

Center for Sustainable Energy at Notre Dame

A UNIVERSITY RESEARCH CENTER WHOSE RESEARCHERS MAKE NEW DISCOVERIES, SCIENTIFIC ADVANCEMENTS, AND TECHNOLOGICAL BREAKTHROUGHS THAT EMPOWER STUDENTS AND FACULTY TO INNOVATE, EDUCATE, AND INFLUENCE THE WORLD TOWARD A MORE SUSTAINABLE ENERGY FUTURE FOR ALL.

2018 Annual Report



UNIVERSITY OF
NOTRE DAME

| RESEARCH

Welcome

Dear Friends and Colleagues,

I am pleased to present to you ND Energy's annual report for CY2018. This report covers major activities in energy-related research, education, and outreach and highlights the many accomplishments of ND Energy's leadership team, our affiliated faculty, associated researchers, student scholars, energy board members, campus partners, and external collaborators. As you read through the following pages, I hope you will recognize the growth our center has experienced in nearly every aspect of our mission. This includes international development, student engagement, energy research and scholarly advancements, and a myriad of other programs and services that support our mission and goals to achieve excellence in energy-related research and education at Notre Dame.

This year was especially eventful as ND Energy kicked off its annual research symposium with a celebration of faculty who recently received early career awards and large-center grants. Researchers, educators, and administrators from across campus listened to several outstanding presentations, including the keynote address by Sally Benson, co-director of the Precourt Institute for Energy at Stanford University. Sally discussed the current state of energy and the challenges we currently face on a global scale to provide clean, affordable, reliable, and sustainable energy, especially to those living in countries where little to no electricity exists. The day-long event concluded with an awards ceremony for the top three posters presented by graduate students and postdoctoral scholars during the poster session that was held earlier in the day.

This symposium was just the beginning of many more important discussions about the future of energy, and I invite all of you to join me and the ND Energy community in our efforts to ensure access to affordable, reliable, and sustainable energy for all.

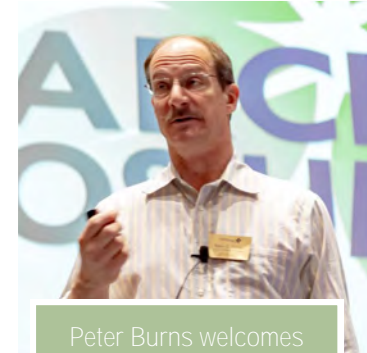
Thank you for your continued interest and support of ND Energy. I wish you the very best in the year ahead.

Kindest regards,

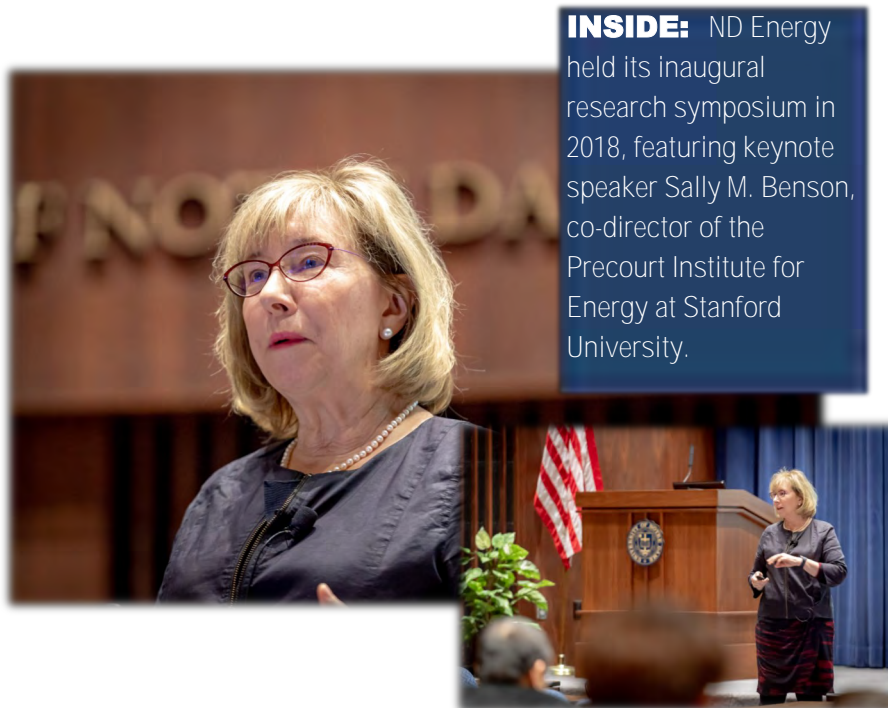


Peter C. Burns

The Henry Massman Professor of Civil and Environmental Engineering and Earth Sciences
Director, Center for Sustainable Energy at Notre Dame (ND Energy)
Director, Actinide Center of Excellence (ACE)



Peter Burns welcomes participants to the inaugural ND Energy Research Symposium



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LOOK FOR US IN THESE PUBLICATIONS

The *milliJoule* (weekly email—internal)

The Joule (biannual newsletter—external)

The *kiloJOULE* (annual report—external)

This report is published annually by ND Energy. Questions and comments may be directed to Ms. Barbara Villarosa, managing editor, at bvillaro@nd.edu or to Dr. Ginger Sigmon, managing director, at gsigmon@nd.edu.

Contents

The *kiloJOULE* provides an annual review of major accomplishments and activities in energy-related research, education, and outreach at the University of Notre Dame. This report covers CY2018 and highlights the work of affiliated faculty, associated researchers, students, and key collaborators. The key content areas below help to organize these efforts in support of the ND Energy mission.

Community

Relationships that influence further discussions and actions toward ensuring access to affordable, reliable, and sustainable energy for all

Research BUSINESS DEVELOPMENT

Research proposal developments and related cross-campus collaborations that improve research capabilities and enable faculty to broaden and increase Notre Dame's funding portfolio in energy

Education ENERGY STUDIES MINOR, EXPERIENTIAL LEARNING

Opportunities for students to become knowledgeable researchers and responsible citizens in energy

Outreach ENERGY WEEK, K-12 PARTNERSHIPS, HIGH SCHOOL INTERNSHIP

Programs that create an environment where people of all ages can learn and understand important issues and topics in energy

Impact

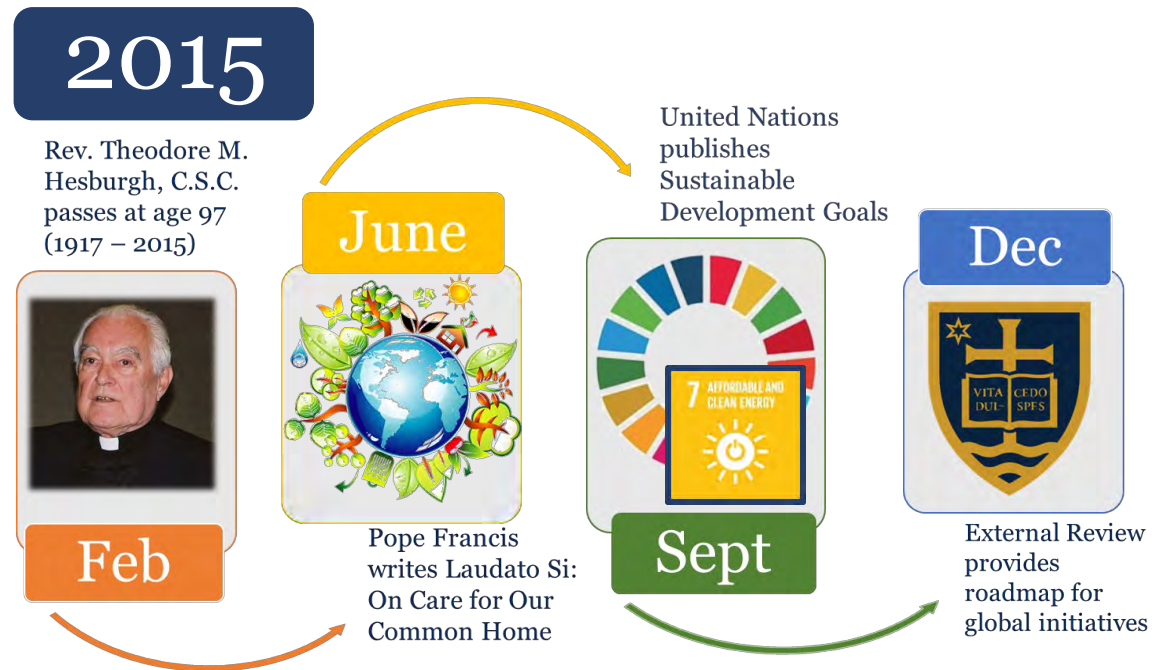
Contributions and outcomes representing advancements in energy-related research and education at Notre Dame

History



ND Energy is built upon the foundations laid by the Notre Dame Energy Center, a College of Engineering research center founded in 2005, and the Sustainable Energy Initiative, a Strategic Research Investment funded by the University in 2010. These two entities have been integrated into ND Energy, which now serves as the umbrella organization for energy-related programs at Notre Dame.

In 2015, several events occurred that later became the inspiration behind our expanded vision — to strengthen our goals to better align with the University's Catholic identity and to broaden our research capabilities to include international development. The image here demonstrates these events and concludes with the external review where all seemed to crystalize and generate a refreshed pathway for ND Energy.



Mission



Our mission is to foster and grow energy-related research, support education and community outreach, and influence the national and global discussions of the most pressing energy policy issues and questions of our time.

Global Vision



Our expanded vision goes beyond our call to excellence in scientific research, education, and community outreach to include global energy and sustainability challenges, especially in low-to-middle-income countries.

Goals

Serve as a focal point for all University-wide energy research and education activities

Improve inter-college participation

Enhance research collaborations

Increase educational opportunities at the undergraduate and graduate levels

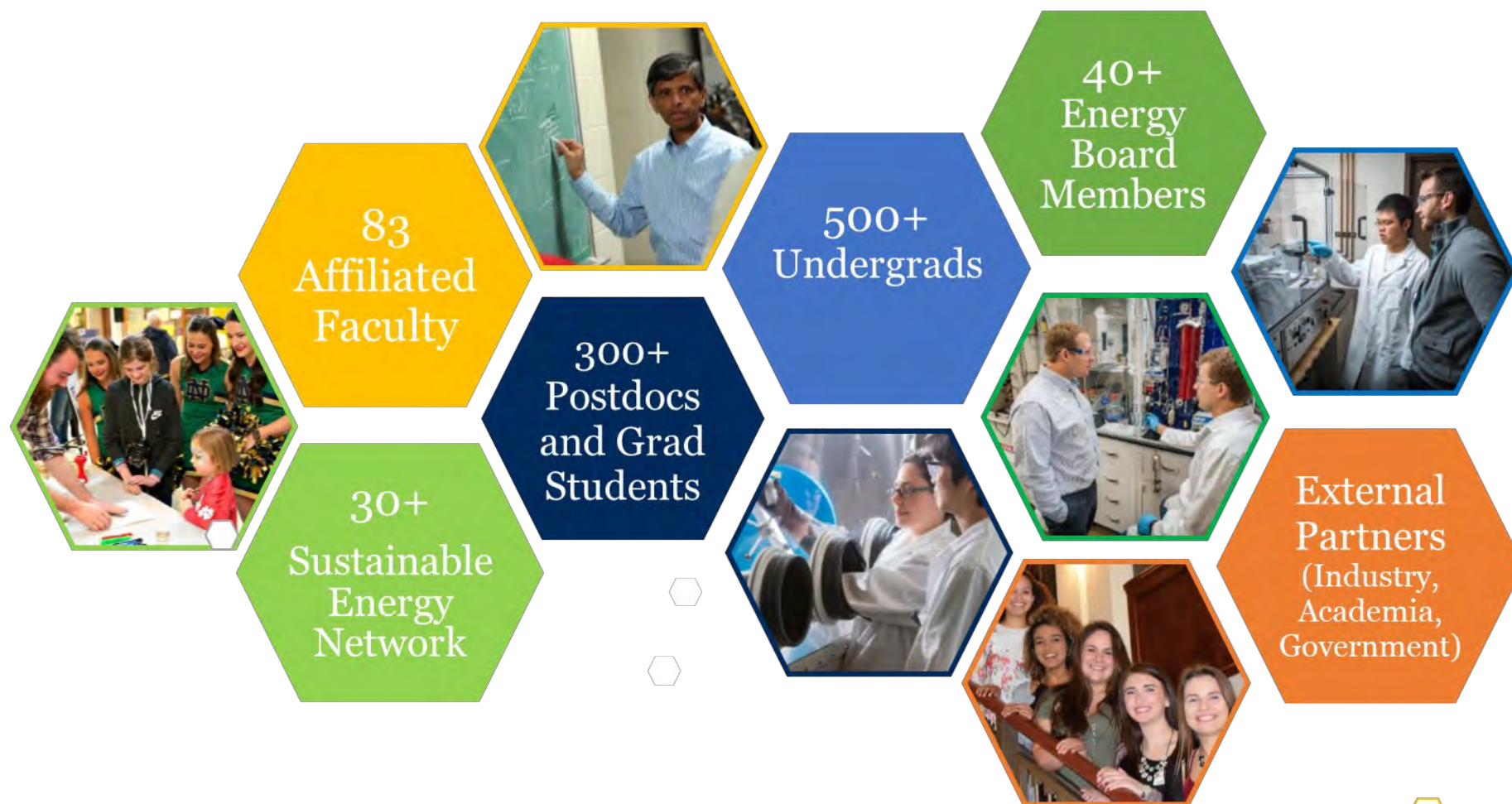
Create opportunities to promote informed choices for socially responsible and ethical energy production and use internationally, nationally, locally and individually

Influence the national and global views on energy policy, ethics, and international relations

Ensure long-term financial viability of these activities at Notre Dame

Community

Relationships that influence further discussions and actions toward ensuring access to affordable, reliable, and sustainable energy for all



LEADERSHIP TEAM

The leadership team directs the operations of ND Energy and supports the strategic research initiatives and other scholarly advancements of Notre Dame researchers and educators interested in energy. A major part of every goal is to build strong relationships and communities of individuals with similar interests in an effort to make significant advancements in energy research and education, policy development, and global relations.



Peter C. Burns
Director



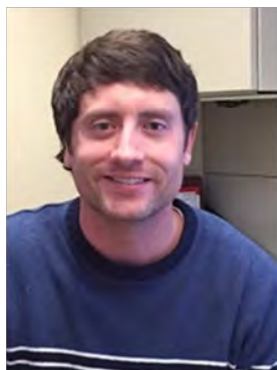
Ginger E. Sigmon
Managing Director



Subhash L. Shinde
Associate Director



Abigail Mechtenberg
Int. Sustainable Dev.
Researcher



Koby Keck
Administrative
Coordinator



Anna Matzner
Laboratory
Specialist



Anne Berges Pillai
Education and Outreach
Associate Program
Director



Ian Steele
Laboratory
Program
Manager



Barbara Villarosa
Business and
Communications
Program Director

MEET THE NEWEST MEMBER OF THE LEADERSHIP TEAM

Anna Matzner

Anna joined ND Energy at the end of December as the Laboratory Specialist within the Materials Characterization Facility (MCF). In her new role, Anna works closely with Dr. Ian Lightcap to deliver high quality products, services, and customer relations to the MCF internal and external users. Anna is specifically responsible for the operation, maintenance, and calibration of instruments, training and support, conducting analyses and preparing reports for external customers, procurement of supplies and organization of laboratory resources, and administrative functions within the CORES billing system.

Prior to joining ND Energy, Anna worked as an analytical chemist, pursuing opportunities in quality control in the beverage, flavor and fragrance industries. She also gained unique experiences working in the power generation industry, performing metallurgical analysis of power plant components, as well as coal analysis. Anna studied chemistry at the University of Louisville where she gained valuable research experience in electrochemical and single crystal X-Ray analysis. She graduated with a B.S. in Chemistry in 2014.

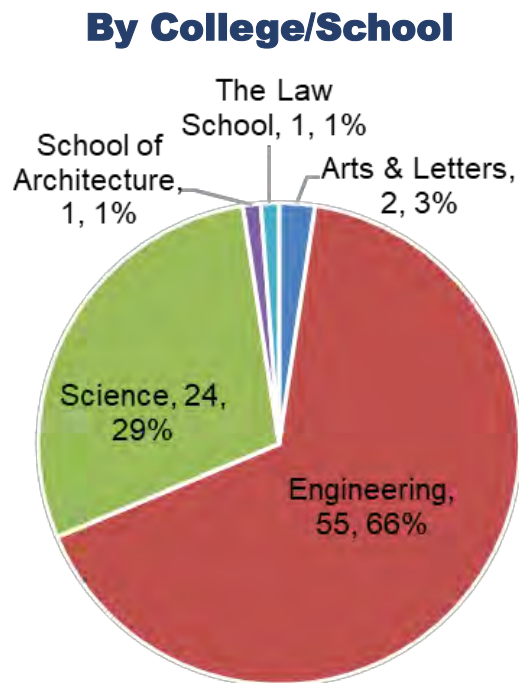


AFFILIATED FACULTY

The ND Energy leadership team works closely with affiliated faculty to ensure they have the appropriate resources and support to enable them to create new technologies and scientific advancements in energy production and use. This also allows for the facilitation of other scholarly initiatives in ways to further advance energy-related research and pedagogy at Notre Dame.

ND Energy welcomed three new affiliated faculty members this year, raising the total from 80 to 83. Affiliated faculty represent 13 departments across 5 colleges and schools.

The pie chart shows the total number of faculty by college/school, and the table shows the number of faculty in each affiliated department by college/school.



By Department

College of Science	
ACMS	1
Biological Sciences	1
Chemistry	14
Physics	8
College of Engineering	
AME	13
CBE	19
CEEES	14
CSE	1
EE	8
College of Arts & Letters	
Economics	1
Political Science	1
School of Architecture	
	1
The Law School	
	1

MEET THE NEWEST AFFILIATED FACULTY MEMBERS



Yamil Colón

Melchor Visiting Assistant
Professor, Department of
Chemical and Biomolecular
Engineering

Interests:

Energy Conversion and
Efficiency, Smart Distribution and
Storage



Thomas Corke

Clark Chair Professor,
Department of Aerospace and
Mechanical Engineering
Director, Hessert Laboratory
Director, Institute for Flow
Physics and Control

Interests:

Transformative Wind



Eric Matlis

Research Assistant Professor,
Department of Aerospace and
Mechanical Engineering

Interests:

Transformative Wind

ASSOCIATED RESEARCHERS

Associated researchers are graduate students and postdoctoral scholars working with ND Energy affiliated faculty. There are over 300 researchers, and many of them collaborate on projects that address some of the most critical energy challenges facing the world today.

