E555 Renewable and Nuclear Energy
Spring 2021

(Preliminary draft syllabus, September 2020)

Class Meeting Time: 11:15 to 12:30 MW
Class Location: online/synchronous/Zoom
Instructors: John A. Rupp
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Office hours: by appointment

Secretary: Susie Van Doren, vandores@indiana.edu, (812) 855-4556

Goal and Objectives:
The impact of energy use by humankind on the surrounding environment has always existed. But now the impact of 7^{+} billion of inhabitants of the Earth is much greater and destructive to the life supporting ecosystems of our planet. A very important question is, can we continue to use energy and yet decrease the associated pollution and degradation of the natural systems? As we utilize various energy sources, are we able to have a smaller footprint… individually, nationally, and globally? Is it possible to address climate change problems? Can we sustainably develop and consume the energy we as a society require?

In this regard, utilizing renewable energy sources and their technologies could be seen as a part of the solution. They could, while not exclusively but, in several niches, offer significant contributions toward efficiently and effectively reaching positive goals. As in most all areas of life, there are no singular simple answers or solutions. Often in the field of environmental management no "good" solutions exist, only "bad" or "worse" ones. For every environmental solution, environmental friendly technology has its pro's and con's. As both renewable and nuclear energy sources have positive environmental benefits, these sources needs to be closely examined for their ability to positively contribute to environmental stewardship. While nuclear energy is not a renewable energy source, the pros and cons of the nuclear energy should be discussed in this context.

The integration of renewable and nuclear usage within the total energy portfolio of the nation and globe community will be explored. The environmental and climate consequences of these technologies as well as the dynamics of the global development of both will be highlighted. Considering holistically the technical and policy aspects about renewable energy and nuclear usage will be a key part of this course.

This course is fundamentally a science and technology course but will involve economic and policy components. An understanding of the complex interactivities of these factors are necessary for policymakers, analysts and scientists involved in making management decisions regarding this rapidly evolving renewable resource and development of new type of nuclear energy.

Assuming that most students upon graduation from SPEA will not be directly involved in working in the nuclear industry or in renewable energy sector but, as global citizens and future public policy makers, environmental regulators and business members it is incumbent upon them to know about what controls the viability of these energy resources and how they can be used. The goal is to help students make more informed decisions when parts of the question may involve renewable energy or nuclear development and use, along with the associated consequences. To be an informed decision-maker allows one to

contribute to the better management of these important energy resource and to make a higher quality of life for the planet.

To accomplish this overall strategic goal of the course, a set of tangible objectives will be used. The course will be taught at a graduate level with major emphasis placed on information compilation, investigation, and critical analysis being performed by the individual student and by small groups. These analyses, whether as part of the student-led case studies, debates, discussions or as a part of the final research paper must be based on substantiated information. Based on the number of students in the class and inclination of the group, some investigations and analyses will be performed by groups, but the performance of each individual student will still be assessed.

Learning Outcomes:
For this course, it is anticipated that the students will gain an understanding of the various facets of renewable energy technologies integrated with the economic and policy implications of their utilization. Specifically the learning outcomes for this course are that the students obtain:

- An understanding of the energy technologies associated with wind, solar, hydro, geothermal, and biofuels systems.
- Insight into the positives, negatives and associated tradeoffs that are implicit in utilizing each of these technologies.
- An understanding of the roles and motivations, al0ong with engagement strategies, of the key stakeholders involved in deploying renewable energy systems.
- The ability to collaboratively research and present information on a set of case studies that represent the systems being evaluated.
- Refine abilities and techniques to communicate effectively in writing and orally to colleagues, and the instructor, in a research and discussion centered course.
- Development and refine the ability to propose and support a position on a renewable energy related issue both neutrally and also as an advocate or opponent.
- The ability to propose a policy- or technology-centric research topic, organize and carry out the research effort, generate a meaningful and well-executed report and oral presentation.

