

Overview of the Energy & Environmental Research Center (EERC)

**Energy Development and Transmission Committee (EDTC) Meeting
EERC
October 16, 2014**

**Thomas A. Erickson
Interim Director**

The banner features a dark blue background with a subtle pattern of text including "RESEARCH AND DEVELOPMENT PROGRAMS, OPPORTUNITIES FOR TECHNOLOGY COMMERCIALIZATION", "WORLD-CLASS CENTERS OF EXCELLENCE", "ENVIRONMENTAL TECHNOLOGIES TO PROTECT AND CLEAN OUR AIR, WATER, AND SOIL", and "INDUSTRY, GOVERNMENT, AND THE RESEARCH COMMUNITY".

 **EERC**
Energy & Environmental Research Center®
Putting Research into Practice

Energy & Environmental Research Center (EERC)

 THE UNIVERSITY OF NORTH DAKOTA

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RESEARCH AND DEVELOPMENT PROGRAMS, OPPORTUNITIES FOR TECHNOLOGY COMMERCIALIZATION

Introduction

WORLD-CLASS CENTERS OF EXCELLENCE ENVIRONMENTAL TECHNOLOGIES

- Introduction to the EERC
- EERC trends
- Principles of success
- North Dakota's opportunity

A World-Renowned Research Center



The EERC is recognized as one of the world's leading developers of:

- Cleaner, more efficient energy technologies to guarantee clean, more reliable energy supplies for the United States and the world.
- Environmental technologies to protect and clean our air, water, and soil.

Worldwide Clients Since 1983

**TOTAL
CLIENTS:** **1285**
more than



Client Specs

Private corporations: 963
International market: 167
Governmental clients: 101
Academia: 56

Strategic Expertise

The EERC provides practical, cost-effective solutions to today's most critical energy and environmental issues and challenges:

- Oil exploration and production technologies
- Clean coal technologies
- Emission control – SO_x, NO_x, air toxics, fine particulate, and CO₂
- Mercury measurement and control
- CO₂ capture and sequestration
- Global climate change
- Energy and water sustainability
- Distributed power generation – various fuels
- Hydrogen technologies
- Natural gas production and utilization technologies
- Alternative fuels – ethanol, biodiesel, 100% renewable diesel and jet, including strategic fuels for the military
- Biomass utilization
- Water management
- Waste utilization
- Contaminant cleanup
- Advanced analytical/extraction technologies

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PROGRAMS, OPPORTUNITIES FOR
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World-Renowned Programs

