# MINTernship Program

## Transatlantic Energy Research Experiment

## (TE-REx)

## Research opportunities available at UNC Charlotte Summer 2025


**General Contact**

Ms. Robin Moose robin.moose@charlotte.edu
Business Operations Officer
UNC Charlotte Energy Production and Infrastructure Center (EPIC)
William States Lee College of Engineering
9201 University City Blvd. | Charlotte, NC 28223
704-687-1813

# Research Opportunities

| **Project Title: Colocation of Offshore Wind (OSW), and Wave Energy in Mid-Atlantic OSW Lease Areas – Integration and Transmission Challenges and Strategies** | |
|---|---|
| Energy Field Research Interest<br>**please select from one of the options on the following page* | Renewable Energy Integration, Energy Distribution, Analytics. |
| Abstract of the project[1] | The US Department of Energy has been a global leader in advancing offshore wind energy (OSW) and supporting the transmission and distribution infrastructure upgrades to successfully integrate it with the grid. The Mid-Atlantic and Southeastern coastal states (Delaware, Maryland, Virginia, and North Carolina) have multiple OSW lease areas under development with a combined commitment of 10 GW of OSW by 2034. These coastal states also have marine energy resources including waves, currents, tides, and thermal gradients that could provide clean energy to meet the growing energy needs. Co-location of OSW and wave energy devices presents a multitude of benefits, including increased energy production from the same area, more stable and reliable supply of electricity, reduced intermittency, and shared infrastructure (transmission lines, substations, offshore operations, and surveillance) that can significantly reduce levelized cost of energy (LCOE). This project will study the combined OSW and wave farms and identify and analyze approaches to develop transmission infrastructure essential for successfully harnessing the offshore energy resources. |
| Tasks | The student will perform following tasks: (1) conduct a thorough survey to identify existing approaches and limitations to optimize the energy yield from collocated wind and wave energy resources; (2) Analyze the main technological aspects of combined wave–wind energy such as the OSW substructures and the wave energy conversion technologies and |

[1] Wherever possible, please avoid job-related terms such as “work” (=> project, research) and “internship” (=> research opportunity, research stay).

| | |
|---|---|
| | classify the solutions in terms of their degree of development and prospects; (3) Model and simulate the OSW wind farm as an equivalent doubly-fed induction generator, the wave energy converter farm as a squirrel-cage induction generator, and the battery energy storage system to effectively stabilize the combined power output under various disturbance conditions; (4) Identify and analyze the impact of transmission infrastructure (offshore substation and cables) for various transmission topologies on the LCOE of combined OSW and wave energy deployments and its impact on regional electricity costs; (5) Develop and analyze tools and datasets incorporating the bathymetry conditions at the combined farm sites corresponding to the OSW lease areas in Mid-Atlantic and Southeastern United States to determine and optimize potential offshore cable routes considering economics and ocean co-uses; and (6) Publish and present findings from the project in reputed venues including conference/symposia/workshops and high impact journals. |
| Learning Outcomes[2] | Participant students will:<br>1. Develop a deep understanding of combined OSW and wave energy systems through exhaustive literature search using online and library resources.<br>2. Leverage knowledge from previous courses in power and energy systems and conversion machinery to develop mathematical models of OSW and wave energy systems. |

[2] Please consider learning outcomes and/or choose applicable skills from the list below and mention how they will be acquired by the student:
- professional skills e.g. *by using tool X / learning skills Y / using software Z*
- intercultural competences and social skills *by collaborating with an international team*
- (virtual) collaboration skills *by interacting with a team of X people via platform Y* - (virtual) communication skills *by…*
- problem solving skills *by…*
- the purposeful use of networked online tools *by…*
- active, self-regulated learning skills *by…*
- autonomous learning skills *by…*
- etc...

