proposals	# of SUNRISE proposals with 3 or more faculty participants	12	15	18	18	20	20
Total research proposals	# of proposals submitted by SUNRISE researchers related to Sustainable energy	60	65	65	65	70	70
Active grants valued at >$1 million	# of SUNRISE projects funded at over $1 million	1	2	2	2	2	2
Total research funding	Value of newly funded SUNRISE research projects ($million)	9	6*	6	6	6	6
Intellectual Property	# of invention disclosure and patent applications	1	2	2	3	3	3

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
	generated						
Commercialization	# of proposals with commercial partners	2	3	3	4	4	5
Commercialization	# of projects funded by commercial partners	1	2	2	2	3	3
Commercialization	# of economic development activities resulting in transfer of technology to commercial sector	1	1	2	2	2	3

* SUNRISE's long-term sustainability target is $6 M per year in new funding

Outcome 3: Facilitate Collaborative Research between UND and NDSU

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Research proposals	# of proposals submitted including both UND and NDSU researchers	1	2	2	3	3	4
Active grants	# of SUNRISE projects with participants from both UND and NDSU	1	2	2	2	3	3

Outcome 4: Facilitate Administration of SUNRISE Outreach Programs

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Undergraduate Summer Research Program	# of students participating	9	11	11	11	8	8
Power ON! Summer Camps to Stimulate Interest in STEM fields	# of weeks of summer camps held for 4th-8th graders	0	1	2	2	3	3
"Chemistry vs. Dust" workshops for High School students	# of students attending workshops	25*	50	50	50	50	50
Native American Freshman Experience	# of NA students participating	5	5	5	7	7	7
California bridge program - undergraduates	# of undergraduate students from Cal Poly Pomona and San Jose State participating in UND	3	5	5	7	7	7

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
	associated research activities						
California bridge program – graduate studies	# of students from Cal Poly Pomona and San Jose State enrolling at UND for graduate studies	0	0	1	2	2	3
South African Exchange Program	# of South African students studying in North Dakota	0	1	1	2	2	2
South African Exchange Program	# of North Dakota students studying in South Africa	0	0	1	1	2	2

* 2006-07 data, workshop was not held in 2007-08

Research Related Outcomes (these outcomes are associated only with the specific SUNRISE researchers receiving funding to support their work under the NSF EPSCoR RII: Mark Hoffmann, Mike Mann, Irina Smoliakova, Darrin Muggli, Julia Zhao, and Alena Kubatova).

Outcome 5: Increased Capabilities for Energy-Related Heterogeneous Catalysis

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Increased proposal submissions	# of proposals including energy-related heterogeneous catalysis in work scope	2	3	3	4	4	4
Active grants	# of SUNRISE projects including energy-related heterogeneous catalysis in work-scope	1	1	2	2	2	3
Publications	# of peer-reviewed publications energy-related heterogeneous catalysis	3	3	5	5	6	7

Outcome 6: Novel F-T Catalysts to Generate Long-Chain Hydrocarbons

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Develop Nanocatalysts for FT reactions	Synthesize highly uniform, nano-sized Pd/SiO2 catalysts			X			
	Catalyst characterization complete				X		
	CH_4 FT reactions with new catalyst complete					X	
	Assessment of technology complete						X

Outcome 7: Novel Novel Catalytic Cracking of Crop Oils

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Develop nanosized HZSM-5 catalysts to reduce fouling problems	Synthesize nano-sized HZSM-5 catalysts		X				
	Build high throughput reactor system			X			
	Catalyst characterization complete				X		
	Analytical procedures complete				X		
	Catalysts testing in high throughput reactor complete					X	
	Assessment of technology complete						X

Outcome 8: Nanocatalysts for Direct Methanol Fuel Cells

Component	Metric	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Develop nanocatalyst to improve the efficiency of Pt-based catalysts	Synthesize of Pt-doped silica nanoparticles complete		X				
	Catalyst characterization complete			X			
	Adapt fuel cell test system				X		
	Catalysts testing in fuel cell reaction system complete					X	
	Assessment of technology complete						X

