UND PETROLEUM ENGINEERING

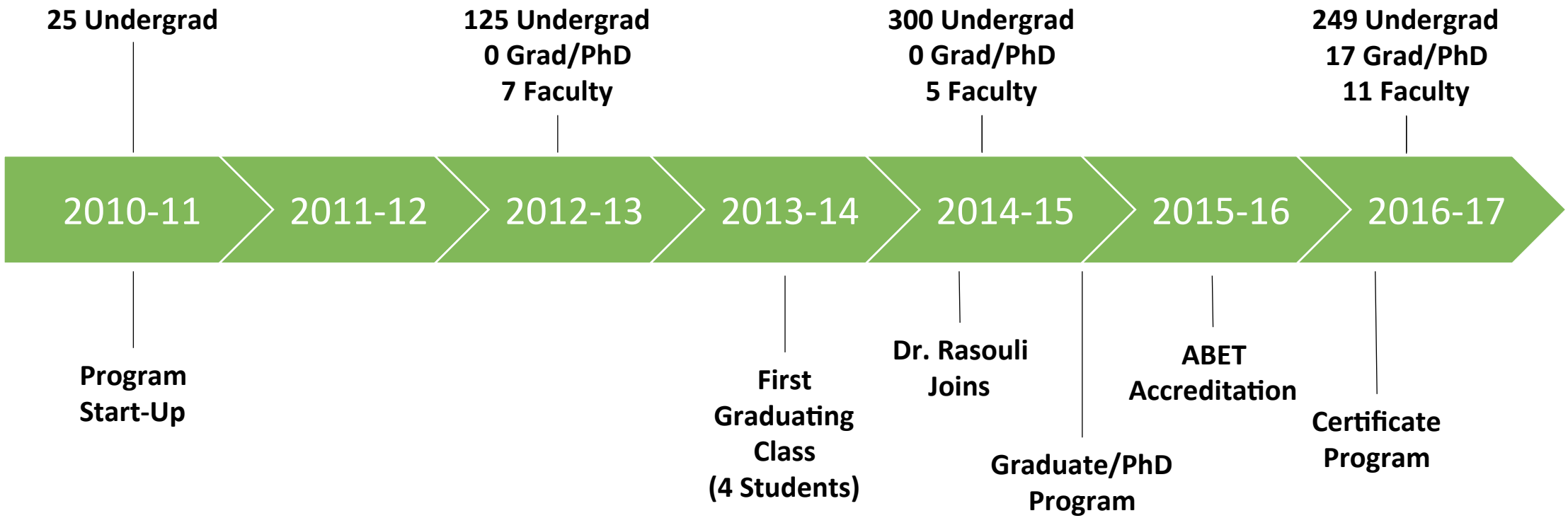
UNIVERSITY OF NORTH DAKOTA

Presentation to the ND Oil & Gas Research Council

"State of the Program"

