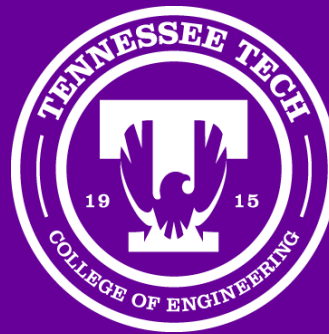


Center For Energy Systems Research
Tennessee Tech University
Annual Report for Fiscal Year 2018-2019



Center for
Energy
Systems
Research

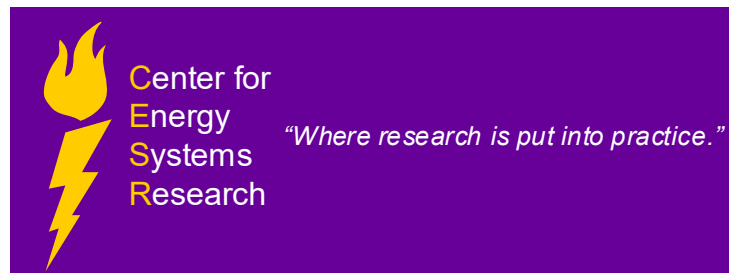


Annual Report for Fiscal Year

July 1, 2018—June 30, 2019

Satish M. Mahajan, Director

www.tntech.edu/cesr



Center for Energy Systems Research

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Cookeville, TN 38505

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www.cesr.tntech.edu/



The CESR Solar Tree.

The solar tree is located adjacent to Clement Hall and is connected to the Smart Grid Lab.

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PROGRAMMATIC REPORT

MISSION

The Center for Energy Systems Research (CESR) was established to advance and apply scientific and engineering knowledge associated with energy systems and in particular with electric power while supporting the instructional program of Tennessee Technological University (TTU) in academic areas associated with energy systems. During the College of Engineering Strategic Planning of 2012-13, two strategic research areas, Smart Grid and Resilient Infrastructure, were assigned to the Center for Energy Systems Research as focus areas of research. Present research efforts, both theoretical and experimental, are focused on solving current and anticipated problems associated with energy and infrastructure systems. Special emphasis is given to the needs of the electric power industry by way of conducting research on Smart Grid.

VISION

The Center will be known and be recognized nationally for its research contributions in Energy Systems and Infrastructure areas.

The Center's vision is to enhance research and education in support of its mission. The Center will conduct advanced and applied research to enhance knowledge in currently needed and emerging technical areas of Energy and Infrastructure Systems. The Center also has major interests in the dissemination of knowledge and enhancing education in energy systems.

The Center draws upon the expertise from the faculty in the College of Engineering as well as from other faculty on campus. Participating faculty and faculty associates represent Basic Engineering, Chemical Engineering, Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Mathematics, Mechanical Engineering, Manufacturing and Engineering Technology, and Physics.

HISTORY

The State of Tennessee established the Center for Electric Power in 1985 in the College of Engineering at Tennessee Technological University. Reflecting the broadening of the activities of the Center, its name was changed to Center for Energy Systems Research. Over the years, research projects have been sponsored by more than 20 major electric utilities, EPRI, federal agencies such as DOE, NASA, NSF, and ONR, State agencies such as TDOT and Tennessee Department of Education, and industries such as Buswell Energy.

In the 2012-2013 academic year, the College of Engineering identified six strategic research areas in which to focus the research efforts of its faculty and students. Of the six areas, CESR chose two areas, namely, 1) Smart Grid and 2) Resilient Infrastructure to focus its research. Development of large collaborative research proposals will be encouraged in these areas.

To promote the research and innovation, CESR provides services of an R&D Engineer, Financial Analyst, Financial Associate, and Administrative Associate in support of the various research activities performed by faculty and students. The Center has set up laboratories and computational resources for the benefit of researchers.

The Center promotes international collaboration by hosting visiting scholars, scientists and engineers and establishing Memoranda of Understanding with international academic institutions and research organizations.

YEAR IN REVIEW



Satish M. Mahajan,
Director, CESR

Dr. Satish M. Mahajan continued as the Director of the Center for Energy Systems Research (CESR) for fiscal year 2018-2019. The CESR continues to focus on two strategic research areas of the College of Engineering: Smart Grid and Resilient Infrastructure.

2018-2019 was another good year for the CESR—four years in a row. In fact, **this year's activations totaling \$2,254,049 is the record for CESR since 1985 when the Center was established.** It is only the third time since 1985 that the CESR activations have crossed \$2 million. Of course, it represents the extra energy put into the proposals, and into supporting proposals and research of faculty by the staff.

This year's proposals submitted by the CESR faculty associates amount to about \$14.8 million, an increase of about 23 percent over last year. Hopefully, this increased proposal activity will help CESR sustain activations over \$2 million per year and possibly go beyond. It is important to keep these efforts—even with the additional burden of performing the research—particularly in view of TTU's Carnegie Classification (R2) that requires a sustained growth of doctoral students. The CESR's momentum lines up very well with the TTU

President's vision of doubling the external funding/activations by 2025. While benefits to the students' education are of primary interest, benefits to the State of Tennessee are bound to increase as a result of long-term investments made by the State.

In the 2018-2019 fiscal year, the CESR funded 21 M.S. assistantships (5 on grants only; 5 on CESR only; and 11 on grants, CESR, and other University sources); and 13 Ph.D. assistantships (3 on grants only; and 10 on grants, CESR, and other University sources), representing a significant ongoing commitment to improve the research efforts at TTU. The CESR supported a total of 70 graduate students on an hourly basis. The CESR also supported 30 undergraduate students in the research, a majority of them on grants.

Ms. Barbara Fenlon joined the CESR as an Administrative Associate. With more than eight years of experience at TTU, she brings a welcome relief to the CESR staff. Special thanks to each of them for their outstanding efforts in maintaining the quality of support CESR is known for.

The Center continues to involve expertise of faculty beyond the engineering College. This year faculty from Physics and Agriculture departments had contributions to the research efforts of the CESR. Hiring of five new faculty in the Computer Science Department of the College of Engineering represents a great opportunity to make inroads into the area of Cyber Physical Systems since many of the new faculty have expertise in the security aspects of the energy infrastructure.



Digging of 500 ft. deep hole to initiate fundamental studies on wireless power transfer through earth, a project sponsored by the National Science Foundation (Investigators: Charles Van Neste (PI), Satish M. Mahajan, and Brian Leckie)

PROGRAMMATIC REPORT

Research contract and grant awards included in Matching from July 1, 2018 thru June 30, 2019 total \$1,914,228.69. Gifts and Other Awards included in Matching total \$7,940.00. Therefore, the 2018-2019 Match is \$1,922,168.69. Indirect costs of approximately \$331,880.49 were also received during the 2018-2019 Fiscal Year. The result is that the 2018-2019 Matching and Indirect Costs total \$2,254,049.18. The State Appropriation was \$947,800.00 for 2018-2019.

CESR continues to enjoy a broad base of support. The funding categories for 1985 thru 2019 as illustrated in Figure 1 are: in-state utilities, 10.48 percent; out-of-state utilities, 5.69 percent; state and local agencies, 9.7 percent; federal government, 60.27 percent; other, 13.86 percent. The “other” category includes a variety of national and international industries, universities and professional societies. Through June 2019, the cumulative research funding of the Center is \$32,684,846.89. State appropriations are compared to matching, on an annual basis, in Figure 2. Matching is divided into contracts and grants (without indirect costs); equipment; and all other items such as software, books and reports, and funding for faculty and student exchange programs. The 34-year match of about \$31.5 million represents 103.96% percent of the state appropriations of \$30.3 million. Indirect costs of approximately \$5.7 million were also received. A list of the projects conducted under the major research areas is given in SM-3 in this report.

CESR RESEARCH FUNDING 1985-2019

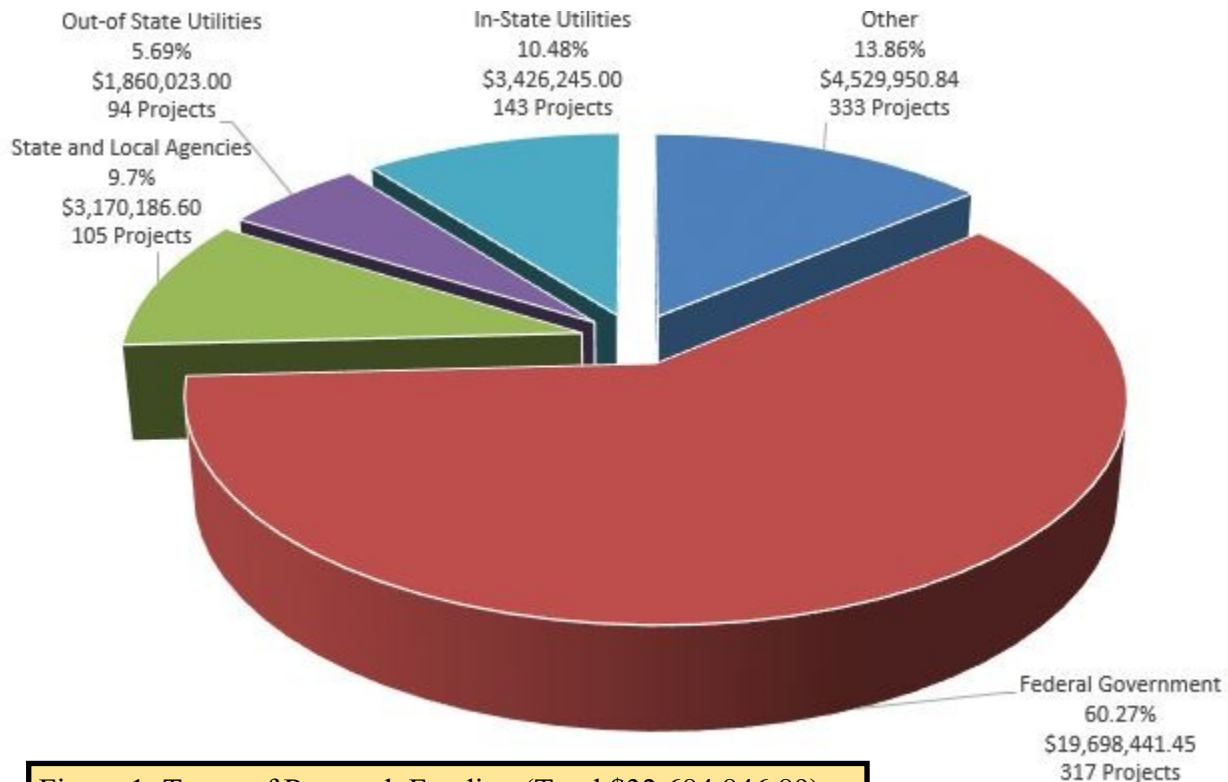


Figure 1: Types of Research Funding (Total \$32,684,846.89)