Outcome 9: Functionalization of aryl and alkyl groups using cyclopalladation

Component	Metric	Baseline	Annual Benchmarks				
		2007-08	08-09	09-10	10-11	11-12	12-13
Synthesis of new cyclopalladated complexes (CPC)	Number of characterized new compounds		X	X	X	X	X
Determination of mechanisms	Characterization sufficient for publication in peer-reviewed journal			X	X	X	X
Optimization of reaction conditions	Plausible lab-scale processes for investigation of scale-up				X	X	X
Investigation of reactions of CPCs with other reagents, especially carboxylic acids and other oxidizers	Number of well-characterized reactions				X	X	X

Outcome 10: Theoretical Studies of Catalytic Reactions Mechanisms

Component	Metric	Baseline	Annual Benchmarks				
		2007-08	08-09	09-10	10-11	11-12	12-13
Development of general embedding theory	Completed formal work, including extensions to properties		X	X			
DFT-in-DFT realization	Working computer programs; application to real systems			X	X		
Wavefunction-in-DFT realization	Working computer programs; application to real systems				X	X	
Advances in multireference methods	Working computer programs; application to real systems			X	X	X	
Applications to realistic models of catalysts of experimental interest	Completion of specific studies				X	X	X

Appendix 2-A. FlexEM

ND EPSCoR RII Project: FlexEM

GOAL/Mission Statement: FlexEM will discover new materials and formulate novel concepts relevant to manufacture of disposable devices that useful and provide benefit to humanity.

Strategies/Vision Statement: The FlexEM team will leverage existing core competencies toward thesis projects that combine materials discovery and device prototyping with an emphasis on linking theoretical concepts and experimental observables. As technology targets are identified, strategic relationships with academia, national labs and industry on an international scope will be developed that augment the activities of the FlexEM team. FlexEM graduate students will thereby be exposed to a broad spectrum of research cultures providing them an outstanding basis to guide their career.

Outcome 1: Confirm Competitive Advantages of FlexEM processes by Cataloguing of State of the Art Applications (i.e., process, temperature and conditions), Performance and Price

Component	Metric	Baseline 2008-09	Annual Benchmarks 09-10	10-11	11-12	12-13	13-14
FlexEM-PC[a]	Manuscript submission	Comprehensive. Review	Annual update	Annual update	Annual update	Annual update	Annual update
FlexEM-DD[b]	Manuscript submission	Comprehensive. Review	Annual update	Annual update	Annual update	Annual update	Annual update

Legend: [a] FlexEM – Polymer Composites (FlexEM-PC); [b] FlexEM – Discovery and Devices (FlexEM-DD).

Outcome 2: Build the FlexEM infrastructure and boost productivity

Component	Metric	Baseline 2008-09	Annual Benchmarks 09-10	10-11	11-12	12-13	13-14
New faculty hires	Number of new faculty hired	0	1	1	-	-	-
FlexEM-PC[a] Publications	Peer-reviewed journal	2	3	4	4	4	4
FlexEM-DD[a] Publications	Peer-reviewed journal	2	3	4	4	4	4
FlexEM-PC[a] Conferences	Oral Presentation	2	3	4	4	4	4
FlexEM-DD[b] Conferences	Oral Presentation	2	3	4	4	4	4
Federal grant submission	Number of Federal grants submitted	3	6[c]	9	10	11	12
FleEM: Int'l Outreach[d]	Host Si in FlexEM Workshop	0	0	1	0	0	1
Student training[e]	Number of U/G postdocs	5	7	9	10	11	12

Legend: [a] FlexEM-PC = FlexEM Polymer Composites; [b] FlexEM-DD = FlexEM – Discovery and Devices; [c] Workshop grant for a meeting to be held in Fargo ND; [d] lead by Project 8 Co-PIs; [e] including NATURE.

Outcome 3: Enhance research discoveries

Component	Metric	Baseline	Annual Benchmarks				
		2008-09	09-10	10-11	11-12	12-13	13-14
FlexEM-PC[a]	Invention Disclosures	2	3	4	4	4	4
FlexEM-DD[b]	Invention Disclosures	2	3	4	4	4	4

Legend: [a] FlexEM-PC = FlexEM Polymer Composites; [b] FlexEM-DD = FlexEM – Discovery and Devices.