December 12, 2016

History of UND Petroleum Engineering



UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

Faculty & Staff

Prof
Vamegh Rasouli

Assistant Prof
Hadi Jabbari

Assistant Prof
Kegang Ling

Assistant Prof
Mehdi Ostadhassan

Assistant Prof
Minou Rabiei

Instructor
Bailey Bubach

Assistant Prof
Hui Pu

Dr Behzad
Tokhmechi

Dr Haleh Azizi

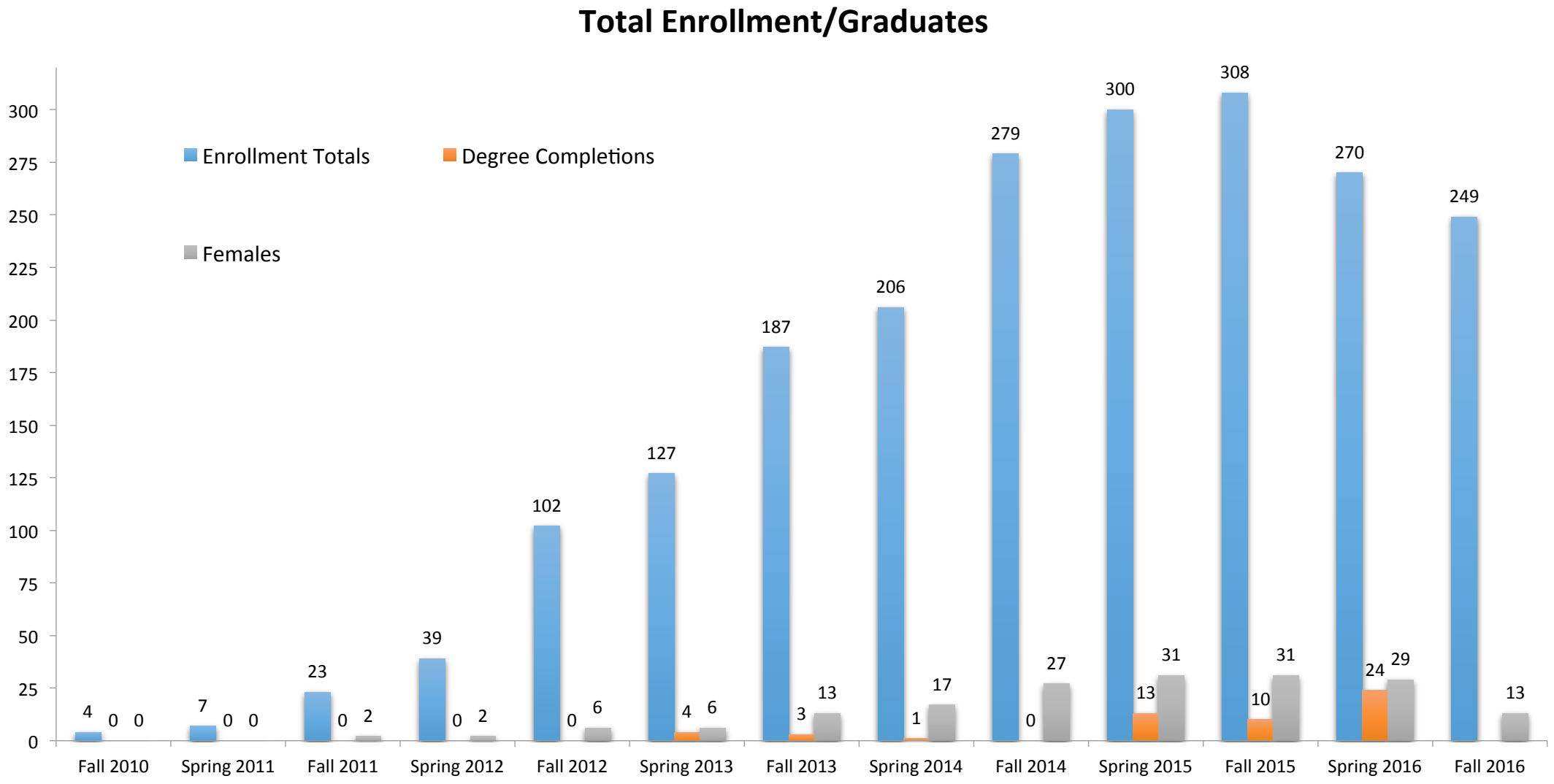
Admin Assistant
Cassandra Olson

Instructor
Scott Johnson

Technical Officer
Junior Nasah

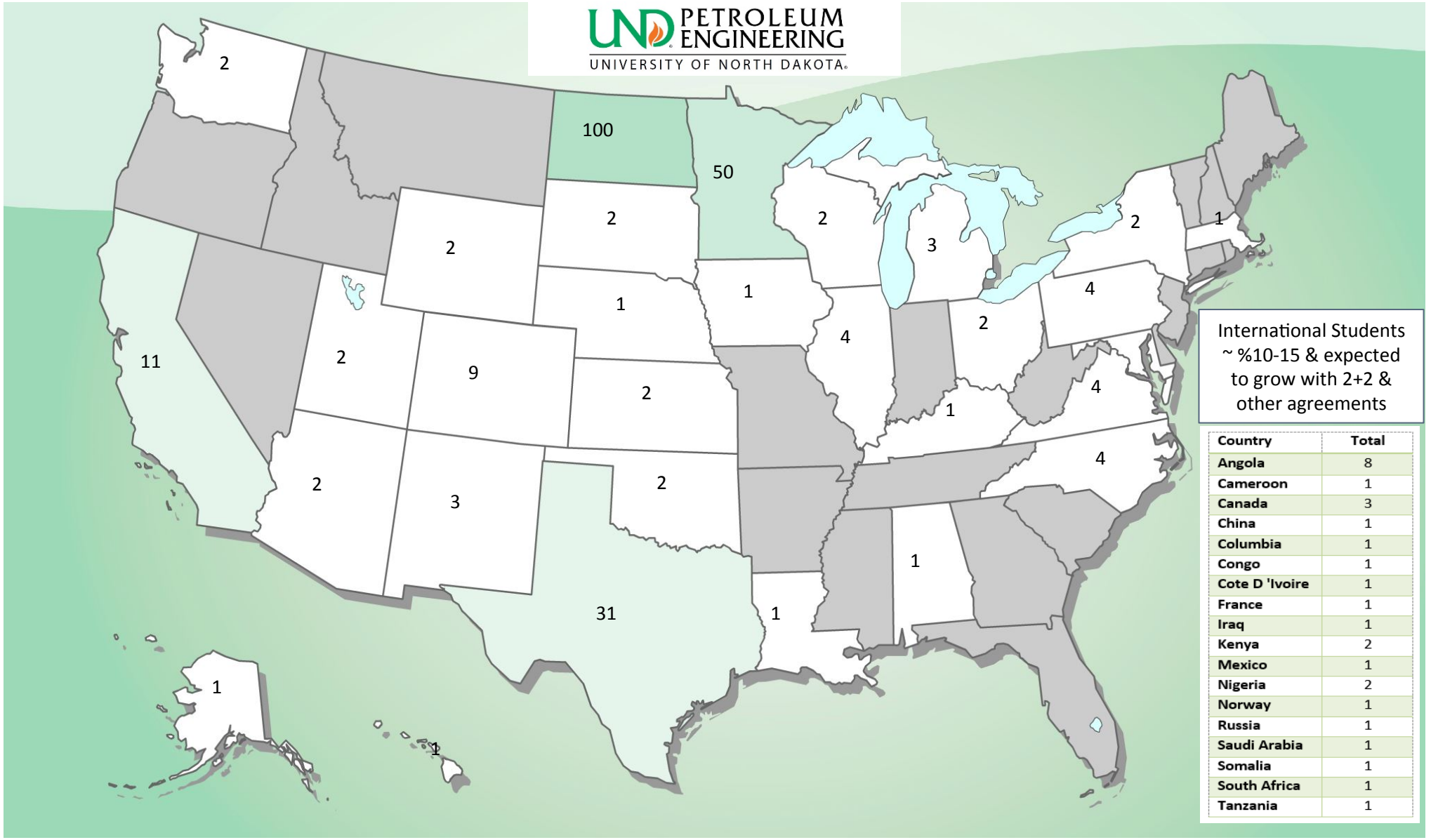
UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