Prerequisites:
The subjects presented and the evaluation of topics in this course will use both concepts and content from numerous disciplines including: physics, chemistry, geology, biology, environmental science, engineering/applied technologies, public policy and economics. Although there are no formal prerequisite courses for taking this course, students are expected to have the fundamental skills needed to: 1) read and comprehend technical issues on a fundamental level, 2) pursue individual research investigations, 3) write an analysis on a given topic and, 4) to present orally the findings of their own research as well as on the content from other published research papers.

Participation:
I am interested in investigating with the students, many of the interrelated complexities associated with these unique energy sources. In many cases, these lines of inquiry will be driven by the various interests of the individual students. I very much appreciate the interrogative, and at times, Socratic Method of teaching and learning. Plan to engage fully in this process. I intend to learn from the students as well as they learn from me through this process. And please attend all the class sessions. There will a variety of lecturers and activities and, all are important. The knowledge that will be gained is cumulative and toward the end of the class, when we debate, advocate for and, discuss issues, many of the basic principles and considerations discussed earlier in the course will be used to frame and bound operational and policy concepts.

Grading and Assignments:
The assessment of performance in this course will be based on four principle elements:

1) Class participation: As this is a graduate class on a specific topic, I consider that the most effective manner to teach and learn in this case is discussion. Therefore I will use the method of asking and answering questions to stimulate critical thinking and to illuminate ideas. We are going to have some interesting guest speakers and we will be in the field with practitioners; talk with them about your concerns and questions. We will also have a series of three activities in which the members of the class will be divided into teams that will 1) debate (4/1), 2) advocate (4/3) and 3) discuss (4/8) aspects of renewable and nuclear energy development. Therefore, attendance to all class sessions and verbal engagement is highly valued. (15% of course grade)

2) Midterm examination: As the class will be roughly divided into two parts (investigation of topics and individual research), the content covered in the topical portion of the class will be need to be retained to be of value to the student in the research portion. The test will be comprised of short essays with possibly some short answer and perhaps multiple choice questions designed to assess your retention of the key concepts covered up to that time in the course. This material covered in the midterm will be from lectures, discussions and the review of technical papers by other students. (15% of course grade)

3) Case studies and discussion leadership: An important aspect developing a substantial understanding of technical and developmental issues associated with various energy sources is the ability to access and understand the information that is available in the media and technical literature. Following the instructor-led lecture on a given energy system, pairs of students will investigate an example of where this technology has been deployed, a case study. Presenters need to be systematic in their treatment of the case study, addressing the: who, what, where, when, and how and lastly why of the development. This is necessary so that we can contrast developments of the various technologies. To cover each, a pair of students will **1)** choose an example of project where a given technology has been implemented, **2)** find and distribute to the class (three days ahead of time) a select group of technical papers (1-2) and media reports (2-3) that document the case, **3)** formulate and distribute (along with readings ahead of time) a set of questions about the development and **4)** make a short overview presentation outlining the positive and negatives of the development and then lead the class in discussion about the implications of developing this type of energy system, using the case study as an example. Part of the presentation will a single slide, using a standardized template that provides a succinct summary of the case study along with a critique of the papers and reports used to frame the study. A part of the grade for this assignment will be an assessment on how well students respond to the questions provided by the presenters. (20% of course grade)

4) Research project and presentation: in addition to the three performance metrics listed above, each student will need to conduct a research investigation, using existing sources of information, on a renewable energy related topic of their choosing. As graduate students, you need to demonstrate your ability to find, analyze, discuss, and interpret information that has been put forth by others in the literature. These 12-15 page research papers will provide a critical review of a topic that is proposed in one page proposal and agreed upon before starting the research for the paper. As these are to be critical assessments of a given topic, they will include a well-presented set of arguments that defend your position on the topic and a set of recommendations on alternative or additional actions that the world can undertake to accomplish your recommendations. (50% of course grade; Due - May 3, 2019)

At the end of this syllabus there is a schedule that shows when each assignment is to be received by myself and the other students. Please honor your colleagues in the class and me as the instructor by turning in all assignments when required. Life is complex and unpredictable; when you have a challenge that will keep you from meeting an obligation, please let me know as soon as possible and let's work together toward a solution. In fairness to others, makeup and replacement assignments will come at a cost; generally, a full grade penalty per day of lateness.