ND Energy provides regular opportunities for associated researchers to discuss their research projects with their peers and to participate in outreach activities to share their energy-related research with the broader community.

New researchers working with ND Energy affiliated faculty should contact ND Energy to receive regular communications about upcoming events and outreach opportunities.



STUDENT ENERGY BOARD

The Student Energy Board is a diverse group of students at Notre Dame who understand the importance of raising awareness and increasing knowledge of key energy issues and topics in order to create a more sustainable energy future for all. The board works to provide energy-related education and outreach throughout the Notre Dame and surrounding communities with many opportunities for leadership and personal and professional development.

The board consists of a group of core leaders (listed below) and a group of volunteers. This allows for various roles that students can choose from, depending on their level of interest and availability.

Core leaders serve a one-year term from January through December. Seniors serve an abbreviated term from January to May. Board members meet as needed to perform the following functions in support of the ND Energy mission:

- Plan, organize, and execute energy-related education and outreach programs, including the annual Notre Dame Energy Week, Science Alive, and our partnership with Madison Primary Center in South Bend.
- Suggest speakers and energy-related topics for seminars, lectures, and conferences.
- Collaborate with and participate in other student clubs, groups, and organizations to develop energy-related education and outreach programs for the Notre Dame and surrounding communities.
- Aid in publicizing education and outreach events, research initiatives, and other ND Energy activities to the Notre Dame and surrounding communities through social media, marketing, and advertisements.

Core Leader	Major/Minor
Alex Baumann	Accounting, Applied & Comp Math and Stats, Energy Studies Minor
Breanna Belz	Mechanical Engineering, Energy Studies Minor
Emily Black	Environmental Engineering, Energy Studies Minor
Justin Blake	Chemical Engineering, Engineering Corporate Practice Minor
Daniela Brkic	Mechanical Engineering, Engineering Corporate Practice Minor
Matthew Chamberlain	Chemical Engineering, Energy Studies Minor
Sudalakshmee Chiniah	Mechanical Engineering
Amorette Hernandez	First Year of Studies, Economics
Erika Kim	Civil Engineering, Energy Studies Minor
Cassondra Kronenberg	First Year of Studies, Chemical Engineering
Angelo Liu	Science-Business, Energy Studies Minor
Lauren Lombard	First Year of Studies, Environmental Engineering
Chase Miller	First Year of Studies, Biochemistry
Jake Miyazaki	Chemical Engineering, Energy Studies Minor
Kelly Moran	First Year of Studies, Mechanical Engineering
John Quinlan	Science-Business, Energy Studies Minor
Henry Ridder	Chemical Engineering, Energy Studies Minor
Ashleigh Rogers	Mechanical Engineering, Computational Engineering Concentration
Claire Saltzman	Science-Business, Energy Studies Minor, Glynn Family Honors Prg Minor
Tansy Wang	Electrical Engineering

SUSTAINABLE ENERGY NETWORK

Center for Ethics and Culture	Kristi Haas
Center for Social Concerns	Bill Purcell
Center for Theology, Science, and Human Flourishing	Fr. Terry Ehrman, Rebecca Artinian-Kaiser
Chemical and Biomolecular Engineering	Susan Vissage
Chemistry Department	Brian Baker, Mary Prorok
College of Arts & Letters	Josh Weinhold, Mark Schurr
College of Engineering	Gary Gilot
College of Science	Bill O'Hayer
College of Science Committee on Sustainability	Anthony Serianni
College of Science – Physics	Thomas Loughran
Energy Engineering Minor	Joseph Powers
Energy Studies Minor	Peter Burns, Anne Pillai
Environmental Change Initiative	Kara Primmer
Facilities Design and Operations – Utilities	Paul Kempf
Flatley Center for Undergraduate Scholarly Engagement	Yvonne Mikuljan
GLOBES	Gary Lamberti, Anna Geltzer
GreeND Student Organization	Kristina Bonnet, Greg Campion, Jonathan Roberts, Katie Lane, Grace Castle, Ashley Finster
Initiative for Global Development (IGD)	Jennifer Krauser, Luis Ruuska, Tom Purekal
Institute for Advanced Study	Donald Stelluto, Carolyn Sherman
Institute for Flow Physics and Control (FlowPAC)	Thomas Corke
Kellogg Institute	Therese Hanlon, Holly Rivers
Kroc Institute	Anna VanOverberghe
LEAST and ASCENT	Robert Dunn
Mendoza College of Business	Sam Miller
Mendoza Energy & Resources Club	Sam VandenHeuvel, current President
Minor in Sustainability	Carly Hubers, Rachel Novick
ND Nano	Heidi Deethardt, Derek Lake
ND Research	Joanne Fahey
Office of Sustainability	Charles Allen, Caitlin Hodges
Radiation Laboratory	Ian Carmichael, Laura Mortlock-McMinn
Reilly Center for Science, Technology and Values	Melinda Gormley, Jessica Nickrand
Resiliency and Sustainability of Engineering Systems Minor	Kevin Walsh, Consuelo AntonioGuerra
School of Architecture	Dennis Doordan, Barbara Panzica
Student Energy Board, ND Energy	Representative TBA
Student Government	Elizabeth Boyle, Patrick McGuire, Juliette Kelley, MacKenzie Isaac, and Beth Steiner

The Sustainable Energy Network (SEN) consists of individuals representing colleges and schools, departments, centers and institutes, and other groups and organizations across campus with interest in sustainable energy issues and topics.

The goal of the network is to provide an avenue for important information sharing and collaborations with a strong focus on combining resources to strengthen University-sponsored initiatives and events.

The network gathers at least once a year. This year, the network met three times. Each meeting allowed time for information sharing and presentations by invited speakers on the following topics:

- ND Energy International Development (January)
- IDEA Week (April)
- Office of Sustainability (August)

ALUMNI ENERGY BOARD

Building a strong community of knowledgeable researchers and influential leaders who play a pivotal role in fulfilling ND Energy's mission is key to creating a highly visible and sustainable organization to support energy-related activities at Notre Dame. The Alumni Energy Board is comprised of Notre Dame alumni who are leaders in the energy field or have interests in energy. They meet annually to provide advice and counsel on the strategic growth and financial direction of ND Energy. The Alumni Energy Board members are also members of the College of Engineering Advisory Council.



Anthony F. Earley, Jr.
Pacific Gas and Electric Co.



John M. Kelly, Jr.
Vanguard Oil and Gas



Robert N. Schleckser
ExxonMobil Corporation



Edward B. Fitzpatrick, Jr.
P.E. Consulting



Michael A. O'Sullivan
FPL Energy



Richard L. Stanley
GE Energy

This year's meeting was held in September and included other members from the College of Engineering Advisory Council who were interested in learning about ND Energy. Peter C. Burns, ND Energy Director, provided an overview of the center, which was followed by a presentation by Dr. Abigail Mechtenberg, ND Energy's International Sustainable Development Researcher, and her undergraduate students. Students discussed their participation in the implementation of the Energy E3 (Education, Engineering design, and Entrepreneurship) program in Nigeria, Rwanda, Uganda, and Haiti and also shared their personal research experiences, with some of them collaborating in their home countries.



Anne Stratman
Physics and Math
Global Energy,
Health and Equality



Brady McLaughlin
Physics and Medicine
Energy and Health,
Uganda



Henri Francois
Computer Science
and Engineering
E3 Smart Grid, Haiti
(home country)



Janaya Brown
Aerospace and
Mechanical Engring
Weaved Wind Turbine
Blades, Uganda



Musodiq (Tolu)
Ogunlowo
Electrical Engineering
E3 Smart Grid, Nigeria
(home country)



Perfect
Mfashijwenimana
Electrical Engineering
E3 Smart Grid, Rwanda
(home country)

EXTERNAL PARTNERSHIPS

ND Energy has cultivated relationships and affiliations with local, regional, national, and global institutions, industries, and other universities to advance new developments in energy-related research and education through synergistic collaborations. Partnerships typically focus on one or more key attributes of ND Energy, yet all relationships have an impact on the mission and goals of ND Energy and the University as a whole. A list of the current partnerships are provided below.

American Electric Power
Argonne National Laboratory
AT&T
Atlanta University Center Consortium
Bertrand Farm
Boeing
City of South Bend
Deloitte
EDF Energy
Food Rescue US
Fund for the Public Interest
General Electric
IBM*
Indiana University
Inovateus Solar LLC
KPMG
Mishawaka Parks and Recreation
Mishawaka School Corporation
Prairie Winds Nature Farm
Purdue University
Regional Environmental Action Network, Indiana University South Bend
Sandia National Laboratories
South Bend Community School Corporation
Sustainability and Environmental Education Center, Goshen College
Sustainability Office, Indiana University South Bend
Unity Gardens

Energy and Sustainable Development + Design (ESDD) Laboratory

Energy E3 Partnerships

In addition, implementation of Energy E3 requires close collaborations and partnerships with other countries and institutions; currently, involving 12 professors, 10 technical instructors, and 100+ students, engineers, and technicians. These partnerships have been developed over the years by Dr. Abigail Mechtenberg through her work in the ESDD Laboratory.

Partner institutions in each of the countries where Energy E3 is being implemented are listed below.

Uganda

Makerere University, Holy Ascension Vocational and Business College, University of Notre Dame and Harvard Medical School in the United States

Rwanda

University of Rwanda

Nigeria

University of Lagos and Federal University of Technology

Haiti

Institute Haitien de L'Energie

Research BUSINESS DEVELOPMENT

Research proposal developments and related cross-campus collaborations that improve research capabilities and enable faculty to broaden and increase Notre Dame's funding portfolio in energy

ND Energy carries out research proposal development activities, including identifying funding opportunities, building teams and proposal reviews, to broaden and advance energy-related research at Notre Dame to over 80 affiliated faculty members and more than 300 associated researchers. Research capabilities are categorized in six main areas with the expansion of international development that encompasses all areas. Introduced in 2017, this new area focuses on energy and sustainability and ensures access to reliable, affordable, and sustainable energy in low- to middle-income countries.

RESEARCH THEME AREAS

The figures below indicate the number of affiliated faculty with expertise in each of the six theme areas within ND Energy. Many of our faculty have expertise in more than one area, which is also reflected in the following numbers.



55
Energy Conversion and Efficiency
energy catalysis, conversion of fuels, and energy efficient separations



33
Smart Distribution and Storage
smart grid technology and battery storage



23
Sustainable Bio/Fossil Fuels
biofuels design and carbon sequestration



16
Sustainable and Secure Nuclear
nuclear materials, nuclear forensics, and nuclear structures



19
Transformative Solar
photovoltaics and energy conversion efficiencies



10
Transformative Wind
ultra-tall towers and site locations



2017
International Research
energy and sustainability in low- to middle-income countries

E3 Education
Engineering design
Entrepreneurship

INTERNATIONAL EMPHASIS

The work by Abigail Mechtenberg, ND Energy's International Sustainable Development Researcher, and her collaborators in Africa continues to be at the forefront of ND Energy's international efforts.

Mechtenberg engages undergraduate students at Notre Dame in the implementation of **Energy E3 (Education, Engineering-design, and Entrepreneurship)**. Students typically travel to Africa to implement the E3 curriculum, most often in their own home countries. Energy E3 has been implemented in Uganda (where it originated), Nigeria and Rwanda, as well as in Haiti.

A major part of the curriculum involves the students developing teams of local technicians and engineers (as shown in the adjacent photo), who learn how to prototype, design, build, install, maintain, and create a business venture for renewable energy devices, all by using local materials and resident experts. Team members collaborate with the students until all devices have been completed and power generation is achieved.

Devices include **mechanical to electrical** — cattle-go-round generator, merry-go-round generator, bicycle generator, hand-crank generator, hydroelectric generator, wind turbines — **thermal to electrical** — concentrating solar power generator, thermal electric cook-stove/solar, waste incinerator generator — and **chemical to thermal to electrical** — retrofitted petrol generator (biogas) using anaerobic digester: methane, retrofitted petrol generator (biogas) using urine electrolysis: hydrogen, bio-diesel generator using Ugandan algae: oil. These devices, when combined, create micro-grids.

WEAVER IN UGANDA
CONSTRUCTING A WIND
TURBINE BLADE



EMPOWERING UGANDANS TO POWER UGANDA



LED BY DR. ABIGAIL MECHTENBERG, ND STUDENTS ARE WORKING WITH UGANDAN TEAMS TO CREATE SUSTAINABLE ENERGY DEVICES. THIS TEAM HAS INSTALLED WIND TURBINES WITH HAND-WOVEN BLADES AND OTHER LOCAL MATERIALS.

INTERNATIONAL (cont.)

Other international developments include an exploratory visit to **Nepal** with members of the Notre Dame Initiative for Global Development (NDIGD) to assess the energy needs of several communities for future collaborations.

A new relationship also was formed during Energy Week, when Arturo Massol Deyá, executive director of **Casa Pueblo** and professor of microbiology and ecology at the University of Puerto Rico-Mayaguez, received the attention of several campus groups during his presentation on Puerto Rico's goal to achieve energy independence by 2027. As a result, efforts are currently underway to develop curriculum for student service projects, experiential learning opportunities, and other student programs.

RESEARCH CENTERS



Since 2017, ND Energy has provided administrative and education and outreach

services to the NSF-funded **Center for Innovative and Strategic Transformation of Alkane Resources (CISTAR)**, Engineering Research Center (ERC), for Notre Dame's part, led by principal investigators Thomas Degan, Alex Dowling, Ruilan Guo, Jason Hicks, and William Schneider. Notre Dame is

RESEARCH CENTERS (cont.)

one of five CISTAR affiliated universities, with Purdue University as lead institution, and others being Northwestern University, University of Texas at Austin, and the University of New Mexico. (Visit <https://cistar.us/>)

ND Energy administered Notre Dame's first **CISTAR Young Scholars program** during summer 2018. Two local high school students, **Lee Ngochi** and **Hunter Allen**, rising seniors at South Bend Riley High School, participated in the program. Ngochi and Allen worked in laboratories on campus with CISTAR principal investigators William Schneider, H. Clifford and Evelyn A. Brosey Professor of Engineering, and Jason Hicks, associate professor of chemical and biomolecular engineering.

Ngochi's project focused on developing approaches to convert ethane, a major component of shale gas, into ethylene, a more valuable chemical product. Allen's project evolved around developing zeolite materials that will combine ethylene molecules into longer, more useful chemicals and fuels. Both students learned how to prepare materials in the lab, analyze them using modern laboratory instrumentation, and evaluate them using flow reactors.

At the end of the six-week program, Ngochi and Allen presented their research during Notre Dame's Summer Undergraduate Research Symposium in the Jordan Hall of Science.

Ngochi is shown below with graduate student mentor Jessica Muhlenkamp, and Allen is shown with graduate student mentor Neha Mehra. Other mentors, not shown here, were Galiya Magazova, Hanyu Ma, and Jeonghyun Ko.



Lee Ngochi with graduate student mentor Jessica Muhlenkamp



Hunter Allen with graduate student mentor Neha Mehra

RESEARCH CENTERS (cont.)



Actinide Center of Excellence

ND Energy also provides management and administrative support to the U.S. Department of Energy's NNSA-funded **Actinide Center of Excellence (ACE)**. Directed by Peter C. Burns, Henry Massman Professor of Civil and Environmental Engineering and Earth Sciences, the lead institution is the University of Notre Dame with other team investigators from Northwestern University, Oregon State University, University of Minnesota, and Washington State University.

The center's mission is to conduct research in actinide chemistry and materials with integration of experimental and computational approaches, emphasizing research questions and priorities that are important for security of the nation via Stockpile Stewardship with

workforce development as a motivating goal. The specific research themes are the following: (1) the properties and structure of nanoscale radioactive materials, (2) the thermochemistry, or heat energy, associated with these materials, and (3) how nanoscale nuclear materials react in various chemical environments.

(Visit <http://www.actinidecenter.com/>)

RESEARCH PROPOSALS, AWARDS, AND EXPENDITURES

The following represents the total number of energy-related research proposals submitted, award increments received, and the expenditures that were made in CY2018, as well as the percentage and total amount affiliated with ND Energy. The 32 awards represent 29 different projects.