Enrollment Statistics



UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

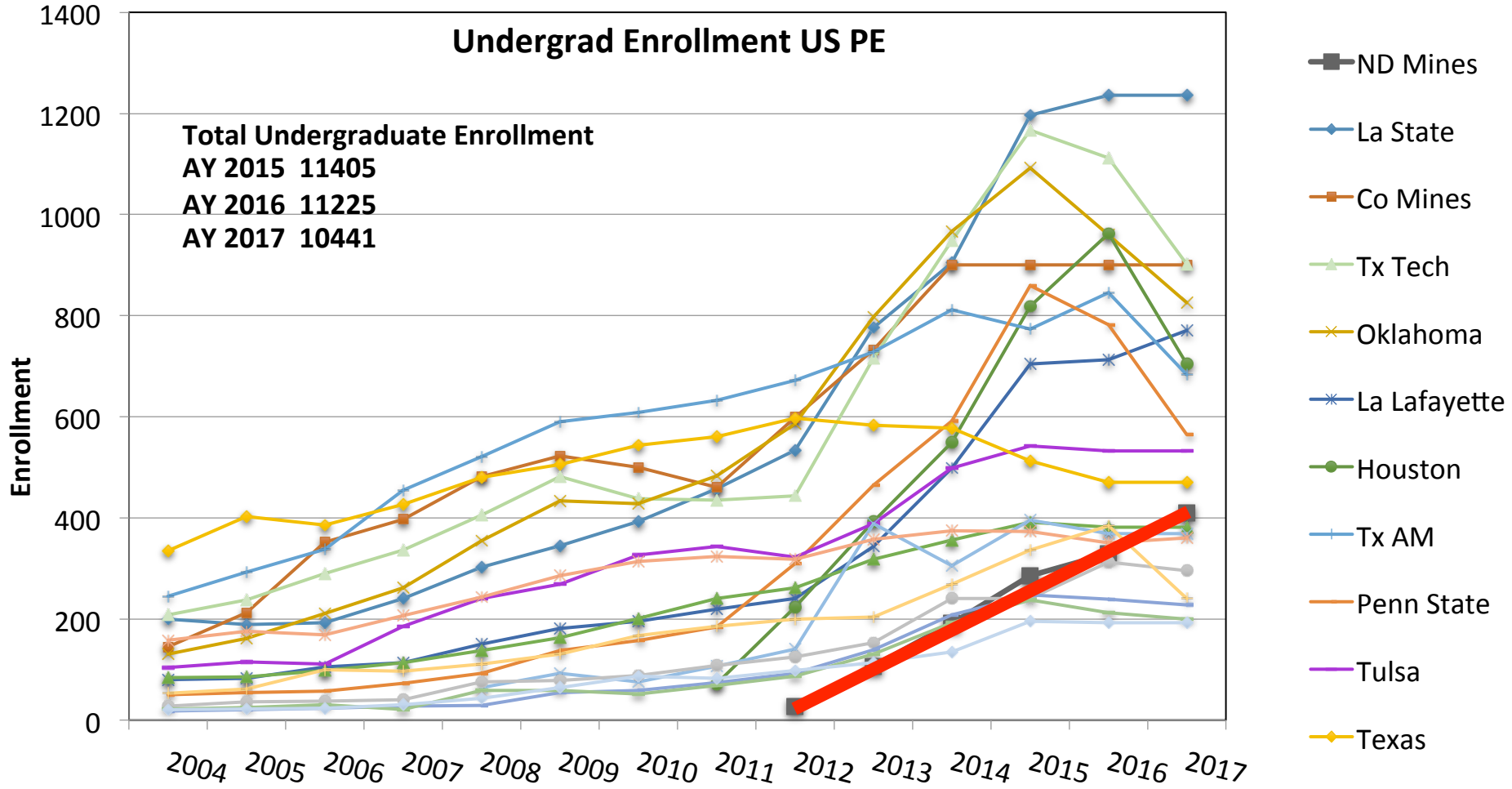
Student Demographics



International Students ~ %10-15 & expected to grow with 2+2 & other agreements

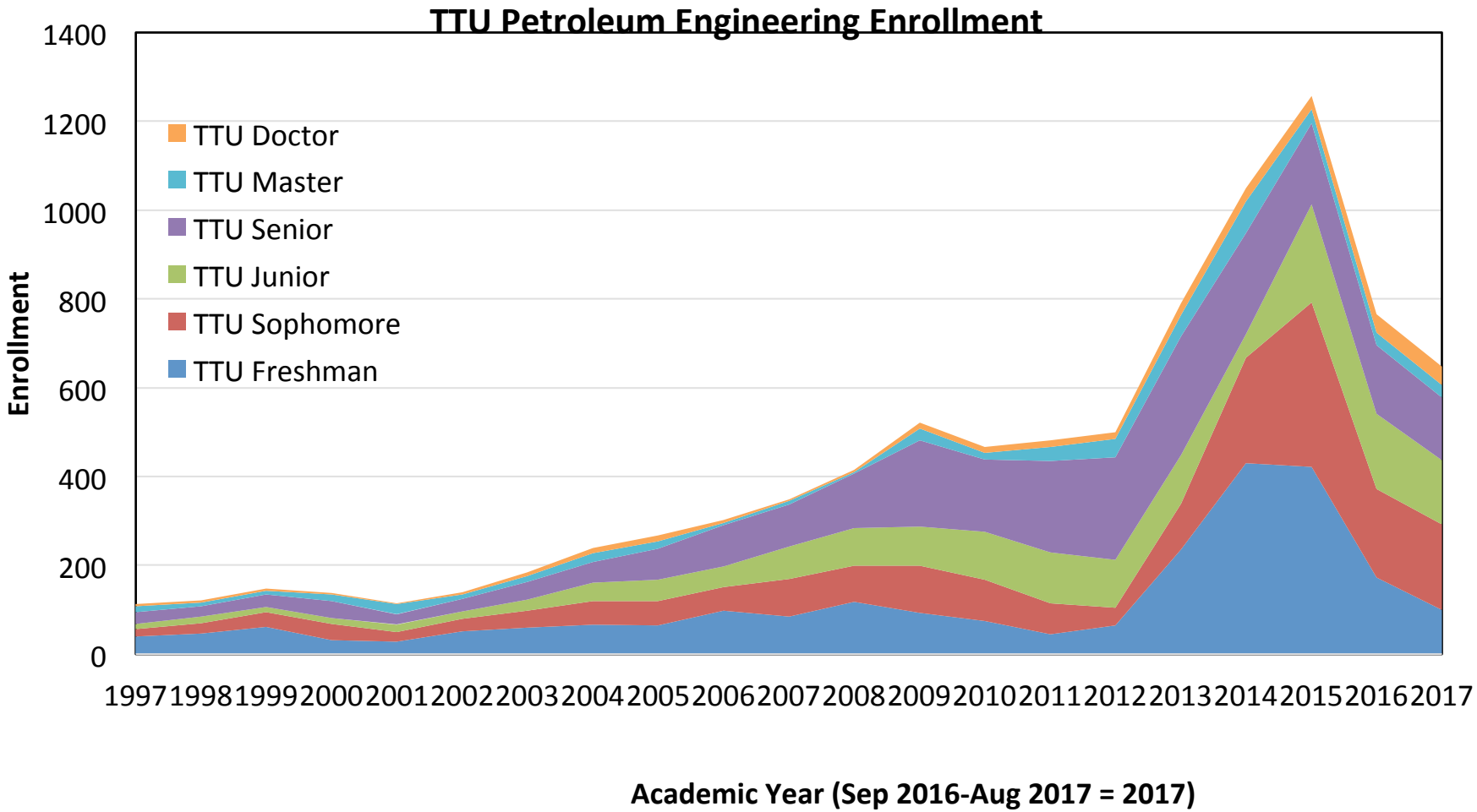
Country	Total
Angola	8
Cameroon	1
Canada	3
China	1
Columbia	1
Congo	1
Cote D 'Ivoire	1
France	1
Iraq	1
Kenya	2
Mexico	1
Nigeria	2
Norway	1
Russia	1
Saudi Arabia	1
Somalia	1
South Africa	1
Tanzania	1

