Certificate Title: Renewable Energy Assessment and Development

New: X
Revision: □

Classification of Instructional Programs (CIP) Discipline # (6 digits): 15.0505

*Please ensure that you select the appropriate CIP code for your certificate program. Please consult this website for more information about CIP codes: https://nces.ed.gov/ipeds/cipcode/default.aspx?y=55

Certificate Type:
On-Campus: □ Distance: X On-Campus & Distance: □

Proposed Effective Date: May 2019

Director of the Certificate Program: Linda Taylor
Program Coordinator (if different from Director): Lyra Rakusin
Graduate Services Coordinator: Sarah Slover
College: Natural Resources
Department/Program: Forestry and Environmental Resources

Catalog Description:
The Graduate Certificate in Renewable Energy Assessment and Development at NC State University provides students with graduate level academic credentials in renewable energy assessment and development. The program is designed for students who wish to enhance their knowledge of renewable energy assessment practices and obtain a background for certification. The Certificate can be completed entirely online. The certificate is available to current NC State students enrolled in graduate degrees. The entire program requires 12 credits hours. Students in the Renewable Energy Assessment and Development Certificate program may wish to continue on to a Graduate degree. Students may transfer up to 6 credit hours from the Renewable Energy Assessment and Development Certificate into the Master of Environmental Assessment upon application and acceptance into the program.

Continuing
Yr. 1- Yr. 2-1 Yr. 3-1 Yr. 4-2
New
Yr. 1-1 Yr. 2-1 Yr. 3 2 Yr. 4-4
Yr. 1-3 Yr. 2-8 Yr. 3-14 Yr. 4-19

Attachments:
Proposal Document
Statement of other departments likely to be affected and summary of consultation with those departments
Program-level assessment
Campus Routing Form
Signature Page
NC State University
Proposal for Graduate Certificate in
Renewable Energy Assessment and Development

Introduction
The Department of Forestry and Environmental Resources (FER) at North Carolina State University wishes to establish a graduate certificate program in Renewable Energy Assessment and Development.

The Graduate Certificate in Renewable Energy Assessment and Development is an online graduate-level program that provides students and professionals the opportunity to immerse themselves in theoretical and practical topics relating to the development of renewable energy projects. Additionally, the program guides students in building recognized academic and industry credentials in the renewable energy industry by covering the technical, policy and financial aspects of clean energy project development. This interdisciplinary approach allows students of diverse STEM and non-STEM backgrounds to gain a comprehensive understanding of renewables and be able to better incorporate their professional experience and expertise in this fast-growing industry. The majority of potential applicants for this program would be working professionals who need to improve their knowledge and skills in the new and changing field of renewable energy assessment and development but who are unable to attend courses on campus due to workplace demands. Many students who have already inquired about coursework in the renewable energy assessment field cannot leave employment for an extended period to complete the certificate. They could, however, attain further expertise and credentials through a distance-based certificate program.

The Department of Forestry and Environmental Resources has a 30-credit option B, Master’s degree in Environmental Assessment. The EA Master’s degree provides students with an understanding of environmental assessment, risk assessment, and the impacts of pollutants on health and the environment. Students in the EA program would benefit from the addition of coursework in the area of renewable energy development. It is anticipated that students in the Renewable Energy Assessment and Development Certificate program who would like further professional growth could choose to apply for the Master’s degree in Environmental Assessment. Likewise, it is possible that students in the Master’s program could choose to take additional coursework and complete the certificate in renewable energy assessment and development.

A review of the education market reveals a void in this type of university program. A Burning Glass report shows few certificate programs similar to Renewable Energy Assessment and Development nationwide. And while there has been a preponderance of online non-credit bearing renewable energy certificates in the country, such as those offered by Solar Energy International, Everblue Training, HeatSpring, and even NCSU’s NC Clean Energy Technology
Center, there are few, if any, online graduate-level programs with a science-based interdisciplinary focus that can also count as partial credit towards a Master’s degree.

In 2018, the US Bureau of Labor Statistics (BLS) projected that jobs associated with solar photovoltaics and wind turbines would have the fastest employment growth (105% increase for solar and 96% for Wind turbine) from 2016 - 2026. And despite the 2017 dip in solar installations and labor force, predictions indicate that the growth of renewable energy, particularly solar photovoltaics, is not a fad, but is a pragmatic and necessary part of the energy mix.

Additionally, the 2015-2020 Employment Opportunities for College Graduates in Food, Renewable Energy and the Environment Report indicates shortages of graduates, specifically in the food, agriculture, natural resources and human sciences disciplines to fill the estimated 57,900 annual openings for individuals with baccalaureate or higher degrees in food, renewable energy and environmental specialties between 2015 and 2020.

It is for these reasons that the Department of Forestry and Environmental Resources within the College of Natural Resources is proposing an online graduate certificate program focused on renewable energy assessment development.

**Certificate Coordinator**
The Graduate Certificate in Renewable Energy Assessment and Development will be coordinated by the Lyra Rakusin in the NC State College of Natural Resources, Department of Forestry and Environmental Resources.