Outcome 4: Establish Working Partnerships

Component	Metric	Baseline	Annual Benchmarks				
		2008-09	09-10	10-11	11-12	12-13	13-14
NATURE Outreach	Summer HS students	2	2	3	3	4	4
NATURE Outreach	Junior year UGRA	-	-	1	2	2	2
NATURE Outreach	MS Degree in STEM	-	-	-	1	2	2
FlexEM-PC[a] Manuf. partner	Research Agreement	Identify candidates	Identify candidates	Negotiate agreement	Sign agreement	-	-
P5[b]/P6[c]: PLED Manuf. Partner	Research Agreement	Identify candidates	Identify candidates	Negotiate agreement	Sign agreement	-	-
P7: STNC Lithograhpy Mnftg partner[d]	Research Agreement	Identify candidates	Identify candidates	Negotiate agreement	Sign agreement	-	-
P8: Development partner[e]	Measure EO of Si CNF	Identify candidates	Identify candidates	Negotiate agreement	Sign agreement	-	-
P8: Int'l Outreach[e]	Establish working activity with Si Chem community (Japan, S. Korea, China, Germany)	Initiate	Develop agreement	Sign agreement	-	-	-

Legend: [a] FlexEM-PC = FlexEM Polymer Composites; [b] P5 = Project 5 DTP Discovery; [c] P6 = Project 6 Polymer LEDs; [d] P7 STNC = Project 7 Surface-Tension Controlled Nanolithography; [e] P8 = Project 8 Si CFN (Clusters, Fullerenes, NTs).

Outcome 5: Sustainable Research Competitiveness (Early Objectives / YEAR 1).

Objective	Tasks/Activities [List tangible outcomes]	Person(s) Responsible	Strategies Used	Resources Needed [Tangible resources put toward objective]	Milestones	Metrics
***Thrust #1* FlexEM-PC[a]**						
Proj 1 Formulation	Define composite parameters	D. Webster, K. Katti	Polymer formulation	CMRL	P1 compiled with T1[e]	Written SOW for T1
Proj 2 Char/modeling	Define char/model workflow	K. Katti D. Katti	FE, MM, ab initio	PolrizdFTIR, HPC time	P2 compiled with T1[e]	Written SOW for T1
Proj 3 Life prediction	Define predictive model parameters	S. Croll	Software modeling	Computer time	P3 compiled with T1[e]	Written SOW for T1
Proj 4 Permation Char	Define/setup lab for gas permeation test	B. Tande	P transducer	Hardware mods	P4 compiled with T1[e]	Written SOW for T1
***Thrust #2* FlexEM-DD[b]**						
Proj 5 DTP Discovery	Discover 1 new DTP	S. Rasmussen	Synth Chem	Chemicals	Prove DTP	EA, CV, NMR
Proj 6 PLEDs	Setup LED fab facility	K. Pokhodnya	Evaporation	Modifications to glovebox	Operational facilities	Photograph of system
Proj 7 STCN[c]	STCN of nanosized dots	I. Akhatov	STM-based deposition	STM time	Submit manuscript	Manuscript accepted
Proj 8 Si CFN [d]	Establish options for growth of CFNs	D. Schulz, X. Dai	Electro-chem; MALDI-TOF; other.	Inert box; glassware; galvanostat; other.	Operational facilities	Photograph of completed system

Legend: [a] FlexEM – Polymer Composites (FlexEM-PC); [b] FlexEM – Discovery and Devices (FlexEM-DD); [c] STCN = Surface Tension-Controlled Nanolithography (task modified from CAB-DW); [d] Si CFN = Silicon Clusters, Fullerenes and Nanotubes; [e] P1 = Proj 1, P2 = Proj 2, P3 = Proj 3, P4 = Proj 4, T1 = *Thrust #1* FlexEM-PC.

Appendix 3-A. Competitive Enhancements

COMPETITIVE ENHANCEMENT GOAL: Maintaining momentum toward the goal of nationally-competitive faculty at NDSU and UND.