| | |
|---|---|
| | 3. Become proficient in the use of numerical modeling, simulation, and model-based design tools including MATLAB and Simulink.<br>4. Gain fundamental understanding of economic issues in the deployment of offshore transmission infrastructure and calculation of LCOE using tools such as National Renewable Energy Laboratory's System Advisor Model (SAM) and Microsoft Excel.<br>5. Become proficient in the use of Bathymetry Data Viewer from National Center for Environmental Information.<br>6. Develop oral and written communication skills through professional presentations and research papers and reports.<br>7. Participate in culturally enriching experience of working within a team of diverse students and engaging with peer researchers from North Carolina Renewable Ocean Energy program. |
| Requirements | A hardworking, dedicated, and competent student with a positive "can do" attitude to accomplish assigned tasks within the tight deadlines. Students must have demonstrated proficiency in academics (high GPA) and ability to work in a diverse team comprising undergraduate and graduate students from engineering and computer science disciplines at UNC Charlotte. |
| Language Skills | Written and oral proficiency in English is a must for this position. |
| Software Skills | MATLAB, Simulink, Microsoft tools especially Excel, Visio and Project, Python (preferred but not essential), Power System Modeling (PSCAD, MATPOWER, or PowerWorld) |
| Other skills | Teamwork, critical thinking, listening, time management, attention to detail, research, and networking. |
| Duration of the project (*up to six months (April 1–September 30) | April 1 – September 30, 2025. |
| Type of research project | Applied Research Study |
| Responsible Professor | Dr. Saffeer M. Khan, P.E. |
| Supervisor/Mentor | Dr. Saffeer M. Khan, P.E. |
| Supervisor`s Telephone Number | 704-687-5339 |

| | |
|---|---|
| Supervisor`s Email | mkhan8@charlotte.edu |
| Faculty, Institute or Company Name | Energy Production and Infrastructre Center, UNC Charlotte |
| Address | 8700 Phillips Road, Charlotte, NC 28223 |
| Can your project be completed virtually if global travel is not allowed or restricted in 2024? | No. |

**Energy Field Research Interests:**

1. Power Conversion and Power Electronics
2. Renewable Energy Devices and Integration
3. Energy Storage and Energy Distribution
4. Efficient Energy Use
5. Fusion Technology
6. Nuclear Energy and Safety
7. Energy Markets and Analytics

**For questions please contact: Dr. Saffeer M. Khan, P.E. (mkhan8@charlotte.edu)**

| Project Title: Renewable Energy Devices and Integration I | |
|---|---|
| Energy Field Research Interest<br>**please select from one of the options on the following page* | Renewable Energy Devices and Integration |
| Abstract of the project[1] | During the research stay, the student will be part of a team tasked with designing, modeling, testing, and deploying a wave-powered desalination system for use in disaster response and remote communities. This project is funded by a grant from the US Department of Energy as a follow-up to the Waves to Water competition. Water Bros Desal was a finalist in the multi-stage nationwide competition, earning the second largest amount of prize money.<br><br>https://youtu.be/gw36hg29ehk?si=Nqp3ZHcOaQRyEFPR |
| Tasks | • Mechanical Design<br>• Technical Computing in Python and MATLAB<br>• Numerical Modeling in MATLAB Simulink and Simscape<br>• Engineering Research (Literature Reviews, etc.)<br>• Engineering Documentation (Quarterly Reports, PowerPoint Presentations, Research Posters)<br>• Physical Prototyping of Key Components and Scaled Models |
| Learning Outcomes[2] | • The student will gain technical proficiency in physics-based modeling of renewable energy mechanisms through MATLAB Simscape and WEC-Sim |

| | |
|---|---|
| | • The student will be introduced to commonly used tools for modeling wave energy resources and device performance<br>• Introduction to marine energy standards through the application of IEC TC 114 Technical Standards<br>• Exercising problem-solving skills by balancing component performance with cost and manufacturability<br>• Collaboration skills by working with a geographically distributed team via Zoom and the suite of Google tools<br>• Collaboration skills by working with a multidisciplinary team (designers, deployers, national labs, funding agency, etc.)<br>• Agile project management strategies skills by working with a dynamic small business |
| Requirements | A strong candidate will have prior experience/coursework in some of the following areas<br>• Mechanical design<br>• Computer Aided Design (SolidWorks, Creo, Fusion 360)<br>• MATLAB and Simulink<br>• Python<br>• Manufacturing or prototyping |
| Language Skills | None beyond English |
| Software Skills | Skills in the following software packages will be an asset on this project<br>• MATLAB<br>• Simulink<br>• Simscape<br>• Solidworks<br>• Microsoft Office Suite<br>• Google Suite |
| Other skills | Willingness to work a project with a mix of physical and numerical modeling |

| | |
|---|---|
| Duration of the project (*up to six months (April 1–September 30) | 6 months, April 1st – September 30th |
| Type of research project | Design, Numerical Modeling, Physical Prototyping |
| Responsible Professor | Wesley Williams<br>https://coefs.charlotte.edu/wbwillia/ |
| Supervisor/Mentor | Wesley Williams |
| Supervisor`s Telephone Number | 704-687-5064 (office) \| 704-258-3042 (cell) |
| Supervisor`s Email | Wesley.williams@charlotte.edu |
| Faculty, Institute or Company Name | Water Bros Desal, LLC |
| Address | 9201 University City Blvd.<br>Charlotte, NC 28223 |
| Can your project be completed virtually if global travel is not allowed or restricted in 2025? | Potentially, but it would have to be rescoped. |