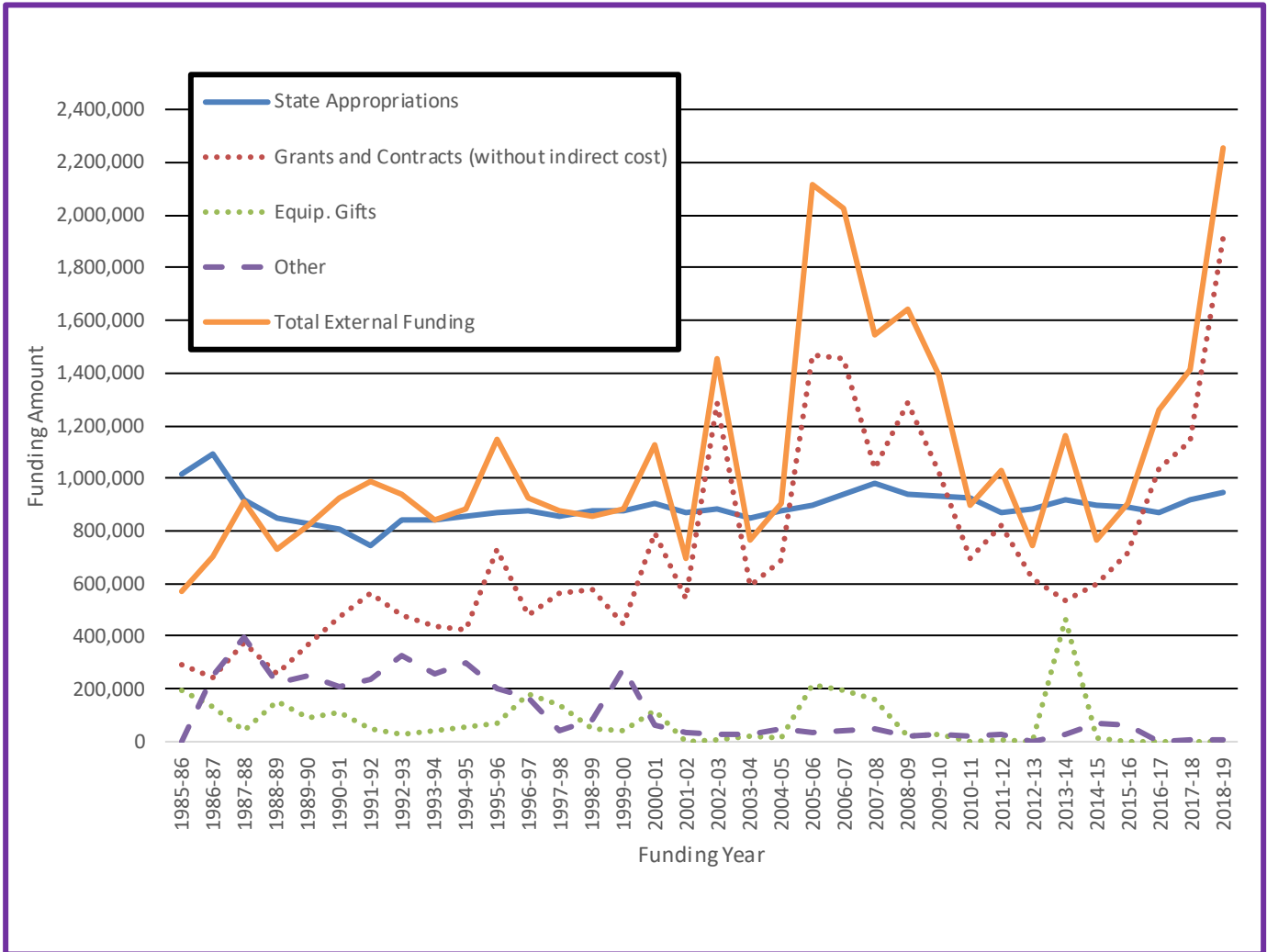


Figure 2: Historical State Appropriations, Matching, & Total External Funding 1985-2019

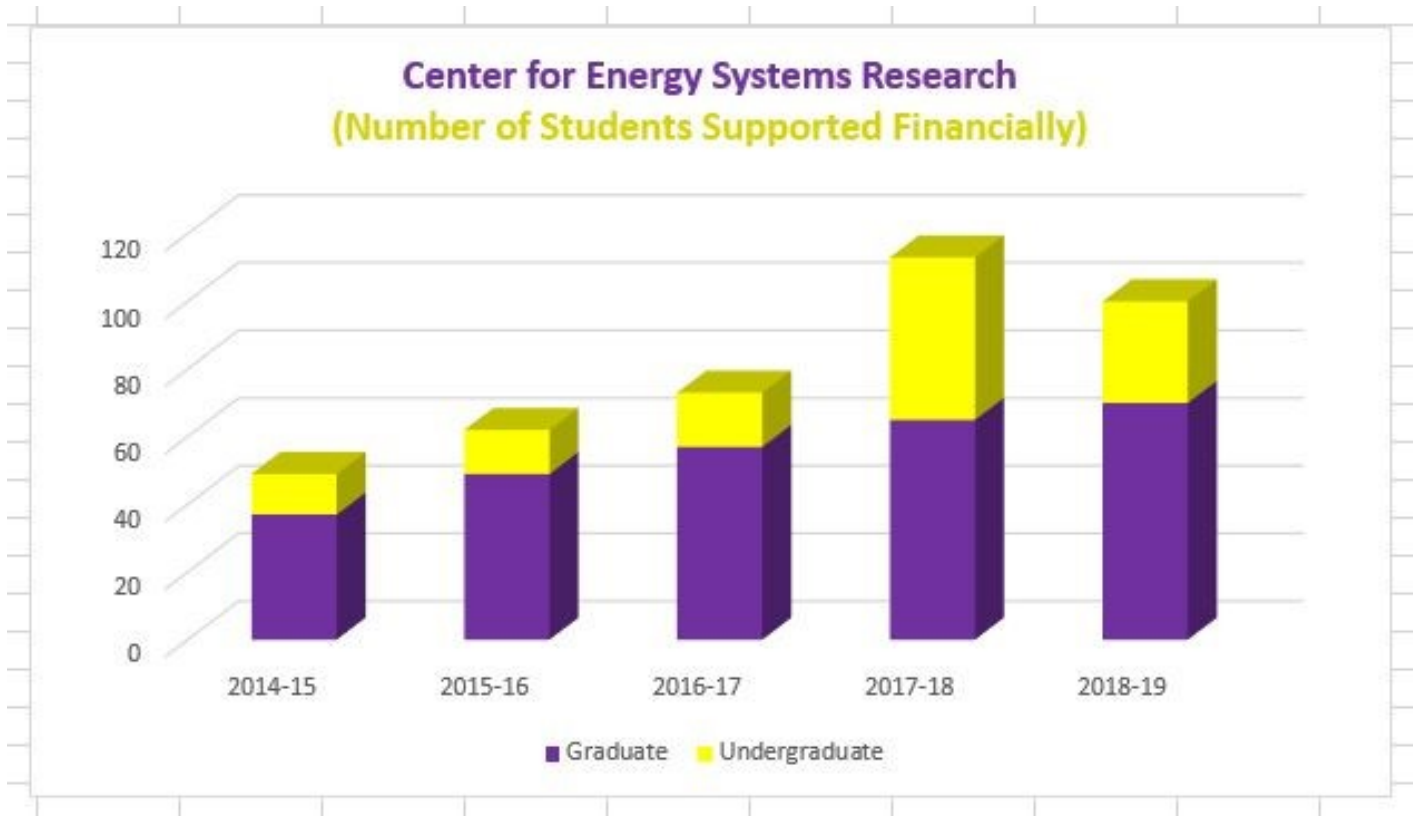


Figure 3: Number of Students Supported.

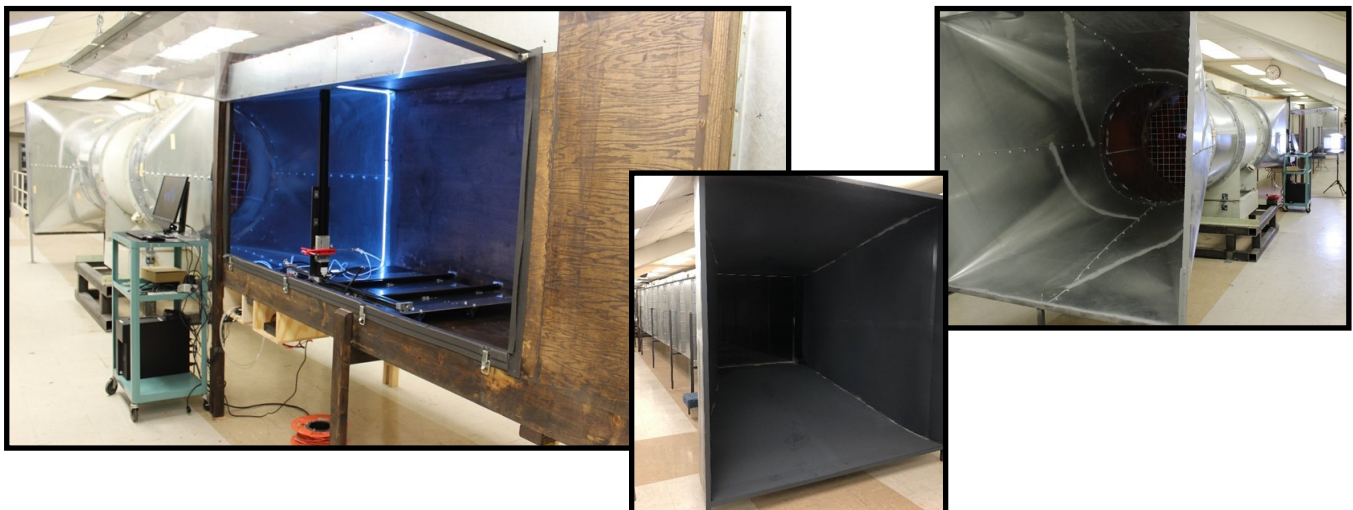
Dr. L. K. Crouch was recognized as a 25-year member of American Concrete Institute in Concrete International July 2019 Issue.

Dr. Holly Stretz was recognized with the Tennessee Tech University Scholar-Mentor Award 2018.

Dr. Holly Stretz was recognized with the Tennessee Tech University Excellence in Creative Inquiry Mentoring Award 2018.

Dr. Holly Stretz was recognized with the Insight into Diversity Journal's Insight into Diversity Inspiring Programs in STEM Award 2018.

Dr. Joseph Biernacki was recognized with the Journal of the American Ceramic Society Best Paper Invited Symposium Presentation at the Materials Science & Technology Annual Meeting in October 2018.



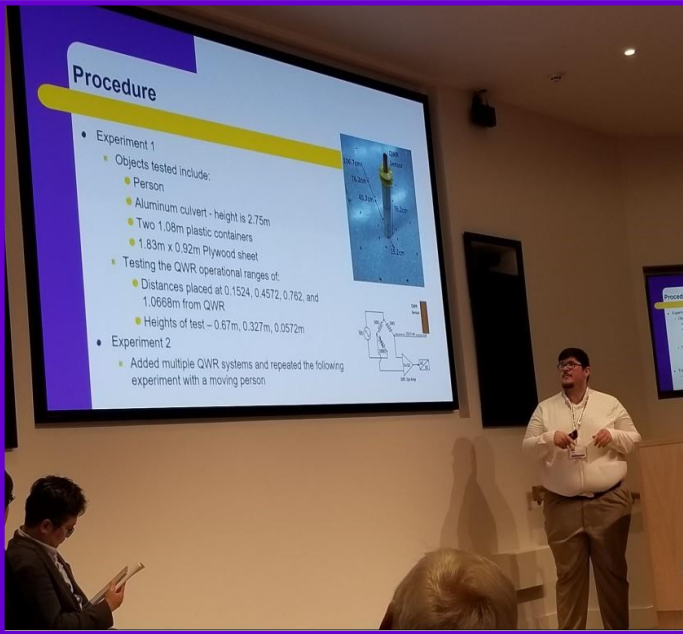
Photos from research project of Dr. Ahmad Vasselbeagh—Mechanical Engineering—developing an open-loop wind tunnel with top speed of 20 m/s for fluid mechanics and aerodynamics experiments.



Dr. Charles Van Neste and his Ph.D. Student, Charles Robinson, traveled to London, England in June 2019 to present papers at the 2019 IEEE Wireless Power Week Conference. Charles Robinson won First Prize for Best Talk .



Dr. Van Neste giving a talk at Cambridge University in London prior to the WPW 2019 Conference. Attending (L-R) are Patrick Hu, University of Auckland; Grant Covic, University of Auckland; Jurgen Meins, University of Braunschweig; and Delepa Thrimawithana, University of Auckland.