**Program Director**
The Graduate Certificate in Renewable Energy Assessment and Development will be administered by the Director of Master of Environmental Assessment Program (Linda Taylor) in the NC State College of Natural Resources, Department of Forestry and Environmental Resources.

**Renewable Energy Development Faculty**
Elizabeth Nichols, Professor  
Barry Goldfarb, Professor  
Dennis Hazel, Professor  
Jordan Kern, Assistant Professor  
Lyra Rakusin, Lecturer  
Tommy Cleveland, Lecturer  
Linda Taylor, Lecturer

Additional faculty may be added to the Renewable Energy Faculty by the Director of the Master of Environmental Assessment Program in the Department of Forestry and Environmental Resources as necessary.
The certificate program will reside in the Department of Forestry and Environmental Resources within the College of Natural Resources. The program director and certificate coordinator will make all admissions decisions in coordination with the Renewable Energy Assessment and Development faculty.

**Application Process**

*Process*

Students must apply online through the graduate school application process to participate in the certificate program. [https://applygrad.ncsu.edu/apply/](https://applygrad.ncsu.edu/apply/)

*Tuition and Fees*

Tuition is the standard graduate school tuition.

**Admission Requirements**

All Students enrolled in the certificate must have completed a bachelor’s degree from a regionally accredited institution of higher education; a transcript of this degree including conferral date must be submitted to the Graduate School. All applicants should have a minimum 3.0-grade point average. Interested individuals should be prepared to submit a personal statement, a resume identifying educational preparation and work experience, and official transcripts of all prior undergraduate and graduate coursework.

Students enrolled in existing NC State University graduate programs who are in good standing can be admitted to the certificate program upon completing discussion with and review by the certificate coordinator.

Applicants who do not meet the graduate certificate program requirements for full admission may be admitted provisionally based on the quality of the admission package (letters of recommendation, work experience) and other criteria at the discretion of the Certificate Program Director. Students admitted provisionally must successfully complete 6 units with a B or better for full admission.

**Academic Requirements**

<table>
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<tr>
<th>Requirements for Graduate Certificate in Renewable Energy Assessment and Development</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>Twelve (12) hours of graduate coursework is required to complete the Graduate Certificate in Renewable Energy Assessment and Development. All coursework must be taken at NC State University.</td>
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</tbody>
</table>
### Required Coursework (12 credit hours):

The students must take the following 4 courses. A student may substitute one (1) course with an appropriate substitute graduate course from NC State with content in a related area. The substitute course must be approved by the student’s advisor in Renewable Energy Assessment and Development prior to enrolling in the course.

- EA 520 Renewable Energy Policy and Economics (Fall) 3
- EA 521 Fundamentals of Renewable Energy Site Assessment (Spring) 3
- EA 522 PV Design and Assessment (Fall) 3
- EA 523 Assessment of Renewable Energy Storage Systems (Spring) 3

### Substitute Courses

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ECE 562 Renewable Electric Energy Systems</td>
<td>3</td>
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</tbody>
</table>

A total of 12 hours are required to complete the Graduate Certificate in Renewable Energy Assessment and Development.

### Grading

All courses must be taken for a letter grade. No transfer credits from other institutions are allowed for the certificate. To receive the Graduate Certificate, a student must have a minimum 3.00 average on all certificate course work. Students must receive a C or better in each course to receive certificate credit. All courses which count towards the certificate must be 500 Level or above.

### Completion

All certificate requirements must be completed within four (4) calendar years, beginning with the date the student starts coursework related to the certificate. Students must apply to graduate from the certificate program. Students may obtain more than one graduate certificate but each certificate must have at least nine (9) credit hours that are unique to it.

Note: Academic success might have a strong bearing on admission to a degree program, but completion of a certificate program in no way guarantees entry into a graduate degree program, which is done through a separate application process.
Learning Objectives:

Learning objectives are designed to enhance students’ knowledge of information and then synthesize and apply that knowledge at the graduate level.

1. Students will demonstrate knowledge of how financial considerations and regulatory frameworks affect the development of renewable energy projects.
2. Students will demonstrate knowledge of the basic principles of wind, solar, and bioenergy systems across multiple size scales and be able to apply this knowledge to specific sites.
3. Students will demonstrate knowledge of how solar photovoltaic systems function and be able to apply this knowledge to installation of a solar system on particular sites.
4. Students will demonstrate knowledge of the design and function of electricity storage systems from renewable energy sites and recommend best practices for the operation and maintenance of said systems.

Learning Outcomes and Methods and Schedule of Assessment:

Each of the four courses in the certificate has one overall learning objective and two specific learning outcomes. All outcomes will be measured by instructor rating of students’ ability to synthesize information based on performance on the capstone project. Learning objectives and associated outcomes will be assessed in alternate years.