Collaboration is generally a good thing and I endorse it but, don't cheat. We will need to evaluate each of you on your individual performance so do your own work. In preparing for all of the assignments and obligations of the class, work with your colleagues, discuss the papers, compare impressions and solutions, but on the written assignments, do your own work. The expected academic performance and personal conduct of all students at Indiana University is defined by the IU Code of Student Ethics. Please be sure to abide by these policies.

Resources:

There is no formal text for this course. There are series of readings to accompany the lectures that will be drawn from a variety of sources including media stories, books, and technical papers. To complement the lectures, we will have seminar sessions. You will be asked to select readings for the class to read and then to lead the discussion of them. We will us Canvas as a locus for placing readings and distributing technical resources, as well as questions, responses to questions and critical reviews.

I am happy to talk with you should you have a question or a concern about this complex subject. Please contact me (email is best) to set up a time when we can meet either one on one or with a group as part of a topic that you are interested in understanding. We also encourage you to polish your professional skills by contacting some of the guest speakers (in a professional manner befitting of their positions) to find out more information from their particular positions or disciplines.

Logistics:

This class is formally scheduled at 11:15 to 12:30 on Mondays and Wednesdays. Additionally, we would like to go into the field to visit a couple of operations where renewable energy systems are being deployed and operated. These will be essentially all day fieldtrips that we would like to hold on a couple of Saturdays.

Activities:

Debate: We will have a debate in this course. We will organize the students into opposing teams of debaters to present and defend ideas associated with renewable and nuclear energy systems and the consequences of their utilization. We will work up the questions to be used before the debate.

Advocacy Meeting: in this class session, we will emulate a meeting in which: 1) part of the students will advocate for the implementation of a renewable portfolio standard (RPS) to a state utility regulatory commission, 2) part will serve as opposition/modification to the proposed RPS and, 3) part will serve as the decision-makers.

Favorite Renewable or Nuclear Development Project Discussion: in this session, each student will present a short overview of their favorite renewable or nuclear project development, anywhere in the world. Students should select a paper or media story that outlines the development that will be loaded onto Canvas so that the student can access key diagrams or findings for discussion.

Course Policies

The expected academic performance and personal conduct of all students at Indiana University is defined by the IU Code of Student Ethics. Additionally, below are listed the O'Neill School policies. Please be sure to abide by these policies.

Academic Dishonesty
O'Neill School faculty do not tolerate cheating, plagiarism, or any other form of academic dishonesty. If you have not done so, you should read the IUB *Code of Student Rights, Responsibilities and Conduct*, which can be accessed at http://studentcode.iu.edu/ so you will be sure to understand what these terms mean and what penalties can be issued for academic dishonesty. Academic dishonesty can result in a grade of F for the class which cannot be removed from the transcript. Significant violations of the Code can result in expulsion from the University.

Plagiarism is using another person's words, ideas, artistic creations, or other intellectual property without giving proper credit. According to the *Code of Student Rights, Responsibilities and Conduct*, a student must give credit to the work of another person when the student does any of the following:

a. Quotes another person's actual words, either oral or written;
b. Paraphrases another person's words, either oral or written;
c. Uses another person's ideas, opinion, or theory; or
d. Borrows facts, statistics, or other illustrative material, unless the information is common knowledge.