Ph.D. student, Charles Robinson, presenting his paper (left) and receiving his awards (right)



THE 14TH ANNUAL RESEARCH AND CREATIVE INQUIRY DAY

Research and Creative Inquiry Day is an annual event designed to promote student research and creative inquiry and provide a venue for presenting that work. This event is open to undergraduate and graduate students from all departments who want to display their research and creative projects. Research projects and literature-based reviews will follow the standard poster format while the English Department has elected to use a paper presentation format.

AWARDS CEREMONY, APRIL 9, 2019

- ◆ Best Ph.D. Research Award for Electrical and Computer Engineering: Devendrasinh Darbar, student of Dr. Indranil Bhattacharya
- ◆ Doctor of Philosophy Best Paper Award: Devendrasinh Darbar, student of Dr. Indranil Bhattacharya
- ◆ TTU Excellence in Creative Inquiry Student Award (apex award for undergraduate students who are awarded CISE funding) was received by Tessa Eskander, student of Dr. Holly Stretz.

COE STUDENT AWARDS

- ◆ Master of Science Best Paper Award: Zach Grigg and Brandon Anderson, co-recipients, students of Dr. Timothy Huff
- ◆ Tessa Eskander, student of Dr. Holly Stretz, was awarded the COE Eminence Award for best undergraduate publication. Her work on lithium ion recovery and the sorbents used in manufacturing is related to the NSF REU grant through CESR, where she is one of the mentors, was published in the *Journal of the American Ceramic Society* 102.5 (2019): 2398-2404. Ms. Eskander also received the Chemical Engineering Distinction in the Major which is an Honors diploma. The DITM requires publication of a senior thesis which takes about two years of commitment and is publication quality research effort. You have to be accepted into the program to get this distinction. These awards were received in the last few months before she graduated. She is now working for Visionary Fiber in Lockhart, Texas, a startup company creating reactors aimed at economical production of biodiesel.

OTHER AWARDS & HONORS

- ◆ Samuel Mathews, student of Dr. L. K. Crouch, was the recipient of the Student Oral Presentation Award at the Midwest Coal Ash Association (MCAA) for his talk, "Preliminary Study of the Potential of a Beneficiated Ultrafine Class F Fly Ash."



Tessa Eskander with Dr. Stretz on graduation day (above); and with Dr. Arce (right)



Students receiving Eminence Awards at E-Week Banquet, February 2019

OTHER AWARDS & HONORS, Continued

Dr. Heather J. Brown

Dr. L. K. Crouch is honored to report that his first Ph.D. student, Dr. Heather J. Brown, has been elected to serve on the ACI Board of Directors. Dr. Brown, FACI, joined the Concrete Industry Management (CIM) Program in August 2001 and is currently Director and Professor of the newly formed School of Concrete and Construction Management at Middle Tennessee State University (MTSU), Murfreesboro, TN. She is a member of the ACI Foundation Scholarship Council, and ACI Committees 522, Pervious Concrete, and C655, Foundation Constructor Certification. She has also served on ACI Committee 544, Fiber-Reinforced Concrete, and as a Student Chapter Advisor. Named a Fellow of ACI in 2015, Brown also received the 2008 ACI Walter P. Moore, Jr. Faculty Achievement Award.

Brown has authored and coauthored more than 30 papers and has been published in Concrete International, ASTM Journal of Testing and Evaluation, Transportation Research Record, International Center for Aggregate Research Journal, American Chemical Society Journal, and Tennessee Concrete. She has been a presenter and guest lecturer on topics such as factors affecting concrete strength, pervious pavements, fiber-reinforced concrete, whitetopping pavements, high-performance concrete, flowable fill, skid-resistant aggregates, and concrete construction tolerances.

Brown has been honored as a recipient of the MTSU Outstanding Grantsmanship, MTSU Overall Excellence, and MTSU Faculty Who Make a Difference Awards. She was named as one of the Influential Women in Business in Rutherford County in 2015 and one of the Most Influential People in Concrete Construction in 2017.

She received her BS, MS, and PhD in civil engineering, all from Tennessee Technological University, Cookeville, TN. Her technical experience also includes 5 years of material research for the Tennessee Department of Transportation as a graduate student.



Dr. Audrey Copeland

Dr. L. K. Crouch is honored to report that his former Master's student, Dr. Audrey Copeland, has been named the new President/CEO of the National Asphalt Pavement Association (NAPA). Copeland, who has worked for NAPA since 2012, succeeds Mike Acott at NAPA's Annual Meeting in January 2019, based on the recommendation of NAPA's Succession Planning Task Group and the unanimous support of NAPA's Executive Committee,

Copeland brings a high level of expertise, passion and perspective to the role. She has strong relationships with the state asphalt pavement associations, APA, NCAT, the Asphalt Institute, FHWA, and other industry professionals and partners. A proven leader, speaker and communicator, Copeland is poised to forge opportunities for NAPA, its members and the industry as a whole.

Since joining NAPA as the VP for Engineering, Research & Technology in 2012, Copeland has grown the NAPA engineering team – attracting and retaining high-quality staff who are experts in their fields – and served as the technical lead for more than \$2 million in Pavement Economics Committee research projects. In 2013, she secured more than \$2 million in government funding for advancing asphalt technologies, which has resulted in the Annual Industry Survey on RAP and Warm Mix Asphalt usage.

Copeland, who started her career as a highway engineer with FHWA, earned a PhD in Civil Engineering from Vanderbilt University in 2007 and Master and Bachelor of Science degrees in Civil & Environmental Engineering from Tennessee Technological University

Increase Research Activity in the Areas of the Center

Generate external funding that will contribute to the long-term growth and sustainability of the Center. As a minimum, the external funding generated per year by the center should match the state funding.

Center faculty and the R&D Engineer will produce at least five publications in total. Once sufficient data is collected, it will be reported on a running three-year average to smooth differences between publication timing and research project timing.

The Center Focus Areas also intersect the University Flight Plan focus areas to Create Distinctive Programs and Invigorate Faculty. In addition to hosting meetings for each research area to promote collaboration and proposal writing, the Center has initiated several seminars to kick start collaborative research efforts and energize faculty efforts, these efforts will be continued in the next year.

Increase Student Research Activity

Continue pursuing support to the MS and Ph.D. graduate students in the strategic research areas of the Center consistent with the level of external funding.

Support at least two undergraduate research projects per year in the areas related to energy systems.

This goal intersects the University Flight Plan's New Graduate Programs sub goal.

Increase Collaborative research

Continue pursuing the development and submission of two collaborative proposals with interdisciplinary focus. The number of collaborative proposals submitted should be at least two per year.

This goal intersects the University Flight Plan's Multidisciplinary Research Innovation sub goal. Efforts towards a food, energy, and water (FEW) nexus have already yielded positive results.

Add Laboratory Facilities

Acquire a research trailer for in-the-field testing. Continue to support the development of the wireless power laboratory.

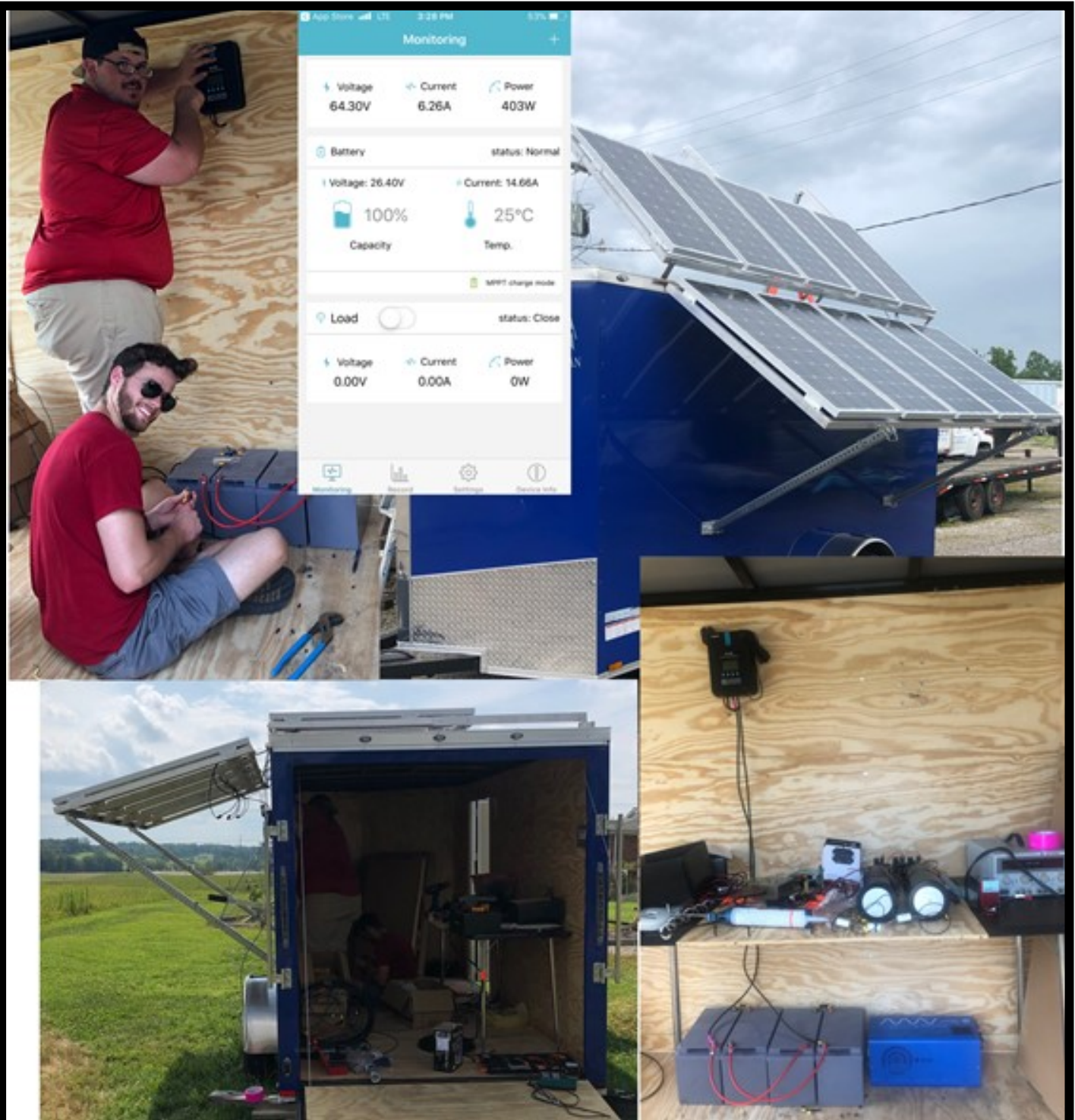
This goal intersects the University Flight Plan's Physical Infrastructure Priorities sub goal and the Technology Service to Students sub goal, and the Technology in Teaching sub goal. Better facilities in areas of national importance like the Smart Grid benefit research, education, and hire-ability of our graduates.

Increase Outreach Activities

Organize a minimum of two seminars by external speakers per year.

This goal intersects the University Flight Plan's Co-Curricular Undergraduate Program sub goal and the Multidisciplinary Research Innovation sub goal. By having research area experts from outside the university come teach seminars, workshops or short courses, the students will be exposed to a broader base of information and hopefully promote collaborative efforts from TTU researchers with those at other institutions.

SUPPORTING MATERIALS



During Fiscal Year 2018-2019, the CESR acquired a trailer and had solar panels installed for use in field testing, such as on the NSF-sponsored Sensors in the Soil project.

Pictured are Ph.D. Student, Charles Robinson (top left), and Undergraduate Student, Brandon Nieman (bottom left).