Proposals

COUNT: **68**

AMOUNT: **\$65M**

AFFILIATION: **38% \$25M**

Awards

COUNT: **32**

AMOUNT: **\$9M**

AFFILIATION: **75% \$7M**

Expenditures

COUNT: **32**

AMOUNT: **\$10M**

AFFILIATION: **87% \$9M**

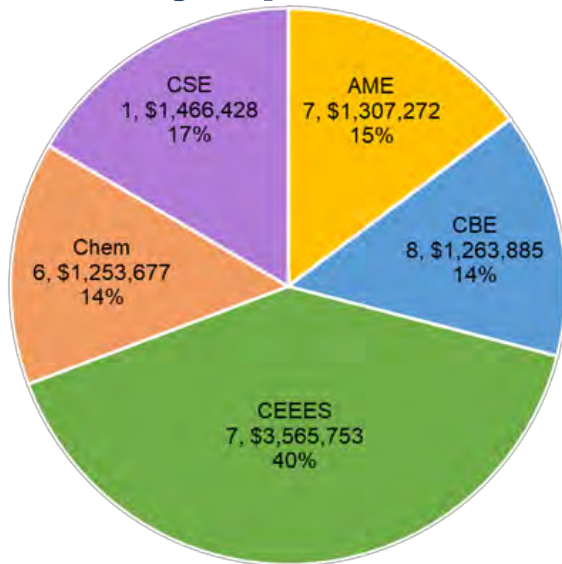
RESEARCH PROJECTS AND AWARD INCREMENTS — \$8,857,015

Project Title	Sponsor	Lead PI	Dept	Amount
Towards Realistic Models of Heterogenous Catalysis: Simulations of Redox Catalysis from First Principles	DOE	Schneider, William	CBE	\$171,142
Topological Structural Relationships, Properties, and Nano-structures	DOE	Burns, Peter	CEEES	\$173,525
Advancement of Nuclear Forensic Science	DHS	Simonetti, Antonio	CEEES	\$199,739
Probing Local, Hybrid Perovskite Photophysics through Spatially- and Temporally-resolved Absorption/ emission Microscopy	DOE	Kuno, Masaru	CHEM	\$199,440
Spatially-resolved Infrared Absorption Spectroscopy of Individual Semiconductor Nanostructures and Nanoscale Chemical Imaging	NSF	Kuno, Masaru	CHEM	\$58,705
Multidisciplinary Approaches to Radiation Balanced LasERS (MARBLE): Rare Earths and Semiconductors in Disks, Fibers, and Microstructures	Other	Kuno, Masaru	CHEM	\$158,863
CAREER: Fundamental Materials Studies on Fast Ion Diffusion in Model Side-chain Ionomers	NSF	Schaefer, Jennifer	CBE	\$96,444
Whitmer MICCoM Subcontract - SSAGES and COPSS Packages	Nat Lab	Whitmer, Jonathan	CBE	\$130,000
CAREER: SusChEM: Renewable Biocatalysts for Degradation of Persistent Organic Contaminants Using Synthetic Biology	NSF	Wei, Na	CEEES	\$199,601
2016 DuPont Young Professor Program	Other	Luo, Tengfei	AME	\$25,000
Nanoscale Imaging of Optical-Frequency Plasmonic Energy Transfer in Individual Nanoparticles and their Assemblies	DOE	Camden, Jon	CHEM	\$168,071
CDS&E: Method Development for Coupled Charge and Thermal Transport in Molecular Simulations	NSF	Gezelter, J. Daniel	CHEM	\$150,000
In-Pile Instrumentation Initiative: Work Package 4: Advanced Manufacturing	Nat Lab	Zhang, Yanliang	AME	\$90,000
Collaborative Proposal: Chicxulub Impact Effects and the Recovery of Life Using Scientific Drilling Investigations at Ground Zero	NSF	Neal, Clive	CEEES	\$69,431
Understanding the Chemical Complexity of Multi-component Systems: Uranium Polyoxometalates as Nanosorbents	DOE	Hixon, Amy	CEEES	\$144,283
Actinide Center of Excellence (ACE)	NNSA	Burns, Peter	CEEES	\$2,449,096
Engineering Research Center for Innovative and Strategic Transformation of Alkane Resources - CISTAR	Purdue	Degnan, Thomas	CBE	\$458,358
CAREER: Targeting Assembly in Colloidal Materials by Tilting the Free Energy Surface	NSF	Whitmer, Jonathan	CBE	\$95,092
Plasma-Enhanced Catalysis: A Detailed Study of Surface Interactions Between Low-Temperature Plasma and Catalytic Materials	Air Force	Go, David	AME	\$358,986
CAREER: Self-consistent Models of Electronic Dynamics and Relaxation	NSF	Parkhill, John	CHEM	\$518,598
Collaborative Research: Intermittency in Multi-Phase Flows in 2D and 3D Porous Media: Coordinated Experiments and Simulations	NSF	Christensen, Kenneth	AME	\$333,643
Leveraging a New Theoretical Paradigm to Enhance Interfacial Thermal Transport In Wide Bandgap Power Electronics	Other	Luo, Tengfei	AME	\$190,550
Regulating Gas Transport in Molecularly Engineered Polymer Membranes	DOE	Guo, Ruilan	CBE	\$168,849
Energy Harvesting Approaches to Low-Temperature Plasma Generation for Field Applications	NSF	Go, David	AME	\$274,093
SCC: Smart Water Crowdsensing: Examining How Innovative Data Analytics and Citizen Science can Ensure Safe Drinking Water in Rural Versus Suburban Communities	NSF	Wang, Dong	CSE	\$1,466,428
GOALI: Effect of Hydroxylamine on the Structure and Function of Nitrifying Biofilms	NSF	Nerenberg, Robert	CEEES	\$330,078
Breakthrough Electrolytes for Energy Storage (BEES)	Other	Maginn, Edward	CBE	\$108,000
Magnesium-polysulphide Flow Batteries for Large Energy Storage	Other	Schaefer, Jennifer	CBE	\$36,000
Skin Friction Reduction by Micro-fiber Coating in Water	Other	Sakaue, Hirotaka	AME	\$35,000

Multi-investigator Projects

Cross-disciplinary Projects

2018 Award Increments by Department



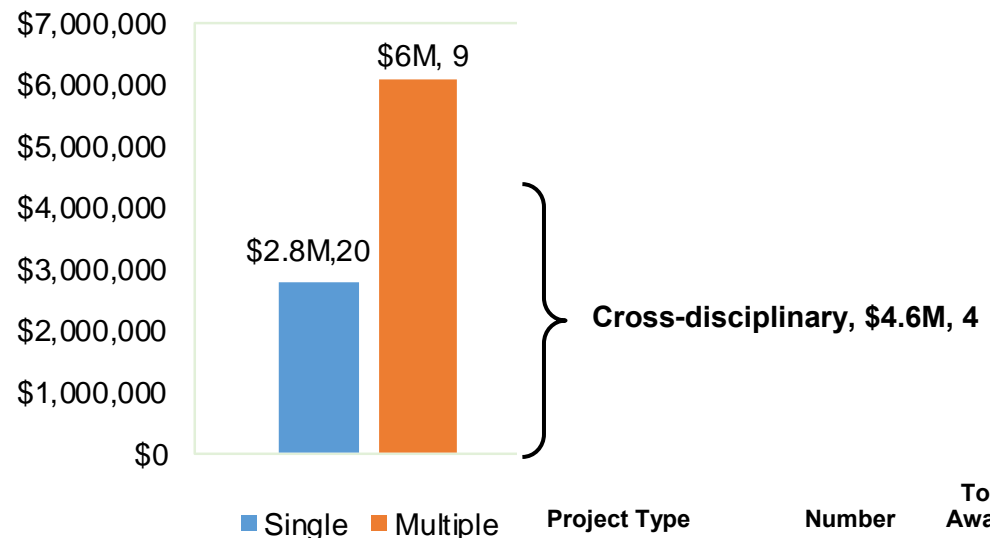
Dept	Total Awards	Total Projects	Total Lead PI
AME	\$1,307,272	7	5
CBE	\$1,263,885	8	6
CEEES	\$3,565,753	7	6
Chem	\$1,253,677	6	4
CSE	\$1,466,428	1	1
5	\$8,857,015	29	22

AME = Aerospace and Mechanical Engineering
 CBE = Chemical and Biomolecular Engineering
 CEEES = Civil & Environmental Engineering & Earth Sciences
 Chem = Chemistry and Biochemistry
 CSE = Computer Science and Engineering

Twenty-two (22) principal investigators (PIs) affiliated with ND Energy received award increments in 2018 for 29 different projects. The PIs represented 5 departments in 2 colleges: 18 PIs from 4 departments in the College of Engineering and 4 PIs from 1 department in the College of Science.

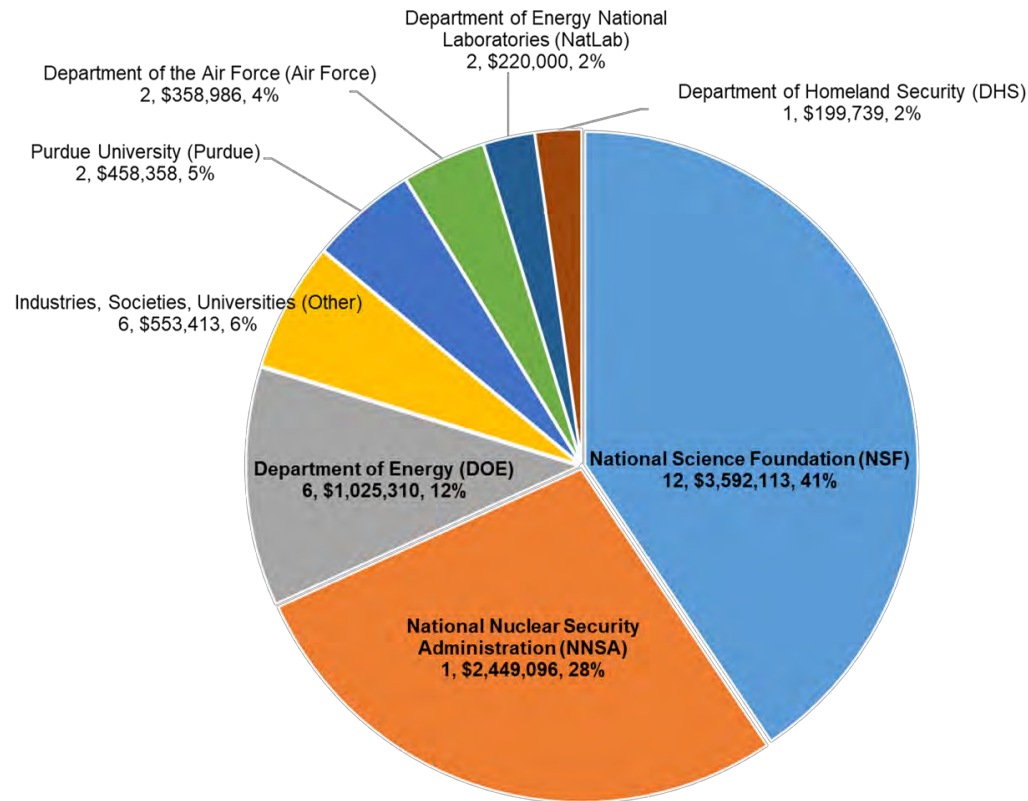
The pie chart shows the total amount of award increments by department, and the table below shows the number of projects and lead PIs within each department. The department with the highest dollar amount was CEEES with \$3.6M for 7 projects led by 6 different PIs. One of the projects was the NNSA funded Actinide Center of Excellence with an increment amount of \$2.5M.

In addition, there were 20 single-investigator projects and 9 multi-investigator projects of which 4 were cross-disciplinary, involving PIs from both colleges. The graph below shows the total amount of award increments by project type.



Project Type	Number	Total Awards
Single Investigator	20	\$2,787,154
Multiple Investigator	5	\$1,461,708
Cross-disciplinary	4	\$4,608,153
TOTAL	29	\$8,857,015

Funding by Sponsor



The highest total amount of funding was from the National Science Foundation (NSF) (\$3.6M) with the next highest from the National Nuclear Security Administration (NNSA) (\$2.5M) and then the Department of Energy (DOE) (\$1M).

Other (\$553K) includes industries, societies, and universities.

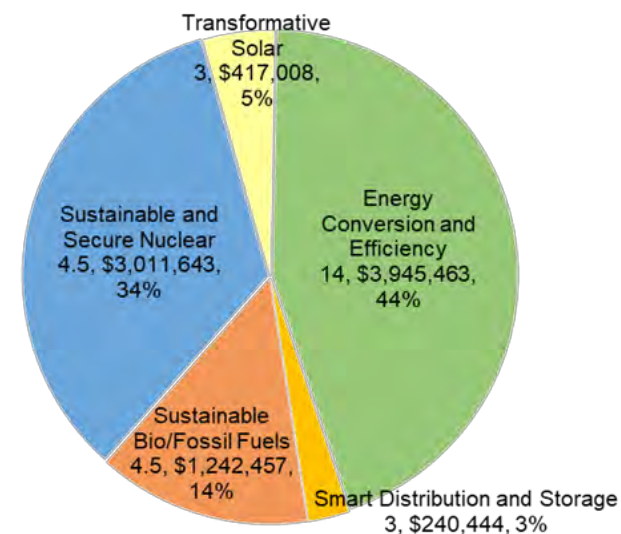
Purdue (\$458K) is the lead organization on the NSF ERC, CISTAR, of which Notre Dame is a part.

The remaining includes the Department of the Air Force (Air Force) (\$359K), the DOE National Laboratories (NatLabs) (\$220K), and the Department of Homeland Security (DHS) (\$200K).

Funding by Research Area

Of the 32 awards, there were 29 different projects that were focused on one or more of the six research theme areas of ND Energy. They were as follows:

14 Energy Conversion and Efficiency	\$3,945,463
3 Smart Distribution and Storage	\$240,444
4.5 Sustainable Bio/Fossil Fuels	\$1,242,457
4.5 Sustainable and Secure Nuclear	\$3,011,643
3 Transformative Solar	\$417,008
0 Transformative Wind	\$0

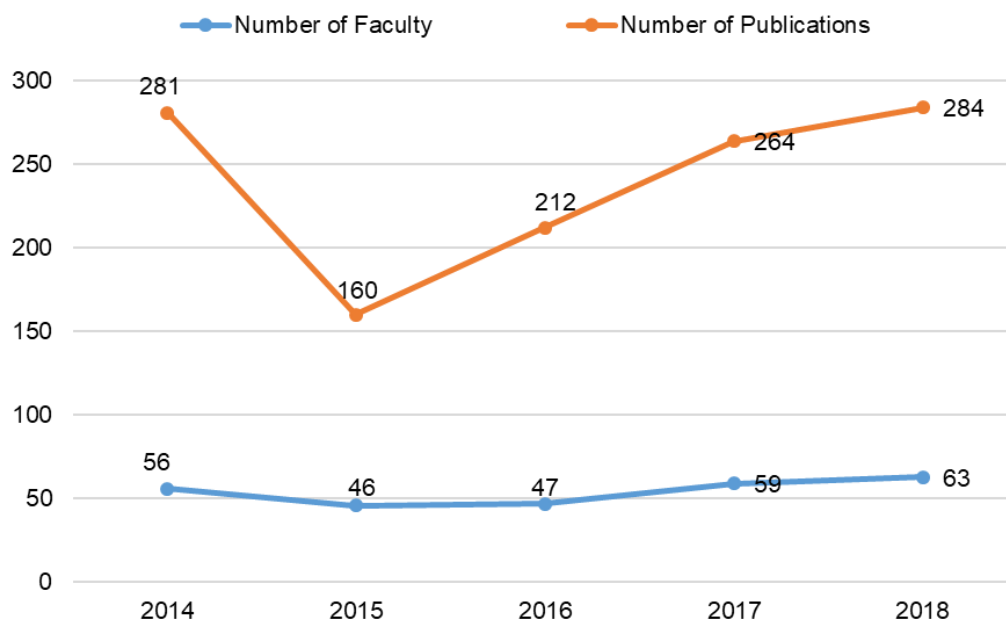


ENERGY-RELATED PUBLICATIONS — 284

Sixty-three (63) affiliated faculty members published a total of 284 energy-related journal articles in 2018. Nine (9) faculty members published 10 or more journal articles this year, representing nearly 50% of the total publications.

Departments with the highest number of publications were Chemical and Biomolecular Engineering with 89, Chemistry and Biochemistry with 64, Civil and Environmental Engineering and Earth Sciences with 45, and Aerospace and Mechanical Engineering with 44.

**TOTAL NUMBER OF FACULTY AND ENERGY-RELATED PUBLICATIONS
2014—2018**

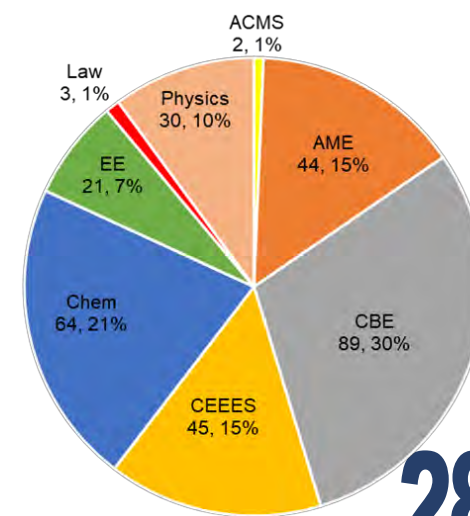


Faculty with = / > 10 Publications

PI	Dept	No.
Burns, Peter	CEEES	22
Camden, Jon	Chem	11
Kamat, Prashant	Chem	20
Luo, Tengfei	AME	15
Maginn, Edward	CBE	10
Mathews, Grant	Physics	11
Mukasyan, Alex	CBE	13
Schneider, William	CBE	14
Whitmer, Jonathan	CBE	10

126
PUBLICATIONS

Total Publications by Department



284
PUBLICATIONS

RESEARCH BUSINESS DEVELOPMENT

Research business development is a key component of ND Energy. ND Energy enabled new relationships and created new faculty groups to create synergies across disciplines with the aim to broaden research collaborations and foster new ideas and cross-cutting programs. ND Energy works to create these synergies by focusing monthly faculty forums on selected topics related to upcoming or anticipated external funding opportunities. This year's topics featured the following faculty and discussion areas.

Nanostructuring and Additive Manufacturing Towards High-performance and Flexible Thermoelectric Energy Systems

Yanliang Zhang, Assistant Professor of Aerospace and Mechanical Engineering

Operando Spectroscopy in Catalysis, Gas Separation Membranes, and Beyond

Casey O'Brien, Assistant Professor of Chemical and Biomolecular Engineering

Modus-operandi of Various Funding Agencies and Upcoming Opportunities in DOE, NSF, and DoD

Peter Burns, Massman Professor of Civil and Environmental Engineering and Earth Sciences

Kathie Olsen, Managing Director of ScienceWorks

Richard Billo, Associate Vice President of Research

Light-matter Interactions

Anthony Hoffman, Associate Professor of Electrical Engineering

Svetlana Neretina, Associate Professor of Aerospace and Mechanical Engineering

Jon Camden, Associate Professor of Chemistry and Biochemistry

Greg Hartland, Professor of Chemistry and Biochemistry

Polymer Sciences

Haifeng Gao, Associate Professor of Chemistry and Biochemistry

Ruilan Guo, Associate Professor of Chemical and Biomolecular Engineering

Jennifer Schaefer, Assistant Professor of Chemical and Biomolecular Engineering

William Phillip, Associate Professor of Chemical and Biomolecular Engineering

Research Frontiers in Nuclear Science

Peter Burns, Massman Professor of Civil and Environmental Engineering and Earth Sciences

Jay LaVerne, Professional Specialist and Concurrent Professor in Radiation Physics

Ani Aprahamian, Freimann Professor of Experimental Nuclear Physics

RESEARCH SERVICES

Working closely with affiliated faculty and associated researchers is an integral part of ensuring that we provide the right resources and support services to enable new technologies and scientific advancements in energy production and use. This also allows us to support other scholastic initiatives and academic achievements in ways to further enhance research and pedagogy in energy. The following services are the key areas of support provided by ND Energy.

Proposal Preparation

- Identify FOAs/RFPs relevant to PIs core expertise.
- Assist with identifying and building internal and external collaborations.
- Provide a checklist of items to be completed in accordance with the FOA Guidelines.
- Coordinate proposal writing activity – gathering information, organizing meetings, timeline, etc.
- Write the non-technical sections of the proposal in accordance with the FOA Guidelines.
- Review technical and non-technical sections of the proposal and suggest improvements in accordance with the FOA Guidelines.
- Gather the Current and Pending and CV for each PI.
- Prepare internal budget and budget justification in accordance with the FOA Guidelines.
- Provide letters of support from ND Energy for core research facilities, broader impacts, and other related services.
- Prepare or coordinate the completion of sponsor forms.