CENTERS OF EXCELLENCE

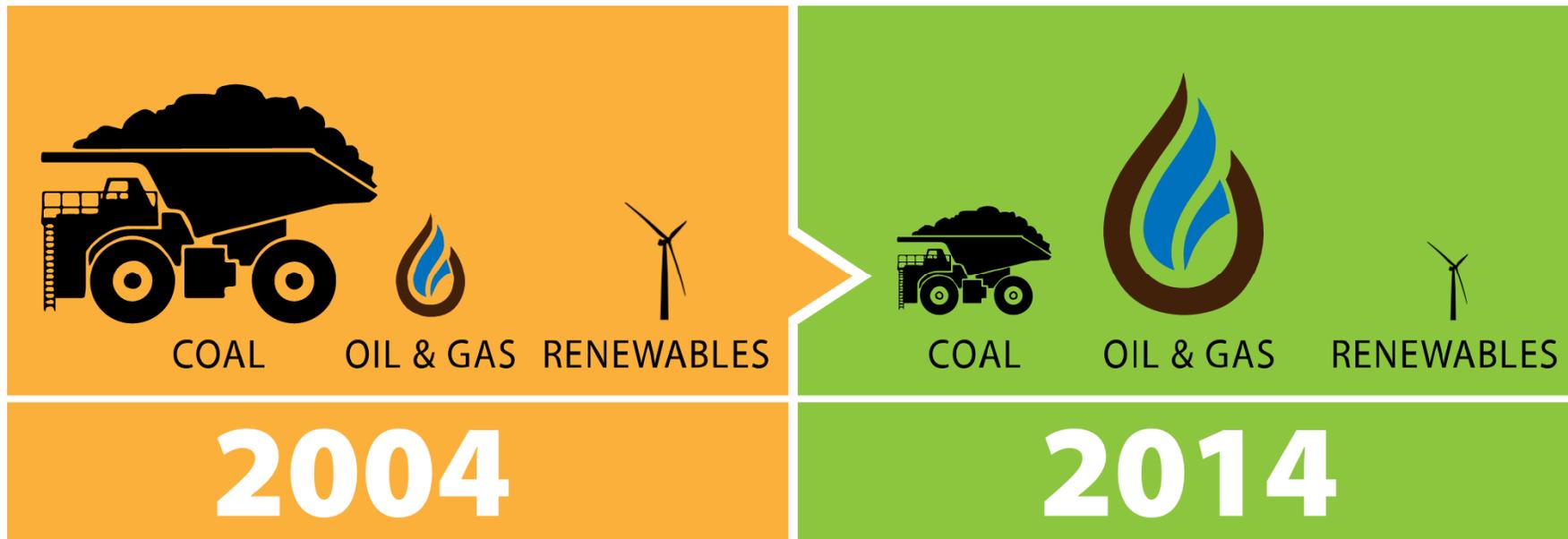
CENTERS OF EXCELLENCE
ENVIRONMENTAL TECHNOLOGIES





EERC Trends