CESR FACULTY & STAFF—2018-2019

Center Director:	Satish M. Mahajan, Professor	Director, CESR
Center Faculty:	Charles Van Neste	Assistant Research Professor
Center Staff:	Robert Craven	R & D Engineer
	Barbara Fenlon	Administrative Associate 4
	Tammy Martin (Part Time)	Administrative Associate 3
	Anysa Milum (also with CMR)	Financial Associate 6
	Etter Staggs	Financial Analyst
CESR Staff (Part Time, Temporary):		
	Md Mosharaf Hossain	Research Assistant
	Prabin Lamichhane	Research Assistant
	Mohammed Arman Ullah	Research Assistant

Faculty participating in the Strategic Research of the Center are:

Smart Grid

Ali Alouani – ECE
Rabie Belkacemi – ECE
Indranil Bhattacharya – ECE
Robert Craven – CESR
Jie Cui – ME
Sheikh Ghafoor – CSC
Syed Rafay Hasan – ECE
Brian Leckie—Agriculture
Satish Mahajan – ECE
Mohamed Mahmoud – ECE
Joseph Ojo – ECE
Robert Qiu – CMR/ECE
Terry Guo—CMR
Vahid Motevalli—Engineering
Ghadir Radman – ECE
Mohammad Rahman – CSC
Michael Rogers—CSC
Ambareen Siraj – CSC
Charles Van Neste – CESR
Ahmad Vasselbehagh—ME

Resilient Infrastructure

Steven Anton—ME
Daniel Badoe – CEE
Joseph Biernacki – CHE
J. W. Bruce—ECE
Laura Arias Chavez – CHE
Stephen Canfield – ME
Steven Click – CEE
L. K. Crouch – CEE
Ahmed Elsayy – MET
Jerry Gannod – CSC
Craig Henderson – CEE
Timothy Huff – CEE
Sharon Huo – CEE
Stephen Idem – ME
Alfred Kalyanapu—CEE
Ethan Languri – ME
Jane Liu – CEE
Benjamin Mohr – CEE
Jessica Oswald—Engineering
Venkat Padmanabhan – CHE
Derek Potter—STEM Center
Mustafa Rajabali - PHY
Holly Stretz – CHE
Daniel VandenBerge – CEE
Liqun Zhang – CHE

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019**

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
533156	What Do Engineers Do? Communicating the Diverse, Dynamic Field through Outreach (Principal Investigator Elizabeth Powell, Co Principal Investigator Harry Ingle)	Tennessee Board of Regents	7/1/18-6/30/19	34,969.00	18,974.14
531298	EAGER SitS: A Multi- Sensor Probe Network for Continuous Monitoring of the Soil Health (Principal Investigator Charles Van Neste, Co-Principal Investigator Satish M. Mahajan and Co-Principal Investigator Brian Leckie)	National Science Foundation	10/1/18-9/30/19	100,988.00	69,880.09
531294	CyberTraining: CDL: iPDC - Summer Institute for Integrating Parallel and Distributed Computing in Introductory Programming Classes (Principal Investigator Sheikh Ghafoor, Co-Principal Investigator Mike Rogers, Co-Principal Investigator David Brown)	National Science Foundation	9/1/18-8/31/19	177,377.00	173,321.03
531291	TWC: Small: Collaborative: Multi-Layer Approaches for Securing Enhanced AMI Networks against Traffic Analysis Attacks (Year 3 of 3) (Principal Investigator Mohamed Mahmoud)	National Science Foundation	9/1/18-8/31/19	95,381.00	80,577.15
SUB - TOTAL, GRANTS AND CONTRACTS				408,715.00	342,752.41

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019**

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
535266	Understanding the Expected Deformation of Rectangular Ductwork (Principal Investigator Y. Jane Liu, Co-Principal Investigator Stephen Idem)	Industrial Sponsor	9/1/18-12/31/18	9,761.00	9,756.20
531279	Supplement to Tennessee Cybercorps: A Hybrid Program in Cybersecurity - Community College Inclusion (Principal Investigator Ambareen Siraj)	National Science Foundation	8/1/18-7/31/19	19,674.55	6,886.09
534302	Incorporating the Preferences for Everyday Living Inventory into Ohio's Nursing Homes to Improve Resident Care (Principal Investigator Gerald Gannod)	Miami University (Funding from the Ohio Department of Medicaid)	7/1/18-6/30/19	61,911.00	58,435.13
531279	Supplement to Tennessee Cybercorps: A Hybrid Program in Cybersecurity - Community College Inclusion 2017-2018 (Principal Investigator Ambareen Siraj)	National Science Foundation	8/1/18-7/31/19	18,442.55	6,454.89
531279	Tennessee Cybercorps: A Hybrid Program in Cybersecurity (Principal Investigator Ambareen Siraj, Co-Principal Investigator Mohammad Ashiqur Rahman, Co-Principal Investigator Doug Talbert)	National Science Foundation	1/1/18-12/31/18	351,905.75	174,884.63
SUB - TOTAL, GRANTS AND CONTRACTS				461,694.85	256,416.94

CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
532318	Soil Mechanics Research, Year 2 (Principal Investigator Daniel VandenBerge)	External University Sponsor	9/28/18-9/15/19	22,653.00	49,583.98
539357	New High Resolution Neutron Detector for the Studies of Exotic Nuclei (NEXT) Year 3 of 3 (Principal Investigator Mustafa Rajabali)	Subaward from the University of Tennessee (Funding from the Department of Energy)	6/4/18-6/3/19	54,260.00	36,654.93
532279	Supplement to The Structure of Neutron-rich Deformed Nuclei Studied by Beta Decay (Principal Investigator: Mustafa Rajabali)	Department of Energy	2/1/17-1/31/19	29,000.00	-
532295	Rapid Distributed Sensing of Subsurface In-situ Stress (Principal Investigator Daniel VandenBerge)	Industrial Sponsor	8/2/18-12/1/18	4,260.00	10,393.83
535260	Hybrid AC/DC Islanded Micro-Grid: Planning, Operation, and Cyber Security (Year 3 of 3) (Principal Investigator Mohamed Mahmoud)	External University Sponsor	8/1/18-8/1/19	28,645.20	20,610.72
SUB - TOTAL, GRANTS AND CONTRACTS				138,818.20	117,243.46

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019**

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
535268	Power Transmission through an Optical Fiber (Principal Investigator Charles Van Neste)	Industrial Sponsor	8/1/18-12/31/18	12,500.00	12,451.93
532388	Tracking Water Storage in Lakes: Citizens and Satellites and Implementation Phase (Principal Investigator Sheikh Ghafoor)	The University of North Carolina at Chapel Hill (Funding from NASA)	6/25/18-6/24/19	87,955.00	47,034.06
539371	Detection and Analysis of Malware in Critical Infrastructure (Principal Investigator Sheikh Ghafoor)	Oak Ridge National Laboratory	10/1/18-9/30/19	18,239.00	9,158.36
535267	Combustion Turbine Exhaust Duct, Silencer, and Stack Scale Modeling (Principal Investigator Stephen Idem)	Industrial Sponsor	11/1/18-12/5/18	10,000.00	9,998.03
531279	Tennessee Cybercorps: A Hybrid Program in Cybersecurity (Principal Investigator Ambareen Siraj)	National Science Foundation	1/1/19-12/31/19	321,146.35	112,401.22
539283	Development of Tennessee Travel Demand Model Users' Group (Principal Investigator Daniel Badoe)	University of Tennessee - Knoxville (Funding from TDOT)	1/1/19-12/31/19	7,000.00	11,570.87

SUBTOTAL, GRANTS AND CONTRACTS

456,840.35 202,614.47

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019**

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
539373	Black Box: Highly Secure Environment for Health Data Computation (Principal Investigator Sheikh Ghafoor and Co-Principal Investigator Mike Rogers)	Oak Ridge National Laboratory	1/1/19-12/31/19	46,820.00	934.38
539375	MIMIR/MEASURE: A Live Dashboard Project for Industrial Devices (Principal Investigator Gerald Gannod)	Oak Ridge National Laboratory	1/18/19-5/31/19	5,000.00	1,251.53
532324	Advanced Metal Anodes for Lithium Metal Secondary Batteries (Principal Investigator Liqun Zhang)	Industrial Sponsor	1/1/19-6/30/19	21,500.00	15,619.73
539374	Simulation of HF Inverter Circuits for High-Power Wireless Charging (Principal Investigator Satish M. Mahajan)	Oak Ridge National Laboratory	1/14/19-5/31/19	15,675.00	15,675.00
531200	REU Site: Immersive Research in Energy Generation, Storage/Conversion, and Power Transmission (Principal Investigator Indranil Bhattacharya, Co-Principal Investigator Joseph Biernacki) Supplies encumbrance of \$180	National Science Foundation	3/1/19-2/28/20	107,249.00	103,500.34

SUB - TOTAL, GRANTS AND CONTRACTS

196,244.00 136,980.98

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019**

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
532279	The Structure of Neutron-rich Deformed Nuclei Studied via Beta Decay (Year 3) (Principal Investigator Mustafa Rajabali)	The Department of Energy	2/1/19-1/31/20	56,000.00	51,513.17
539369	Nuclear Hybrid Energy Systems: Desalination and Wastewater Reclamation Process Modeling (Principal Investigator Laura Arias Chavez)	Oak Ridge National Laboratory	9/1/18-12/31/19	87,788.00	18,808.18
539377	From Can't to Can: Attack Prevention and In-situ Detection of Advanced Attacks on Controller Area Networks (Principal Investigator Sheikh Ghafoor)	Oak Ridge National Laboratory	3/1/19-9/30/19	21,455.00	11,707.03
535269	Development of Unified Duct Design Equations and Improvements to the Current FEA Model (Principal Investigator Jane Liu, Co-Principal Investigator Stephen Idem)	Industrial Sponsor	4/1/19-3/31/20	82,999.00	45,885.94
539371	Detection and Analysis of Malware in Critical Infrastructure (Principal Investigator Sheikh Ghafoor, Senior Personnel Mike Rogers)	Oak Ridge National Laboratory	10/1/18-9/30/19	75,000.00	63,270.04
SUBTOTAL, GRANTS AND CONTRACTS				323,242.00	191,184.36

CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
535224	Investigation of Effective Management of Energy Demand in Distribution Management Systems of Smart Grids using Formal Verification Methods (Principal Investigator Rafey Hasan)	External University Sponsor	2/24/2018-6/1/20	9,074.00	3,009.50
535259	Efficient Energy Management System with Integrated Cybersecurity Measures in Smart Grid (Principal Investigator Mohamed Mahmoud)	External University Sponsor	4/1/19-3/31/20	29,988.00	7,073.87
535241	Measurement of Unreinforced and Reinforced Spiral Flat Oval Duct Deformation Under Positive and Negative Pressure (Principal Investigator Stephen Idem, Co-Principal Investigator Jane Liu)	Industrial Sponsor	5/28/19-9/30/19	10,066.00	443.29
532392	"K-12 Summer STEM Teacher Workshop" Regional Transportation Center on Reducing Congestion (Principal Investigator Vahid Motevalli, Co-Principal Investigator Darek Potter)	University of Florida Transportation Institute (UFTI), Department of Transportation	1/10/19-9/10/19	12,000.00	8,360.79
532392	Regional Transportation Center on Reducing Congestion: ADMIN Year 2 and Year 3 (Principal Investigator Vahid Motevalli)	University of Florida Transportation Institute (UFTI), Department of Transportation	1/19/18-12/31/19	41,254.00	986.49
SUBTOTAL, GRANTS AND CONTRACTS				102,382.00	19,873.94

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019**

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
531279	Supplement to Tennessee Cybercorps: A Hybrid Program in Cybersecurity for TNTech Cyber Bootcamp - Summer 2019 (Principal Investigator Ambareen Siraj, Co-Principal Investigator Doug Talbert)	National Science Foundation	6/1/19-5/31/20	24,238.90	33,016.70
531279	Supplement to Tennessee Cybercorps: A Hybrid Program in Cybersecurity for TNTech Cyber Bootcamp - Summer 2019 (Principal Investigator Ambareen Siraj)	National Science Foundation		19,344.50	26,351.65
532239	Investigating Unipolar Capacitive Wireless Power Transfer Technology for the Wireless Charging of EV's - (Phase I - Design) (Principal Investigator Charles Van Neste, Co-Principal Investigator Satish M. Mahajan, Co-Principal Investigator Vahid Motevalli)	Tennessee Valley Authority (TVA)	6/10/19-10/1/19	50,000.00	-
532292	High-Energy Density Lithium/Sodium Ion Batteries for Grid Level Energy Storage -- Phase I (Principal Investigator Indranil Bhattacharya)	Tennessee Valley Authority (TVA)	6/11/19-10/1/19	50,000.00	-
SUBTOTAL, GRANTS AND CONTRACTS				143,583.40	59,368.35

**CONTRACT AND GRANT AWARDS
Activated Between July 1, 2018 and June 30, 2019**

POWER-TEST-SERVICE ACCOUNT

Contract Number	Title	Source	Project Dates	Total Amount	Estimated Expendit.
538597	Power-Test-Service Account (Principal Investigators: Professor and Director Satish M. Mahajan; Professor Stephen Idem, and Professor L. K. Crouch)	Various	7/1/18-6/30/19	14,589.38	12,318.56
SUB-TOTAL				14,589.38	12,318.56
POWER-TEST-SERVICE ACCOUNT					
TOTAL CONTRACTS AND GRANTS DURING 2018-2019				2,246,109.18	1,338,753.47



Wireless Power Transfer Project in Summer 2019

Pictured: Front L-R are Dr. Charles Van Neste, Dr. Satish M. Mahajan, student Brandon Nieman, Student Whitney Kirby, and CESR R&D Engineer Robert Craven; Back L-R are graduate student Michael Coultis, student Sean Denn, student Tanner Mingen, and student Charles Trevor Johnson.