Education and Outreach Development

- Consult with faculty to assess outreach needs and opportunities within the scope of research and make suggestions for connections with existing programs.
- Develop new education and outreach programs to address specific requirements of the “broader impacts” of the research proposal.
- Write or provide descriptions of outreach opportunities for the “broader impacts” section of the proposal to include existing programs such as K-12 outreach programs, community events, laboratory tours, seminar speakers, lectureship series, conferences, and any new programs that are developed to address specific requirements of the research proposal.
- Communicate, promote, and help execute existing and new education and outreach programs, including inviting speakers for seminars, lectures, and conferences and developing promotional materials such as articles, flyers, and posters.
- Maintain a list of faculty interested in various outreach events to best match faculty interests to outreach opportunities.

Project Management and Financial Coordination

- Manage project goals and provide operational oversight as needed.
- Manage all aspects of the grant budget, including tracking and projecting expenditures, identifying and reconciling anomalies, approving invoices, and requesting budget revisions and cost or no-cost extensions, interfacing with Notre Dame Research and Sponsored Programs Accounting.
- Coordinate the hiring process of researchers on the project with appropriate department personnel.
- Organize and coordinate group meetings to assess progress on the project.
- Assist with quarterly progress reports and production deadlines by collecting data from researchers and subcontractors, organizing materials, and submitting quarterly progress reports in accordance with sponsor requirements.
- Consult as needed with the PI and provide monthly reports on budget activities and areas requiring attention.

DISTINGUISHED LECTURES, SYMPOSIA, AND WORKSHOPS

ND Energy organized or co-sponsored the following distinguished lectures, symposia, and workshops during 2018. These efforts were designed to bring nationally recognized experts from academia, industry, and government to Notre Dame to discuss topics of importance to faculty and students and to share best practices, new technologies, and policy developments in energy.

Distinguished Lectures



Chris Tindal

Assistant Director,
Commercial
Aviation Alternative
Fuels Initiative
(CAAFI)

“Sustainable
Alternative Fuel Use
in the Military and
Commercial
Aviation”

January 31, 2018



**Richard van de
Sanden**

Director, Dutch
Institute for
Fundamental Energy
Research (DIFFER),
Professor of Applied
Physics, Eindhoven
University of
Technology,
Netherlands

“Renewable Energy
Driven Non-
equilibrium
Chemistry: Plasma
Chemistry as the
Special Case”

March 16, 2018



Sally Benson

Co-Director,
Precourt Institute for
Energy, Stanford
University

“The Global Climate
and Energy
Challenge”

April 18, 2018



Ashish Sharma

Research Assistant
Professor, Civil &
Environmental
Engineering & Earth
Sciences, University
of Notre Dame

“Global Warming
and Social Justice:
Fighting for
Vulnerable Chicago
Neighborhoods”

September 17, 2018



Darron Scott

President and Chief
Executive Officer,
Kodiak Electric
Association, Inc.

“Kodiak, Alaska:
How an Energy
Co-op Went 100%
Renewable”

September 18, 2018



Distinguished Lectures (cont.)



Patrick Regan

Professor of Political Science and Associate Director, Environmental Change Initiative, University of Notre Dame

“Policy vs. Science: The Politics of Climate Change”

September 24, 2018



Arturo Massol-Deya

Executive Director of Casa Pueblo and Professor of Microbiology and Ecology, University of Puerto Rico at Mayaguez

“Casa Pueblo’s Energy Insurrection in Puerto Rico”

September 26, 2018



Altaf H. Carim

Office of High Energy Physics (HEP) and the Office of Science (SC), U.S. Department of Energy

“High Energy Physics at DOE: Spotlight on the Neutrino Research Program and Quantum Information Science”

October 23, 2018



Babu Chalamala

Head of the Energy Storage Technology and Systems Department and Program Manager for Grid Energy Storage, Sandia National Laboratories

“Grid Energy Storage Technologies and the Future Electric Grid”

October 30, 2018



Arun Majumdar

Jay Precourt Provostial Chair, Professor of Mechanical Engineering and Materials Science and Engineering, Co-Director, Precourt Institute for Energy, Stanford University

“Navigating the Turbulence of the Global Energy System”

November 3, 2018

Symposia and Workshops



Notre Dame-Purdue Symposium on Soft Matter and Polymers

University of Notre Dame

October 6, 2018



4th Workshop on Management and Control of Energy Supply-demand Networks with Renewables

University of Notre Dame

October 24, 2018



Notre Dame-Purdue Symposium on Soft Matter and Polymers “Best Poster” award winners with event organizers (from left to right): Wei Zhao (Indiana University), Prof. Haifeng Gao (Notre Dame), Prof. Jianguo Mei (Purdue), Longfei Liu (Purdue), Hunter Ford (Notre Dame), Prof. Matt Webber (Notre Dame), Lei Zou (Notre Dame), Loan Bui (Notre Dame), Feng Gao (Notre Dame), Jaeyub Chung (Purdue), and Saadia Chaudhry (Purdue)



ND Energy held its inaugural research symposium on April 18, 2018, drawing nearly one-hundred researchers from the University of Notre Dame.

The event focused on celebrating recent accomplishments in energy-related research and featured presentations by faculty who recently received early career awards and large-center grants. The day-long event also featured keynote speaker **Sally M. Benson**, co-director of the Precourt Institute for Energy at Stanford University. She discussed **“The Global Climate and Energy**

Challenge” and highlighted emerging solutions to provide secure, affordable, and sustainable energy for the nine billion people expected on Earth by 2050. She described the challenge of meeting the world’s growing energy needs while also finding ways to reduce carbon dioxide emissions. Benson highlighted game changers that have brought low carbon and low cost energy, such as natural gas, wind turbines, and photovoltaics. She looked ahead to new technologies for renewable integration and decarbonizing transportation, stressing the importance of research and development in the creation of the next generation of energy solutions. She concluded by saying that leadership, innovation and persistence are the keys to a sustainable energy future.



After the keynote presentation, the focus of the symposium shifted to specific research being done at Notre Dame and faculty who had recently received early career awards. Their presentations were as follows:

“Unprecedented Chain-growth Polymerization Method to Access Structurally Defined Hyper-branched Polymers” by **Haifeng Gao**, Associate Professor, Department of Chemistry and Biochemistry

“Understanding the Chemical Complexity of Multi-Component Systems: Uranium Polyoxometalates as Nanosorbents” by **Amy Hixon**, Assistant Professor, Department of Civil and Environmental Engineering and Earth Sciences

“Thermal Transport across Hydrogen-Bonded Hard-Soft Interfaces” by **Tengfei Luo**, Dorini Family Collegiate Associate Professor, Department of Aerospace and Mechanical Engineering

“Renewable Biocatalysts for Degradation of Persistent Organic Contaminants Using Synthetic Biology” by **Na Wei**, Assistant Professor, Department of Civil and Environmental Engineering and Earth Sciences

“Fundamental Materials Studies on Fast Ion Diffusion in Model Side-chain Ionomers” by **Jennifer Schaefer**, Assistant Professor, Department of Chemical and Biomolecular Engineering

“Nucleophilic, Radical, and Electrophilic Palladium Carbene Complexes: New Types of Reactivity for Palladium” by **Vlad Iluc**, Associate Professor, Department of Chemistry and Biochemistry



After lunch, associated graduate students and postdoctoral scholars participated in a poster session and presented their energy-related research projects. Four judges evaluated the presentations based on statement of research purpose, explanation of methods, analysis of results, and ability to answer questions about the conclusions. The aesthetic effectiveness of the poster was also considered in the scoring. Three graduate students were selected to receive awards. They were **Nick Kempf** (Zhang Laboratory) who presented **“A Robust High-sensitivity Scanning Thermal Probe for Simultaneous Microscale Thermal and Thermoelectric Property Mapping.”** The next award went to **Rebecca Scheidt** (Kamat Laboratory) for her poster on **“Modulation of Charge Recombination in CsPbBr₃ Perovskite Films with Electrochemical Bias.”** The final award went to **Brooke Stemple** (Wei Laboratory) who presented **“Enhanced Ionic Liquid Tolerance of *Yarrowia Lipolytica* Through Evolutionary Engineering for Simultaneous Saccharification and Fermentation of Lignocellulosic Biomass.”**



Poster Winners from left to right: Brooke Stemple, Nick Kempf, and Rebecca Scheidt

After the poster session, the afternoon concluded with presentations focused on the following three, recently awarded, large-center grants:

Center for Innovative and Strategic Transformation of Alkane Resources (CISTAR), presented by William Schneider, H. Clifford and Evelyn A. Brosey Professor of Engineering in the Department of Chemical and Biomolecular Engineering; Concurrent Professor of Chemistry and Biochemistry. Funded by the National Science Foundation (NSF), this Engineering Research Center (ERC) is led by Purdue University with principal investigators from the University of Notre Dame, University of New Mexico, University of Texas-Austin, and Northwestern University. The mission of CISTAR is to create a transformative engineered system to convert light hydrocarbons from shale resources to chemicals and transportation fuels in smaller, modular, local, and highly networked processing plants.

Extremely Energy Efficient Collective Electronics (EXCEL), presented by Michael Niemier, Associate Professor in the Department of Computer Science and Engineering. Co-funded by the Semiconductor Research Corporation Nanoelectronics Research Initiative (E2CDA-NRI) and the National Science Foundation (NSF), the EXCEL Center is one of six cross-disciplinary, collaborative research efforts, led by the University of Notre Dame with principal Investigators from the University of California-San Diego, University of California-Irvine, University of Chicago, Pennsylvania State University, and Georgia Tech. The primary goal of EXCEL involves creating a revolutionary, highly-efficient, general purpose computing platform with neuro-inspired cognitive and learning abilities to address the vast range of future data types and workloads.

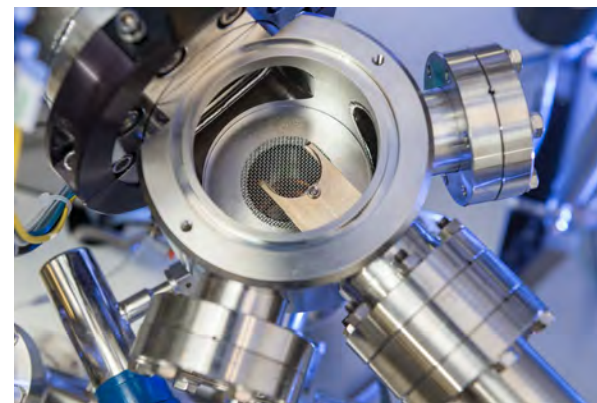
Actinide Center of Excellence (ACE), presented by Peter C. Burns, Henry Massman Professor of Civil and Environmental Engineering and Earth Sciences, Concurrent Professor of Chemistry and Biochemistry, and Director of ND Energy. Funded by the National Nuclear Security Administration's Stewardship Science Academic Alliances (SSAA) program, the center is led by the University of Notre Dame with principal investigators from Washington State University, University of Minnesota, Oregon State University, and Northwestern University. The center's mission is to conduct research in actinide chemistry and materials with integration of experimental and computational approaches, and an emphasis on research questions and priorities that are important for security of the nation via Stockpile Stewardship, with workforce development a motivating goal.

MATERIALS CHARACTERIZATION FACILITY

mcf.nd.edu

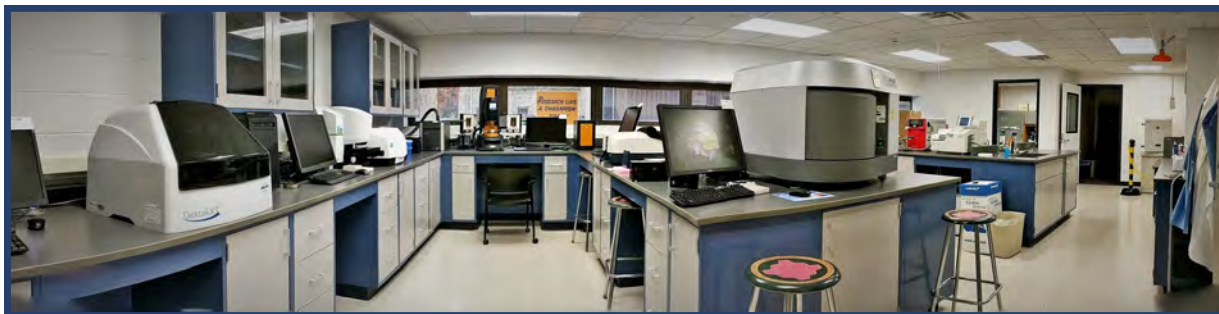
The Materials Characterization Facility (MCF) is part of ND Energy and provides world-class, state-of-the-art equipment and instrumentation to support scientific advancements and new or improved sustainable energy technologies and systems. Managed by Dr. Ian Lightcap, Research and Facilities Program Director, the MCF has capabilities in the following major areas:

- **General Materials Characterization** provides modern instrumentation and expertise for solid, liquid and gas characterization by spectroscopic, thermal, X-ray, BET, and spectrometric analytical methods.
- **Photovoltaic and Electrocatalyst Characterization** provides two catalyst and photovoltaic testing stations that include solar simulators, automated gas sampling loops for in-line GC evolved gas detection, and a potentiostat with electrochemical impedance and rotating disc electrode capabilities.
- **Crystallographic Characterization** provides powder and single crystal X-ray diffractometers for a wide range of structural characterization.



In August 2018, the MCF moved to 146-147 Stepan Chemistry Hall. The new site offers additional space for instrumentation and allows for further growth in research capabilities. Tours of the new facility were held in late August and are available to groups and individuals upon request. To schedule a tour and to learn more about the MCF, contact Dr. Ian Lightcap, 146 Stepan Chemistry Hall, (574) 631-1493, ilightca@nd.edu.

Other developments included the new [MCF LinkedIn page](#), where general information and timely announcements about training opportunities, new instrumentation, and other relevant topics will be posted. Also, the MCF has a redesigned website -- mcf.nd.edu -- showcasing instrumentation and capabilities, laboratory safety and training, and use of the facility for both internal and external users.

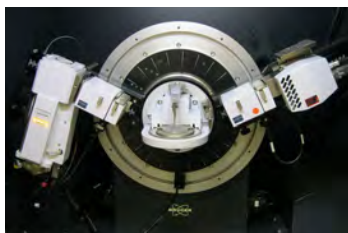


The MCF's mission is to provide researchers with high quality data, driving every aspect of the MCF including its major goals to provide:

1. excellent training,
2. excellent customer service,
3. excellent education, and
4. instrument acquisition.

MCF MAJOR CAPABILITIES

The MCF delivers state-of-the-art analytical services, expertise, and instrumentation with unique capabilities to resolve some of the most relevant scientific problems facing researchers today. There are nine major areas of research capabilities, all with world-class instruments for quality results that are available to both internal and external users. They are as follows:



Crystallography

Instruments:

Powder XRD
Single Crystal XRD
High-Res XRD



Electrochemistry

Instruments:

Solar Fuels and
Electrocatalyst Testing
Stations



Gas Analysis

Instruments:

Gas Chromatograph with
Mass Spectrometry
GC-FID
GC-TCD
Triple Quad GC-MS*



Polymer/Particle Analysis

Instruments:

SEC-MALS
Zetasizer and DLS



Rheometry/DMTA/Tribology

Instruments:

Hybrid Rheometer*



Spectroscopy

Instruments:

FTIR
FTIR Microscope
Micro-Raman
Solar Simulators
UV-Vis



Surface Analysis

Instruments:

ASAP 2020 Surface Area
and Porosity Analyzer
Profilometer
AFM Park XE7
Asylum AFM
XPS
Microprobe



Synthesis

Instruments:

Microwave Reactor
Thermal Evaporator



Thermal Analysis

Instruments:

DSC
Calorimeter - Drop Solution
Calorimeter - Reaction
TGA/DSC
TGA/DSC-Mass

*** New instruments are added to the MCF as new faculty join the University, when awards are received through the University's Equipment Restoration and Renewal (ERR) Program, and when faculty purchase equipment with research funds. For example, in 2018, the Triple Quad GC-MS and, in 2017, the Hybrid Rheometer were acquired through the ERR program.**

The MCF provides external users with customized analytical solutions that run the gamut of customer-specified analytical work to sponsored R&D projects that involve coordinated use of analytical services across campus, as well as experienced faculty with expertise in materials areas important to the issues being investigated.

MCF IN NUMBERS

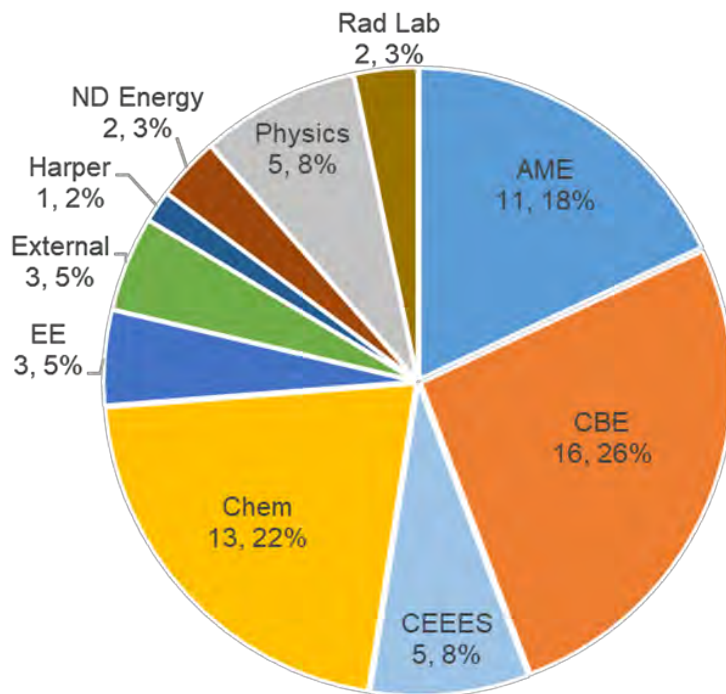
PROPOSALS

There were **29** research proposals submitted to external funding sources that included the use of the MCF in its “facilities and equipment” sections in order to achieve research objectives.

AWARDS

There were **12** research awards that indicated the use of the MCF to achieve its research objectives. The total amount of funding received for all awards was \$4,892,810, representing a 19% increase in funding from the previous year.

PIs by Department



PUBLICATIONS

Publications are another key indicator for the MCF. There were an estimated **52** publications that used data from MCF instruments.

USERS

There are **61** principal investigators (PIs) from **10** different departments or centers/institutes on campus who have group members using facility resources.

The largest user group was from the Department of Chemical and Biomolecular Engineering with 16 PIs. The next largest was from the Department of Chemistry and Biochemistry with 13 PIs.