Trends

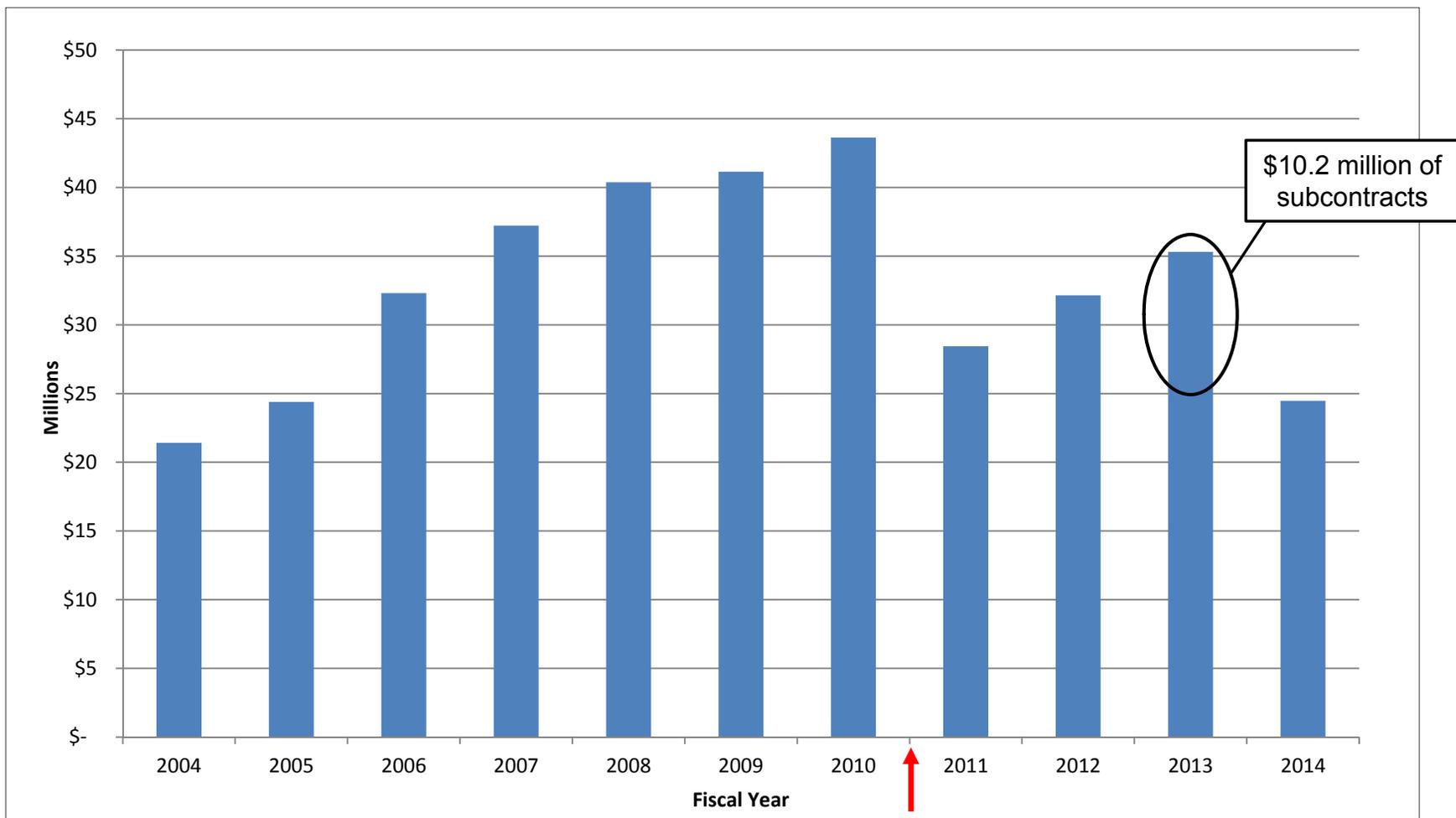


Transitioned from coal being our largest focus area to oil and gas.