US PE Departments



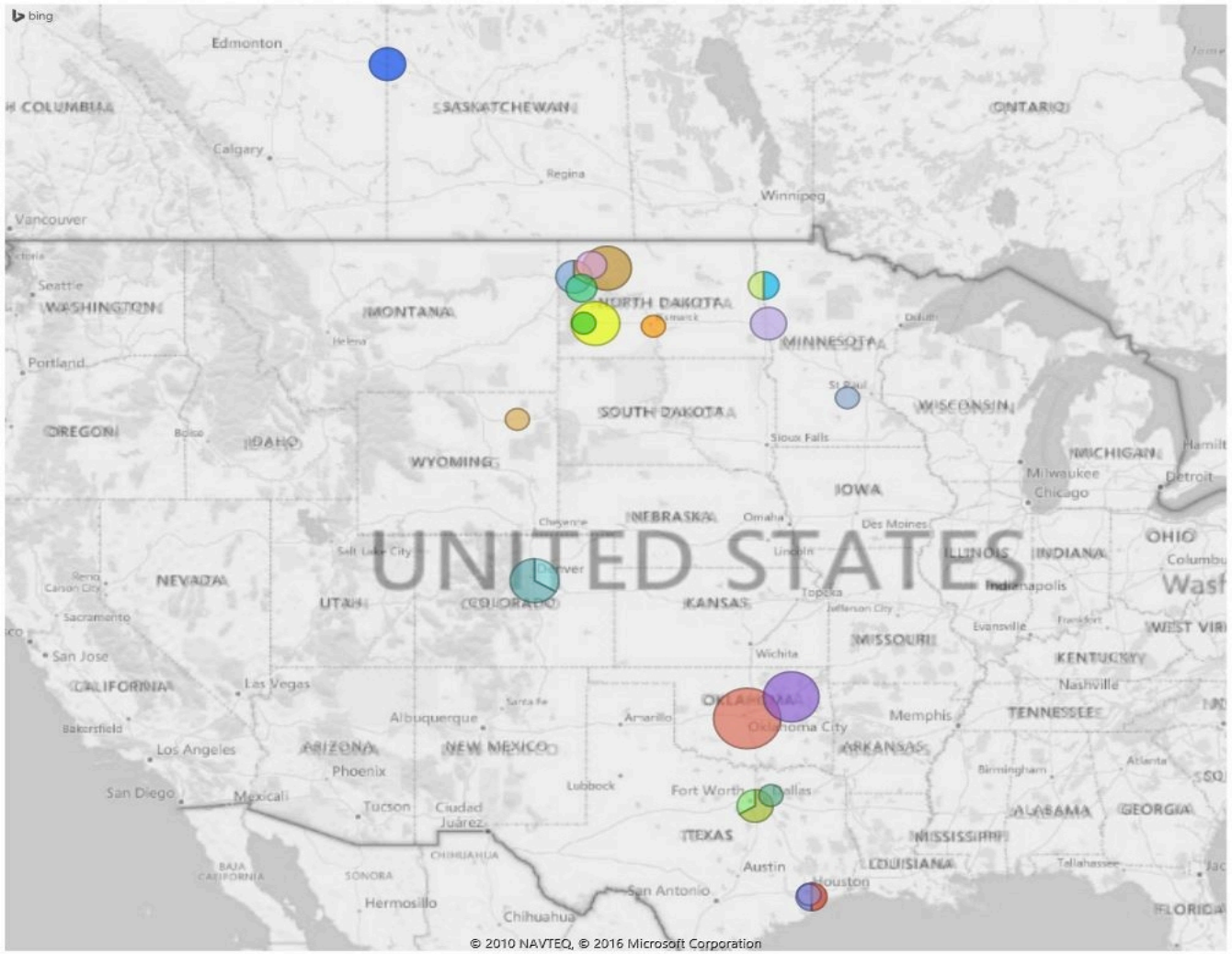
From Lloyd Heinze

Petroleum Degree National Statistics



From Lloyd Heinze

Internships – Summer 2016



Company

- AE2S (1)
- Anglo-Dutch Energy, LLC (1)
- Ballantyne Oil, LLC (1)
- Big 85 Well Service (1)
- Braun Intertec (3)
- Continental Resources (12)
- Crescent Point Energy (2)
- Denbury Resources, Inc. (1)
- DS Smith Manufacturing (1)
- EERC (1)
- EnerVest (1)
- EOG Resources Inc. (6)
- Husky Energy (3)
- Magna Energy Services (1)
- Marathon Oil (6)
- MBI Energy Services (2)
- Murex Petroleum (2)
- Northern Production Co Inc (1)
- Packers Plus (2)
- RockPile Energy Services (4)
- Tesco Corporation (1)
- Wagner Oil Company (1)
- WPX Energy (8)
- XTO Energy (2)

Total: 64

UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

Undergraduate Program

UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

Bachelor of Science

On-campus and Distance Education (DEDP)

University of North Dakota's College of Engineering and Mines offers the only Petroleum Engineering degree program in the state. With the discovery and development of the unconventional resources, this program is strategically important to UND and the state in terms of educating **practical and hands-on engineers** who can work in the field, and also develop the latest technologies for discovery, exploration, drilling and production of the oil and gas fields to produce future energy. The department offers on-campus and distance-learning (DEDP) undergraduate programs in Petroleum Engineering.

The future for the Petroleum Engineering program at UND is very promising based on the **strategic location of North Dakota**. With the strong support of the state, the University and the industry, it is expected that high quality hands-on and practical graduates will be produced to join the workforce and play an important role in leading the future of the **energy industry** in the country.

The program has found widespread support from the university, and from industry. Also, the Student Chapter of the **Society of Petroleum Engineers (SPE)** is actively involved in inviting industry professionals to present short courses, workshops and to talk about future careers in this profession. In addition, students spend a few months in the industry during their **summer internship program** which is an excellent opportunity for them to get exposed to a real life workplace. Talented **domestic and international students** are highly encouraged to consider the Petroleum Engineering program at UND as a place of choice for their studies.

UND Petroleum Engineering Graduate, Joel Brown, at the field site

UND SPE Petrobowl Competition Team, 2014

Why Petroleum Engineering?

- *An exciting and technically challenging industry.*
- *Increasing demand on energy has resulted in increased need for petroleum engineers.*
- *Petroleum Engineering is an interdisciplinary program covering a broad range of subjects in geology, chemistry, physics and engineering.*
- *Graduates work in a high-tech prestigious industry.*

Why UND?

- *The Petroleum Engineering program at UND is aimed at educating petroleum engineers to meet the growing demands in North Dakota and elsewhere.*
- *The program has great support from the university, and from industry.*
- *A new program aimed at developing a unique applied education and research to meet industry needs.*
- *Concerned for the environment for future generations, implementing and developing new clean technologies.*
- *Fun and exciting place to study and grow.*

Future Opportunities:

- *Enhance your skills and knowledge in Petroleum Engineering by doing a Masters degree.*
- *Continue your education into Ph.D. level for a career in academia.*
- *Join the oil and gas industry as a reservoir engineer, production engineer or drilling engineer, either in the field or in an office environment.*

UND Petroleum Engineering Department:
701.777.2533
Upson II Room 366, Stop 8154
243 Centennial Drive
Grand Forks, ND 58202-8154

Bachelor of Science

On-campus and Distance Education (DEDP)

First Year	
Fall Semester	**Spring Semester**
General Chemistry I	Intro to Petroleum Engineering
College Composition I	Calculus II
Computer Applications in Eng.	University Physics I/Lab
Earth Dynamics & Geophysics	General Chemistry II
Calculus I	Arts & Humanities Elective
Second Year	
Fall Semester	**Spring Semester**
Statics	Fluid Mechanics
Formation Evaluation	Petro Fluid Properties
Calculus III	College Composition II
University Physics II/Lab	Mechanics of Materials
Thermodynamics	Petroleum Engineering Lab I
	Elementary Differential Eq.
Third Year	
Fall Semester	**Spring Semester**
Well Logging	Adv. Drilling Engineering
Reservoir Engineering	Geoscience Lecture
Drilling Engineering	Adv. Reservoir Eng.
Arts & Humanities Elective	Technical Elective
Statistics Elective	Geology Elective
Fourth Year	
Fall Semester	**Spring Semester**
Production Engineering	Ethics Elective
Petroleum Geomechanics	Enterprise/Leadership Elective
Numerical Reservoir Simulation	Senior Design
Seminar I	Seminar II
Engineering Economics	Petroleum Engineering Lab II
Technical Elective	

ABET Accredited program

Graduate Programs

UND PETROLEUM ENGINEERING
COLLEGE OF ENGINEERING & MINES

Master Programs

On-Campus and Distance Education (DEDP)

The petroleum industry has played a vital role in shaping North Dakota into the state it is today, and will surely be a guiding force in the region's future. The tendency of the oil and gas industry towards unconventional plays has placed this State into a special position, with the Bakken Shale Formation in the Williston Basin being the second largest oil producer in the U.S., and many more new discoveries and field developments being underway.

The mission of the petroleum engineering master programs is to educate students with problem solving skills to contribute to uncovering advanced technologies needed for exploration and development of unconventional plays.

The department encourages and welcomes students with a strong academic background to apply for the master programs at UND. The Department of Petroleum Engineering is committed to establishing and expanding practical research projects in line with industry needs.

Several advanced courses have been designed in response to the immediate and future direction of industry needs. Examples of these courses that are offered at graduate levels are: Data Mining in Petroleum Engineering, Advanced Production Engineering, Reservoir Geomechanics, Petroleum Geostatistics, and Advanced Petroleum Engineering labs.

The future for the petroleum engineering program at UND is very promising based on the strategic location of North Dakota. With the strong support from the State, the university, and the industry, it is expected that high quality hands-on and practical graduates will be produced to join the workforce and play an important role in leading the future of the energy industry in the country.