There are over **300** active researchers that use one or more of the instruments in the MCF

29

12

52




61

10

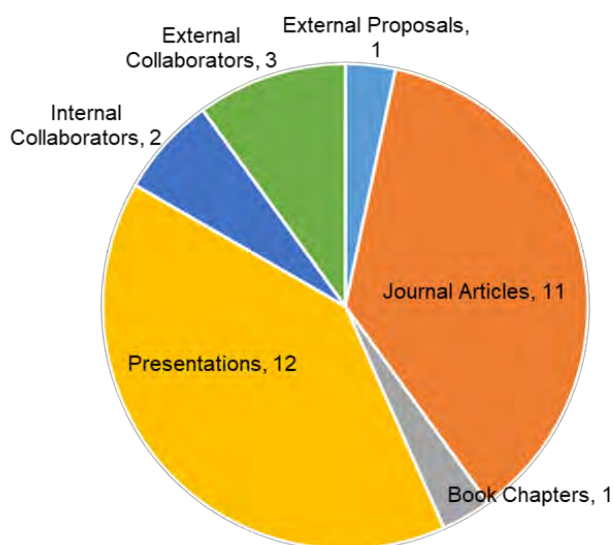
300

POSTDOCTORAL FELLOWSHIPS IN ENERGY RESEARCH

Starting in 2014, the ND Energy Postdoctoral Fellowship Program offered competitive fellowships to postdoctoral scholars committed to advancing energy-related research at Notre Dame. Fellows received 50% of their annual stipends, travel funds to attend professional conferences, and funds to use core research facilities at Notre Dame. Funding was for at most a 2-year period. Throughout the 4-year program period, there were 18 fellowships granted. During 2018, the following 3 postdoctoral scholars wrapped up their fellowships. The program ended in 2018.

Fellow	Faculty Advisor	Project Title
 Ashkan Zeinalzadeh (2016-2018)	Vijay Gupta Electrical Engineering	<i>Real Time Pricing in the Presence of High Penetration of Solar Energies</i>
 Yaofa Li (2016-2018)	Kenneth Christensen Aerospace and Mechanical Engineering	<i>Ensuring Long-Term Security of Stored CO₂: Fundamental Studies of the Multiphase Flow of Water and Liquid/ Supercritical CO₂ in 2D Heterogeneous Porous Micromodels</i>
 Tyler Spano (2017-2018)	Antonio Simonetti Civil and Environmental Engineering and Earth Sciences	<i>Development of Novel Isotope Tracer Methods for Nuclear Forensic Applications</i>

2018 Total Output



Former postdoctoral recipients are listed here.





Fellow	Years	Dept	Faculty Advisor
Peng Cui	2014-2015	Chem	Vlad Iluc
Guoliang Li	2014-2015	Chem	Jon Camden
Chad Stephenson	2015-2017	EE	Mark Wistey
Tao Jiang	2015-2016	AME	Tengfei Luo
Ashish Sharma	2015-2016	ECI/Bio	Jessica Hellmann
Shuangjiang Luo	2015-2017	CBE	Ruilan Guo
Matthew Smylie	2015-2017	Physics	Boldizsar Janko
Deisy Pena Romero	2015	Chem	Brandon Ashfeld
Peng Gao/Jacob Weidman	2015-2017	CBE	William Phillip
Yanlin Guo	2015-2016	CEEES	Gino Kurama
Maksym Zhukovskiy	2015-2017	Chem	Masaru Kuno
Gary Zaiats	2016-2017	Chem	Prashant Kamat
Yi Shi	2016-2017	Chem	Haifeng Gao
Paul Rumbach	2016-2017	AME	David Go
Jarrold Schiffbauer	2016-2017	AME	Tengfei Luo

STUDENT FELLOWSHIPS IN ENERGY RESEARCH

ND Energy offers research fellowships to undergraduate and graduate students, providing unique opportunities for students to enhance their knowledge and research capabilities in energy. Undergraduate fellowships were first offered in 2006, while graduate fellowships began in 2012. Each opportunity asks students to submit a collaborative research proposal with their faculty advisor explaining their research objectives and demonstrating their academic achievements and capabilities to accomplish their goals.

The Patrick and Jana Eilers Graduate Student Fellowship for Energy Related Research

The Patrick and Jana Eilers Graduate Student Fellowship for Energy Related Research provides financial support for graduate students who are affiliated with ND Energy faculty to enable their work in energy-related research. Since 2012, 20 fellowships have been awarded totaling \$182,946. In 2018, 4 graduate students received awards totaling \$33,000. The recipients and their projects are highlighted below.

	2018 Eilers Fellow	Department	Project Title
	Yolanda Bonita Advisor: Jason Hicks	Chemical and Biomolecular Engineering	Catalytic Performance of Molybdenum Based Bimetallic Phosphide Catalysts for C-O Bond Activation for Renewable Energy Production
	Feng Gao Advisor: William Phillip	Chemical and Biomolecular Engineering	Elucidating the Role of Electrostatic Interactions in Facilitating Ion Transport through Charge-Mosaic Membranes for Water Purification and Desalination Applications
	Rebecca Scheidt Advisor: Prashant Kamat	Chemistry and Biochemistry	Charge Carrier Migration and Halide Ion Movement in All-Inorganic Perovskite Films for Photovoltaic Applications
	Andrew Schranck Advisor: Kyle Doudrick	Civil & Environmental Engineering & Earth Sciences	Urea Electrolysis Cells for Producing Hydrogen Fuel

The Patrick and Jana Eilers Graduate Student Fellowship for Energy Related Research is made possible through the generosity of Patrick (ND '90) and Jana Eilers. Since 2013, the *Fitzpatrick Endowment for Excellence in Energy*, made possible through the generosity of Edward Fitzpatrick, Jr. (ND '54), and since 2015, the *Michael A. O'Sullivan Endowment for Excellence in Energy Research*, made possible through the generosity of Michael O'Sullivan (ND '82), have been combined with the *Eilers fellowship* to provide greater financial support to students.

2012-2018

20 Awards

\$182,946

Associated Researchers

Associated researchers are graduate students and postdoctoral scholars working with ND Energy affiliated faculty. To support advancements in energy-related research, ND Energy provides regular opportunities for associated researchers to discuss their research projects with their peers and to participate in outreach activities to share their research with the broader community.

Each month ND Energy hosts a luncheon seminar for associated researchers. Up to two associated researchers are invited to present their research projects in energy. This series is designed to facilitate cross-disciplinary collaborations and to provide a forum for researchers to gain a better understanding of the energy-related research programs at Notre Dame. Below are the presentations that were held during 2018.

Date	Researcher	Dept	Presentation Title
January	Kazuhiro Iwamatsu	Rad Lab	Decomposition of Hydrogen Peroxide in Water Radiolysis
February	Hansheng Ye (Fay Lab)	EE	Defect Study for III-V Multijunction Solar Cells
	Jinghan Wang (Fay Lab)	EE	High Voltage Vertical p-n Diodes with Ion-Implanted Edge Termination and Sputtered SiNx Passivation on GaN Substrates
March	Hernan Delgado (Go Lab)	AME	Plasma-liquid Interactions: Chemistry at the Plasma-liquid Interface
	Laura Merrill (Schaefer Lab)	CBE	Electrolytes for Magnesium Batteries Based on Ether-Sulfone Mixtures with Increased Thermal Stability
May	Josh Wright (Hicks Lab)	CBE	Immobilized Group IV Metal Precursors on Acidic Supports for Ethylene Oligomerization
	Nunzia Pirro (Fernando Lab)	CEEES	Generation and Propagation of Rossby Waves in the Bay of Bengal during Summer Monsoons
August	Joanne Fahey	Guest Speaker	ND Research: Professional Use of Social Media
September	Larry Milks	Guest Speaker	Career Development: Graduate Career Consultant for Engineering
October	Prateek Mehta (Schneider Lab)	CBE	Towards Sustainable Ammonia Synthesis with Plasma-enabled Catalysis
	Suzanne Neidhart (Gezelter Lab)	Chem	Interfacial Thermal Conductance from Gold Nanoparticles: Particle Shape and Size
November	Joshua Pauls (Mukasyan Lab)	CBE	Reaction Mechanisms in the Ti-B-N Ternary System

The Forgash Student Fellowship in Solar Energy Research

The Forgash Student Fellowship in Solar Energy Research provides financial support to an undergraduate or graduate student interested in solar energy collection/conversion technologies through research and development at Notre Dame. Since 2009, 9 fellowships have been awarded totaling \$19,000. Forgash funds are sometimes combined with other fellowships to provide greater financial support to students working on solar energy research.



The award recipient in 2018 was **Sergiu Draguta**, a graduate student in the Masaru (Ken) Kuno Laboratory in the Department of Chemistry and Biochemistry, whose project was entitled ***Spatially-resolved Charge Carrier Transport Measurements in High Efficient Perovskite Solar Cells.***

The Vincent P. Slatt Endowment for Undergraduate Research in Energy Systems and Processes

The Vincent P. Slatt Endowment for Undergraduate Research in Energy Systems and Processes began in 2006 and provides support for students who are interested in conducting energy-related research with ND Energy affiliated faculty. The focus of the program is to advance technologies in energy systems and processes and to improve the future of energy through the development of policies and infrastructure to support new technologies. Since 2006, 125 fellowships have been awarded to undergraduate students, totaling \$560,087.

In 2018, 18 awards were granted to undergraduate students in the total amount of \$75,600. The scholars and their research projects are highlighted on the following page.

The Forgash Student Fellowship in Solar Energy Research is made possible through the generosity of John (ND '00) and Karla Forgash.

**2009-2018
9 Awards
\$19,000**

The Vincent P. Slatt Endowment for Undergraduate Research in Energy Systems and Processes is made possible through the generosity of Christopher (ND '80) and Jeanine Slatt in honor of Vincent P. Slatt, Notre Dame Class of 1943.

**2006-2018
125 Awards
\$560,087**

	2018 Slatt Scholar	Major	Faculty Advisor	Project Title
	Corey Atwell	Chemical and Biomolecular Engineering	Prashant V. Kamat	Gradient to Mixed Halide Perovskite Architecture for Perovskite Solar Cells
	Tyler Bear	Chemical and Biomolecular Engineering	Ruilan Guo	Synthesis and Characterization of Iptycene-based Polyimides with Tunable Chain Rigidity for Gas Separation Membranes
	Colin Brankin	Chemical and Biomolecular Engineering	Jennifer Schaefer	Alternative Batteries: Magnesium Electrodeposition from Polymer Films
	David Brown	Chemical and Biomolecular Engineering	William Phillip	Designing Energy Efficient Diafiltration Units around Self-Assembled Copolymer Membranes that Separate Molecules of Comparable Size
	Gabriel Brown	Aerospace and Mechanical Engineering	David Go	Understanding Plasma Catalyst Synergy via Ammonia Production
	Janaya Brown	Aerospace and Mechanical Engineering / Energy Studies	Abigail Mechtenberg	Novel Ugandan Wind Turbine Blades: Science and Technique
	Anthony Deziel	Chemistry and Biochemistry	Vlad Iluc	Synthesis, Characterization, and Reactivity of Platinum Carbene Complexes
	James Drysdale	Chemistry and Biochemistry/ Energy Studies/AL/SC Honors Program	Prashant V. Kamat	Photovoltaic Application of Perovskite Nanomaterials for Commercial Cell Phone Use
	Henri Edouard Francois	Computer Science and Engineering	Abigail Mechtenberg	Restoring Energy Production Capacity to Rural Haiti: Energy Generation Systems and Micro Grid Optimization
	Joseph Gonzales	Aerospace and Mechanical Engineering	Hiroataka Sakaue	Development of Chemical Anti-Icing Coating for Use on Wind Turbines
	Anna Kluender	Chemical and Biomolecular Engineering	Brandon Ashfeld	Synthesis of Ionic Liquids Displaying Lower Critical Solution Temperature Behavior
	Eric Lee	Applied and Computational Math and Statistics	Stefano Castruccio	Forecasting Wind Turbine Vulnerability to Dust Storms in Saudi Arabia
	Madison Mettey	Chemistry and Biochemistry	Emily Tsui	Synthesis of Transition Metal Alumosiloxide Complexes as Models of Zeolite Active Sites for Energy Related Catalysis
	Perfect Mfashijwenimana	Electrical Engineering	Abigail Mechtenberg	Evaluating how the E3 Propagation Model can Intertwine with the Rwandan Energy Vision 2050
	Musodiq Ogunlowo	Electrical Engineering	Abigail Mechtenberg	Empowering Nigerians to Power Nigeria: Designing Multiple Energy Source Input Charge Controller with Locally Built Systems
	Arsenii Panteleev	Chemical and Biomolecular Engineering	Jonathan Whitmer	Investigation of Structure and Phase Behavior of a Novel Ionic Liquid Crystal
	Morgan Seidler	Chemical and Biomolecular Engineering	Jennifer Schaefer	Crosslinked Ionomer Films for use in High-performance Lithium Ion Batteries
	Ethan Sunshine	Chemical and Biomolecular Engineering	Ian V. Lightcap	Iron-Carbide-Graphene Oxide Sheets: An Entirely New, Non-Precious Metal Catalyst for the Oxygen Reduction Reaction in Fuel Cells

Summer Research Programs

Several departments, centers, and institutes on campus provide programs that bring undergraduate students from other universities to Notre Dame during the summer months to conduct research. These programs include the National Science Foundation (NSF)-funded Research Experiences for Undergraduates (REU), endowed student fellowships, and department-funded research opportunities. In addition, many Notre Dame undergraduates choose to stay on campus during the summer months to gain the additional experience from conducting full-time research.

Starting in 2017, program coordinators from the Colleges of Engineering and Science, Notre Dame International, Notre Dame Research, and The Graduate School created a joint calendar of professional development and social events for summer student researchers. Events were focused on enhancing their research experiences and provided opportunities for them to network, have some fun, and learn about topics that would not be addressed in the laboratories. The 2018 calendar is shown here.

At the end of the summer, students also participated in a Summer Undergraduate Research Symposium, where they presented their research projects during a poster session and sharpened their public speaking skills. In 2018, 44 students presented posters from Analytical Chemistry, Center for Research Computing, Graduate School, ND Energy, NDnano, and the Wireless Institute. (Biological Sciences, ND International, Physics, and the Turbomachinery Laboratory held their own poster sessions.)

The programs that hosted 2018 events were Analytical Chemistry REU, Biological Sciences REU, Center for Research Computing REU, The Graduate School Summer Programs, ND International iSURE, ND Energy Slatt Fellowships, NDnano NURF, Physics REU, Turbomachinery Laboratory Fellowships, and the Wireless Institute REU.

SUMMER PROGRAMS

FOR UNDERGRADUATE STUDENTS AT NOTRE DAME

JUNE 20
TapTax Information Session for International Students
 9:00 AM
 258 Fitzpatrick Hall
 No RSVP Required

JUNE 26
"Graduate School - What's It Good For, and Should I Go?" by Dr. Nyree McDonald and Dr. Gregory Snider
 9:00 AM
 131 DeBartolo Hall
 RSVP by 6/22

Kaplan GRE Workshop
 6:00-7:30 PM
 138 DeBartolo Hall
 RSVP by 6/22

JUNE 29
Robinson Center Outreach Science Day for K-12 Students
 3:00-5:00 PM
 Jordan Hall of Science
 RSVP by 6/6

JULY 12
"Creating Effective Posters," by Dr. Marya Lieberman
 9:00 AM
 Auditorium, Mendoza College of Business
 RSVP by 9:00am on 7/10

JULY 19
"Research Elevator Pitches," by Erik Oswald
 9:00-10:30 AM
 Center for Career Development
 RSVP by 7/13

Pizza Party and DVT Show by Keith Davis
 5:30-7:30 PM
 Jordan Hall of Science Galleria
 RSVP by 7/17

JULY 25
Summer Undergraduate Research Symposium
 9:30 AM - 11:45 AM
 Jordan Hall of Science Galleria
 9:30 AM-10:30 AM: Poster Session 1
 10:45 AM - 11:45 AM: Poster Session 2
 12:00 PM - 1:00 PM: Luncheon for Researchers and Faculty/Mentor

MAY 25
Speed Friending and Appetizers
 6:00-8:00 PM
 Legends Night Club
 RSVP by 5/24

MAY 29
"Professional Best Practices and Lessons Learned," by Dr. David Balkin
 4:30 PM
 118 Nieuwland Science Hall
 RSVP by 5/25

JUNE 8
Stargazing
 9:30-11:00 PM (Rain Date: 6/22)
 Rooftop, Jordan Hall of Science
 RSVP by 6/6

JUNE 12
"Research at the Intersection of Technology, Economics and Policy: A Case Study in Wireless," by Prof. Nick Laneman
 9:00 AM
 101 Jordan Hall of Science
 RSVP by 6/8

JUNE 15
Ice Skating
 6:00-7:50 PM
 Compton Family Ice Arena (\$3 for skate rental)
 RSVP by 6/13

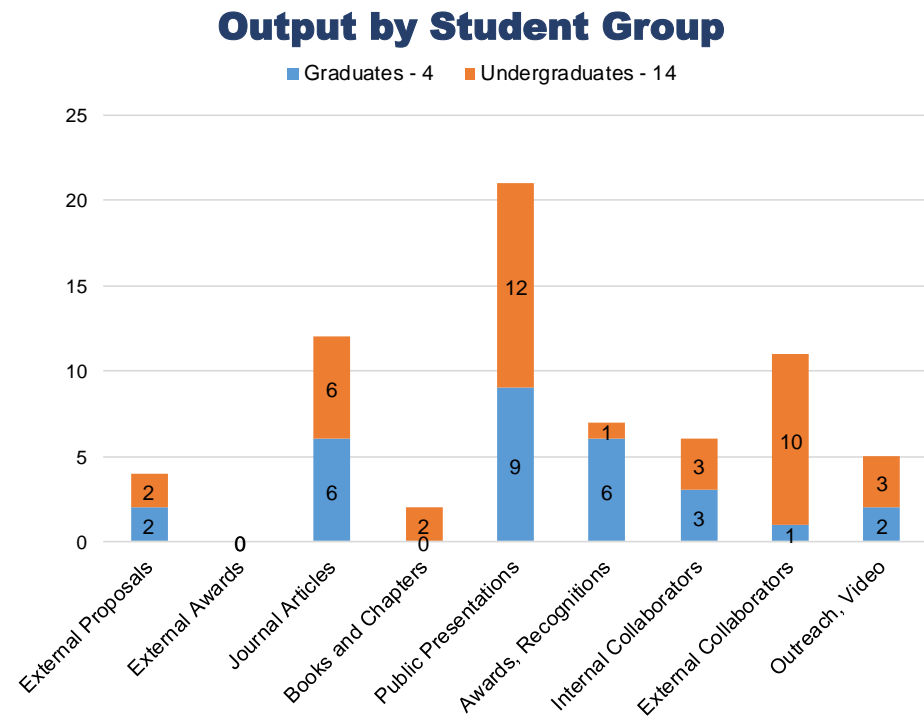
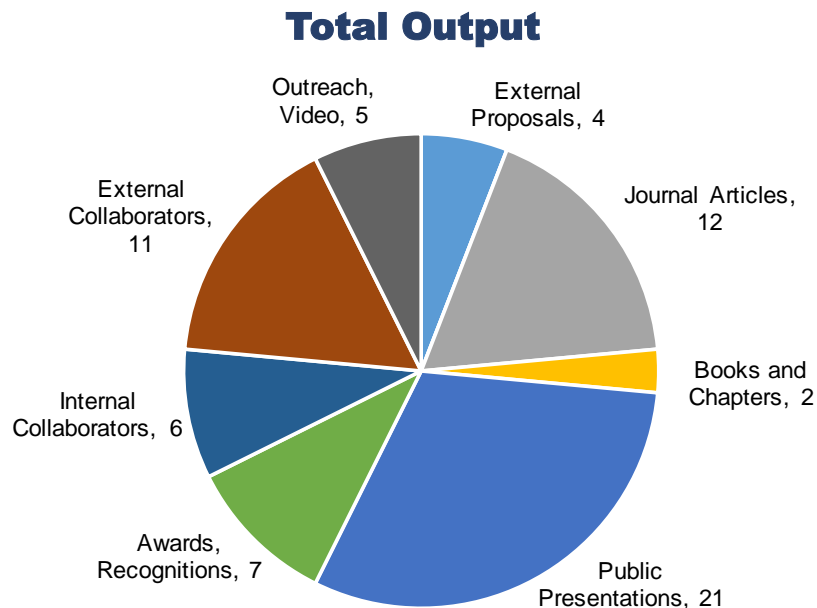
JUNE 19
"Check It Out! Finding the Right Resources for Your Research," by Willie Baer
 9:00 AM
 Carey Auditorium, Hesburgh Library
 RSVP by 6/15

2018 Output from Student Fellowships

Students who received ND Energy fellowships were asked to submit a final report at the end of year to include a brief summary of their research results and accomplishments including the following output: (1) External Proposals, (2) External Awards, (3) Journal Articles, (4) Books and Chapters, (5) Public Presentations, (6) Awards and Recognitions, (7) Internal Collaborations, (8) External Collaborations, and (9) Outreach, Videos, Websites, etc.