Strategies: Improve hiring and retention of outstanding chairs and faculty by supplementing start-up and retention packages; support collaborative research through seed investments; support additional graduate student assistantships (GSRA and DDA programs); and provide additional expertise supporting competitiveness.

Activities: New Faculty Start-Up Program, seed investments supporting interdisciplinary research, Graduate Student Research Assistantships (GSRA), Doctoral Dissertation Assistantships (DDA), grant writing workshops, external proposal review before submission, writing assistance and funding for travel.

Outcome 1: Hire and retain an increasingly ethnic, racial and disability diverse number of chairs and faculty.

Component	Metric	Annual Benchmarks				
		08-09	09-10	10-11	11-12	12-13
New Faculty Start-Up	Number of new hires	15	15	15	15	15
Faculty Retention	Percentage new retained	100%	100%	90%	90%	90%
Diversity of faculty hires	Number URM & disabled	3	5	5	7	8
New FlexEM hires	Number of FlexEM hires	1	1	-	-	-
New SUNRISE hires	Number of SUNRISE hires	1	1	-	-	-
Tenure-track hires	Number of tenure-track hires	10	10	10	10	10

Outcome 2: Seed investments, faculty professional support and additional graduate students result in competitiveness for large-scale national awards.

Component	Metric	Annual Benchmarks				
		08-09	09-10	10-11	11-12	12-13
Seed investments	Number of awards	4	4	4	-	-
Interdisciplinary efforts	Number publications	10	15	20	15	10
Proposal productivity	Number of proposals	200	220	240	260	240
Award productivity	Funding dollars	$15M	$18M	$20M	$15M	$15M
Publication productivity	Number of publications	140	150	160	160	140
Presentation productivity	Number of presentations	200	225	250	250	250
Jr. faculty productivity	Number awards in 5 years					2 each
Collaborative research	Number of proposals	8	8	8	-	-
Center-type proposals	Number of proposals	-	1	1	1	1
Regional partnerships	Number of partnerships		2	2	2	2
Large-scale center award	Award	-	-	-	-	1
NSF applications	Number of IGERT	1	1	2	1	-
NSF applications	Number of GOAL1	-	-	1	1	-
NSF applications	Number of GK12	-	-	1	-	-

Appendix 4-A. Cyberinfrastructure

CYBER INFRASTRUCTURE GOAL: Increase access to cyberinfrastructure tools and foster a research environment that increasingly engages researchers with virtual communities across the global research community.

Strategies: Increase cyber tools by increasing broadband access, install CAVE visualization to allow faster, more accurate data interpretation, hire staff for computer center support, provide training, and co-sponsor statewide K-20 and tribal college cyberinfrastructure events.

Activities: Purchase and installation of desk top broadband (10 gbps) network, install CAVE in 2008-09, hire staff (two new CI project managers)and graduate research assistants (two at UND and two at NDSU), provide training and support cyber outreach.

Outcome 1: Increase research productivity by strengthening cyber infrastructure at NDSU and UND.

Component	Metric	Annual Benchmarks				
		08-09	09-10	10-11	11-12	12-13
Desktop connectivity	Number of new connections	288	384	288	0	0
Research productivity	All productivity metrics	Double all productivity metrics				

Outcome 2: Increase use of Cyberinfrastructure among K-20 students (including tribal colleges).

Component	Metric	Baseline	Annual Benchmarks				
		2007-08	08-09	09-10	10-11	11-12	12-13
Cyber-outreach	Number of workshops	0	2	2	2	2	2

Appendix 5-A. Broadening Participation

ND EPSCoR RII Project: NATURE
GOAL: Provide a science education pathway for tribal middle school, high school and college students in North Dakota to continue their education in tribal colleges, in baccalaureate institutions and eventually to graduate schools and STEM careers. Strategies: The strategies for attaining this goal are based on NATURE's ten-year successful educational collaboration with the five North Dakota tribal colleges and the two ND research universities, which has focused on strengthening and broadening participation in STEM. The strategies are based on the premise that it is more effective to retain and enhance existing human resources and collaborative structures than to institute new programs. Dr. Davis, the liaison, will actively coordinate with existing UND and NDSU NSF and other grants to promote opportunities for NATURE students and will work with the tribal colleges to apply for funding to expand summer camps to include K-8 (currently 9-12). The NATURE team will work with the external evaluator on restructuring data collection, recording, analysis and reporting. American Indian demographic data will be disaggregated by gender.
Activities: Summer camps for middle school and high school students, summer camps for tribal college students, Sunday academies, the undergraduate research experience and planning sessions wherein the middle/high school teachers learn to utilize new materials, equipment, and hands-on inquiry lessons

Outcome 1: Maintain or increase participation in all NATURE components.