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Awarded \$

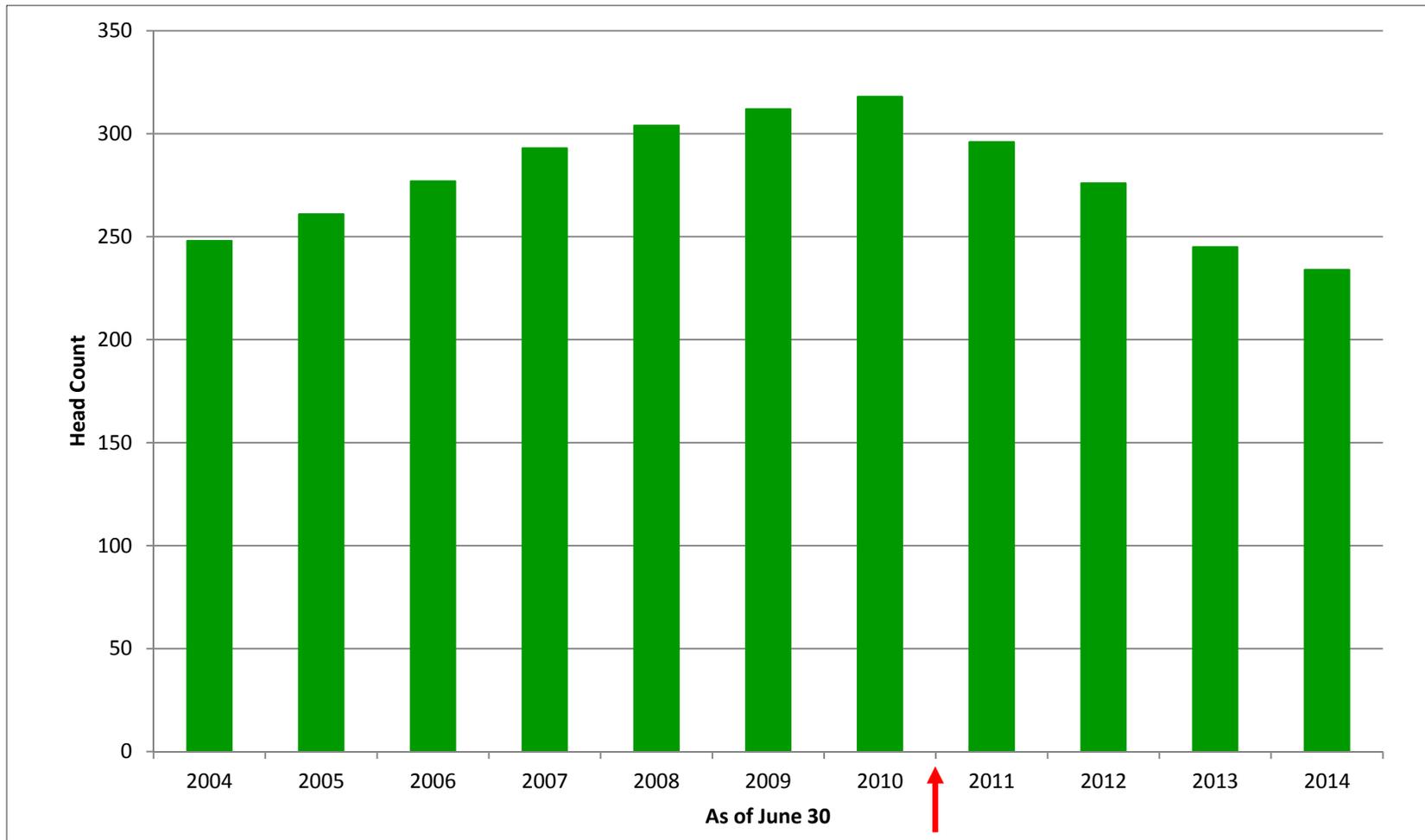