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2018 through June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
1.	CAREER: Beyond Lithium: Nanofiber Based Next Generation Energy Dense, Safe and Cost Effective Sodium ion Batteries and Serving Society through Outreach Activities	Associate Professor Indranil Bhattacharya	National Science Foundation	525,982	Unfunded
2.	CAREER: Probing the Polymer Architectures for improving the Gas Separation Performance of PIM-Based Membranes	Assistant Professor Venkat Padmanabhan	National Science Foundation	562,990	Unfunded
3.	CAREER: Control-Aware Resiliency Analysis and Hardening for Cyber-Physical Systems	Assistant Professor Mohammad A. Rahman	National Science Foundation	549,492	Unfunded
4.	Power Transmission through an Optical Fiber	Research Assistant Professor Charles Van Neste	Industrial Sponsor	12,500	Funded
SUBTOTAL, PROPOSALS FOR 2018-2019				1,650,964	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
5.	CAREER: Investigation of Evaporation under Heat Localization in Porous Media	Assistant Professor Ethan Languri	National Science Foundation	501,724	Unfunded
6.	Advanced Wake Loss Modeling for Large Wind Farms with Variable Wind Speed and Direction	Assistant Professor Ahmad Vasselbehagh	External University Sponsor	20,715	Pending
7.	An Offshore Power- Generating Energy Storage Plant	Assistant Professor Ahmad Vasselbehagh and Research Assistant Professor Charles Van Neste	Department of Energy - EERE	1,805,516	Pending
8.	Understanding the Expected Deformation of Rectangular Ductwork	Professor Y. Jane Liu, Professor Stephen Idem	Industrial Sponsor	9,761	Funded
9.	Black Box: Highly Secure Environment for Health Data Computation	Professor Sheikh Ghafoor and Associate Professor Mike Rogers	Oak Ridge National Laboratory	112,508	Funded
SUBTOTAL, PROPOSALS FOR 2018-2019				2,450,224	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
10.	Use of Recycled Concrete Aggregate in New Concrete Mixes	Professor L. K. Crouch	Tennessee Department of Transportation	219,985	Unfunded
11.	Coarse-Grained Molecular Dynamics Study of Asphaltene Aggregation	Assistant Professor Venkat Padmanabhan	American Chemical Society (ACS)	110,000	Unfunded
12.	Investigating the Service of App-Based Rideshare Offered by Transportation Network Companies in Tennessee	Professor Daniel A. Badoe	University of Memphis (Funding from the Tennessee Department of Transportation)	60,000	Unfunded
13.	Design of Dowels Loaded in Shear for Rock Stabilization	Assistant Professor Daniel VandenBerge	Tennessee Department of Transportation	147,132	Unfunded
14.	Measurement of Unreinforced and Reinforced Spiral Flat Oval Duct Deformation under Positive and Negative Pressure	Professor Stephen Idem and Professor Y. Jane Liu	Industrial Sponsor	10,013	Funded

SUBTOTAL, PROPOSALS FOR 2018-2019**547,130**

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS
Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
15.	Collaboration: Secure Schemes for Smart Grid Energy Storage Units and AMI Networks	Associate Professor Mohamed Mahmoud	External University Sponsor	160,000	Pending
16.	Combustion Turbine Exhaust Duct, Silencer, and Stack Scale Modeling	Profession Stephen Idem	Industrial Sponsor	10,000	Funded
17.	CNS Core: Small: Collaborative Research: SSD-ESU: Secure, Scalable and Dynamic Network Models for Energy Storage Units	Associate Professor Mohamed Mahmoud	National Science Foundation	260,000	Pending
18.	Earthquake Ground Motion Suites for Oak Ridge TN	Assistant Professor Timothy Huff	Oak Ridge Associated Universities (ORAU)	5,000	Unfunded
19.	Simulation of HF Inverter Circuits for High-Power Wireless Charging	Professor and Director Satish M. Mahajan	Oak Ridge National Laboratory	15,675	Funded
SUBTOTAL, PROPOSALS FOR 2018-2019				450,675	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
20.	MRI: Development of an Instrument for Smart Autonomous Construction of Concrete Structures	Professor Joe Biernacki, Professor Stephen Canfield, Professor Craig Henderson, Professor Ismail Fidan, Assistant Professor Steven Anton	National Science Foundation	1,233,760	Pending
21.	MRI: Development of a High-Resolution Neutron Detector for Decay and Reaction Studies with Exotic Nuclei	Assistant Professor Mustafa Rajabali	National Science Foundation	157,584	Pending
22.	MIMIR/MEASUR: A Live Dashboard Project for Industrial Devices	Chairperson Gerald Gannod	Oak Ridge National Laboratory	5,000	Funded
23.	Measurement of Unreinforced and Reinforced Spiral Flat Oval Duct Deformation under Positive and Negative Pressure	Professor Stephen Idem, Professor Jane Liu	Industrial Sponsor	10,066	Funded
SUBTOTAL, PROPOSALS FOR 2018-2019				1,406,410	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS
Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
24.	Ultra-high Durability Cement based Materials with Controlled Microstructural Architectures	Professor Joe Biernacki, Professor Stephen Canfield	U.S. Department of Energy	1,496,000	Unfunded
25.	Investigation on Human Beta Defensin Type 3 Interaction with Lipid Membrane, Chemokine Receptor and Eph Receptor	Assistant Professor Liqun Zhang	National Institute of Health	425,963	Pending
26.	Development of Unified Duct Design Equations and Improvements to the Current FEA Model	Professor Jane Liu, Professor Stephen Idem	Industrial Sponsor	82,999	Funded
27.	NRT-FW-HTF: Engendering the Spirit of Gadugi at the Food-Energy-Water Nexus	Professor Pedro Arce, Assistant Professor Laura Arias Chavez, Assistant Professor Tania Datta, Associate Professor Robby Sanders, Professor Ada Haynes	National Science Foundation	3,000,000	Pending
SUBTOTAL, PROPOSALS FOR 2018-2019				5,004,962	

STATUS OF PROPOSALS

Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
28.	MRI: Acquisition of Fiber Optic Sensing Instrument for Distributed Measurement of Strain and Temperature	Assistant Professor Daniel VandenBerge, Professor Craig Henderson, Research Assistant Professor Charles Van Neste, Assistant Professor Ethan Languri	National Science Foundation	108,160	Pending
29.	Vortex Induced Vibrations of Flexible Buoyant Finite Cylinders within Turbulent Boundary Layers for Microgrid Applications	Assistant Professor Ahmad Vasselbehagh	Oak Ridge Associated Universities (Ralph E. Powe Junior Faculty Enhancement Award)	5,000	Unfunded
30.	CyberTraining: Pilot: Collaborative Research: Growing the Workforce in High Performance Computing and Scalable Systems	Associate Professor Michael Rogers	National Science Foundation	80,770	Pending
31.	Enabling Efficient Integration of Electric Vehicles in Smart Grid: Planning, Operation, and Cybersecurity	Associate Professor Mohamed Mahmoud	External University Sponsor	90,022.80	Pending

SUBTOTAL, PROPOSALS FOR 2018-2019**283,952.80**

STATUS OF PROPOSALS
Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
32.	From Can't to Can: Attack Prevention & In-situ Detection of Advanced Attacks on Controller Area Networks	Professor Sheikh Ghafoor	Oak Ridge National Laboratory	56,260	Funded
33.	Coarse-Grained Molecular Dynamics Study of Asphaltene Aggregation	Assistant Professor Venkat Padmanabhan	American Chemical Society (ACS)	110,000	Pending
34.	A Fundamental Study of Non-Equilibrium Water Foaming Process: Towards Economic and Environmental Benign Processing	Assistant Professor Liqun Zhang	National Science Foundation	245,155	Pending
35.	CyberTraining: Pilot: Collaborative Research: Semi-Automatic Assessment of Parallel Programs in Training of Students and Faculty	Professor Sheikh Ghafoor, Professor Ada Haynes	National Science Foundation	82,000	To be funded in 2019-2020
36.	Implementing a Preference-Based, Person-Centered Communication Tool in Tennessee	Professor Gerald Gannod	Tennessee Department of Health (via Subcontract from Miami University)	49,449	To be funded in 2019-2020

SUBTOTAL, PROPOSALS FOR 2018-2019

542,864

STATUS OF PROPOSALS
Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
37.	Adaptive and Reconfigurable Sensor Elements and Networks for Monitoring Critical Infrastructure and Maneuver Corridors	Research Assistant Professor Charles Van Neste (Principal Investigator) and Professor and Director Satish M. Mahajan (Co-Principal Investigator)	External University Sponsor	1,000,000	Pending
38.	Single-Surface Wireless Dynamic Charging of Electric Vehicles	Research Assistant Professor Charles Van Neste (Principal Investigator), Professor and Director Satish M. Mahajan (Co-Principal Investigator), Professor and Associate Dean for Research and Innovation, College of Engineering Vahid Motevalli (Co-Principal Investigator)	Tennessee Valley Authority	50,000	Funded
39.	High-Energy Density Lithium/Sodium Ion Batteries for Grid Level Energy Storage - Phase I	Associate Professor Indranil Bhattacharya	Tennessee Valley Authority	50,000	Funded
40.	A Program to "Demonstrate Enhancement of Heat Transfer in Important Components of Grid Operation"	Assistant Professor Ethan Languri	Industrial Sponsor	196,544	Funded
SUBTOTAL, PROPOSALS FOR 2018-2019				1,296,544	

STATUS OF PROPOSALS
Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
41.	Collaborative Proposal: ECR: PEER: Software Engineering Workforce Development in High Performance Computing for Digital Twins	Chairperson Gerald Gannod, Professor Sheikh Ghafoor	National Science Foundation	42,365	Pending
42.	"K-12 Summer STEM Teacher Workshop" Regional Transportation Center on Reducing Congestion	Associate Dean for Research and Innovation and Professor Vahid Motevalli, Interim Director of the STEM Center Darek Potter	University of Florida Transportation Institute	12,000	Funded
43.	Supplement: REU Site: Immersive Research in Energy Generation, Storage/Conversion, and Power Transmission	Associate Professor Indranil Bhattacharya, Professor Joseph Biernacki	National Science Foundation	8,400	Funded
44.	Estimated Transition Periods for Seismic Design Spectra Based on an Expanded Ground Motion Database	Assistant Professor Tim Huff	U. S. Geological Survey	78,827	Pending
SUBTOTAL, PROPOSALS FOR 2018-2019				141,592	