The following pie chart shows the total output by category for both student groups combined in 2018, while the bar graph shows total output by category for each of the two student groups. There were 4 graduate student respondents and 14 undergraduate student respondents.

As shown, the highest amount of output was in public presentations with 21, 12 of which were given by undergraduate students and 9 by graduate students. The next highest was in journal articles with 12, 6 from each student group. There were 11 external collaborations, 10 by undergraduate students and 1 by a graduate student.



Education

ENERGY STUDIES MINOR, EXPERIENTIAL LEARNING

*Opportunities for students to become
knowledgeable researchers and
responsible citizens in energy*

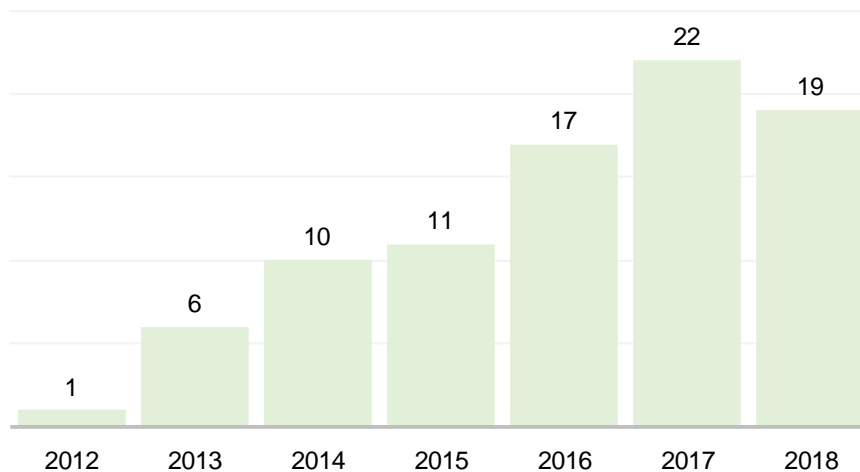
The Energy Studies Minor (ESM) is open to undergraduate students in all majors and colleges at the University of Notre Dame. The minor prepares students to become successful leaders who understand the complexities of global energy challenges and can help move our country and the world toward a more sustainable energy future. Requirements of the minor include the successful completion of three required courses focused on energy and society, the business of energy, and a capstone that encompasses the use and understanding of several major elements in energy. Students also are required to take three, 3-credit electives from an approved list of technical and non-technical courses.

The capstone course offers students the option to participate in an energy-focused one-week seminar hosted by the Center for Social Concerns or enrolling in a semester-long class on campus. Both emphasize involvement in a hands-on experience. Students who attend the seminar in Washington, DC meet with various advocacy groups, government officials, and industry leaders to learn about energy policy. Other students spend a week in Appalachia, learning about the impact of coal on the lives of the citizens. Those who participate in the more traditional course on campus use internships, research opportunities in laboratories, or other individualized projects to learn about energy.

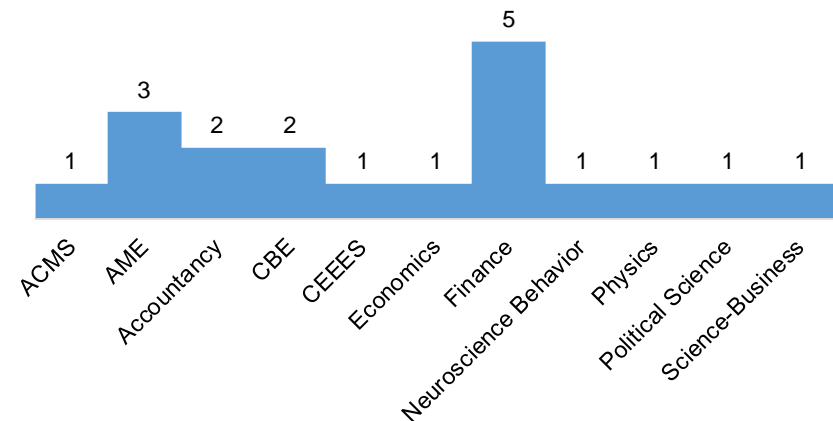
ND Energy hosts an annual recognition ceremony for graduates, presenting each graduate with a certificate of accomplishment.

The charts below show the number of graduates since the minor began in 2012, and the number of recent graduates by major.

Total Graduates by Year



2018 Graduates by Major



Class of 2018

Gustavo Alberto Ariza Matos

Santo Domingo, Dominican Republic

Majors: Finance, Economics

Future plans: Investment Banking Analyst at JP Morgan Chase

Rodrigo Benavides Martinez

Monterrey, Mexico

Major: Applied and Computational Mathematics and Statistics

Future plans: Data Scientist at Vector Casa de Bolsa

Andrew James Boushka

Houston, Texas

Major: Accountancy

Future plans: University of Notre Dame Masters in Accountancy

Rory T. Burke

Andover, MA

Major: Mechanical Engineering

Future plans: Systems Engineer at Booz Allen Hamilton

Spencer Charles Clark

Andover, MN

Major: Physics, Glynn Family Honors Program, concentration in Advanced Physics

Future plans: Pursuing a position in energy consulting

Robert Georges Courtadon

Suffern, NY

Major: Political Science

Future plans: Working in state/local government, or for an environmental non-profit organization

John T. Feger

Louisville, KY

Major: Neuroscience Behavior

Future plans: Teaching middle school for Alliance for Catholic Education (ACE)

John Higham

Poland, OH

Major: Chemical Engineering

Future plans: Process Engineer at ExxonMobil

Joseph Charles Jared

The Woodlands, Texas

Major: Environmental Engineering

Future plans: Graduate school at Texas A&M, studying sub sea engineering

Robert Leo Lucian

Cincinnati, OH

Major: Finance

Future plans: Risk and Compliance Consultant with Protiviti in Chicago

Austin W. Matheny-Kawesch

San Diego, California

Major: Economics (minor in the Hesburgh Program in Public Service)

Future plans: Working with the German Department in Berlin this summer, with hopes of working on sustainability policy in the future

Kevin Michael Mickan

New Orleans, LA

Major: Finance

Future plans: Financial planning and analysis for United Airline

Abigail B. Mines

Little Rock, AR

Major: Finance

Future plans: Discover Financial Services

Julia Christine Pucillo

Summit, NJ

Major: Finance

Future plans: Sales and Trading Associate at Guggenheim Securities (New York, NY)

John Julian Salvadore

San Antonio, TX

Major: Mechanical Engineering

Future plans: Master's degree in Engineering Science in Sustainable Energy at University College Cork in Cork, Ireland

Benjamin William Schultz

Howell, Michigan

Majors: Chemical Engineering, Political Science

Future plans: Energy industry analyst in the Washington, DC area

Michael Robert Sinanian

Flushing, MI

Major: Mechanical Engineering

Future plans: Protection and Controls Engineer at American Electric Power

Kala Rene Sperbeck

Coldwater, Michigan

Major: Science-Business

Future plans: Hoping to implement sustainability initiatives in the Midwest

Declan Thomas Zidar

Glenview, IL

Major: Accountancy

Future plans: Financial Analyst at Amazon

19 Graduates

NEW ZEALAND LEARNING EXPERIENCE

During summer 2018, a group of students from the Energy Studies Minor (ESM) and the Resiliency and Sustainability of Engineering Systems Minor participated in an inaugural New Zealand experience that fused classroom learning with real world experiences. Spearheaded by Notre Dame professor Kevin Walsh, 16 undergraduate students began their summer with a three-week course that prepared them for internships in Auckland, Wellington, and Queenstown.

This collaboration between ND Energy's ESM and the resiliency minor took advantage of New Zealand's extreme terrain, multiple rivers and geothermal geysers, along with its location on major fault lines, to teach students about environmental issues that are nonexistent in the Midwest. With New Zealand generating over 80% of its electricity from renewable energy, this was also a perfect location to learn about energy efficiency and usage.

ESM graduate **Rory Burke** ('18) participated in the program as a teaching assistant before heading to his new position as systems engineer at Booz Allen Hamilton. Other ESM participants were **Emily Black**, **Charles "CJ" Naudet**, **Nick Naudet**, and **Marisa Ross**.

ENERGY STUDIES MINOR STUDENT WINS 2018 MCCLOSKEY GRAND PRIZE

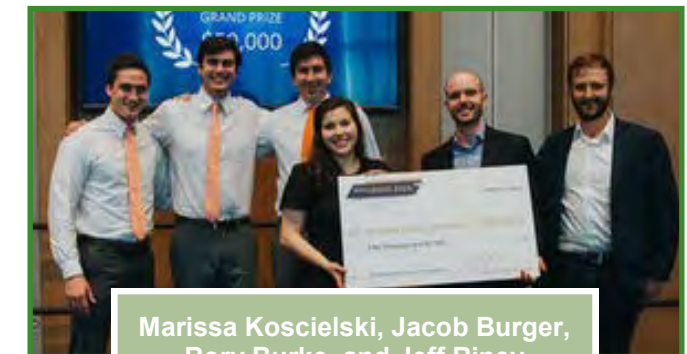
Senior Energy Studies Minor (ESM) and Student Energy Board (SEB) member **Rory Burke** was a member of the winning team — Enlighten Mobility — for the 2018 McCloskey Grand Prize. His team split the \$50,000 award presented during the McCloskey New Venture Competition on April 27, 2018. This award is given to individuals or teams of Notre Dame students or alumni with outstanding ideas for business solutions for new products, services or technology. Final presentations were given during IDEA Week and judged by a panel including Daymond John from ABC's Shark Tank and Matt Rogers, co-founder of NEST.



Clyde Hydropower Dam
New Zealand



Rotorua Geothermal Park
New Zealand



Marissa Koscielski, Jacob Burger,
Rory Burke, and Jeff Riney
McCloskey Winning Team

Outreach

ENERGY WEEK, K-12 PARTNERSHIPS, HIGH SCHOOL INTERNSHIP

Programs that create an environment where people of all ages can learn and understand important issues

An important part of ND Energy's mission is to complement energy-related research through the development of outreach programs that have a broad-reaching impact on the education and understanding of today's global energy challenges. By translating the research performed within Notre Dame laboratories, ND Energy is able to transform this information into meaningful hands-on activities and curricula that then can be taken out into the communities and classrooms to help educate people of all ages.

This year, there were several unique opportunities for students, faculty, and staff to interact with their peers and the general public during on- and off- campus events about important topics in energy.

MISHAWAKA HIGH SCHOOL INTERNSHIP PROGRAM

The internship program between Mishawaka High School and ND Energy engages students with Notre Dame faculty on research projects while students earn school credit for their participation. Five of the seven students who were enrolled in the program since fall continued their work through spring and participated in a poster presentation at the end of May. Students discussed their research projects with family, friends, school administrators, and other research groups on campus.

Paola Amezcuita, Senior (Dr. Vlad Iluc Laboratory)

Poster Title: *Pincer Ligands*

Paola's research focused on developing catalysis materials.

Moira Ferrer, Senior (Dr. Svetlana Neretina Laboratory)

Poster Title: *Galvanic Replacement of Silver with Gold*

Moira's research project explored how to exchange silver particles for gold particles.

Elizabeth McKesson, Junior (Dr. Amy Hixon Laboratory)

Poster Title: *UO₂ Aging Under Controlled Storage Conditions*

Elizabeth examined how mineral phases change when exposed to different levels of humidity.

Joy Thompson, Junior (Dr. Peter Burns Laboratory)

Poster title: *Analysis of Uranium Minerals Using Big Data Network Methods*

Joy explored mineral locations using the Big Data approach.

Samuel Trowbridge, Senior (Dr. Ruilan Guo Laboratory)

Poster Title: *Gas Separation with Polyamide Membranes*

Sam's research focused on developing new membranes for separating CO₂.



From left to right: Joy Thompson, Moira Ferrer, Paola Amezcuita, Elizabeth McKesson, and Samuel Trowbridge.

UNDERGRADUATE SUSTAINABILITY RESEARCH & EDUCATION EXPO: MAKING CONNECTIONS IN ENERGY, THE ENVIRONMENT, AND SUSTAINABILITY STUDIES

In February, the **Undergraduate Sustainability Research & Education Expo** was held for all undergraduate students at Notre Dame and featured both on- and off-campus opportunities in research, education, outreach, and internships in the areas of energy, the environment and sustainability studies. Nearly 80 students attended the expo and made connections with over 30 participants, highlighted below. While the majority of students were from the Colleges of Engineering and Science, the expo attracted over 25 different majors, ranging from accounting to political science.

Research Groups and Projects

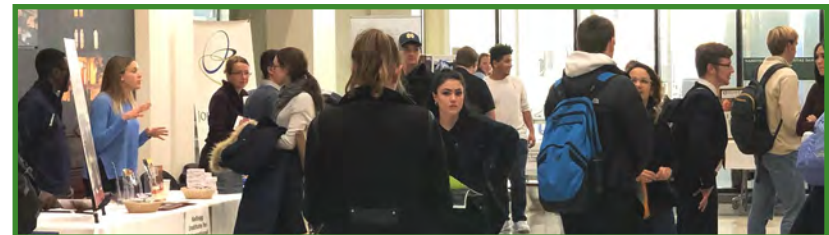
- Actinide Geochemistry- Hixon Research Group
- Catalytic Conversion of Methane and Carbon Dioxide into Hydrogen Gas – Wolf Research Group
- Energy and Sustainable Development with Design - Mechtenberg Research Group
- Filling the Tank with Sunshine - Lightcap Research Group
- Historical Forest and Marsh Ecology - McLachlan Research Group
- Laboratory for Advanced Environmental Research - Doudrick Research Group
- Water purification and Advanced Transport Engineering Research (W.A.T.E.R.) - Phillip Research Group

Academic Programs and Organizations

- Center for Career Development
- Center for Sustainable Energy at Notre Dame (ND Energy)
- Energy Studies Minor
- Environmental Change Initiative and Linked Experimental Ecosystem Facility (ND-LEEF)
- Flatley Center for Undergraduate Scholarly Engagement (CUSE)
- IDEA Center
- Kellogg Institute for International Studies
- Minor in Resiliency and Sustainability of Engineering Systems
- Minor in Sustainability
- ND Energy Student Energy Board
- ND Food Rescue U.S.
- Notre Dame Stewardship and Sustainability Alumni Network
- Reilly Center for Science, Technology & Values
- University of Notre Dame Environmental Research Center (UNDERC)

Local Organizations

- Bertrand Farm
- Bowman Creek Educational Ecosystem–Engineering
- Center for a Sustainable Future–Indiana University South Bend
- Merry Lea Environmental Learning Center of Goshen College
- Prairie Winds Nature Farm, Inc.
- Unity Gardens
- Urban Forestry & Native Habitat - City of Mishawaka



The expo is sponsored annually by the Center for Sustainable Energy (ND Energy); the Minor in Sustainability; the Notre Dame Environmental Change Initiative (ND-ECI); and the Reilly Center for Science, Technology, & Values.

WHAT'S IT REALLY LIKE?: CAREERS IN ENERGY

What's It Really Like (WIRL)? Is a program that focuses on bringing undergraduate students and experts together for small group discussions about career development and other topics in energy. During Energy Week Plus!, five WIRL sessions were offered to students that focused on specific research areas and positions in sustainability. Students met with group members from the following areas:

Jason Hicks Laboratory: Catalysis research and what it's like to be a part of a larger team doing research across five universities. (Prof. Hicks is a principle investigator of CISTAR, an NSF-funded Engineering Research Center led by Purdue University with principal investigators from Notre Dame, Northwestern University, University of New Mexico, and the University of Texas at Austin.)

Eric Matlis Laboratory: Wind energy and how students can get involved.

Prashant Kamat Laboratory: Solar energy and research on perovskite films for solar panels.

Peter Burns Laboratory: Nuclear research and what it's like to work with uranium, plutonium, and other radioactive chemicals.

Office of Sustainability: What it's like to work in the sustainability field and how to conduct a successful job search.

ENERGY ABROAD: HOW I SPENT MY SUMMER

Four undergraduate students who traveled abroad during the summer to work on energy-related projects shared their experiences with other students during a panel presentation. A representative from ND International was present to answer questions about international travel and related services available through the University.

John Salvatore: research assistant with ND Environmental Fluid Dynamics group in Portugal

Cristian Lagunas: volunteer with Green Empowerment in Nicaragua

Donald Reed: campus representative for the Green Program

Brady McLaughlin: research on electricity needs of hospitals in Uganda

This panel was part of ND Energy's on-going **What's It Really Like?** series, which is designed to help students gain a better understanding of various opportunities in energy.