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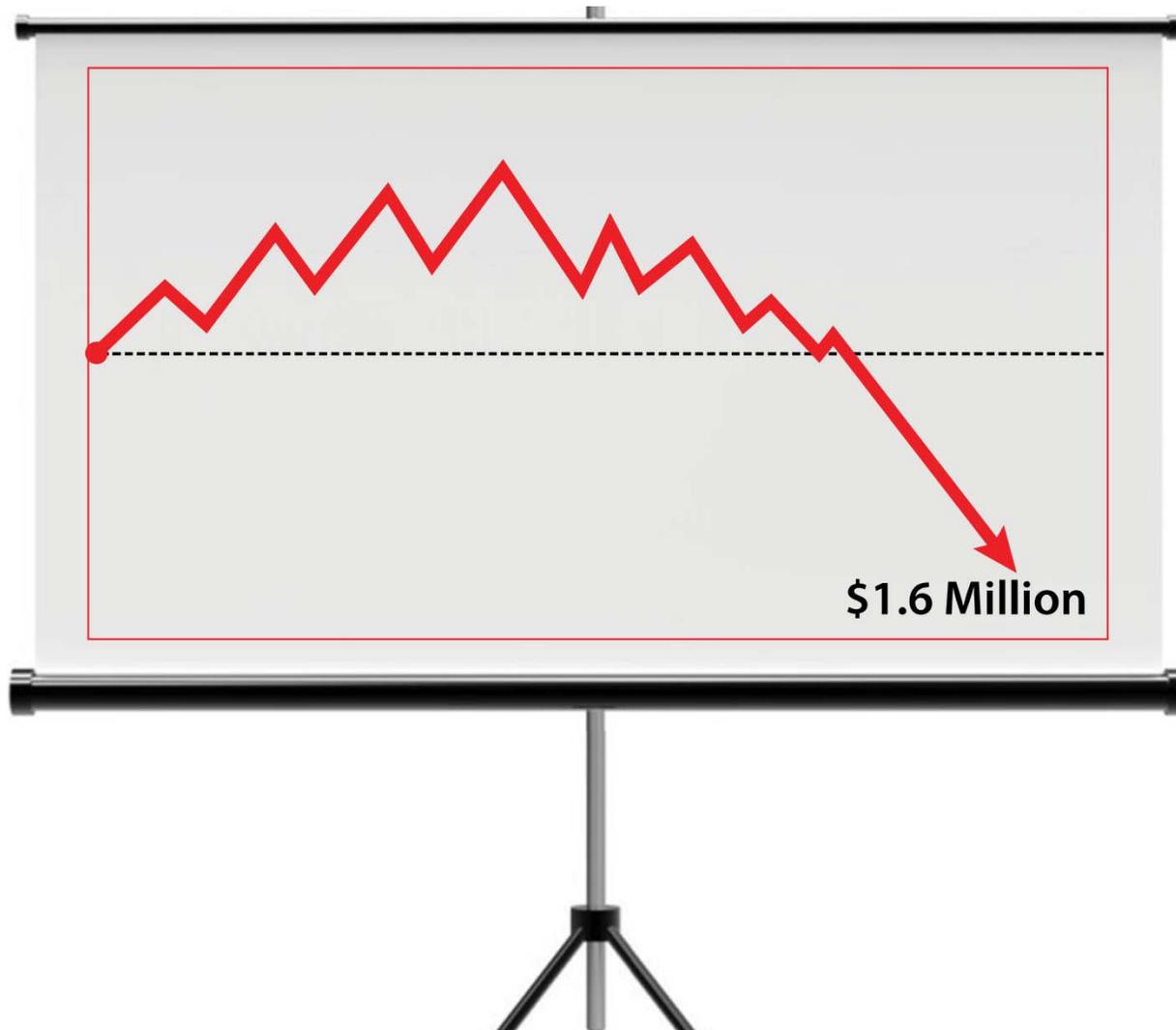
World-Class Employees