**For questions please contact:**
Wesley Williams
Wesley.williams@charlotte.edu

| Project Title: Renewable Energy Devices and Integration II | |
|---|---|
| Energy Field Research Interest<br><br>**please select from one of the options on the following page* | Renewable Energy Devices and Integration |
| Abstract of the project[2] | The project team will receive operational data from a functioning community microgrid operated by utility partner - Duke Energy. This microgrid already has a large solar plant and a battery energy storage facility. The purpose of the data transfer is to test (1) the newly developed adaptive protection scheme; (2) methods for improving islanded black start; (3) methods for improving stability during islanded mode when grid-forming inverters are used; (4) loss-of-communications and (5) specific cyberattack scenarios The research will also involve the development of a digital twin of the microgrid in EPIC's Smart Grid laboratory which will to allow researchers to test several scenarios that assume thousands of third-party Distributed Energy Resources (DERs) installed on the same feeder. The team also expects to compare the results between the existing microgrid to those that could be achieved if multiple networked microgrids were used. |
| Tasks | - Assist team with the use of VillasNode to integrate an OpenDSS network model (power flow) with real-time simulations on the RTDS.<br>- Help develop scenarios on the digital twin to test the scalability of 100%-inverter based microgrids, including, model-validation during grid-forming operation, an control and coordination with third-part behind the meter (BTM) DERs |

[2] Wherever possible, please avoid job-related terms such as "work" (=> project, research) and "internship" (=> research opportunity, research stay).

| | |
|---|---|
| Learning Outcomes[3] | - professional skills by using python and data analytics tools, and industry-standard power system analysis tools for a targeted application.<br>- collaboration skills and team work by interacting with a team of other researchers at various levels |
| Requirements | Must have at least a B.S. degree or equivalent in Electrical or Computer Engineering with some courses taken in power and energy; some travel to relevant meetings may be required for project. |
| Language Skills | English |
| Software Skills | Python; statistical tools; experience with any power analysis software is a plus. |
| Other skills | Good communication (speaking and writing) skills |
| Duration of the project (*up to six months (April 1–September 30) | 6 months |
| Type of research project | Engineering study related to the power industry |
| Responsible Professor | Professors Badrul Chowdhury and Robert Cox |
| Supervisor/Mentor | Dr. Chowdhury/Dr. Cox and their Doctoral students |
| Supervisor`s Telephone Number | 704-687-1960; 704-687-8402 |
| Supervisor`s Email | b.chowdhury@charlotte.edu; rober.cox@charlotte.edu |

[3] Please consider learning outcomes and/or choose applicable skills from the list below and mention how they will be acquired by the student:

- professional skills e.g. *by using tool X / learning skills Y / using software Z*

- intercultural competences and social skills *by collaborating with an international team*

- (virtual) collaboration skills *by interacting with a team of X people via platform Y*

- (virtual) communication skills *by…*

- problem solving skills *by…*

- the purposeful use of networked online tools *by…*

- active, self-regulated learning skills *by…*

- autonomous learning skills *by…*

- etc...

| | |
|---|---|
| Faculty, Institute or Company Name | EPIC/UNC Charlotte |
| Address | EPIC Building (first floor), UNCC |
| Can your project be completed virtually if global travel is not allowed or restricted in 2024? | No |

| Project Title: Development of a Large-Scale Integrated Transmission & Distribution Testbed | |
|---|---|
| Energy Field Research Interest<br><br>**please select from one of the options on the following page* | 1. Renewable Energy Devices and Integration<br>2. Energy Storage and Energy Distribution |
| Abstract of the project[4] | The project team is developing a large-scale testbed for co-simulating transmission & distribution systems. The technical objectives are the following: (1) To develop a massively parallel, proof-of-concept framework to co-simulate a transmission<br><br>and distribution system consisting of at least 1000 detailed distribution feeders; and (2) Develop dynamic models for large-scale IBRs which can be included in the co-simulation framework. |
| Tasks | The student selected for this project will collaborate with team members at UNC Charlotte to help in the development of the co-simulation system. The system under development uses open-source power-system simulation tools, including GridLab-D and GridPack. It also uses the open-source co-simulation tool known as HELICS. The student will work within a team to develop the appropriate tool set. |
| Learning Outcomes[5] | - professional skills by using python and data analytics tools |

[4] Wherever possible, please avoid job-related terms such as "work" (=> project, research) and "internship" (=> research opportunity, research stay).