From left to right: Cristian Lagunas, John Salvatore, Donald Reed, and Brady McLaughlin

NORTHERN INDIANA REGIONAL SCIENCE AND ENGINEERING FAIR

Student Energy Board members and Energy Studies Minor students volunteered to serve as judges for the annual **Northern Indiana Regional Science and Engineering Fair (NIRSEF)** held in Notre Dame's Stepan Center. The judges discussed and evaluated several energy-related projects of middle and high school student competitors. The middle school award was presented to **Benjamin Pamachena** and **Jacob Dixon** from John Young Middle School in Mishawaka for their project, "One Man's Junk Is another Man's Insulation". The high school award went to **Alek Wujcikowski**, a senior from Elkhart Memorial High School, for his cutting edge project, "The Application of an Ion Engine for Space Exploration". The judges were **Erika Kim, Cameron Gorsak, Alex Baumann, Michael Kay, Breanna Belz, Kelly Moran, Emily Black, Francie Fink, Rory Burke, Jake Miyazaki, Matt Chamberlain, and Cristian Lagunas.**



DIVERGENT EXIT OPPORTUNITIES FOR STEM GRADUATE STUDENTS: LEVERAGING ON-CAMPUS RESOURCES

A panel of campus experts provided valuable feedback to graduate students on ways to prepare for careers in academia and industry. **Samuel VandenHeuvel**, Ph.D. candidate from the Sevov Group in the Department of Chemistry and Biochemistry, initiated the conversation and provided his personal perspectives on his own experiences. Other panelists were **Prof. Ani Aprahamian**, the Frank M. Freimann Professor of Physics; **Prof. Thomas Degnan**, the Anthony and Sarah Earley Professor of Energy and the Environment in the Department of Chemical and Biomolecular Engineering; and **Ryan Willerton**, Associate Vice President for Career and Professional Development in the Division of Student Affairs.

During the hour-long conversation, many resources for STEM graduate students were mentioned, including Irish Compass, where there are over 500 alumni signed up to serve as mentors or contacts in the area of Energy and the Environment alone. Other resources discussed were internships, academic societies, and networking to gain potential leads. The overall consensus was that STEM graduate students should find additional ways to develop the "soft skills" that are not required for their majors. This included taking advantage of the wide range of courses and clubs on campus, establishing networks with professors and alumni, and becoming involved in the community through volunteer opportunities.



From left to right: Samuel VandenHeuvel, Prof. Ani Aprahamian, Prof. Thomas Degnan, and Ryan Willerton

SCIENCE ALIVE!

More than 1,300 members of the South Bend community made it to the third floor of the St. Joseph County Public Library to enjoy energy-related hands-on activities presented by ND Energy affiliated laboratories. Science Alive! is an annual event sponsored by the library that draws families and people of all ages to learn about a wide variety of science topics.

ND Energy contributed 10 stations to the event, filling a room and spilling out into the hallway. Over 40 graduate students, professors, Student Energy Board undergraduates, and staff participated during the six-hour event. Research topics included radiation, membranes, nanoparticles, polymers, low temperature plasma, hydrogen gas generation, superconductivity, and concentrated solar power. Research groups that participated were from the laboratories of **Kyle Doudrick**, **David Go**, **Amy Hixon**, **Abigail Mechtenberg**, **Svetlana Neretina**, **Jennifer Schaefer**, **William Schneider**, and **Jonathan Whitmer**.



JINA-CEE ART 2 SCIENCE SUMMER CAMP

The Jordan Hall of Science was bursting with 150, 8-to-12-year-old, budding scientists and engineers the weeks of July 9 and July 16 for the annual Art 2 Science summer camp, sponsored by the Joint Institute for Nuclear Astrophysics, Center for Evolution of Elements (JINA-CEE), and the Department of Physics at Notre Dame. Students learned about math, science, and engineering through a variety of art styles and rotated through hands-on activities designed by local artists, science teachers, and more.

ND Energy offered a project that combined the Magnus effect with potential elastic energy. Students experienced converting one form of energy into another while flying cups around the lab and testing variables.

The following group members helped with this activity over the four-day event: **Neha Mehra** (Schneider Group), **Michael Quevillon** (Whitmer Group), **Tyler Spano** (Simonetti Group), **Andrew Schranck** (Doudrick Group), **Jessica Muhlenkamp** (Hicks Group), **Eimear Conroy**, **Sam Perry**, and **Tsuyoshi Kohlgruber** (Burns Group), **Hunter Allen** and **Lee Ngochi** (Schneider and Hicks Groups).



ALUMNI REUNION: ND EXPLORES STEM

The College of Engineering, College of Science, and Notre Dame Research celebrated the Alumni Association's Annual Reunion with an event, featuring S.T.E.M. (Science, Technology, Engineering, and Math) research and education programs at Notre Dame.

Over 30 departments, centers and institutes participated, including **ND for the Environment**, which is comprised of ND Energy, the Office of Sustainability, and the Minor in Sustainability, all offering lots of information and demonstrations about campus initiatives. Among the demos was ND Energy's smoothie bike for all to enjoy!

Initiated in 2017 by the Alumni Association, ND for the Environment showcases the many ways in which the university is working to address environmental issues and helping to combat the negative effects of climate change on the environment. The original thought was to use Football Fridays as the primary venue since thousands of alumni and interested fans are on campus for home football games. This idea has since expanded to include other venues such as the Alumni Association's Leadership Conference and Alumni Reunion Weekend.



OTHER OUTREACH

Youth Power Indiana—Local families gathered to learn how youths in Indiana can take part in a stand against climate change. Participants viewed the short film, Little Warriors, and participated in an open panel discussion with panelists Jim Poyser, Executive Director of Earth Charter Indiana; Therese Dorau, South Bend Director of Sustainability; and Jo Broden, South Bend Council Member for the 4th District.

South Bend March for Science—ND Energy hosted a teach-in table with a hands-on scientific activity in energy.

Sustainability Festivals (Spring and Fall)—ND Energy shared information about energy-related research and education, while warming up the participants with some much needed hot chocolate from the smoothie bike.

EdTech in the Bend—Graduate student Jeffrey DuBose from the Radiation Laboratory represented ND Energy and taught local high school teachers how to find statistics on energy usage and how to manipulate the data using Google sheets.

Upward Bound Students Discover Energy at Notre Dame—ND Energy coordinated hands-on energy-related research experiences for students in the TRiO Upward Bound program, providing the opportunity for them to interact with faculty and research groups from three different fields of science and engineering: Prof. Emily Tsui from the Department of Chemistry and Biochemistry, Prof. William Schneider from the Department of Chemical and Biomolecular Engineering, and Dr. Ginger Sigmon from the Department of Civil and Environmental Engineering and Earth Sciences.

Fall Undergraduate Research Fair (FURF)—ND Energy provided information to undergraduate students about the Energy Studies Minor, the Student Energy Board, and the Slatt Fellowships for Undergraduate Research in Energy Systems and Processes.



The 12th annual Notre Dame Energy Week extended beyond the traditional week-long format and was consequently billed as “Energy Week Plus” this year. The extensive program, sponsored by ND Energy and its Student Energy Board, offered a wide range of activities focused on major energy topics and issues of interest to the Notre Dame community and general public.

Energy Week Plus was anchored by five presentations which took place between September 17-26. **Ashish Sharma**, research assistant professor in the Department of

Civil and Environmental Engineering and Earth Sciences, kicked off the event with a talk that examined the effect of rising temperatures on the poorest neighborhoods in Chicago and how green roofs help to improve urban resiliency in extreme heat.

Kodiak Electric Association CEO **Darron Scott** visited campus to share how his electric cooperative has implemented a nearly 100% renewable energy system through hydroelectric and wind power. Scott discussed how Kodiak Island, Alaska reduced their carbon emissions and reaped economic benefits from the energy savings, which surpassed the initial investment of the project in less than a decade.

Paul Kempf, Senior Director of Utilities and Maintenance at Notre Dame, highlighted the investments made by Notre Dame to reduce carbon emissions through renewable energy sources. He announced the University's effort to stop burning coal by 2020 is ahead of schedule.

During the “Plus” week, Environmental Change Initiative Associate Director **Patrick Regan** discussed the role of politics in the climate change debate and contended that the science has been settled, yet the political environment continues to resist adopting the right policy to address a potentially catastrophic outcome.

The final presentation was given by **Arturo Massol-Deyá**, executive director of the award-winning organization Casa Pueblo, which operated as an energy oasis in the aftermath of Hurricane Maria that devastated the island of Puerto Rico in 2017. Using solar panels and independent microgrids, Casa Pueblo models energy independence and the potential future infrastructure for the island. [View the videotaped presentation at energy.nd.edu](#)

Throughout the week and a half, tours of energy-related facilities were offered to faculty, students, and staff that included the **Notre Dame power plant**, the **solar panels** on the roof of Stinson-Remick Hall, and the newly relocated **Materials Characterization Facility** in Stepan Chemistry Hall.

Other events included ND Energy's **What's It Really Like?** series for undergraduate students who attended small group discussions led by group members from the following laboratories: **Jason Hicks**, **Eric Matlis**, **Peter Burns**, and **Prashant Kamat**, as well as staff members from the **Office of Sustainability** who discussed careers in sustainability.

Energy Week Plus received support from several campus partners: Center for Civic Innovation; Center for Social Concerns; Department of Romance Languages and Literatures; Environmental Change Initiative; Hesburgh Program in Public Service; Institute for Latino Studies; John J. Reilly Center for Science, Technology, and Values; Kroc Institute for International Peace Studies; Notre Dame Initiative for Global Development; Office of Digital Learning; and Office of Sustainability.

[View the Photo Album on Facebook](#)

Impact

Contributions and outcomes representing advancements in energy-related research and education at Notre Dame

AWARDS AND RECOGNITIONS

ND Energy Associate Director honored as a Fellow of the National Academy of Inventors

Subhash L. Shinde, associate director of the University of Notre Dame's Center for Sustainable Energy (ND Energy), has been named to the National Academy of Inventors' (NAI) 2017 Class of Fellows. The fellowship is considered "the highest professional accolade bestowed to academic inventors who have demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development, and welfare of society."



Thrall Honored with Early Career Faculty Award from the American Institute of Steel Construction

The American Institute of Steel Construction (AISC) has selected Department of Civil & Environmental & Earth Sciences (CEEES) Professor Ashley Thrall to receive the Early Career Faculty Award. The honor recognizes individuals who demonstrate promise in the areas of structural steel research, teaching and other contributions to the structural steel industry.



Go to receive 2018 NPSS Early Achievement Award

David B. Go, the Rooney Family Associate Professor of Engineering at the University of Notre Dame, has been selected to receive the 2018 Institute of Electrical and Electronics Engineers (IEEE) Nuclear & Plasma Sciences Society (NPSS) Early Achievement Award.



Nerenberg appointed to the International Scientific Committee through CEDEUS

Associate Professor Rob Nerenberg has been appointed to the International Scientific Committee through the Academic Committee of the Center for Sustainable Urban Development (CEDEUS). CEDEUS is funded by the National Commission for Scientific and Technological Research (CONICYT) and is sponsored by the Pontificia Universidad Católica de Chile (PUC). The objective of the International Scientific Committee is to bring together leading researchers who increase awareness and strengthen policies relating to sustainable urban development in Chile.



Faculty awards honor undergraduate teaching and advising

Twenty University faculty members have received Rev. Edmund P. Joyce, C.S.C., Awards for Excellence in Undergraduate Teaching, and three have been honored with Dockweiler Awards for Excellence in Undergraduate Advising. The awards are presented by the Office of the Provost, and the recipients are selected through a process that includes peer and student nominations.

Featuring William Philip and Ashley Thrall



Three Faculty Promoted to Endowed Chair Positions

Kyle J. Bibby, Kenneth T. Christensen and Michael J. Seelinger have been named endowed faculty in the College of Engineering.

Featuring Ken Christensen



Kamat honored in tribute issue of Journal of Physical Chemistry

A Notre Dame chemistry professor well known for his contributions to the field of photoelectrochemistry and renewable energy research was honored with a tribute issue to him in one of the four journals of The Journal of Physical Chemistry, published by the American Chemical Society.

Featuring Prashant Kamat



Aprahamian speaks at TRIUMF Science Week

Professor Ani Aprahamian, the Frank M. Freimann Professor of Physics, was invited to TRIUMF Science Week in Vancouver, Canada in July 2018. TRIUMF, the national laboratory of Canada for particle and nuclear physics and accelerator-based science, is celebrating its 50th anniversary. TRIUMF Science Week focused on state-of-the-art theory, observation, and experiments connected to our place in the universe. The week also included an ARIEL Science Workshop, From ARIEL to the Universe.



AWARDS AND RECOGNITIONS

Aprahamian to serve as a member of the U.S. Liaison Committee for the International Union of Pure and Applied Physics (IUPAP)

The National Academies of Sciences, Engineering and Medicine, and their Policy and Global Affairs group, has invited Freimann Professor Ani Aprahamian to serve as a member of the U.S. Liaison Committee for the International Union of Pure and Applied Physics (IUPAP). Her term is September 18, 2018 – December 31, 2020. IUPAP representation in the USA is carried out by the Science Academies.



Early career faculty awarded nationally competitive awards

The National Science Foundation (NSF) has recognized four University of Notre Dame faculty members for their excellence in research with new Early Career Development (CAREER) Awards. Over the past five years, Notre Dame faculty have received 37 of these highly competitive awards.

Featuring John Parkhill, Jonathan Whitmer, and Yanliang Zhang



Burns Appointed as Honorary Professor at Top Chinese University

Peter C. Burns, Henry J. Massman professor and director of the Center for Sustainable Energy and director of the Actinide Center of Excellence, was appointed as an Honorary Professor at Xi'an Jiaotong University in China. An esteemed professorship is one of the highest honors at Xi'an Jiaotong University and only conferred to a person who has made a significant contribution to his or her research area.



FACULTY IN THE NEWS

Notre Dame to lead \$26 million multi-university research center developing next-generation computing technologies

A new \$26 million center led by the University of Notre Dame will focus on conducting research that aims to increase the performance, efficiency and capabilities of future computing systems for both commercial and defense applications. ASCENT is one of six research centers funded by the SRC's Joint University Microelectronics Program (JUMP), which represents a consortium of industrial participants and the Defense Advanced Research Projects Agency (DARPA).

Featuring Suman Datta



Researchers uncover most complex mineral on Earth

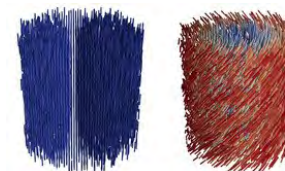
Researchers at the University of Notre Dame found that the complexity of a uranium-based mineral, dubbed ewingite, is nearly twice as high as the previous most complex mineral. The study, published in *Geology*, required the use of the Advanced Photon Source at the U.S. Department of Energy's Argonne National Laboratory, the brightest X-ray source in the Western Hemisphere, to define the mineral's structure.



Featuring Peter C. Burns

Notre Dame researchers develop way to measure and engineer properties of liquid crystal systems

Liquid crystals are perhaps most well known for their use in electronic displays, but many biological molecules, such as those in cell membranes are forms of liquid crystals, as are some detergents and clays. What is unique about liquid crystals is that they exhibit properties of both liquids and solids. A liquid crystal may flow like a liquid but be more ordered in its molecular structure, where each molecule is aligned with others in the phase.

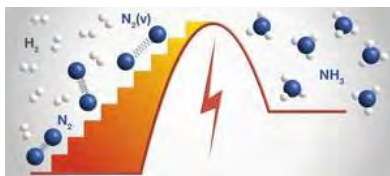


Featuring Jonathan Whitmer

FACULTY IN THE NEWS

Notre Dame researchers developing renewable energy approach for producing ammonia

Researchers at the University of Notre Dame are developing a renewable energy approach for synthesizing ammonia, an essential component of fertilizers that support the world's food production needs. The Haber-Bosch process developed in the early 1900s for producing ammonia relies on non-renewable fossil fuels and has limited applications for only large, centralized chemical plants.



Featuring William Schneider, David Go, and Jason Hicks

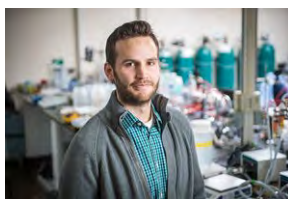
Meet Two Women Engineers Who “Nevertheless, Persisted” and Achieved

Amy Hixon and Svetlana Neretina, as well as many other women, are being honored during National Women's History Month in March. This year's theme is “Nevertheless, She Persisted: Honoring Women Who Fight All Forms of Discrimination Against Women.” As underrepresented women in science and engineering, we are especially proud to recognize Amy and Svetlana for their perseverance and contributions in these areas and wanted to highlight some of their successes as a way to demonstrate the power of voice, action, and believing that meaningful and lasting change is possible.



Engineered polymer membranes could be new option for water treatment

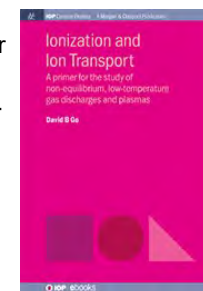
The world's freshwater resources are in short supply. According to the United Nations, water scarcity affects an estimated 1.9 billion people and 2.1 billion people live with drinking water services that are not safely managed. The critical point of water scarcity has led scientists to look for new and efficient ways to make the most of nontraditional sources, including sea water, brackish water and wastewater.



Featuring William Phillip

New Textbook Makes Study of Gas Discharges and Plasmas More Accessible to Students

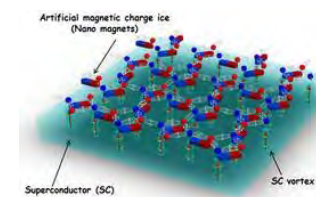
With gas-phase ions, which make up gas discharges and plasmas, accounting for more than 99% of the known matter in the universe, one would think that engineering and science students — even the general public — might understand more about them. Plasmas and gas discharges affect everything from lighting and transportation to water purification and electronics. Yet plasma science requires broad understanding of engineering, chemistry and physics, making it difficult for students at the beginning of their careers to access.



Featuring David Go

Designing a better superconductor with geometric frustration

Superconductors contain tiny tornadoes of supercurrent, called vortex filaments, that create resistance when they move. This affects the way superconductors carry a current. But a magnet-controlled “switch” in superconductor configuration provides unprecedented flexibility in managing the location of vortex filaments, altering the properties of the superconductor, according to a new paper in Nature Nanotechnology.