WORLD-CLASS CENTERS OF EXCELLENCE ENVIRONMENTAL TECHNOLOGIES



Note: The EERC currently employs 20 students.

Financial Fallout: Reverse Economy of Scale



**Now – \$1.6
Million
Debt in
F&A**

**(Facilities and
Administrative
costs)**

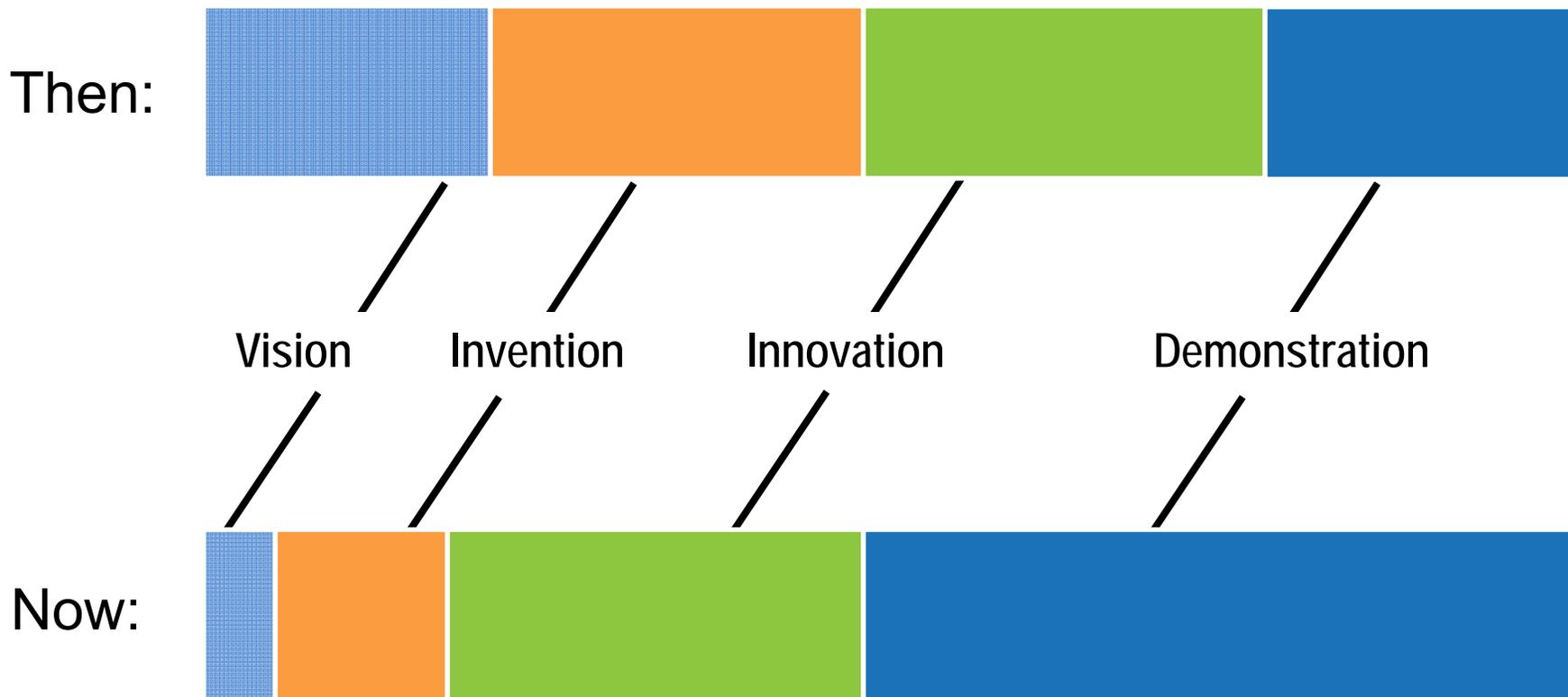
Greatest Change

- Then – providing national vision, inventing new technologies, and leading the development and demonstration of new, innovative technologies.
- Now – more commonly following funding opportunities (i.e., chasing money and chasing industry partners).

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Loss of Earmarks

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EERC Principles of Success

Effective partnerships

Global solutions

Partnerships

- State of North Dakota
- Industry
- Federal agencies
- UND

Top 8 EERC Projects

	North Dakota State Partner		Project Total
Plains CO ₂ Reduction Partnership – Phases II and III	North Dakota Industrial Commission (NDIC)	\$ 4,120,000	\$ 87,465,328*
	North Dakota Department of Commerce	\$ 45,000	
Program to Determine the Uniqueness of Three Forks, Optimal Density in Bakken, and Optimize Bakken Production	NDIC	\$ 8,554,500	\$ 10,804,500*
Design, Construction, and Operation of a Novel Pilot-Scale Biomass Gasification System			\$ 6,460,904
CC-2.18 – Advancing CO ₂ Capture Technology: Partnership for CO ₂ Capture (PCO ₂ C) Phase III	NDIC	\$ 500,000	\$ 3,849,987
Systems Testing in Support of Liquid Fuels Development for Military Applications			\$ 3,128,785
Scalable, Automated, Semipermanent Seismic Method for Detecting CO ₂ Plume Extent During Geologic CO ₂ Injection			\$ 2,400,000
Design, Scale-Up, and Testing of Advanced Palladium Membranes – Phase II			\$ 1,589,608
Thermal Catalytic Syngas Cleanup for High-Efficiency Waste-to-Energy Converters			\$ 1,355,650