Metric	Component	Baseline	Annual Benchmarks				
		2007-08	08-09	09-10	10-11	11-12	12-13
Total number of participants	Tribal College Summer Camp: Student Track	87	100	125	125	125	125
Total number of participants	Tribal College Summer Camp: Teacher Track	10	10	12	12	12	12
Total number of participants	University Summer Camp: Student Track	15	15	15	15	15	15
Total number of participants	University Summer Camp: Teacher Track	10	10	10	10	10	10
# of students attended <50% of sessions	Sunday Academies	20	20	20	20	20	20
# of students attended > ½ but not all sessions	Sunday Academies	60	70	75	85	85	85
# of students attended all sessions	Sunday Academies	20	20	20	20	20	20
Number of students successfully completed	Undergraduate Research Experience	12	15	18	18	19	20

Outcome 2: Increase the number (and percentage) of NATURE students who transfer from the tribal colleges and then enroll in bachelor's degree STEM majors at four-year universities.

Metric	Tribal College	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Number and percentage of students who transfer & enroll in STEM bachelors degrees	Turtle Mtn CC	6	6	6	7	7	7
	Ft. Berthold CC	2	2	2	2	2	2
	Sitting Bull CC	2	2	2	2	2	2
	Cankdeska Cikana CC	0	1	1	1	1	1
	United Tribes Tech C	0	1	1	2	2	2

Outcome 3: Increase the number of NATURE students who graduate with STEM bachelor's degrees.

Metric	Tribal College	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Number and percentage of students who transferred to a 4-year university and graduated with a STEM major.	Turtle Mtn CC	2	2	2	2	2	2
	Ft. Berthold CC	0	0	1	1	1	1
	Sitting Bull CC	1	1	1	1	1	1
	Cankdeska Cikana CC	0	0	0	0	1	1
	United Tribes Tech C	0	0	0	1	1	1

Outcome 4: Increase the number of NATURE students earning STEM bachelor's degrees who enter the STEM workforce in jobs where they use their degree skills and knowledge.

Metric	Tribal College	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Number and percentage of bachelors STEM majors who enter the STEM workforce	Turtle Mtn CC	2	2	2	2	2	2
	Ft. Berthold CC	0	0	1	1	1	1
	Sitting Bull CC	1	1	1	1	1	1
	Cankdeska Cikana CC	0	0	0	0	1	1
	United Tribes Tech C	0	0	0	1	1	1

Outcome 5: Increase the number of NATURE students who graduate with STEM masters and doctorate degrees.

Metric	Tribal College	Baseline 2007-08	Annual Benchmarks 08-09	09-10	10-11	11-12	12-13
Number of students awarded graduate degrees	Turtle Mtn CC	0	0	0	0	1	1
	Ft. Berthold CC	0	0	0	0	1	1
	Sitting Bull CC	0	0	0	1	1	1
	Cankdeska Cikana CC	0	0	0	0	0	0
	United Tribes Tech C	0	0	0	0	0	0

Outcome 6: Enhance and support the research infrastructure in the five tribal colleges.

Component	Metric	Baseline	Annual Benchmarks				
		2007-08	08-09	09-10	10-11	11-12	12-13
Strategic analysis-cyber	Step 1. Facilitate TCUs to partner with ND IT Dept, Northern Tier Network, NDSU and UND	0	In progress Joint Economic Stimulus Proposal				
	Step 2. Engage TCUs to develop a survey of CI needs or discover if they have all ready done this						
Strategic analysis-STEM faculty development	Step 1. Engage TCUs to develop a survey of CI needs or discover if they have all ready done this	0	0	1			
EPSCoR Seed funding		0	0	1			
BRIDGE award	Identify and promote applicants		Provide pre-proposal reviews	1	1		
CAREER award	Identify and promote applicants		Provide pre-proposal reviews	0	1		

Appendix 6-A. Private Sector Partnerships

PRIVATE SECTOR PARTNERSHIPS GOAL: Build private sector partnerships to support strong, sustainable progress in S&T in North Dakota.