CENTER FOR ENERGY SYSTEMS RESEARCH

STATUS OF PROPOSALS

Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
45.	Application of Artificial Intelligence for Air Pollution Monitoring and Remediation using Neural Network and Deep Learning	Assistant Professor Ahmad Vasselbehagh	Industrial Sponsor	5,000	To be funded in 2019-2020
46.	Two-way Interactions of Turbulent Unsteady Flow and Damaged Structures using Particle Image Velocimetry	Assistant Professor Ahmad Vasselbehagh, Professor Stephen Idem, Professor Chris Wilson, Assistant Professor Steven Anton	Department of Defense	492,145	Pending
47.	Planning Grant: Engineering Research Center for Housing Infrastructures for an Inclusive U.S.	Professor Joseph Biernacki	National Science Foundation	99,851	Pending
48.	Regional Transportation Center on Reducing Congestion: Year 2 ADMIN	Associate Dean for Research and Innovation and Professor Vahid Motevalli	University of Florida Transportation Institute	20,627	Funded
SUBTOTAL, PROPOSALS FOR 2018-2019				617,623	

STATUS OF PROPOSALS
Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
49.	CUE: Collaborative Research: Development of a Collaborative Interdisciplinary Cybersecurity-based Curriculum for Construction Engineering	Associate Professor Mohamed Mahmoud	National Science Foundation	75,000	Pending
50.	Advanced Metal Anodes for Secondary Lithium Metal Batteries	Assistant Professor Liqun Zhang	Industrial Sponsor	117,404	Pending
51.	Advanced Metal Anode with Artificial Solid Electrolyte Interphase (SEI) for Rechargeable Lithium Metal Batteries	Assistant Professor Liqun Zhang	National Science Foundation	35,000	Pending
52.	Soil Mechanics Research	Assistant Professor Daniel VandenBerge	External University Sponsor	8,228	Pending
53.	Supplement: Nuclear Hybrid Energy Systems: Desalination Case Study	Assistant Professor Laura Arias Chavez	Oak Ridge National Laboratory	87,788	Funded
SUBTOTAL, PROPOSALS FOR 2018-2019				323,420	

STATUS OF PROPOSALS
Submitted Between July 1, 2018 and June 30, 2019

	TITLE	INVESTIGATORS	SOURCE	AMOUNT	STATUS
54.	Measurement of Efficiency and Power Transmission for an Optical Fiber System	Research Assistant Professor Charles Van Neste	Industrial Sponsor	88,677	Pending
55.	Power-Test-Service Account	Professor and Director Satish M. Mahajan, Professor Stephen Idem, Professor L. K. Crouch	Various Industries	14,589.38	Funded
SUBTOTAL, PROPOSALS FOR 2018-2019				103,266.38	
TOTAL, PROPOSALS FOR 2018-2019				14,819,627.18	

CESR Publications for 2018-2019 Fiscal Year

Conference Papers:

- ◆ Charles A. Robinson, Hao Lu, C.W. Van Neste, “Omnidirectional Vehicle Sensing for Wireless Power Transfer Applications.” IEEE WPW, London, United Kingdom (2019) (Oral, Article).
- ◆ Donald Chaney, Charles A. Robinson, C.W. Van Neste, “Quarter Wavelength Surface Structures for Improved Operation in Unipolar Capacitive Power Transfer.” IEEE WPW, London, United Kingdom (2019) (Oral, Article).
- ◆ Utkarsh D. Kavimandan; C. W. Van Neste; Satish M. Mahajan; “Luxating Inverter for an Inductive Power Transfer System.” IEEE IECON Indus. Elect. Soc., Washington DC, USA (2018) (Oral, Article).
- ◆ “Harvesting Vibration Energy from Vehicle Suspension System for Mileage Improvement”, (With U. C. Chukwu); IEEE PES GM Portland OR August 2018.
- ◆ “The Modeling of V2G Component for Power Flow Studies” (With U.C. Chukwu), Clemson University Power System Conference, PSC, Charleston September 2018.
- ◆ Duong, S., Craven, R., Garner, S., and Idem, S. 2018. “Uncertainty Analysis of a Numerical Performance Model for an Inflatable Fabric Evaporative Cooling Tower,” ASHRAE Transactions, In Press.
- ◆ Duong, S., Craven, R., Garner, S., and Idem, S. 2018. “Measurement of Wind Pressure Coefficients for an Inflatable Fabric Evaporative Cooling Tower,” ASHRAE Transactions, Vol. 124, Part 2, pp. 3-10.

Peer Reviewed Journal Papers:

- ◆ Amirreza Sohrabi, Ghazaleh Haghghat, Parmiss Mojir Shaibani, C.W. Van Neste, Selvaraj Naicker, Mohtada Sadrzadeh, Thomas Thundat, “Degradation of Pharmaceutical Contaminants in Water by an Advanced Plasma Treatment.” Desalination and Water Treatment, Vol. 139, 202-221, (2019).
- ◆ Duong, S., Craven, R., Garner, S., and Idem, S. 2018. “A Novel Evaporative Cooling Tower Constructed From an Inflatable Fabric Duct,” Science and Technology for the Built Environment, Vol. 24, No. 8, pp. 908-918.

(None for 2018-2019)

(None for 2018-2019)



Dr. Zeel Maheshwari

Dr. Zeel Maheshwari, Assistant Professor, Northern Kentucky University, presented her paper, “Smart Integrated Renewable Energy Systems (SIREs) - An Innovative Way to Energize Rural Areas,” on Thursday, September 27, 2018.

Zeel Maheshwari received her Bachelors degree in Electrical and Electronics Engineering from Visveswaraya Technological University, India in June 2011. She completed her Masters and PhD degree in Electrical and Computer Engineering at Oklahoma State University (OSU) in December 2013 and December 2017 respectively. She currently works as an Assistant Professor at Northern Kentucky University (NKU). She received Dorothy Westerman Hermann Endowed Professorship in Science at NKU and is first from her department to receive it. Apart from this, she has more than 10 technical papers published in various international conferences and journals. She won the first place and people’s choice award at the College-level 3 Minute Thesis (3MT) Competition held at OSU in February 2016. Her areas of interest are Smart Grids, Integration of Renewable Energy Systems, Microgrids, Energy Management and Controls, Neural Networks, Deep Learning, Fuzzy Logic and Direct Energy Conversion.

Dr. Michael Rafailov, presented his paper, Ultrafast Bandgap Photonics: Transient Topology and Metastability of Transient States: State Transitions, Metamaterials, Sensing and EE Applications, on Friday, November 30, 2018.



Dr. Michael Rafailov

Dr. Michael K. Rafailov is known as a pioneer of Ultrafast Bandgap Photonics – phenomenology of ultra-short low energy pulse interaction with condensed matter with applications in transient topological effects-material science, sensing, and photonic media engineering. Dr. Rafailov is the chair of SPIE Conferences in Ultrafast Bandgap Photonics held under SPIE charter and a chair of International Conferences in Ultrafast Dynamics, Metastability and Transient Topological Effects at Georgetown University, Washington DC. Before assuming a position of technology advisor to US Army CERDEC at Aberdeen Proving Ground and Ft. Belvoir offices and chief scientist at BNC3 Federal Company he was a lead scientist at US Army JIEDDO, Missile Defense Agency, The Boeing Corporation, Raytheon Missile Systems Company and Northrop Grumman. He also served as a Professor and Director of Laboratory of Electro-Optics, Institute Analytical Instrumentation, Academy of Sciences, USSR as well as in Navy. Dr. Michael K. Rafailov holds a PhD in Physics from the Institute of Physics, Academy of Sciences USSR. He has more than 90 publication credits in leading international journals and proceedings, and holds 24 patents with two more pending. His recent research interests include the application of very short electric pulse pumping thin layered emissive photonic devices like Organic Light Emissive Displays- OLED, Quantum Cascade Lasers – QCL.

MASTERS**BRANDON L. ANDERSON**

Post-Yield Stiffness of Bridge Piers for Nonlinear Analysis
Spring 2019
Assistant Professor Timothy Huff
Civil Engineering

NICLAS BEWERMEIER

Detecting Sybil Attacks Using Proofs of Work and Location for Vehicular Ad-hoc Networks (VANETs)
Spring 2019
Associate Professor Mohamed Mahmoud
Electrical and Computer Engineering

ANSHU BHATTARAI

Increasing Accuracy of Hand-Motion Based Continuous Authentication Systems
Fall 2018
Director and Professor Ambareen Siraj
Computer Science

UDDHAV BHATTARAI

Summer 2018
Electrical and Computer Engineering

BRANDON CHILDRESS

Estimation and Control of Nonlinear Systems with Cross-Sensitive Output Measurements
Fall 2018
Professor Pinggen Chen and Professor Ghadir Radman
Electrical and Computer Engineering

AMARJIT DATTA

A Formal Framework for Cascading Attack Analysis in the Microgrid Islanding Detection Process
Summer 2018
Assistant Professor Mohammad A. Rahman
Computer Science

MASTERS (Continued)**JACOB FESMIRE**

An Application of Neuro-Fuzzy Algorithmic Modeling for State of Charge and State of Health Estimation for Sodium-Ion Batteries

Fall 2018

Associate Professor Indranil Bhattacharya
Electrical and Computer Engineering

SURYA TEJA GUNUKULA

Priority-Based and Privacy-Preserving Electric Vehicle Dynamic Charging System with Divisible E-Payment

Summer 2018

Associate Professor Mohamed Mahmoud
Electrical and Computer Engineering

MD MOSHARAF HOSSAIN

Flexible-Block Partitioning for Parallel Matrix Multiplication Routines in Shared Memory Environment for the Edge Case Matrices

Fall 2018

Professor Sheikh Ghafoor
Computer Science

KRISTINA JEVTIC

Oxidation of Carbamazepine in Aqueous Media by CdS-TiO₂ Photocatalysis Initiated by UV and VIS-Irradiation

Fall 2018

Chairperson and Professor Pedro E. Arce
Chemical Engineering

ALEX HAROLD KELLEY

The Effect of Supplementary Cementitious Material Substitution Rates on Tennessee Bridge Deck Portland Cement Concrete Permeability

Spring 2019

Professor L. K. Crouch
Civil Engineering

MASTERS (Continued)**MIGUEL LASTRES**

Nickel Doped P2-Type Novel Sodium Iron Manganese Oxide ($\text{Na}_{0.67}\text{Fe}_{0.5}\text{Mn}_{0.5}\text{O}_2$) Cathode Materials for High Capacity Rechargeable Sodium Ion Batteries

Fall 2018

Associate Professor Indranil Bhattacharya
Electrical and Computer Engineering

FARZIN MASHALI

Deaggregated and Functionalized Nanodiamond Fluids for Thermal Management

Spring 2019

Assistant Professor Ethan Languri
Mechanical Engineering

RAHAT MASUM

Continuous Surveillance Design for Critical Smart Grid Infrastructure Using Unmanned Aerial Vehicles

Spring 2019

Assistant Professor Michael Rogers
Computer Science

ROBERT ISAAC PONDER

Replication of Force Sensing Bearings and Feasibility of Structural Health Monitoring in total Knee replacements

Spring 2019

Assistant Professor Steve R. Anton
Mechanical Engineering

MEGHAN SIGLER

Evaluating the Effects of Traffic Signalization and Pedestrian Crossings on Pedestrian and Vehicle Service through Superstreet Intersections

Fall 2018

Associate Professor Steven Click

MASTERS (Continued)**ESEME SOTA**

Subsynchronous Induction Generator Effect Mitigation in a Fixed Speed Wind Energy System Using Current Source Converter Based Statcom

Summer 2018

Professor Ghadir Radman

Electrical and Computer Engineering

NOAH STANSFIELD

The Effects of New Emergency Vehicle Loads on the Load Rating of Concrete Culverts in Tennessee

Fall 2018

Professor X. Sharon Huo

Civil Engineering

CLIFTON TUBB

Assessment of Shallow Highway Embankment Failures in Central Tennessee

Fall 2018

Assistant Professor Daniel VandenBerge

Civil Engineering

PRINCE TURKSON

Effect of Initial Suction and Levee Foundation Conditions on the Saturated Zone During Flooding for Rapid Drawdown Analysis