* - Also have very significant in-kind cost-share

Leveraging Funding for the State of North Dakota



Lignite Energy Council Funding

Project Total
\$117,336,427



Industry Partnerships

Plains CO₂ Reduction (PCOR) Partnership Program

PCOR Partnership 2003 – Present														

Partnership for CO₂ Capture (PCO₂C) Program

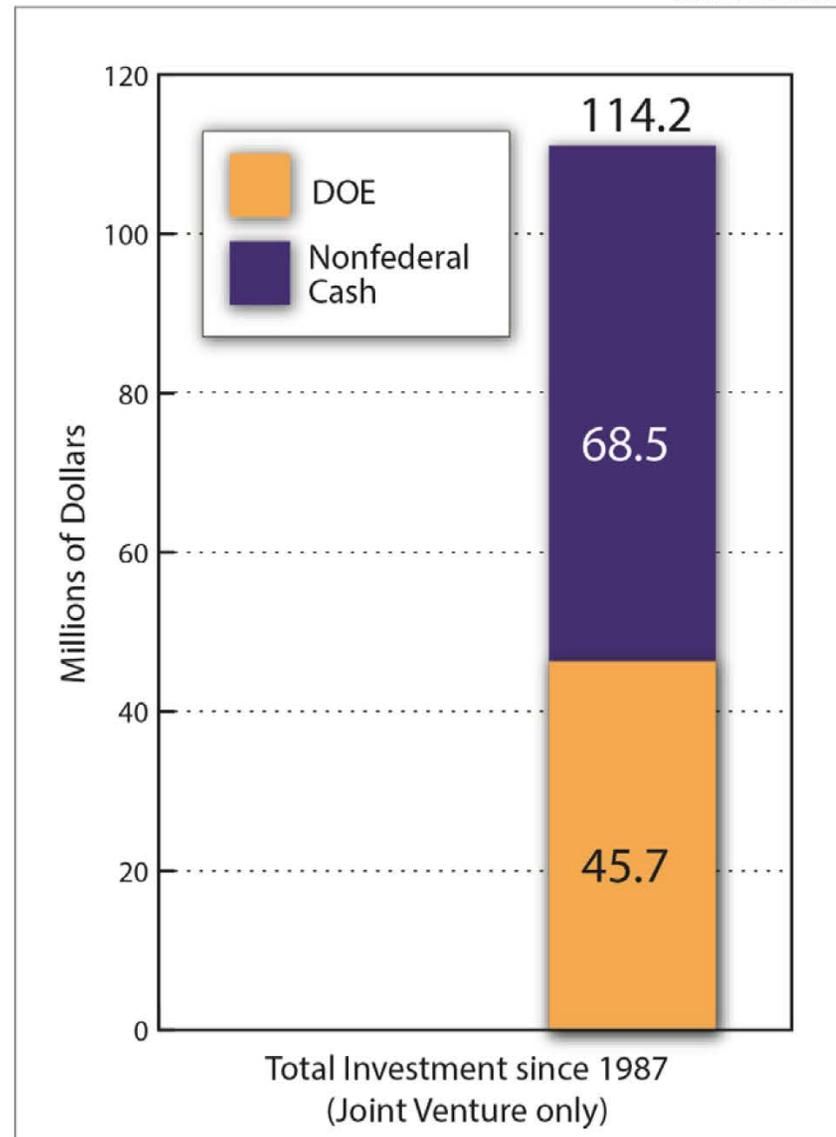
PCO₂C Partners Phases I & II		 EERC Energy & Environmental Research Center® Putting Research into Practice UNIVERSITY OF NORTH DAKOTA	 NETL NATIONAL ENERGY TECHNOLOGY LABORATORY	 Arthur J. Gallagher & Co.	 ATCO Power	 AVISTA	 BAKER HUGHES
 BASIN ELECTRIC POWER COOPERATIVE A Touchstone Energy® Cooperative	 BLACK & VEATCH	 bp	 Cansolv	 Chevron	 ConocoPhillips	 Constellation Energy®	
C-QUEST	 eni	 GE	 HITACHI Inspire the Next	 HUNTSMAN	 LIGNITE Energy COUNCIL	 metso Expect results	 MIDWEST GENERATION An EDISON INTERNATIONAL™ Company
 minnesota power	 Nebraska Public Power District Always there when you need us	 Industrial Commission of North Dakota Lignite Research, Development and Marketing Program	 NorthWestern Energy	 PACIFICORP A MIDAMERICA ENERGY HOLDINGS COMPANY	 PETROBRAS	 Portland General Electric	
 ppl	 PSE PUGET SOUND ENERGY	 SaskPower	 Shell Canada Limited	State of Wyoming Clean Coal Technology Fund	 SULZER	 SUNCOR ENERGY	 TransAlta™
PCO₂C Partners Phase III		 EERC Energy & Environmental Research Center® Putting Research into Practice UNIVERSITY OF NORTH DAKOTA	 NETL NATIONAL ENERGY TECHNOLOGY LABORATORY	 BASIN ELECTRIC POWER COOPERATIVE A Touchstone Energy® Cooperative	 CO ₂ SOLUTIONS	 KCRC	
 MP	 Nebraska Public Power District Always there when you need us	 Industrial Commission of North Dakota Lignite Research, Development and Marketing Program	 ppl	 Shell Canada Limited	 Tri-Mer CORPORATION		

Federal Partnerships

- Over \$14 million in annually federally directed funding (U.S. Department of Energy [DOE], Environmental Protection Agency, and Department of Defense) reduced to zero.
- Very strong DOE partnership remains, but focus is shifted from developing and advancing the technologies of the future to innovation and demonstration of industry technologies (when funding opportunities are available).

Prior Leveraging of Federal Funding

EERC JR19887A12.AI



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UND Collaboration

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NORTH DAKOTA.
COLLEGE OF ENGINEERING & MINES

 UNIVERSITY OF
NORTH DAKOTA.
COLLEGE OF ENGINEERING & MINES
INSTITUTE FOR ENERGY STUDIES

Harold Hamm School of
Geology & Geological Engineering

 UNIVERSITY OF
NORTH DAKOTA.
JOHN D. ODEGARD SCHOOL OF AEROSPACE SCIENCES

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Global Solutions



BAKKEN DEVELOPMENT



POWER PLANT OF THE FUTURE



MERCURY CONTROL



WATER-SAVING COOLING TECHNOLOGIES



CARBON CAPTURE AND SEQUESTRATION



EMISSION CONTROL

All Eyes Are on North Dakota

We are world leaders because we capitalize on our opportunities.