Collaborative Energy Complex (CEC): A new home for the Petroleum Engineering Department with advanced classrooms and labs

Distance Teaching Mode (DEDP):

The Master Programs are available in both on-campus and distance (DEDP) modes. UND has a long history in distance education and the department offers a BS program in the DEDP mode. The advanced Information technologies (IT) capabilities available at UND has proven to be a successful educational tool for international and inter-state students and those who are employed but willing to study in flexible timing. The distance education has many sources to help supports students:

- *all courses are video recorded and made available online through the Tegrity system,*
- *all teaching materials and resources are available online through BlackBoard,*
- *faculty are available to assist students with their technical questions using different communication technology aids,*
- *exams are set up online through secured IT and proctoring systems,*
- *teaching assistantship is offered in all courses as an extra level of support.*

Contact us:

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UND.petroleum@engr.UND.edu
Department of Petroleum Eng.
University of North Dakota
243 Centennial Drive
Stop 8154, Grand Forks, ND
58202

engineering.UND.edu/petroleum

UND UNIVERSITY OF NORTH DAKOTA
COLLEGE OF ENGINEERING & MINES

Department of Petroleum Engineering

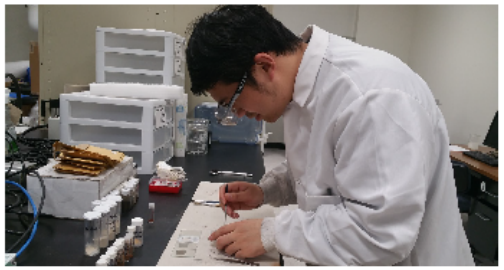
PhD Programs

On-Campus

North Dakota is a Land of Opportunity! The Bakken formation in the Williston Basin is the second largest producer of oil in the U.S. The discovery of new shale plays as well as the use of advanced technologies to enhance production from existing shale formations has placed UND Petroleum Engineering in a strategic position to serve the future energy needs of the country from unconventional resources. Our program is proud of its high rate of success in graduate job placement and career development within the state and the country in petroleum related fields.

Discovery of new shale plays as well as optimizing the drilling, stimulation and production phases as part of the field development planning in unconventional plays requires utilizing advanced knowledge and technologies. The Department of Petroleum Engineering is fulfilling the immediate needs of the industry with hands-on, problem solving petroleum engineers through its dynamic application based undergraduate and Master degree programs.

Our P.h.D program aims at graduating the highest quality students, who are innovative, critical thinkers who will work beyond conventional boundaries and are willing to use their strong science and engineering knowledge to unlock existing oil and gas problems and generate advanced technologies for future discovery, drilling and production of hydrocarbon reservoirs.



UND Petroleum Engineering student analyzing a shale sample from the Bakken

UNCONVENTIONAL PLAYS OUR RESEARCH FOCUS

UND Petroleum Engineering is the only department of its kind in ND dedicated to be the leading research group in all aspects of unconventional plays from exploration to field development; production through abandonment stages.

Current areas of our research focus include:

- *Geomechanics, production and reservoir studies of Hydraulic fracturing;*
- *Studies on Re-fracturing for optimization of production from Unconventional Shales;*
- *Data driven modelling in Unconventional Reservoirs;*
- *Petrophysical and Geochemical analysis of Shale oil;*
- *Geophysics and Seismic analysis of Unconventional Reservoirs.*

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UND PETROLEUM ENGINEERING
COLLEGE OF ENGINEERING & MINES

Certificate Program

On-campus and Distance Education (DEDP)

The petroleum industry has played a vital role in shaping North Dakota into the state it is today, and will be a guiding force in the region's future. The tendency of the oil and gas industry towards unconventional plays has placed the State into a special position, with the Bakken Shale Formation in the Williston Basin being the second largest oil producer in the U.S., and many more new discoveries and field developments being underway.

The Certificate Program is ideal if you:

- Have no background in Petroleum Engineering and would like to learn the fundamentals of some subjects;
- Need to learn about the practical aspects and applications of the subject in industry with minimum math involved!
- Are employed and want to be flexible with your schedule;
- Do not hold any University Degree but are interested to learn about Petroleum Engineering subjects;
- Want to learn the fundamentals of core subjects in Petroleum Engineering and join the oil and gas workforce

Future Developments:

Advanced certificate Programs will be designed in the near future with courses focused on specific subjects including Unconventional Plays, Geothermal and Subsea Engineering.

The Department also offers **industry short courses** in different areas of upstream oil and gas. *For further information please contact the Department Chair: Dr. Vamegh Rasouli — vamegh.rasouli@engr.UND.edu.*

This fully distance-based teaching program is suitable for those who want to learn about specific subjects in Petroleum Engineering. All courses are designed to review the fundamentals of each topic and provide core information required for practical and hands on skills.

Advanced information technologies (IT) available at UND has proven to be a successful educational tools for students needing flexible timing. The distance education program has multiple sources of support available to students:

- *all courses are video recorded and made available online through the Tegrity system,*
- *all teaching materials and resources are available online through BlackBoard,*
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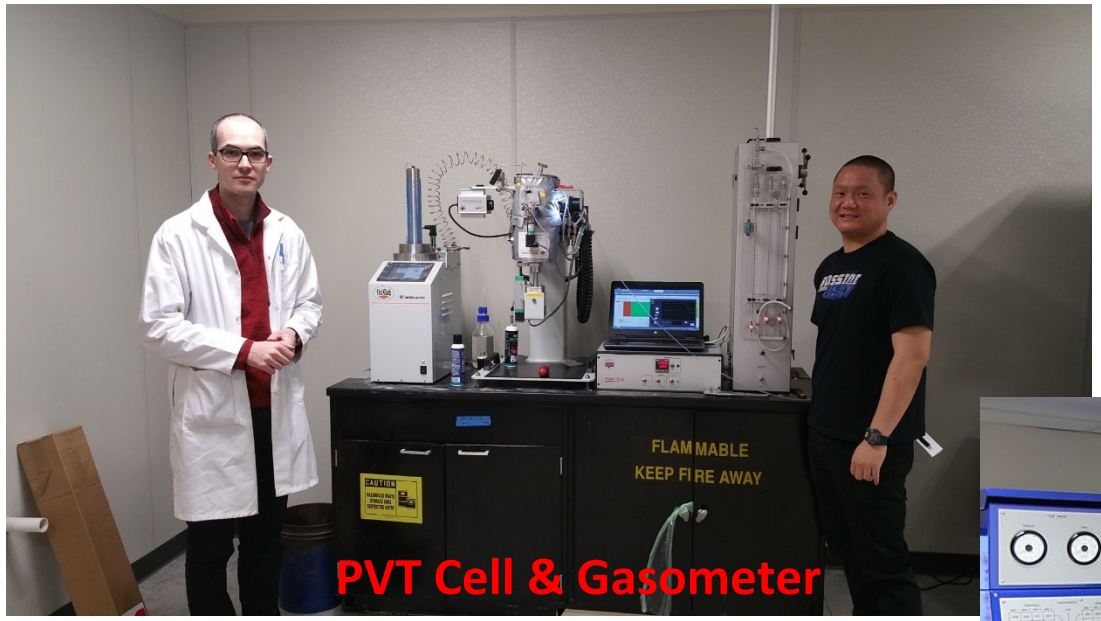
Research/Lab Equipment – Potential