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Assessment Method</th>
<th>Assessment Schedule</th>
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<tbody>
<tr>
<td>Objective 1 - Students will demonstrate knowledge of how financial considerations and regulatory frameworks affect the development of renewable energy projects.</td>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
<td>Even numbered academic years</td>
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<tr>
<td>Outcome 1a. Students will be able to determine the economic feasibility of a renewable energy project.</td>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
<td>Even numbered academic years</td>
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<tr>
<td>Outcome 1b. Students will demonstrate knowledge of how local, national and global policies affect renewable energy development.</td>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
<td>Even numbered academic years</td>
</tr>
<tr>
<td>Objective 2 - Students will demonstrate knowledge of the basic principles of wind, solar, and bioenergy systems across multiple size scales and be able to apply this knowledge to specific sites.</td>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
<td>Odd numbered academic years</td>
</tr>
<tr>
<td>Outcome 2a. Students will be able to assess a site for wind, solar, or bioenergy production.</td>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
<td>Odd numbered academic years</td>
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<tr>
<td>Outcome 2b. Students will be able to evaluate the sustainability of renewable energy systems.</td>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
<td>Odd numbered academic years</td>
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<tr>
<td>Objective 3 - Students will demonstrate knowledge of how solar photovoltaic systems function and be able to apply this knowledge to installation of a solar system on particular sites.</td>
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<td><strong>Outcome 3a. Students will demonstrate knowledge of the design and function of photovoltaic systems.</strong></td>
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<tr>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
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<td>Even numbered academic years</td>
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<tr>
<td><strong>Outcome 3b. Students will be able to apply their knowledge of photovoltaic systems to determine the economic and environmental viability of a solar project.</strong></td>
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<tr>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
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<tr>
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<tr>
<td><strong>Objective 4 - Students will demonstrate knowledge of the design and function of electricity storage systems from renewable energy sites and recommend best practices for the operation and maintenance of said system.</strong></td>
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<tr>
<td><strong>Outcome 4a. Students will demonstrate knowledge of storage systems and the components of ongoing operations and maintenance programs.</strong></td>
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<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
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<tr>
<td><strong>Outcome 4b. Students will be able to apply their knowledge of storage, operations and maintenance to design and recommend a plan for a particular renewable energy project.</strong></td>
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<tr>
<td>Instructor rating of students’ performance on capstone project (percentage rated as excellent, good, fair and poor)</td>
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Statement of Other Departments Likely to be Affected and Summary of Consultations with those Departments

The certificate application and course action forms for the 4 EA Renewable Energy Assessment and Development have been sent to the Academic Affairs Deans in other colleges for consultations. In addition, meetings have been held with specific faculty in other departments, including Dr. Joseph DeCarolis, Civil and Environmental Engineering and Dr. Robert Mera, Marine Earth and Atmospheric Sciences. In addition, we have been working with Dr Tim Petty and other staff with DELTA on the development of this program. DELTA is supporting the program, and there is an MOU between DELTA and FER which includes the approval of the courses and certificate program.

Comments from COE: Dr Douglas Reeves, Associate Dean of Graduate Programs

Thanks for circulating this information. The feedback from the ECE department is that this is much more pragmatic, practitioner-oriented approach than their courses, so I don't think this is undue overlap with what they do. Your students might benefit from being aware of ECE452 / ECE552 Renewable Electric Energy Systems, and ECE585 The Business of the Electric Utility Industry.

Comments for CALS: Dr John Classen, Director of Graduate Programs (Bio and Ag Engineering)

Gary,

I have reviewed the proposed certificate and the course action forms for the four proposed courses. Nothing here duplicates or overlaps our offerings in any meaningful way. A few of our graduate students may be interested in 1 or 2 of the courses but I would not expect any significant SCHs to be generated from our students. Good luck with the program.

Best regards,
John Classen

Comments from CALS: Xiaoyong Zheng, Director Graduate Programs (Ag and Resource Economics)

Dear Gary,

We reviewed your proposal and here are our comments:
1. The certificate and courses do not overlap with any graduate level courses that the Economics graduate programs offer.
2. Some students in our master's program may be interested in taking some of the courses proposed as electives.

Best,
Xiaoyong
I can see one or two classes that would be appropriate for our students. We require 1 elective and the EA courses would fit some of our students’ direction.
Graduate Certificate in Renewable Energy

Assessment and Development
North Carolina State University

This request has been reviewed and approved by the appropriate campus committees and authorities.

Endorsed By: Stith T. Gower
Head, Department/Director of Graduate Program (Printed Name and Signature) Date

Recommended By: Eric Money
Chair, College Graduate Studies Committee (Printed Name and Signature) Date

Endorsed By: Amy B. Clark
College Dean (Printed Name and Signature) Date

Recommended By:
Vice Provost, DELTA (if DE degree) (Printed Name and Signature) Date

Approved By: Peter J. Harrin
Dean of the Graduate School (Printed Name and Signature) Date

Recommended By: Amiee K. Austin
Deans Council (Printed Name and Signature) Date

Approved By:
Executive Vice Chancellor and Provost (Printed Name and Signature) Date

Approved By:
Chancellor (Printed Name and Signature) Date