Fall 2018

Assistant Professor Daniel VandenBerge

Civil Engineering

MOHAMMAD ARMAN ULLAH

Seccan: A Secure Can Based In-Vehicle Network

Fall 2018

Professor Sheikh Ghafoor

MASTERS (Continued)**RABETA YEASMIN**

Investigation on the Dynamics and Interaction of Human β Defensin Type 3 with Lipid Membranes
Using Molecular Dynamics Simulations

Fall 2018

Assistant Professor Liqun Zhang

Chemical Engineering

PHD**AHMAD ALSHARIF**

Secure and Efficient Data Collection with Access Control and Multicast Schemes for Smart Grid AMI
Networks

Spring 2019

Associate Professor Mohamed Mahmoud

Engineering

RYAN JOSEPH MARSHALL

CABS: A Framework for Cellular Automata-Based Simulations in Heterogeneous HPC Environments

Spring 2019

Professor Sheikh Ghafoor

Engineering

BIBEK TIWARI

Synthesis of High Capacity Novel P2-Type $\text{Na}_{0.7}\text{Ni}_{0.3}\text{Mn}_{0.59}\text{Co}_{0.1}\text{Cu}_{0.0102}$ Cathode for Sodium
Ion Batteries and Developing Algorithms for State-of-Change and State-of-Health Estimation

Fall 2018

Associate Professor Indranil Bhattacharya

Engineering

ALI ZOLGHADR

Kinetics of Biomass Fast Pyrolysis

Fall 2018

Professor Joseph J. Biernacki

Engineering

	M.S.	Ph.D.
Number of Students	22	4

MS STUDENTS

Name	Dept.	Source of Support	Anticipated Graduation Date	Advisor
Aboah, Armstrong	CEE	CESR	Fall 2019	Professor Daniel Badoe
Al Amiri, Wesam	ECE	CESR, ECE	Fall 2019	Associate Professor Mohamed Mahmoud
Bewermeier, Niclas	ECE	CESR, ECE	Spring 2019	Associate Professor Mohamed Mahmoud
Dahal, Animesh	CSC	CESR, CEROC, CSC	Fall 2019	Director/Professor Ambareen Siraj
Davis, Nicholas	CEE	CESR	Spring 2020	Assistant Professor Tim Huff
Himes, Joseph Hunter	CHE	ORNL	Fall 2019	Assistant Professor Chavez
Hines, Thomas	CSC	NSF	Fall 2019	Professor Sheikh Ghafoor
Jevtic, Kristina	CHE	CESR, CHE	Fall 2018	Chairperson/Professor Pedro Arce
Kandel, Prajjwal	CSC	NASA, CESR	Fall 2019	Professor Sheikh Ghafoor
Long, Cody	ME	CESR, ME	Summer 2020	Assistant Professor Ahmad Vaselbehagh
Martindale, Nathan	CSC	CESR, Miami University	Spring 2020	Chairperson/Professor Gerald Gannod
Masum, Rahat	CSC	NSF, CSC, CEROC	Spring 2019	Associate Chair Doug Talbert
Mathews, Sam	CEE	CESR	Spring 2020	Professor L. K. Crouch
Mingen, Tanner	ECE	CESR	Spring 2021	Research Assistant Professor Charles Van Neste
Onanuga, Babajide	CHE	CESR	Fall 2019	Professor Joseph Biernacki
Rikli, Daniel	CEE	NCMA, CEE, CESR	Fall 2019	Professor Craig Henderson
Robinson, Charles	ECE	NSF, CESR, ECE	Summer 2020	Research Assistant Professor Charles Van Neste
Sigler, Meghan	CEE	University of Florida	Fall 2018	Associate Professor Steven Click

MS STUDENTS (continued)

Name	Dept.	Source of Support	Anticipated Graduation Date	Advisor
Sonibare, Kolawole	CHE	CESR, CHE	Fall 2019	Assistant Professor Liquan Zhang
Stansfield, Noah	CEE	TDOT	Fall 2018	Associate Provost Sharon Huo
Tubb, Clifton	CEE	External University Sponsor	Fall 2018	Assistant Professor Daniel VandenBerge

PHD STUDENTS

Alsharif, Ahmad	ECE	NSF	Spring 2019	Associate Professor Mohamed Mahmoud
Baza, Mohamed	ECE	NSF, External University Sponsor	Spring 2021	Associate Professor Mohamed Mahmoud
Bima, Muhammad E.	ECE	CESR, ECE	Spring 2021	Assistant Professor Indranil Bhattacharya
Darbar, Devendrasinh	ECE	CESR, ECE	Spring 2021	Associate Professor Indranil Bhattacharya
Hailesellasie, Muluken	ECE	ECE, CESR, External University Sponsor	Summer 2019	Associate Professor Syed Hasan
Jakaria, AHM	CSC	NSF, CEROC, CSC	Spring 2020	Professor/Director Ambareen Siraj
Jaladi, Divya	ME	NSF, CESR	Spring 2020	Assistant Professor Ethan Languri
Kavimandan, Utkarsh	ECE	CESR, ORNL	Summer 2020	Director/Professor Satish M. Mahajan
Lamichhane, Prabin	CSC	CESR, CSC	Spring 2022	Associate Chair Doug Talbert
Li, Xuebin	ECE	NSF	Fall 2020	Professor Robert Qiu
Mohammad, Abdul Salam	CHE	NSF, CESR	Spring 2021	Professor Joseph Biernacki

PHD STUDENTS (continued)

Name	Dept.	Source of Support	Anticipated Graduation Date	Advisor
Yeasmin, Rabeta	CHE	Industrial Sponsor; CHE	Fall 2021	Assistant Professor Liqun Zhang
Yilmaz, Ibrahim	CSC	CESR, CSC, CEROC	Spring 2022	Professor/Director Ambareen Siraj

CEE Civil and Environmental Engineering (Tennessee Technological University)

CEROC Cybersecurity Education, Research and Outreach Center (Tennessee Technological University)

CESR Center for Energy Systems Research (Tennessee Technological University)

CHE Chemical Engineering (Tennessee Technological University)

CMR Center for Manufacturing Research (Tennessee Technological University)

CSC Computer Science (Tennessee Technological University)

ECE Electrical and Computer Engineering (Tennessee Technological University)

ME Mechanical Engineering (Tennessee Technological University)

UNC University of North Carolina at Chapel Hill

NASA National Aeronautics and Space Administration

NCMA National Concrete Masonry Association Foundation

NSF National Science Foundation

ORNL Oak Ridge National Laboratory

STRIDE Southeastern Transportation, Research, Innovation, Development and Education Center

TDOT Tennessee Department of Transportation

Undergraduate StudentsDegree and Major

Mary A. Adkisson	B.S. ME
Dipayan Banik	B.S. CSC
Allison Baldwin	B.S. CE
Alec D. Brenner	B.S. CE
Michael Brunner	B.S. CE
Glen Cathey	B.S. CSC
Donald Zachary Chaney	B.S. ME
Matthew Crispi	B.S. CE
Viviana Cruz	B.S. CHE
Samuel Dunham	B.S. CE
Chelby Faircloth	B.S. CE
Tyler Green	B.S. CE
Andrew J. Harris	B.S. CSC
Samuel Hollifield, Jr.	B.S. General CompE
Robert Hughes	B.S. CE
Cody Innis	B.S. ME
Sean Jones	B.S. EE
Brandon Kemp	B.S. CSC
Aaron Kindred	B.S. Physics
Whitney Kirby	B.S. EE
Nicholas Lawson	B.S. CE
Sung Kyung Lee	B.S. ME
Benjamin K. Luna	B.S. Physics
Gabriel Marinescu	B.S. CSC
Samuel A. Mathews	B.S. CE
Jeffrey S. Neikirk	B.S. CSC
Brandon Nieman	B.S. EE
Cameron Schaff	B.S. CE
Alexander West	B.S. CSC
Jonathan Zigler	B.S. EE

Graduate StudentsDegree and Major

Armstrong Aboah	M.S. CE
Wesam Al Amiri	M.S. ECE
Brandon L. Anderson	M.S. CE
Aaron T. Bain	M.S. ME
Niclas Bewermeier	M.S. ECE
Sudipto Chakraborty	M.S. CE
Brandon J. Childress	M.S. ECE
Michael Coultis	M.S. ECE
Connor Gannon	M.S. CSC
Nathan Ghattas	M.S. ME
Jonathan Gibson	M.S. CSC
Anusha Sai Gollapudi	M.S. ECE
Zachery T. Grigg	M.S. CE
Katie Groves	M.S. ECE
Joseph Hunter Himes	M.S. CHE
Thomas M. Hines	M.S. CSC
Md Mosharaf Hossain	M.S. CSC
Lydia Johnson	M.S. CE
William A. Johnson	M.S. CSC
Prajjwal Kandel	M.S. CSC
Alex H. Kelley	M.S. CE
William L. Lambert	M.S. CEE
Miguel P. Lastres	M.S. ECE
Cody Long	M.S. ME
Rahat Masum	M.S. CSC
Samuel Mathews	M.S. CE
Richard Morrow	M.S. CE
Ryan Nash	M.S. ME
Jacob Nelson	M.S. ECE
Babajide Y. Onanuga	M.S. CHE
Alexander Palentyn	M.S. CE
Vanessa Perez	M.S. ECE
Robert Ponder	M.S. ME
Micah D. Rentschler	M.S. ECE
Daniel C. Rikli	M.S. CE
Meghan A. Sigler	M.S. CE
Kolawole A. Sonibare	M.S. CHE
Jonathan W. Stephenson	M.S. ME
Leif Templeton	M.S. ME
Clifton Dillon Tubb	M.S. CE

Graduate Students

Ismael K. Abdulrahman
 Hajar Taheri Afarani
 Ahmad H. Alsharif
 Mohamed I. Baza
 Muhammad E. Bima
 Bo Bonning
 Devendrasinh Darbar
 Muluken Hailesellasi
 Thomas M. Hines
 Saanyol Igbax
 Md Shariful Islam
 A H M Jakaria
 Divya S. Jaladi
 William A. Johnson
 Utkarsh Kavimandan
 Chaitanya Sai Kodali
 Ryan J. Marshall
 Koteswara Rao Medidhi
 Abdul Salam Mohammad
 Mahdi Mohammadizadeh
 Kuseso Onai
 Babajide Onanuga
 Venkata Avinash Paruchuri
 Vinit Prabhu
 Md Bulbul Sharif
 Bibek Tiwari
 Haley D. White
 Rabeta Yeasmin
 Ibrahim Yilmaz
 Ali Zolghadr

Degree and Major

Ph.D. ECE
 Ph.D. CHE
 Ph.D. EE
 Ph.D. ECE
 Ph.D. ECE
 Ph.D. CHE
 Ph.D. ECE
 Ph.D. ECE
 Ph.D. CSC
 Ph.D. ME
 Ph.D. CEE
 Ph.D. CSC
 Ph.D. CSC
 Ph.D. EE
 Ph.D. ME
 Ph.D. CSC
 Ph.D. CHE
 Ph.D. CHE
 Ph.D. ME
 Ph.D. EE
 Ph.D. CHE
 Ph.D. ME
 Ph.D. ME
 Ph.D. CSC
 Ph.D. ECE
 Ph.D. CHE
 Ph.D. CHE
 Ph.D. CSC
 Ph.D. CHE