[5] Please consider learning outcomes and/or choose applicable skills from the list below and mention how they will be acquired by the student:

- professional skills e.g. *by using tool X / learning skills Y / using software Z*

- intercultural competences and social skills *by collaborating with an international team*

- (virtual) collaboration skills *by interacting with a team of X people via platform Y*

- (virtual) communication skills *by…*

- problem solving skills *by…*

- the purposeful use of networked online tools *by…*

| | |
|---|---|
| | - collaboration skills and teamwork by interacting with a team of other researchers at various levels<br><br>- develop a deep understanding of power-system simulation, particularly for cutting-edge problems involving the integration of inverter-based resources. |
| Requirements | Must have at least a B.S. degree or equivalent in Electrical Engineering. Knowledge of power and energy systems is preferred, and familiarity with power-system simulation is desired. |
| Language Skills | English |
| Software Skills | General programming skills, especially with Python. Knowledge of power system simulation tools such as GridLab-D or OpenDSS is preferred but not required. |
| Other skills | Good communication (speaking and writing) skills |
| Duration of the project (*up to six months (April 1–September 30) | 6 months |
| Type of research project | Engineering study related to the power industry |
| Responsible Professor | Professors Badrul Chowdhury and Robert Cox |
| Supervisor/Mentor | Dr. Chowdhury/Dr. Cox and their Doctoral students |
| Supervisor`s Telephone Number | 704-687-1960; 704-687-8402 |
| Supervisor`s Email | b.chowdhury@charlotte.edu; robert.cox@charlotte.edu |
| Faculty, Institute or Company Name | EPIC/UNC Charlotte |
| Address | EPIC Building (first floor), UNCC |
| Can your project be completed virtually if global travel is not allowed or restricted in 2024? | No |

- active, self-regulated learning skills *by…*

- autonomous learning skills *by…*

- etc...

| **Project Title: Industrial Assessment Engineer** | |
|---|---|
| Energy Field Research Interest<br><br>**please select from one of the options on the following page* | Efficient energy use; renewable energy |
| Abstract of the project[6] | UNC Charlotte is one of the Department of Energy's Industrial Assessment Centers (IACs). This requires students to travel to local industrial plants to assess how energy could be better utilized. Students perform a one-day, on-site assessment and work to complete reports that analyze various options for efficiency improvements. Examples include feasibility studies for improving compressed air usage, improved use of process heating, heat recovery, and on-site solar generation. |
| Tasks | The students will work within a team to (a) conduct on-site assessments; (2) analyze data recorded while on-site, including thermal images and data recorded by data loggers; (3) develop analyses for potential energy savings; (4) complete reports that are provided to real industrial clients |
| Learning Outcomes[7] | Participant students will: |

[6] Wherever possible, please avoid job-related terms such as "work" (=> project, research) and "internship" (=> research opportunity, research stay).

[7] Please consider learning outcomes and/or choose applicable skills from the list below and mention how they will be acquired by the student:

- professional skills e.g. *by using tool X / learning skills Y / using software Z*

- intercultural competences and social skills *by collaborating with an international team*

- (virtual) collaboration skills *by interacting with a team of X people via platform Y*

- (virtual) communication skills *by…*

- problem solving skills *by…*

- the purposeful use of networked online tools *by…*

- active, self-regulated learning skills *by…*

- autonomous learning skills *by…*

- etc...

| | |
|---|---|
| | 1. Develop a deep understanding of how to improve energy transfer in industrial processes through the application of heat transfer and thermodynamics;<br>2. Develop strong technical writing skills;<br>3. Improve their team work skills |
| Requirements | BS in Mechanical Engineering or Electrical Engineering. Mechanical Engineering is preferred |
| Language Skills | Written and oral proficiency in English is a must for this position. |
| Software Skills | Excel; Some programming experience preferred |
| Other skills | Knowledge of heat transfer and thermodynamics is preferred. |
| Duration of the project (*up to six months (April 1–September 30) | April 1 – September 30, 2025. |
| Type of research project | Applied Research Study |
| Responsible Professor | Dr. Ben Futrell |
| Supervisor/Mentor | Dr. Ben Futrell |
| Supervisor`s Telephone Number | 704-687-8402 |
| Supervisor`s Email | Benjamin.futrell@charlotte.edu |
| Faculty, Institute or Company Name | Energy Production and Infrastructre Center, UNC Charlotte |
| Address | 8700 Phillips Road, Charlotte, NC 28223 |