Featuring Boldizsár Jankó

Engineers use Tiki torches in study of soot, diesel filters

Chemical engineers testing methods to improve efficiency of diesel engines while maintaining performance are getting help from a summer staple: Tiki torches. A team of engineers at the University of Notre Dame is using the backyard torches as part of an effort to mimic the soot oxidation process in a diesel engine — when soot in diesel exhaust collects in the walls of a particulate filter and has to be burned off — according to a study recently published in Catalysis.



Featuring Paul McGinn

FACULTY IN THE NEWS

Eco-friendly chrome plating technology developed at Notre Dame advances toward commercialization with investment from Nucor Corp.

Trion Coatings LLC, which owns an environmentally friendly chrome plating process developed in partnership between University of Notre Dame faculty members and a startup company based at the University's IDEA Center, has sold a minority equity position in Trion's parent company to Nucor Corp.

Featuring Edward Maginn and Emerita Professor Joan Brennecke

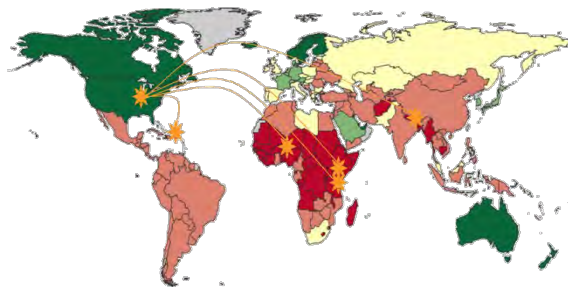


Energy E3 to build innovation center, increase access to sustainable energy in low- and middle-income countries

It powers nearly every aspect of our daily lives, but in low- to middle-income countries, more than one billion people live without electricity. The issue is particularly overwhelming in sub-Saharan Africa where, according to the U.S. Agency for International Development, 600 million people — an estimated 70 percent of the region's population — do not have access to electricity. What's more, the majority of institutions in those countries also lacks reliable electricity, including national hospitals.

Researchers at the University of Notre Dame with counterparts in Uganda, Rwanda and Nigeria are working to bridge the gap through a program called Energy E3 — Empowering Nations to Power Their Nation, with plans underway for an inaugural energy innovation center in Uganda.

Featuring Abigail Mechtenberg



Notre Dame supports spring 2019 meeting of Materials Research Society

Faculty and researchers from the University of Notre Dame are planning to attend the 2019 Materials Research Society (MRS) spring meeting in Phoenix, AZ the week of April 22 – 26, 2019. Over 30 members of the Notre Dame research community are presenting MRS research and many more are in attendance with over 4,000 national and international materials researchers.

Subhash L. Shinde, associate director of ND Energy, was invited by MRS President Sean Hearne to serve as a co-chair for this conference. Shinde helped develop 60 Symposia, organized in seven different topical clusters, and lead the effort to organize the Symposium X involving distinguished international speakers. Symposium X – Frontiers of Materials Research will feature presentations aimed at a broad audience and on topics at the forefront of research on materials science and engineering.

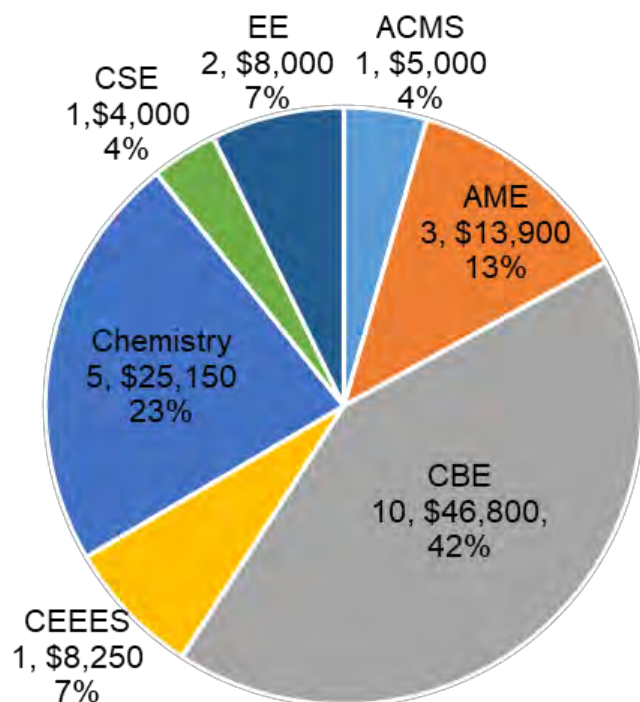
Featuring faculty presenters affiliated with ND Energy Suman Datta, Prashant Kamat, Tengfei Luo, Svetlana Neretina, Jennifer Schaefer, Subhash L. Shinde, Matthew Webber, and Yanliang Zhang



The snippets of articles listed under Awards and Recognitions and Faculty in the News can be found on the ND Energy website in their entirety at <https://energy.nd.edu/news-events/news/>.

UNDERGRADUATE AND GRADUATE STUDENT FELLOWSHIPS IN NUMBERS

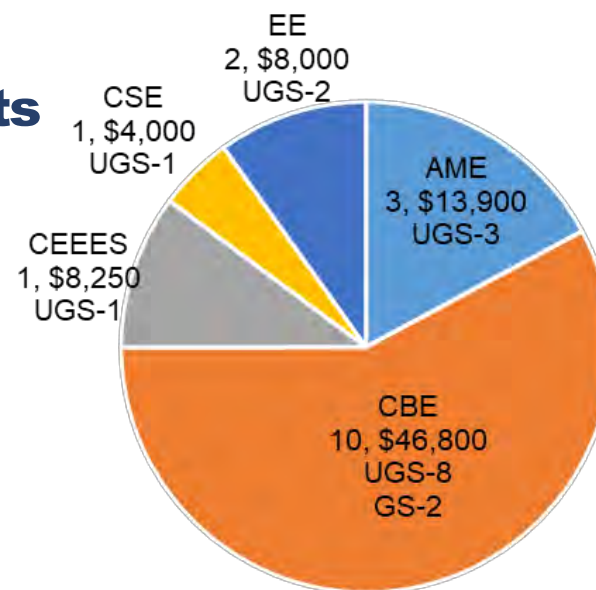
2018 Total Awards by Department



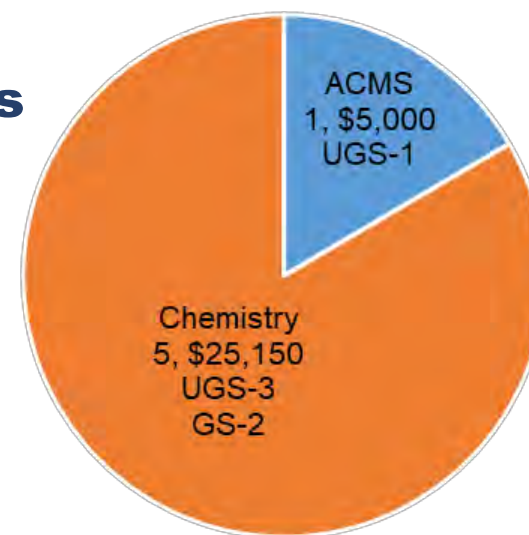
2 Colleges
7 Departments
23 Awards
\$111,100

2018 Total Awards by College and Department

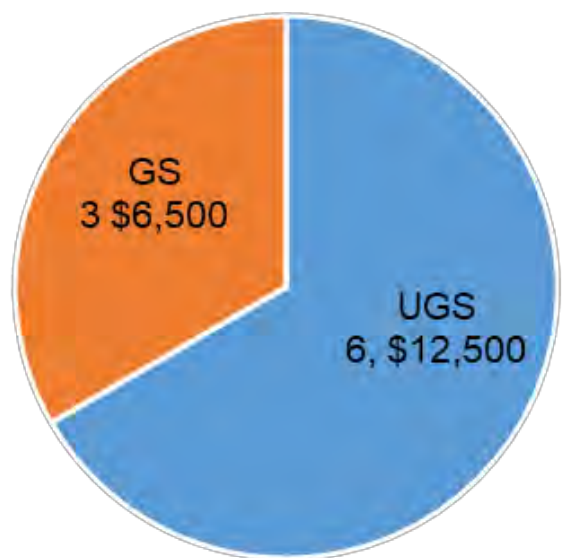
Engineering
5 Departments
17 Awards
\$80,950



Science
2 Departments
6 Awards
\$30,150



Forgash Awards 2009-2018

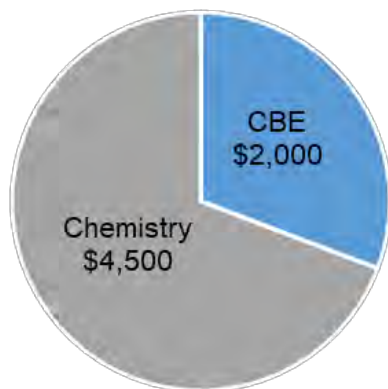


Forgash awards are made annually to an undergraduate or graduate student interested in solar energy research. Since the program began in 2009, there were 12 applications submitted and of those applications, 9 awards were made, totaling \$19,000.

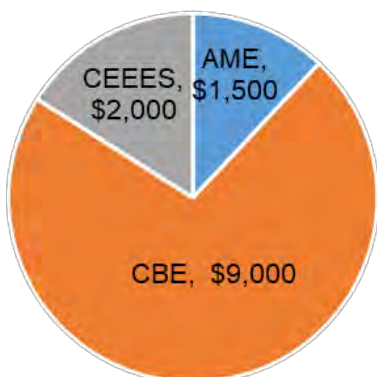
The split between undergraduate student awards and graduate student awards is shown here. There were 6 awards made to undergraduates in 3 different departments within the College of Engineering, and 3 awards were made to graduate students in 2 different departments within the Colleges of Engineering and Science.

The breakdown is as follows:

**Graduate Awards
2009-2018**



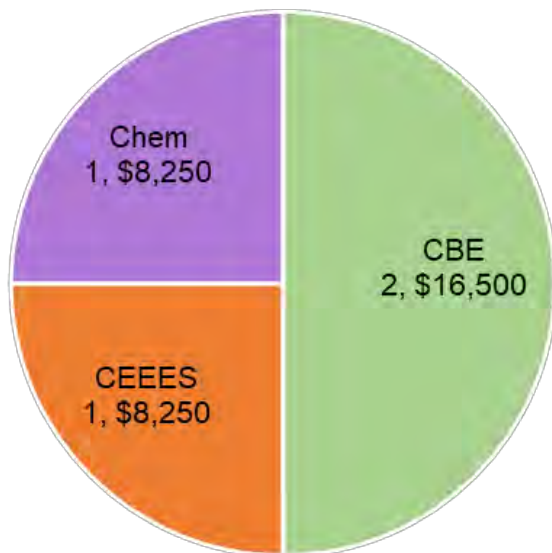
**Undergraduate Awards
2009-2018**



College	No. of Departments	No. of UGS Awards	No. of GS Awards
Engineering	3	6	1
Science	1	0	2

When the program started in 2009, the annual award was \$1,500. From 2010-2017, the annual award was \$2,000. In 2018, the award was increased to \$2,500.

2018 Eilers Awards



Of the 11 Eilers applications received in 2018, 4 students received awards, totaling \$33,000. As shown here, students receiving awards were from 3 different departments in the Colleges of Engineering and Science.

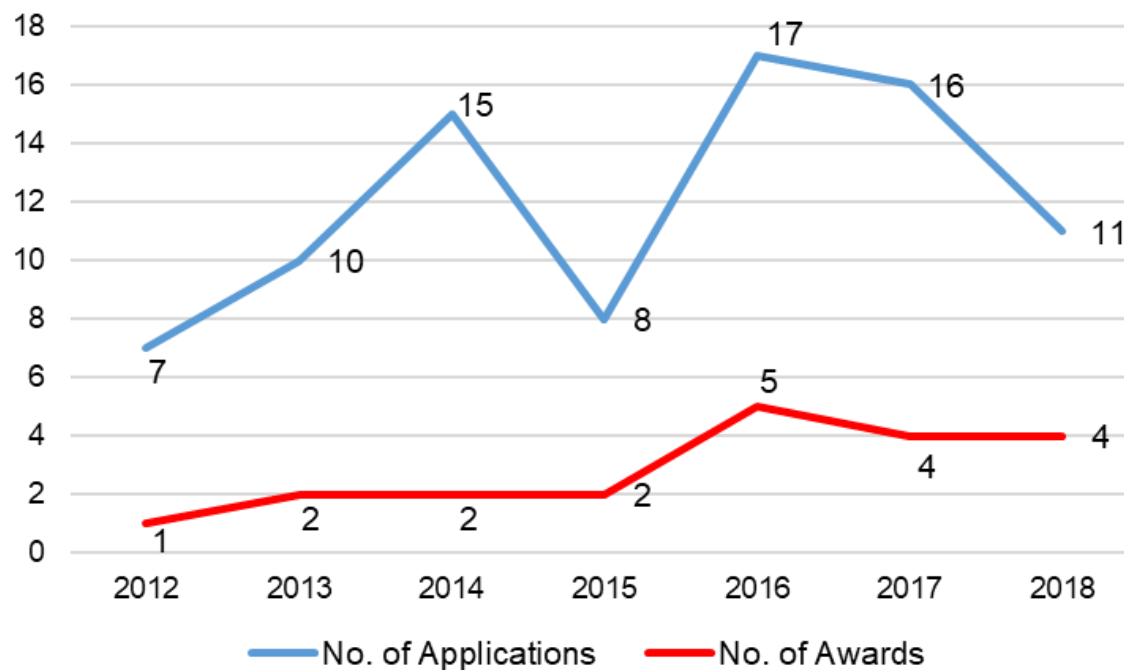
The breakdown is as follows:

College	No. of Departments	No. of Awards	Total Amount of Awards
Engineering	2	3	\$24,750
Science	1	1	\$8,250

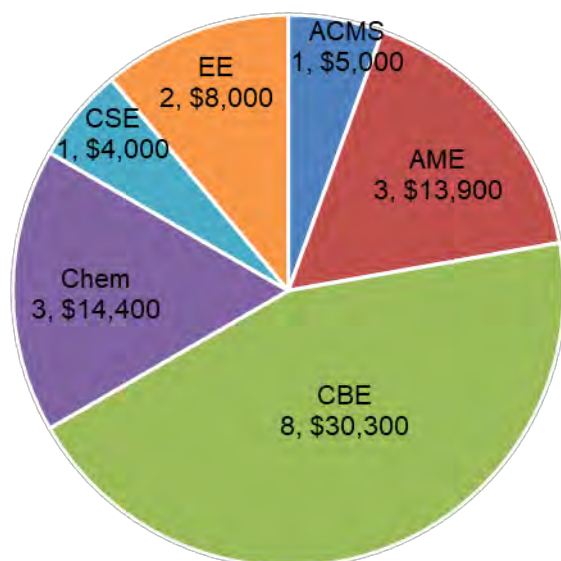
Eilers Applications and Awards 2012-2018

Since the start of Eilers fellowships for graduate research, there were 84 applications submitted and of those applications, 20 awards were made, totaling \$182,946.

On average, 23% of the applications that were submitted received awards.



2018 Slatt Awards



Of the 23 Slatt applications received in 2018, 18 students received awards, totaling \$75,600. As shown here, students receiving awards were from 6 different departments in the Colleges of Engineering and Science.

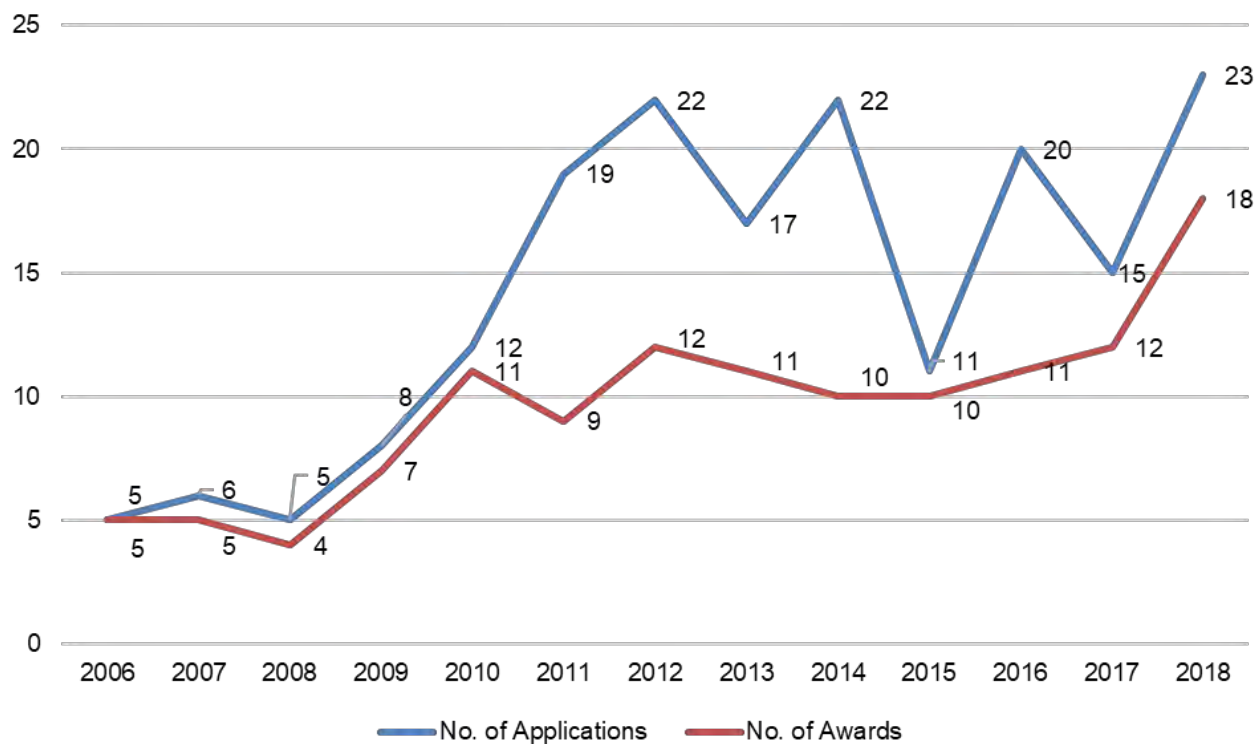
The breakdown is as follows:

College	No. of Departments	No. of Awards	Total Amount of Awards
Engineering	4	14	\$56,200
Science	2	4	\$19,400

Slatt Applications and Awards 2006-2018

Since the beginning of Slatt fellowships for undergraduate research, 185 applications were submitted and of those applications, 125 awards were made, totaling \$560,087.

On average, 74% of the applications that were submitted received awards.





ND Energy

Center for Sustainable Energy at Notre Dame
115 Stinson-Remick Hall
Notre Dame, Indiana 46556



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