EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH

North Dakota EPSCoR

Presentation to Interim Higher Education Committee

May 15, 2012

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Where is North Dakota?

- **US Chamber of Commerce:**
  - "North Dakota ranks No. 1 for job growth... investments in R&D infrastructure are beginning to pay off as the state is the fastest growing in science, technology, engineering and mathematics job growth"
- **Beacon Hill Report:**
  - 1st in USA in growth (31%) of STEM jobs 2002-2009
  - 2nd in USA in % increase (160%) of research funds from the National Science Foundation
  - 3rd in USA in Federal R&D Obligations per capita, a 26% increase over 2003-07
  - 3rd in USA in University R&D/$1000 Gross State Product

Consistent with North Dakota State Goals

NORTH DAKOTA UNIVERSITY SYSTEM

North Dakota DEPARTMENT OF COMMERCE

State Board of Higher Education Strategic Plan Priorities

- Agriculture
- Health Care
- Energy
- Life Sciences
- Advanced Technology

State Dept. of Commerce Target Industries

- Advanced manufacturing
- Energy
- Value-added agriculture
- Technology-based business
- Tourism

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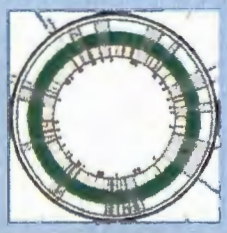
Strategic Plan



Transformative Research
Flex-EM and SUNRISE

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

Cyberinfrastructure
Network, HPC

Technology Based Economic Development
STTAR, Product Design Center, Plus Program

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Nurturing American Tribal Undergraduate Research and Education (NATURE)

ND Universities and Tribal Colleges

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Value Added

- State of ND has provided cash to supplement NSF $$ each biennium since 1986; FY12-13 appropriation is $7M

- Complements state Centers of Excellence Program –SUNRISE Bioproducts COE, Advanced Manufacturing (electronics)

EPSCoR Tools

- **Infrastructure and capacity development through research clusters with leadership shared between UND and NDSU**
- ❖ Supplement institutional new faculty start-up packages at UND and NDSU
- ❖ Equipment grants
- ❖ Seed grants to start new research
- ❖ AURA program—funds undergrad summer research
- ❖ DDA grants—support graduate students' dissertation work
- Outreach to Native American students

❖ Denotes competitively awarded

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- ***Return on Investment = 7.8:1***
  - ND Cash Investment 1986 -2010 = $39.5M
  - Total External Awards = $306.8 M

- **The key is infrastructure: when our faculty have the facilities and the support for students to work in their labs, they are successful.**

Success Stories

Dr. Steven Ralph

New faculty start-up funding in FY08--$134K from EPSCoR
Other EPSCoR funds for equipment, students ~$55K

Received NSF grant in FY09 $677K
Received undergraduate research supplements of $88K,
more pending for his mentoring of undergrad research
Return on Investment: 404%
Jessica Greer, an undergrad in Dr. Ralph's lab, received prestigious national Goldwater Scholarship based on her work with him.

Success Stories

Dr. Alena Kubátová

New faculty startup funds in FY06 $116K from EPSCoR
Other EPSCoR funds for students, equipment, supplies
FY07-12 $137K

Prestigious NSF CAREER Award 2008 for $414K 2008
Grants total $1,057,191 including $598K for undergrads into STEM
21 publications, 1 patent
Return on Investment: 417%

Led first-ever UND application for NSF CCI grant for $1.75M; invited to submit full proposal

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Success Stories

Sustainable Energy Research Initiative and Supporting Education

- Conduct research to solve energy-related problems
- Develop sustainable energy options to improve economic development in ND
- Increase North Dakota research capabilities in sustainable energy
- Produce graduates to develop sustainable energy that transfers into commercial products

31 Faculty in 14 Departments at 4 North Dakota Institutions

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Success Stories

$10.7 M in Total NSF and DOE EPSCoR funding FY04-13

>$28M in *additional* external funding from 47 funding sources including NSF, DOE, DOD, USDA, private sector, and ND Center of Excellence

Return on investment: 280%

> 5 patent submissions; licensing talks underway with multiple possible investors, one a UND grad