NBC NEWS HOME TOP VIDEOS ONGOING: EBOLA VIRUS OUTBREAK MICHAEL BROWN SHOOTING
U.S. WORLD LOCAL POLITICS HEALTH TECH SCIENCE POP CULTURE BUSINESS INVESTIGATIONS SPORTS MORE

Highway to Riches: Oil Boom Transforms Prairies of North Dakota

President Theodore Roosevelt once came to North Dakota's Badlands to find solitude and solace amid "desolate, grim beauty." But Roosevelt's Dakota is barely visible today.

The area's oil boom has resulted in an infrastructure-building frenzy as the rush for jobs and oil demand roads, homes, food trucks and stores. The epicenter is a 45-mile stretch of U.S. Route 85 between the Williston and Walford City. Once a sleepy two-lane road across the lonely prairie, it's being transformed into a lane highway with bypasses cutting around towns. In the spring and summer, oil patch roadwork slows to a trickle akin to a major metropolis' rush hour.



The New York Times

STATED IN PLAY: As Energy Boom Ends, a Political Identity Crisis in Alaska

ADVERTISING: Cascadian Farm 'Bee Friendlier' Effort Enlists Public to Help Protect...

North Dakota Hits Milestone in Oil Production

By THE ASSOCIATED PRESS JUNE 17, 2014

North Dakota is now producing a million barrels of oil a day, with a large part of the credit going to the rich Bakken shale formation in the western part of the state. The state's Department of Mineral Resources on Tuesday released the April production numbers that show the oil fields' production level. In March, the state produced 977,000 barrels a day. The director of the department, Lynn D. Helms, says only Texas, Alaska and California have also reached a million barrels a day. The Bakken and the Three Forks formation below it account for the vast majority of North Dakota's oil production.

FROM THE DIRECTOR OF DALLAS BUYERS CLUB

A version of this brief appears in print on June 18, 2014, on page B2 of the New York edition with the headline: North Dakota Hits Milestone in Oil Production.
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North Dakota Challenges

The challenges we face moving forward today will decide the future of North Dakota and will affect the world.



“North Dakota Derailment Shows Dark Side of America’s Oil Boom” – *Time Magazine*



“Exclusive: Bakken flaring burns more than \$100 million a month” – Reuters



“North Dakota’s Latest Fracking Problem: Bakken Shale Oil Drillers Are Forced to Burn Off Excess Gas” – *The Wall Street Journal*

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WORLD-**North Dakota Opportunities**
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The best is still in front of us

IF

we first **address** the current challenges
and **create and embrace** future
opportunities.

Path Forward

- The state of North Dakota needs to invest in the production and development of energy resources similar to how it built on the incredible agricultural resources of North Dakota (i.e., No. 1 in 13 ag commodities):
 - Not focused on following the money but, rather, focused on serving the needs of the state
 - ◆ Addressing today's challenges – ***quickly***
 - ◆ Advancing tomorrow's opportunities – ***today***
 - Complement, not replace, the Lignite Research Council, the Oil and Gas Research Council, and the Renewable Energy Council programs

Successful Program Will Lead to

- Movement
- Momentum
- Collaboration
- Invention
- Innovation
- Educated *and experienced* employees
- Financial leveraging of state resources
- Forward-thinking policies
-

Successful Program Will Lead to

- Next-generation coal facility(ies) being built in the state of North Dakota.
- Recoverable oil from the Bakken growing by 100%, 200%, 300% or more, with a smaller environmental footprint.
- Existing power plants in North Dakota continuing to produce economical, reliable, environmentally responsible electricity.
- Cost-effective and reliable renewable technologies that can be integrated into existing infrastructure.
- The advancement of both the energy and agricultural industries throughout North Dakota.

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Thank You

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