Work Study/Work Scholarship

Jacob Epley
 Haley Smallwood

Degree and Major

B.S. CSC
 B.S. ME

2018-2019

Undergraduate Student	Sponsor	Program	Faculty Advisor
Mary A. Adkisson	Oak Ridge National Laboratory	Nuclear Hybrid Energy Systems: Desalination Case Study	Assistant Professor Laura Arias Chavez
Dipayan Banik	Oak Ridge National Laboratory	MIMIR/MEASUR: A Live Dashboard Project for Industrial Devices	Chairperson Gerald Gannod
Allison Baldwin	National Concrete Masonry Association (NCMA)	Comparing Strength and Modulus of Elasticity for Prisms Constructed with Lightweight and Normal Weight Grout	Professor Craig Henderson
Alec D. Brenner	Industrial Sponsor	Rapid Distributed Sensing of Subsurface In-Situ Stress	Assistant Professor Daniel VandenBerge
Michael Brunner	National Concrete Masonry Association (NCMA)	Comparing Strength and Modulus of Elasticity for Prisms Constructed with Lightweight and Normal Weight Grout	Professor Craig Henderson
Glen Cathey	Oak Ridge National Laboratory	MIMIR/MEASUR: A Live Dashboard Project for Industrial Devices	Chairperson Gerald Gannod
Donald Zachary Chaney	Center for Energy Systems Research, Tennessee Technological University	Quasi-Capacitive (QWiC) Power Transfer for Charging a Mobility Scooter and 3D Printing of an Electric Generator for Decoupling of Rotor/Stator Drag Forces	Research Assistant Professor Charles W. Van Neste

Matthew Crispi	Industrial Sponsor	Measurement of Unreinforced and Reinforced Spiral Flat Oval Duct Deformation under Positive and Negative Pressure	Professor Stephen Idem
Viviana Cruz	National Science Foundation	REU Site: Immersive Research in Energy Generation, Storage/ Conversion, and Power Transmission	Principal Investigator Indranil Bhattacharya, Professor Holly Stretz
Samuel Dunham	National Concrete Masonry Association (NCMA)	Comparing Strength and Modulus of Elasticity for Prisms Constructed with Lightweight and Normal Weight Grout	Professor Craig Henderson
Chelby Faircloth	National Concrete Masonry Association (NCMA)	Comparing Strength and Modulus of Elasticity for Prisms Constructed with Lightweight and Normal Weight Grout	Professor Craig Henderson
Tyler Green	Industrial Sponsor	Rapid Distributed Sensing of Subsurface In-Situ Stress	Assistant Professor Daniel VandenBerge

UNDERGRADUATE RESEARCH PROJECTS, continued SM-11

Andrew J. Harris	National Science Foundation	CyberTraining: CDL: iPDC - Summer Institute for Integrating Parallel and Distributed Computing in Introductory Programming Classes	Professor Sheikh Ghafoor
Samuel Hollifield, Jr.	Oak Ridge National Laboratory	From Can't to Can: Attack Prevention and In-Situ Detection of Advanced Attacks on Controller Area Networks	Professor Sheikh Ghafoor
Robert Hughes	Tennessee Concrete Association	Going Beyond ACI 332 Type 3 Severe: Residential Enhanced Durability PCC	Professor Lewis K. Crouch
Cody Innis	Industrial Sponsor	Understanding the Expected Deformation of Rectangular Ductwork	Professor Jane Liu
Sean Jones	Subcontract from the University of Tennessee at Knoxville (Funding from the Department of Energy)	New High Resolution Neutron Detector for the Studies of Exotic Nuclei (NEXT)	Assistant Professor Mustafa Rajabali
Sean Jones	Center for Energy Systems Research, Tennessee Technological University	The Structure of Neutron-rich Deformed Nuclei Studied via Beta Decay	Assistant Professor Mustafa Rajabali
Brandon T. Kemp	Miami University, (Funding from the Ohio Department of Medicaid)	Incorporating the Preferences for Everyday Living Inventory into Ohio's Nursing Homes to Improve Resident Care	Chairperson Gerald Gannod

UNDERGRADUATE RESEARCH PROJECTS, continued SM-11

Aaron Kindred	Subcontract from the University of Tennessee at Knoxville (Funding from the Department of Energy)	New High Resolution Neutron Detector for the Studies of Exotic Nuclei (NEXT)	Assistant Professor Mustafa Rajabali
Aaron Kindred	Department of Energy	The Structure of Neutron-rich Deformed Nuclei Studied via Beta Decay	Assistant Professor Mustafa Rajabali
Whitney Kirby	Center for Energy Systems Research, Tennessee Technological University	Quarter Wavelength Resonators for use in Wireless Capacitive Power Transfer for Electric Field Focusing and Wave Shaping	Research Assistant Professor Charles W. Van Neste
Nicholas Lawson	National Concrete Masonry Association (NCMA)	Comparing Strength and Modulus of Elasticity for Prisms Constructed with Lightweight and Normal Weight Grout	Professor Craig Henderson
Sung Kyung Lee	Subcontract from the University of Tennessee at Knoxville (Funding from the Department of Energy)	New High Resolution Neutron Detector for the Studies of Exotic Nuclei (NEXT)	Assistant Professor Mustafa Rajabali
Sung Kyung Lee	Department of Energy	The Structure of Neutron-rich Deformed Nuclei Studied via Beta Decay	Assistant Professor Mustafa Rajabali
Benjamin K. Luna	Subcontract from the University of Tennessee at Knoxville (Funding from the Department of Energy)	New High Resolution Neutron Detector for the Studies of Exotic Nuclei (NEXT)	Assistant Professor Mustafa Rajabali
Benjamin K. Luna	Department of Energy	The Structure of Neutron-rich Deformed Nuclei Studied via Beta Decay	Assistant Professor Mustafa Rajabali

UNDERGRADUATE RESEARCH PROJECTS, continued SM-11

Gabriel Marinescu	Miami University, (Funding from the Ohio Department of Medicaid)	Incorporating the Preferences for Everyday Living Inventory into Ohio's Nursing Homes to Improve Resident Care	Chairperson Gerald Gannod
Samuel A. Mathews	Tennessee Concrete Association	Testing of Beneficiated Fly Ash Comparison of Beneficiated Mixtures with SEFA CC Mixtures	Professor Lewis K. Crouch
Jeffrey S. Neikirk	Miami University, (Funding from the Ohio Department of Medicaid)	Incorporating the Preferences for Everyday Living Inventory into Ohio's Nursing Homes to Improve Resident Care	Chairperson Gerald Gannod
Brandon Nieman	Center for Energy Systems Research, Tennessee Technological University	Marx Inverter for High Frequency Wireless Switching	Research Assistant Professor Charles W. Van Neste
Cameron Schaff	Industrial Sponsor	Development of Unified Duct Design Equations and Improvements to the Current FEA Model	Professor Jane Liu
Cameron Schaff	Industrial Sponsor	Measurement of Unreinforced and Reinforced Spiral Flat Oval Duct Deformation under Positive and Negative Pressure	Professor Stephen Idem
Alexander West	Miami University, (Funding from the Ohio Department of Medicaid)	Incorporating the Preferences for Everyday Living Inventory into Ohio's Nursing Homes to Improve Resident Care	Chairperson Gerald Gannod

Jonathan Zigler

National Science Foundation

REU Site: Immersive
Research in Energy
Generation, Storage/
Conversion, and Power
Transmission

Principal
Investigator Indranil
Bhattacharya,
Associate Professor
J. W. Bruce

Total Count:

30

ACTUAL, PROPOSED, AND REQUESTED BUDGET SCHEDULE 7

Schedule 7

CENTERS OF EXCELLENCE ACTUAL, PROPOSED, AND REQUESTED BUDGET

Institution:	Tennessee Technological University			Center:			Center for Energy Systems Research		
	FY 2019-20 Proposed			FY 2020-21 Requested					
	Matching	Appropri.	Total	Matching	Appropri.	Total	Matching	Appropri.	Total
Expenditures									
Salaries									
Faculty	\$272,827	\$236,500	\$509,327	\$49,737	\$328,285	\$378,022	\$95,278	\$309,606	\$405,884
Other Professional	\$93,449	\$128,352	\$221,801	\$1,000	\$265,451	\$266,451	\$0	\$265,871	\$266,871
Clerical/Supporting	\$5,612	\$37,248	\$42,860	\$0	\$101,398	\$101,398	\$0	\$54,365	\$54,365
Assistantships	\$277,834	\$181,551	\$459,385	\$88,266	\$257,512	\$345,778	\$135,102	\$105,000	\$240,102
Total Salaries	\$649,722	\$583,659	\$1,233,381	\$139,003	\$952,646	\$1,091,649	\$231,380	\$674,842	\$906,222
Fringe Benefits	\$212,710	\$233,396	\$446,106	\$52,340	\$505,172	\$557,512	\$110,118	\$270,261	\$390,379
Total Personnel	\$862,431	\$817,055	\$1,679,487	\$191,343	\$1,457,818	\$1,649,161	\$341,498	\$945,103	\$1,286,601
Non-Personnel									
Travel	\$99,486	\$25,758	\$125,244	\$12,900	\$46,147	\$59,047	\$16,000	\$18,000	\$34,000
Software	\$695	\$2,422	\$3,117		\$2,000	\$2,000		\$2,000	\$2,000
Books & Journals	\$79	\$0	\$79		\$250	\$250		\$200	\$200
Other Supplies	\$103,579	\$21,999	\$125,578	\$12,838	\$118,492	\$131,330	\$41,543	\$45,752	\$87,295
Equipment	\$44,400	\$12,000	\$56,400		\$25,837	\$25,837	\$0	\$5,000	\$5,000
Maintenance		\$745	\$745		\$500	\$500		\$500	\$500
Scholarships		\$0	\$0		\$0	\$0		\$0	\$0
Consultants	\$24,414	\$1,259	\$25,673	\$117,132	\$1,000	\$118,132	\$20,500	\$1,000	\$21,500
Renovation		\$0	\$0		\$0	\$0		\$0	\$0
Other (Specify):		\$0	\$0		\$0	\$0		\$0	\$0
Participant Support Costs	\$787,085	\$0	\$787,085	\$150,337	\$0	\$150,337	\$89,237	\$0	\$89,237
	\$0	\$0	\$0		\$0	\$0		\$0	\$0
Total Non-Personnel	\$1,059,738	\$64,183	\$1,123,921	\$293,207	\$194,226	\$487,433	\$167,280	\$72,452	\$239,732
GRAND TOTAL	\$1,922,169	\$881,239	\$2,803,408	\$484,550	\$1,652,044	\$2,136,594	\$508,778	\$1,017,555	\$1,526,333
Revenue									
New State Appropriation		\$947,800	\$947,800		\$969,100	\$969,100		\$1,017,555	\$1,017,555
Carryover State Appropriation		\$616,383	\$616,383		\$682,944	\$682,944		\$0	\$0
New Matching Funds	\$1,922,169		\$1,922,169	\$484,550		\$484,550	\$508,778		\$508,778
Carryover from Previous Matching Funds			\$0			\$0			\$0
Total Revenue	\$1,922,169	\$1,564,183	\$3,486,352	\$484,550	\$1,652,044	\$2,136,594	\$508,778	\$1,017,555	\$1,526,333

JUSTIFICATION FOR 2020-2021 APPROPRIATIONS REQUEST

The Center for Energy Systems Research (CESR) is requesting a 5% increase in the Appropriations Request for 2020-2021. It is planned to hire a Research and Development Engineer and a second Research Assistant Professor in 2019-2020 and for both of these positions to continue on in the 2020-2021 fiscal year. Another Financial Associate is needed to be hired as there was an increase in the proposals funded during 2018-2019 that will continue into 2019-2020 and other large proposals that are to be funded in 2019-2020 that will continue on into 2020-2021. In addition, the CESR has committed to provide funding toward several proposals that are expected to be funded, including Graduate Student Funding and Equipment purchases. Also, the CESR receives many requests each year for graduate research assistantship funding. The stipends of the Graduate Research Assistant-Ph.D. students are being increased to \$1,600 a month during 2019-2020 and further increases are needed for the stipends to be paid in 2020-2021 to continue to obtain qualified graduate research assistants. In addition, startup funds commitments have been made from the CESR to assist newly hired faculty with summer salary, with funding for their students, and with funding for supplies and equipment purchases for their labs.