Strategies: The Product Design Center (PDC), the Plus Experience (TPE), Students in Technology Transfer And Research (STTAR), and Faculty in Technology Transfer (FITT).

Activities: Hire consultants to advise researchers on how to enhance commercial potential; carry out the activities recommended by the consultants; pay some of the costs of protecting intellectual property and early-stage marketing; and provide training as needed.

Outcome 1: Increased number of partnerships and new companies.

Component	Metric	Annual Benchmarks				
		08-09	09-10	10-11	11-12	12-13
Expanded enterprise	Company Partnerships	15	18	20	18	18
	New Product Research Investigations	3	4	5	3	3
	# of new start-ups		1	1	1	1

Appendix B

Appendix 7-B. Strategic Planning Agenda

AGENDA

North Dakota EPSCoR Strategic Planning Meeting
NSF Research Infrastructure Improvement Award
January 29, 2009
Research 1, Room 202, NDSU, Fargo

8:00-8:30 am **Continental Breakfast**

8:30-8:40 **Welcome and Introductions**
Philip Boudjouk, Vice President for Research, Creative Activities and Technology Transfer, North Dakota State University
Barry Milavetz, Interim Vice President for Research and Economic Development, University of North Dakota

8:40-8:50 **Perspectives from the National Science Foundation (NSF)**
Maija Kukla, ND Program Director, NSF EPSCoR
Arlene Garrison, Program Director, NSF EPSCoR

8:50-9:00 **The Big Picture: EPSCoR in the State and National S&T Enterprise**
(Role of EPSCoR within the broader state and national S&T enterprise, significance of opportunity)
Thomas N. Taylor, Member, National Science Board; Professor, University of Kansas

9:00-9:10 **Strategic Planning Context**
(Charge to the group, outline of expectations and summary outcomes)
Carl A. Batt, Liberty Hyde Bailey Professor, Cornell University

9:10-9:50 **Science Overview: SUNRISE and FlexEM**
Mark Hoffmann, Theme Leader; Chester Fritz Professor & Chair, University of North Dakota
Doug Schulz, Sr. Research Scientist, Center for Nanoscale Science and Engineering, North Dakota State University

9:50-10:00 **Cyberinfrastructure**
Overview:
Mark Hoffmann, Co-Project Director, ND EPSCoR, University of North Dakota
David Givers, Co-Project Director, ND EPSCoR, North Dakota State University
Implementation:
Bonnie Neas, Vice President, Information Technology, North Dakota State University
Emmanuel Grant, Center for High Performance Computing, University of North Dakota

10:20-10:35 **BREAK**

10:35-12:00 **Strategic Planning Discussion**
Facilitated by **Carl A. Batt**, Liberty Hyde Bailey Professor, Cornell University
Visioning

- *How might the current configuration for this RII-funded entity evolve?*
- *Future of SUNRISE and FlexEM*
- *How does the sum of our parts equal something greater?*
- *What are the challenges especially across institutions?*
- *Sustainability-How are we going to position ourselves to be sustained as an entity moving forward? Vision-evolving into a center? Funding agencies? Mechanisms? Management? Other facets*

What are the key elements for the strategic plan that will make the effort cohesive, efficient and greater than the sum of the individuals? How are we going to measure productivity/outcomes? Strategic Implementation Plan Development? Milestones? Metrics?