PVT Cell & Gasometer

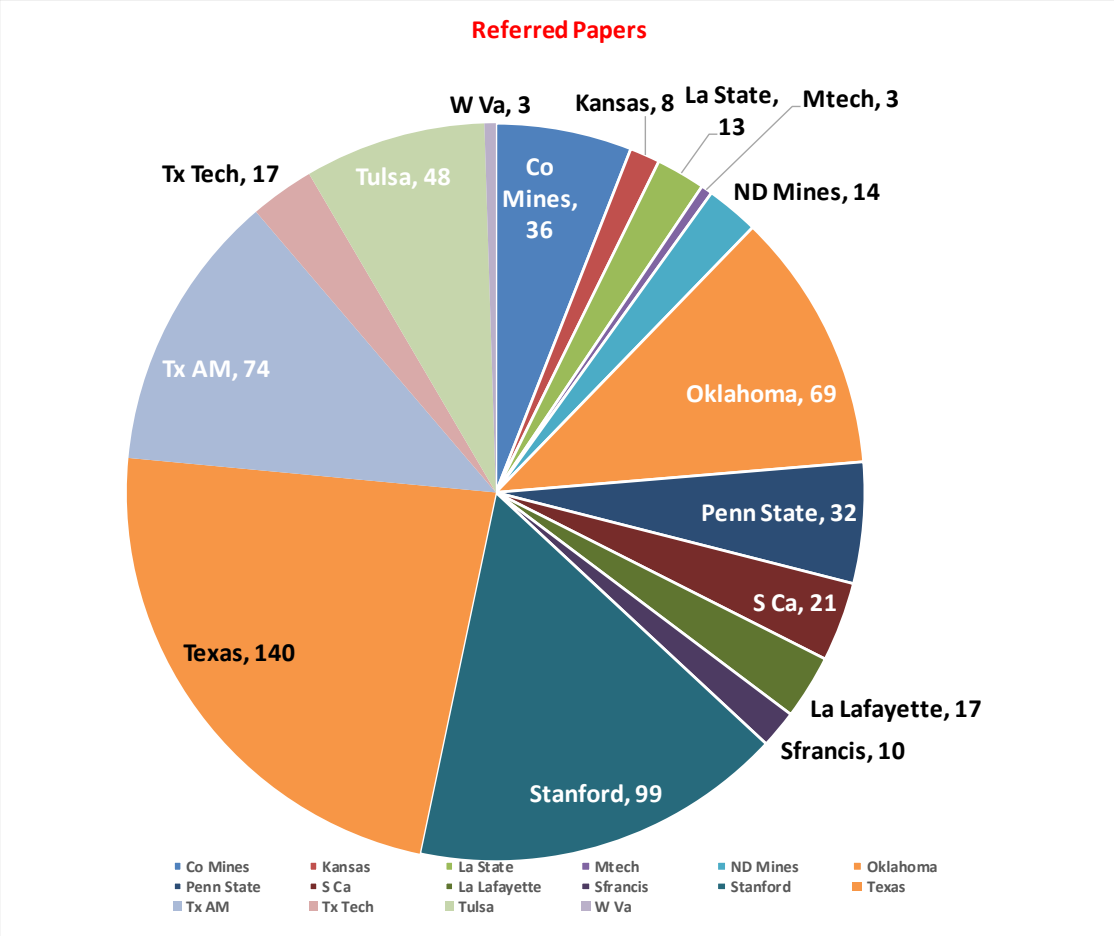
Drilling Simulator

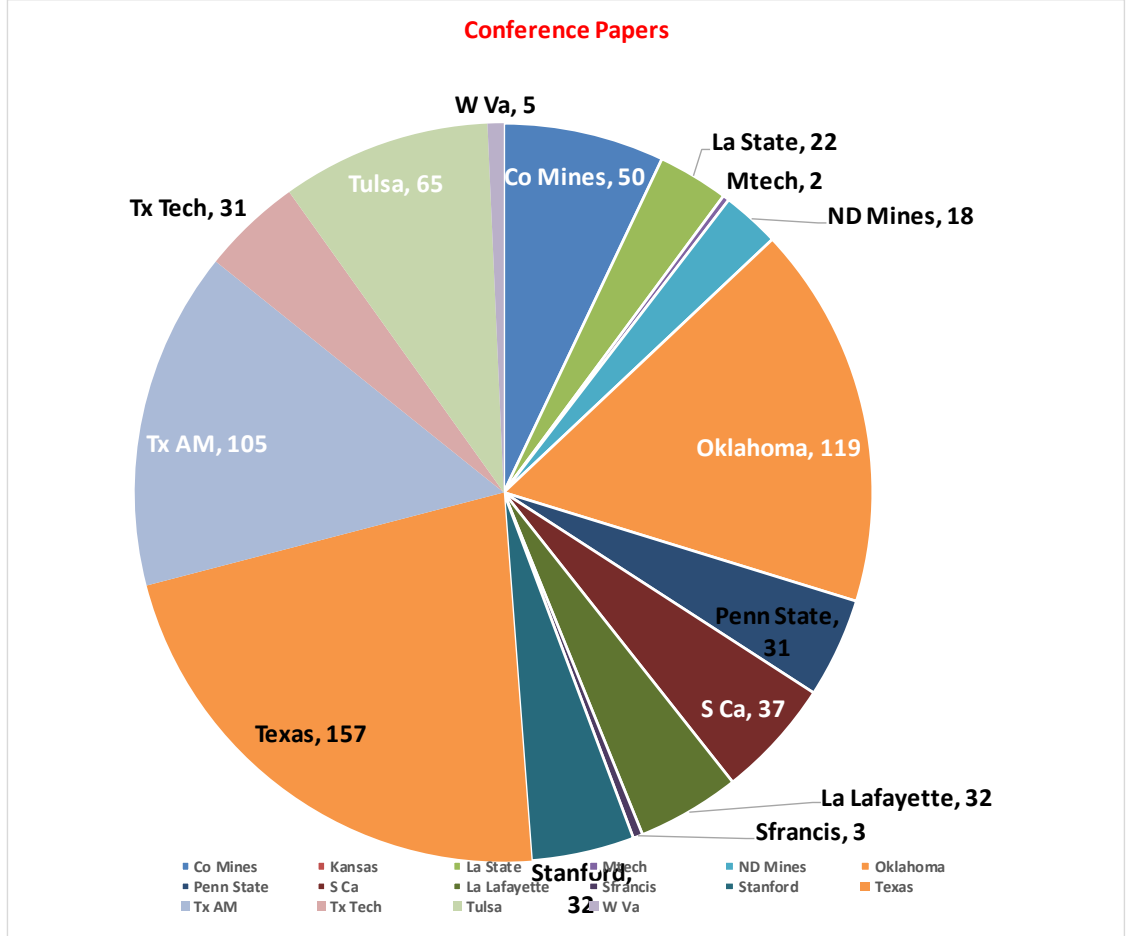

Flexible EOR Coreflood System

Research Funding

Year	PI/CO-PI	Title	Agency	Amount
2016	V. Rasouli	DE-FE0028659. AO1 - Field Demostration of the Krauklis Seismi Wave.	DOE	$167,000
2016	M. Ostadhassan, M. Rabiei	iPELAB: A Technology-Based Teaching and Learning Approach for Petroleum Engineering Teaching Labs	FDIC Summer SIDP	$8,000
2016	H. Jabbari	Senior Design Project for PE Undergraduate Students: Idea and Planning	FDIC Mini-Project	$2,000
2016	H. Jabbari	SPE Professional Development Grants	SPE	1,300
2016	H. Jabbari	SPE Professional Development Grants	SPE	1,000
2016	V. Rasouli (PI), M. Ostadhassan, M. Mann, P. Peng (Co-PI)	Postdoc Funding Program	VP Res & Econ Dev	$60,000
2015	V. Rasouli	EPSCoR Startup Fund for new Faculty	ND EPSCoR Startup fund	$300,000
2015	M. Rabiei	EPSCoR Startup Fund for new Faculty	ND EPSCoR Startup fund	$150,000
2016	M. Rabiei (PI), H. Jabbari, M. Mann, P. Peng (Co-PI)	Postdoc Funding Program	VP Res & Econ Dev	$60,000
2015	M. Ostadhassan (PI), H. Jabbari (Co-PI)	Submicron-Scale Integrated Reservoir Study of the Bakken Reservoir to Improve Field Data -- RESEARCH DEVELOPMENT & COMPLIANCE SEED MONEY PROPOSAL (On-going)	UND-Seed	$55,168
2015	M. Ostadhassan	SPE Awards for Academic Professional Development	SPE	$11,00
2015	H. Jabbari	SPE Awards for Academic Professional Development	SPE	$1,100
2015	H. Jabbari	SPE Awards for Academic Professional Development	SPE	$2,500
2014	H. Jabbari	SPE Awards for Academic Professional Development	SPE	$2,400
2014	H. Jabbari (Co-PI)	Continuation of Underground Coal Gasification Study in Western North Dakota	NDIC	$719,958
2014	K. Ling	SPE Awards for Academic Professional Development	SPE	$2,500
2013	K. Ling	SPE Awards for Academic Professional Development	SPE	$2,500
2012	K. Ling (PI)	Geomechanical Study of Bakken Formation for Improved Oil Recovery	DOE	$200,000
2012	K. Ling (Co-PI)	Williston Basin Oil and Gas Related Electric Load Growth Forecast	ND Transmission Authority	$61,000

Publications





UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

International Collaboration

CSC TOP
VISITING STUDENTS PROGRAM
AGREEMENT

between

University of North Dakota, Grand Forks, North Dakota
United States of America

and

China University of Petroleum (East China), Qingdao
China

In furtherance of their mutual interests in education, a desire to strengthen mutual contact, and as a contribution to increased international cooperation, the College of Engineering and Mines, University of North Dakota, United States of America (hereafter referred to as UND) and China University of Petroleum (East China), Qingdao, China, (hereafter referred to as "UPC") have entered into the following Agreement.

A MEMORANDUM OF UNDERSTANDING
for

INTERNATIONAL EDUCATION COOPERATION

between

The University of Stavanger
Stavanger
Norway

and

The University of North Dakota
Grand Forks, North Dakota
United States of America

UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

Past Funding

STATUS OF PAST NDIC FUNDING GRANT TO UND

Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: Public-Private Partnership to Support Geology and Geological Engineering Education and Research at UND's College of Engineering and Mines

Applicant: University of North Dakota

Principal Investigator: Dr. Hesham El-Rewini, P.E.

Date of Application: August 14, 2012

Amount of Request: $4,000,000