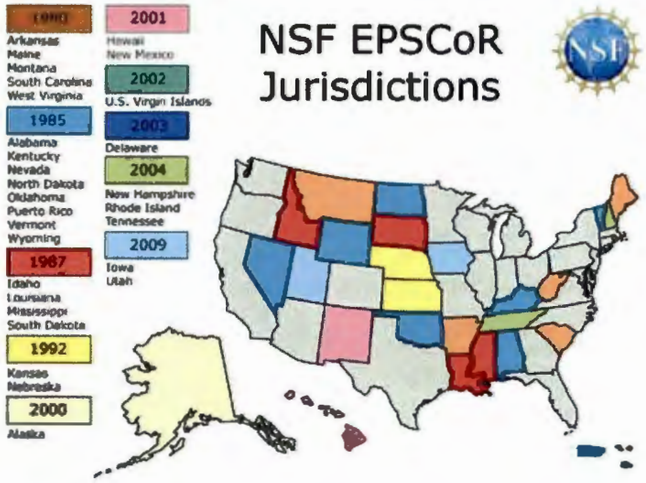
The Bottom Line

- **EPSCoR is a huge success for North Dakota with huge Returns on Investment**
- **Given good facilities and equipment plus support for students to work in their labs, our faculty performance is outstanding**

National Recognition

• North Dakota's unique convergence of university, state, federal and private sector collaborations resulting in economic development as recognized by U.S. Department of Commerce. *http://www.iedconline.org/EDAmerica/Summer2006/NDSU.html*

• North Dakota ranks No. 1 for job growth, says the U.S. Chamber of Commerce, noting "investments in R&D infrastructure are beginning to pay off as the state is the fastest growing in science, technology, engineering and mathematics job growth." (May 2010) *http://ncf.uschamber.com/enterprising-states/*



NSF EPSCoR Jurisdictional Map
Courtesy of National Science Foundation

North Dakota Successes Include:

• **1st** in state competitiveness factors based on academic R&D, science/engineering grad students and degrees awarded (Beacon Hill-2010)

• In technology factors, North Dakota jumped from **36th** in 2001 to **13th** in 2010 (Beacon Hill Institute)

• **3rd** in the nation Fed R&D Obligations per Capita: 26% increase 2003-07

• **3rd** *in the* nation for University R&D/$1,000 of Gross State Product

• **2nd** in the nation in percentage change 1986 -2005, ND's share of National Science Foundation research funds increased by **160%**

• **1st** in growth (**31%** increase) of science, technology, engineering and math jobs 2002–2009

• Facilitated recruitment of over **200 new faculty researchers** to the state

• Provided research opportunities for over **2,100 students** since 1992

• Six federal agencies partnered with ND EPSCoR: NSF, NIH, NASA, EPA, DOE, and DoD

Sources: http://www.ssti.org/Digest/Tables/042110t.htm. http://www.nsf.gov/statistics/nsf10311/pdf/nsf10311.pdf. http://www.ssti.org/Digest/Tables/021308t.htm. http://www.nsf.gov/statistics/showpub.cfm?TopID=8&SubID=1. http://www.beaconhill.org/CompetitivenessHomePage.html. http://ncf.uschamber.com/enterprising-states/http://

North Dakota Research Highlights

• NSF EPSCoR funded researchers are: developing nanomaterials to enable flexible electronic technologies; exploring use of nanocatalysts to convert oil seed crops into commercially important chemicals currently derived from petroleum; which was the subject of a recent workshop; developing new user-friendly cellular phone web browsers.

• NIH EPSCoR/IDeA funded research centers are investigating: *Neural mechanisms* and functional significance of visual perception, visual attention, visual cognition and action; *Pathophysiological* mechanisms and neurodegenerative disease such as alzheimers and epilepsy; *Proteases*, key biological players, impact several diseases including cancer, arthritis, autoimmune diseases, diabetes, and asthma.

• DOE EPSCoR funded researchers are increasing understanding of toxic trace elements transport properties during the initial stages of coal pyrolysis. This knowledge assists in development of oxy-coal combustion systems and abatement technologies for coal combustion and gasification systems. Advancing the science and technology of liquid silanes for use in photovoltaic devices; developing new classes of nylons based on crop oils.