12:00-1:00 **LUNCH (Buffet)**

1:00-1:20 pm **The Tribal Colleges University Partnership**
Laurel Vermillion, President, Sitting Bull College

1:20-1:40 **Broadening Participation:**
NATURE (Nurturing American Tribal Undergraduate Research and Education)
Carol Davis, Tribal Colleges Liaison Manager, ND EPSCoR
G. Padmanabhan, NATURE Coordinator; Professor, North Dakota State University

1:40-1:50 **WISE *(Women In Science and Education)***
David Givers, Co-Project Director, North Dakota State University
Mark Hoffmann, Co-Project Director, University of North Dakota

1:50-2:10 **Infrastructure Investments:**
New Faculty Start-Up
David Givers, Co-Project Director, ND EPSCoR, North Dakota State University
Mark Hoffmann, Co-Project Director, ND EPSCoR, University of North Dakota
Technology Transfer STTAR (Students in Technology Transfer And Research)
Elizabeth Jung, Program Coordinator, ND EPSCoR, North Dakota State University

Product Design Center (PDC)
Philip Boudjouk, Vice President, Research, Creative Activities and Technology Transfer North Dakota State University

Outreach Communication
Carol Renner, RCATT Communications Manager, North Dakota State University
Mark Hoffmann, Asst. Vice President, Research and Economic Development, University of North Dakota

2:10-2:55 **Challenges**
In each discussion, we will brainstorm ideas and look to leverage activities. (Leadership, current activities and new initiatives or opportunities for leveraging existing ones will be considered.)
Co-Facilitated by **Carl A. Batt**, Liberty Hyde Bailey Professor, Cornell University **and** **Thomas N. Taylor**, National Science Board; Professor, University of Kansas

2:55-3:25 **Evaluation** ***(Measuring performance and effectiveness formatively and summatively)***
Rose Shaw, External Evaluator, Metrica, Greeley, CO.

3:25-3:40 **BREAK**

3:40-4:10 **Integration of Research and Education (Group Discussion)**
Maximizing the impact of the various elements, enhancing quality of STEM instruction and graduates
Co-Facilitated by **Carl A. Batt,** Liberty Hyde Bailey Professor, Cornell University **and** **Thomas N. Taylor,** National Science Board; Professor, University of Kansas

4:10 **Summary**
Report back on outcomes. Action items. NB: Strategic plan needs to be finalized and sent to NSF by 90 days after the planning meeting (April 29, 2009).
Carl A. Batt, Liberty Hyde Bailey Professor, Cornell University

4:40 **Closing Remarks and Next Steps**
Philip Boudjouk, Vice President for Research, Creative Activities and Transfer, North Dakota State University
Barry Milavetz, Interim Vice President for Research, University of North Dakota

Appendix 8-B. Participant List

Participant List January 29, 2009

Strategic Planning Meeting

ND EPSCoR

Philip Boudjouk, Co-Chair, ND EPSCoR/V-P Research, Creative Activities & Technology Transfer, NDSU

Barry Milavetz, Co-Chair, ND EPSCoR/Interim V-P Research and Economic Development, UND

David Givers, Co-Project Director, NDSU office

Mark Hoffmann, Co-Project Director, UND office, Asst. V-P Research and Economic Development, SUNRISE PI

Carol Davis, Tribal Colleges Liaison Manager, ND EPSCoR

Elizabeth Jung, Program Coordinator, NDSU office

Cathy Lerud, Program Assistant, UND office

Laura Slicer, Business Officer, RCATT NDSU/ ND EPSCoR Program Assistant

G. Padmanabman, NATURE Coordinator

Doug Schulz, FlexEM PI

Emmanuel Grant, Center for High Performance Computing, UND

Bonnie Neas, VP Information Technology, NDSU

Marc Wallman, Director ITS Infrastructure Services, NDSU

Greg Wettstein, Research Computing Work Group Leader, NDSU

Laurel Vermillion, President, Sitting Bull College

Jonathan Geiger, State Steering Com, UND

Malcolm Butler, State Steering Com, NDSU

Kalpana Katti, State Steering Com, NDSU

Shahryar Kianian, State Steering Com, NDSU

Evguenii Kozliak, Steering Com Alternate, UND

National Science Foundation

Maija Kukla, ND Program Director, ND, NSF
Arlene Garrison, Program Director, NSF

External Consultants

Carl A. Batt, Liberty Hyde Bailey Professor, Cornell University

Rose Shaw, External Evaluator, Metrica, Greeley, CO

Thomas N. Taylor, Member, National Science Board; Professor, University of Kansas