Total Amount of Proposed Project: $14,000,000

Duration of Project: 4 years

Point of Contact (POC): Dr. Hesham El-Rewini, P.E.

POC Telephone: 701-777-3412

POC E-Mail Address: rewini@engr.und.edu

POC Address: UND, College of Engineering and Mines, 243 Centennial Drive Stop 8155, Grand Forks, ND 58202-8155

Match Fund Requested

Project Associated Expense	NDIC's Share	Applicant's Share (Cash)	Applicant's Share (In-Kind)	Other Project Sponsor's Share
Endowed Professor of Petroleum Geology	$0.00	$0.00	$0.00	$3,750,000 (Endowment)
Endowed Professor of Petroleum Engineering	$0.00	$0.00	$0.00	$3,750,000 (Endowment)
Student Scholarships and Assistantships	$720,000	$0.00	$0.00	$1,325,000 (Endowment)
Students Experience Fund	$280,000	$0.00	$0.00	$0.0
Advanced Laboratories Equipment	$1,500,000	$0.00	$0.00	$0.00
High Resolution Virtual Core Library	$1,500,000	$0.00	$0.00	$500,000
Salaries and Benefits	$0.00	$0.00	$0.00	$675,000
Total	$4,000,000	$0.00	$0.00	$10,000,000

Equipment (new and anticipated in bold)

Equipment	Use	Cost	Status
Scanning Electron Microscope	For examining rock textures and porosity, and obtaining mineral analyses	$500,000	Installed and fully operational
X-ray Diffraction	To identify minerals and determine crystallinity	$198,881	Installed and fully operational
X-ray Fluorescence	To analyze major and minor element composition of rocks	$100,000	Installed and fully operational
Core Nuclear Magnetic Resonance	To determine porosity, permeability, and wettability in reservoir rocks	$483,772	Installed and fully operational
Vitrinite Reflectance Microscope	For the determination of Kerogen maturity in shales	$106,751	Installed and fully operational
Keyence VHX-5000 microscope imaging station	**3-D microscopic image capture and processing.**	**$85,047.25**	**Installed and fully operational (2016)**
Weatherford Source Rock Analyzer Lab	**Determination of source rock quality, maturity and kinetic properties**	**$136,740**	**Pending funding finalization (?)**
Total		**$1,611,191**	

Harold Hamm Student Experience Fund

A) Presenting talks/posters at conferences/conventions.

B) Travel to conduct field, laboratory, or museum work outside of Grand Forks.

C) Travel to workshops and conferences for additional learning opportunities.

D) Purchasing minor expendable supplies for Senior Thesis/Senior Design projects.

E) Purchasing minor expendable supplies for graduate student projects

Student Experience Fund Expenditures

Activity FY16	Amount	Faculty	Grad	Under
AAPG National	$3,623.70	2	3	
Smithsonian research	$1,945.15	1	1	
Rocky Mountain Rendezvous	$1,808.00		5	
GSA Baltimore	$5,646.59	1	1	5
Geothermal Resources Council	$1,437.20		3	
SPE Meeting	$996.47		1	
Thesis Research	$498.71		1	
Fossil study	$671.80	1	1	
Purdue AMS measurements	$705.00		1	
GEOL 515 Field Trip	$410.70	1	2	3
Senior Thesis	$381.40			1
Hawaii Spring Break	$21,996.00	1	8*	10*
Watershed	$1,600.00		1	
Waste disposal for research	$500.00		2	
Petroleum Research	$1,795.00		1	
Geothermal research	$1,648.48		1	
LEEPS Speaker	$160.20			
Subtotal	**$45,824.40**	**7**	**32**	**19**

Activity FY17	Amount	Faculty	Grad	Under
Rome	$1,400.00		1	
Thin Sections	$486.91		1	
LEEPS Speaker	$1,430.30			
Lead SD Research	$433.01		1	
Field Trips	$188.27	2		
GSA Denver	$1,156.86		2	2
AAPG Student Expo	$1,044.78		1	
Wyoming Fossil Collection	$402.92		1	
Rocky MT Rendezvous	$808.20		1	
Williston Basin Conference	$442.02			
Subtotal	**$7,793.27**	**2**	**8**	**2**