Note Selling
Several commercial services have approached students regarding selling class notes/study guides to their classmates. Selling the instructor's notes/study guides in this course is not permitted. Violations of this policy will be reported to the Dean of Students as academic misconduct (violation of course rules). Sanctions for academic misconduct may include a failing grade on the assignment for which the notes/study guides are being sold, a reduction in your final course grade, or a failing grade in the course, among other possibilities. Additionally, you should know that selling a faculty member's notes/study guides individually or on behalf of one of these services using IU email, or via Canvas may also constitute a violation of IU information technology and IU intellectual property policies; additional consequences may result.

Online Course Materials
The faculty member teaching this course holds the exclusive right to distribute, modify, post, and reproduce course materials, including all written materials, study guides, lectures, assignments, exercises, and exams. While you are permitted to take notes on the online materials and lectures posted for this course for your personal use, you are not permitted to re-post in another forum, distribute, or reproduce content from this course without the express written permission of the faculty member. Any violation of this course rule will be reported to the appropriate university offices and officials, including to the Dean of Students as academic misconduct.

Civility
The O'Neill School takes matters of honesty and integrity seriously because O'Neill is the training ground for future leaders in government, civic organizations, health organizations, and other institutions charged with providing resources for the public and for members of society who are vulnerable and who are lacking in power and status. Precisely because O'Neill graduates tend to rise to positions of power and responsibility, it is critical that the lessons of honesty and integrity are learned early.

The O'Neill School requires that all members of its community – students, faculty and staff—treat others with an attitude of mutual respect both in the classroom and during all academic and nonacademic activities outside the classroom. A student is expected to show respect through behavior that promotes conditions in which all students can learn without interruption or distraction. These behaviors foster an appropriate atmosphere inside and outside the classroom:

- Students are expected to attend class regularly and be prepared for class.
- Students must be punctual in their arrival to class and be present and attentive for the duration of the class. Eating, sleeping, reading the newspaper, doing work for another class, wandering in and out of the classroom, and packing up or leaving class early are not civil or professional behaviors.
- Students must abide by the course policy regarding use of electronic devices in the classroom.
- Students must responsibly participate in class activities and during team meetings.
- Students must address faculty members, other students, and others appropriately and with respect, whether in person, in writing, or in electronic communications.
- Students must show tolerance and respect for diverse nationalities, religions, races, sexual orientations, gender identity, and physical abilities.

Pursuant to the Indiana University Student Code of Conduct, disorderly conduct which interferes with teaching, research, administration, or other university or university-authorized activity will not be tolerated and will be immediately reported to the Office of the Dean of Students for appropriate disposition which may result in disciplinary action, including possible suspension and/or expulsion from the university.

Well-Being:
The University has many resources available for students including:

Counseling and Psychological Services: for information about services offered to students by CAPS, please visit http://healthcenter.indiana.edu/counseling/index.shtml

Disability Services for Students: for information about support services or accommodations available to students with disabilities, and for the procedures to be followed by students and instructors, please visit https://studentaffairs.indiana.edu/disability-services-students

Food: Did you know that the Crimson Cupboard is available to all in the IU community? http://crimsoncupboard.indiana.edu/home.php

Sexual Harassment: Title IX and IU's Sexual Misconduct Policy prohibit sexual misconduct in any form, including sexual harassment, sexual assault, stalking, and dating and domestic violence. If you have experienced sexual misconduct, or know someone who has, the University can help. If

you are seeking help and would like to speak to someone confidentially, you can make an appointment with:

- The Sexual Assault Crisis Services (SACS) at (812) 855-8900 (counseling services)
- Confidential Victim Advocates (CVA) at (812) 856-2469 (advocacy and advice services)
- IU Health Center at (812) 855-4011 (health and medical services)

It is also important that you know that Title IX and University policy require me to share any information brought to my attention about potential sexual misconduct with the campus Deputy Title IX Coordinator or IU's Title IX Coordinator. In that event, those individuals will work to ensure that appropriate measures are taken and resources are made available. Protecting student privacy is of utmost concern, and information will only be shared with those that need to know to ensure the University can respond and assist. I encourage you to visit http://stopsexualviolence.iu.edu/index.html to learn more.