• NASA EPSCoR researchers are developing an inflatable Lunar/Mars habitat prototype, a pressurized rover, and surface space suits, to study ways to establish modular bases on planetary surfaces; global modeling of clouds and radiation budgets; and a combined experimental and computational study of variable speed turbines.

An Important S&T Resource for the Nation

Percent of:
U.S. Population – 22%
Employed S&E Doctorate Holders –16%
S&E Higher Education Degrees –19%
S&E Gradute Students –17%
High-Tech-Establishments –14%
GDP–14.5%
Federal Research Funding –10%
Source: National Science Foundation

EPSCoR/IDeA: Making A Difference

Since the inception of EPSCoR/IDeA, the success of the programs is clear. At the National Science Foundation, for example, the percentage growth in proposals submitted and awards won by EPSCoR researchers exceeds the percentages from non-EPSCoR states. The National Institute of Health's IDeA program reports similar progress. But more work remains. The uneven distribution of federal research and development funds persists. Just five states received 40 percent of these funds, while the 25 states and two territories of EPSCoR/IDeA states received approximately 10 percent of federal research funding. Over the past decade, the scientific talent and the research infrastructure in EPSCoR/IDeA jurisdictions have undergone enormous change. These states are poised to do more for the nation.

Source: EPSCoR/IDeA Foundation

NSF EPSCoR 2011
Annual Conference

North Dakota Student Posters

Dereck Stonefish, NDSU

Migratory Routes and Winter Roosts of Male Red-Winged Blackbirds and Yellow-Headed Blackbirds Nesting in North Dakota

DERECK STONEFISH1, GEORGE LINZ2, WILLIAM BLEIER1, JEFFREY HOMAN2, AND ERIN GILLAM1
1Department of Biological Sciences, NDSU, Fargo, ND 58108
2USDA, Wildlife Services, National Wildlife Research Center, Bismarck, ND 58501

Northern blackbird populations are migratory, wintering in the southern United States and Mexico and breeding in the northern United States and Canada. These specific populations cause extensive crop damage to sunflowers and corn in the northern states. Blackbirds are plentiful, and relatively easy to capture and recapture and thus are good species for developing base line models that can be used to track affects of climate change on birds. Global climate change is expected to affect these populations' migratory patterns and breeding strategies. If they can be tracked to their wintering grounds, and stop over sites on their migratory routes then Global Climate change effects can be assessed as to how these migratory populations are impacted. Using light sensitive Geolocators to track the birds to their wintering grounds will be important data for the management and control of these populations.

Patrick K. Tamukong, UND

GVVPT2 Multireference Perturbation Theory Description of Diatomic Scandium, Chromium, & Manganese

PATRICK K. TAMUKONG, DANIEL THEIS, YURIY G. KHAIT, & MARK R. HOFFMANN
Chemistry Department, University of North Dakota, Grand Forks, North Dakota 58202

With a simple valence bond model, a straightforward zero-order Hamiltonian, and the use of moderate sized Dunning type correlation consistent basis sets (cc-pVTZ, aug-cc-pVTZ, and cc-pVQZ), the second order Generalized Van Vleck Perturbation Theory (GVVPT2) method produces potential curves and spectroscopic constants close to experimental results. In spite of multiple quasi-degeneracies (particularly for the cases of Sc_2 and Mn_2), the GVVPT2 potential energy surfaces (PES) are smooth with no discontinuities for both ground and excited electronic states of Sc_2, Cr_2, and Mn_2. Since these molecules have been identified as ones that widely used perturbative methods are inadequate for describing well, due to intruder state problems, unless shift parameters are introduced that can obfuscate the physics, this study suggests that the conclusion about the adequacy of multireference perturbation theory be re-evaluated.

CONTACT INFORMATION
ND EPSCoR
www.ndepscor.nodak.edu

NDSU
1735 NDSU Res Pk Dr
Dept 4200, PO Box 6050
Fargo, ND 58108-6050
701.231.8400

UND
Twamley Hall Rm 415
264 Centennial Dr Stop 7093
Grand Forks, ND 58202-7093
701.777.2462

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