* Estimated Number

Harold Hamm Scholars

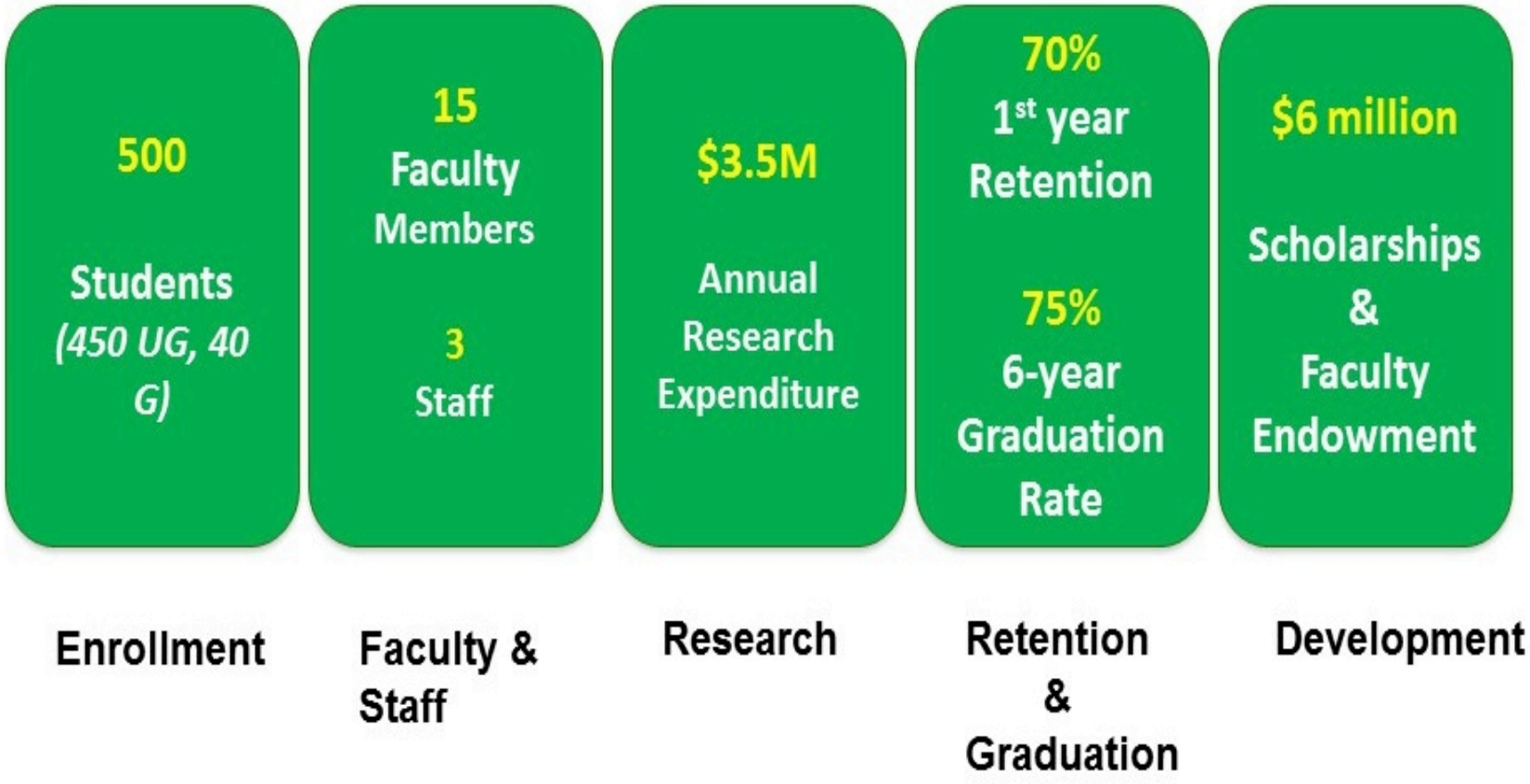
Graduate

- Daniel "Burke" Brunson (M.S. ½ time; Dr. Gosnold advising) Williston Basin Thermal Maturation
- Mark Dickson (M.S. ½ time; Dr. Ho advising)
- Kelsey Forward (M.S. ½ time ; Dr. Gerla advising) Variable-scale Mapping of Groundwater Recharge and Discharge with Satellite and UAS Imagery
- Jin Zhang (Ph. D. ½ time; Dr. Wang advising) Aqueous Imbibition with Enhanced Contact Area Approaches to Extract Oil for Keeping Bakken/Three Forks Wells Flowing.
- Fazilatun Nessa Mahmood (Ph.D. ¼ time; Dr Matheney advising) Oxygen isotope fractionation in biogenic silica.
- Benjamin York (M.S. ¼ time; Dr. Gerla advising)

Undergraduate

- Four $7,500 scholarships
- Scholarships are awarded in recognition of outstanding academic achievements and public service. The recipients of these scholarships are:
  - Stephanie Kitowski (Fall and Spring Semester, 2016)
  - Connor Lindenberg (Fall Semester, 2016)
  - Nicholas Stanislowski (Fall and Spring Semester,2016)
  - Josh Regorrah (Fall and Spring Semester, 2016)

PE 2022 Plan



UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

Collaborative Energy Complex (CEC)

UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA

Industry Advisory Committee

Member	IAC Position	Company	Job Title
Jeff Kummer	Chairman	McKenzie Energy Partners	President
Matt Jurgens	Vice Chair	Zarvona Energy	Vice President - Operations
Dwight Wendschlag	Secretary	DDW Consulting LLC	Owner
Loren Kopseng		Rainbow Gas	CEO
John Harju		EERC	Vice President - Strategic Partnerships
Darren Schmidt		StatOil	Principal Operations Engineer
Kathleen Neset		Neset Consulting	CEO
Kevin Black		Creedence Energy	President
Val Lerma		InterAct Projects	Engineering Manager
Howard Gober		ConocoPhillips	Completions Superintendent
Kyel Hodenfield		Schlumberger	President - Lift Solutions
Steve McNally		Hess Corporation	General Manager
Brent Miller		Whiting Oil & Gas	Senior Operations Manager
Jeff Parker		Marathon Oil	Operations Manager
Kari Cutting		ND Petroleum Council	Vice President
Lynn Helms		NDIC - DMR	Director
Alex Cote	Recent Graduate	Continental Resources	Operations Engineer
Maxwell Johnson	Recent Graduate	Hess Corporation	Operations Engineer
Whitney Page	Recent Graduate	Marathon	Production Engineer

DDW Consulting, LLC

Center of Excellence

Petroleum Engineering Training Center

- "Hands on", practical approach has always been the hallmark of engineering disciplines at UND, and it is one of the critical factors distinguishing UND engineering graduates from graduates of other programs.
- Recognized petroleum engineering programs provide some means for students to experience "Hands-on" the equipment and tools that they are likely to encounter in the oil field as shown in the examples below; however, these are often limited in scope.

Brainstorming Workshop, Feb 24th, 1-5 PM, UND

UND PETROLEUM ENGINEERING
UNIVERSITY OF NORTH DAKOTA