Communication between Faculty and Students
In order to verify the identity of all parties involved, effective September 1, 2004, all email communication from current O'Neill students to O'Neill staff must originate from an Indiana University email account. For email communication with O'Neill faculty, current O'Neill students should refer to course syllabi for instructors' preferences (Canvas, email, etc.) This policy applies to current students only. Instructions for forwarding your IUB email to another account can be found at: https://kb.iu.edu/d/beoj

Course Withdrawals
Students who stop attending class without properly withdrawing from the class may receive a grade of F. It is important to withdraw from a course within specified timeframes (see chart below). Note that withdrawals after Week 12 are rarely granted. **Poor performance in a course is not grounds for a late withdrawal.**

No withdrawal forms will be processed in the Office of the Registrar after the last day of classes. Any requests for a late withdrawal after the last day of classes must go through the grade appeal process, but each student should remember that, in accordance with campus policy, the O'Neill School does not permit a student to withdraw from a course if the course requirements have been completed. Grade replacement should be used in this case. You may drop a class through the One.IU website: https://one.iu.edu/task/iupui/edrop-eadd.

Withdrawal Deadlines

Course deleted from record, no grade assigned, 100% refund Advisor signature **IS NOT** required	Week 1 (last day)
Withdrawal with automatic **grade of W** Advisor signature **IS** required	Week 2 - Week 7
Withdrawal with **grade of W or F** Advisor and Instructor signatures **ARE** required	Week 8 - Week 12

Incompletes
A grade of Incomplete (I) indicates that a 'substantial portion' of the work in a course has been satisfactorily but not entirely completed by the student as of the end of the semester. The Incomplete can be given to a student facing hardship such that it would be unjust to hold the student to the established time limits for completing the work. To be eligible for the Incomplete, the student's work must be of passing quality and the student must have completed 75% of the course requirements. **Poor performance in a course is not grounds for an incomplete**. The O'Neill School follows the campus guidelines in awarding Incompletes which may be accessed at the Office of the Registrar's website. Incompletes must be removed within a time period not to exceed one year after the semester in which the student was enrolled in the course. The Incomplete will revert to an F if the work is not completed within the allotted timeframe established by the instructor.

Students Called to Active Duty
The O'Neill School encourages any student who is in the U.S. armed forces and is called to active duty to finish his/her coursework if at all possible. Students who cannot complete their courses have the option of withdrawing with 100% fee refund, but this request must be made within one week of being called to active duty. Students who are called to active duty may qualify for an Incomplete if all of the above criteria have been met. For further information, go to the Office of the Registrar's website: https://registrar.indiana.edu/policies/withdrawal/military-withdrawal.shtml.

Additional Information for Students

Counseling and Psychological Services
For information about services offered to students by CAPS:
http://healthcenter.indiana.edu/counseling/index.shtml.

Religious Observation
In accordance with the Office of the Dean of Faculties, any student who wishes to receive an excused absence from class must submit a request form available from the Dean of Faculties for each day to be absent. This form must be presented to the course instructor by the end of the second week of this semester. A separate form must be submitted for each day. The instructor will fill in the bottom section of the form and then return the original to the student.
Information about the policy on religious observation can be found at the following website:
http://vpfaa.indiana.edu/policies/bloomington/instructional-responsibilities/religious-observances.shtml.
Disability Services for Students
Securing accommodations for a student with disabilities is a responsibility shared by the student, the instructor and the DSS Office. For information about support services or accommodations available to students with disabilities, and for the procedures to be followed by students and instructors: http://studentaffairs.iub.edu/dss/.
Sexual Harassment
As your instructor, one of my responsibilities is to help create a safe learning environment on our campus. Title IX and our own Sexual Misconduct policy prohibit sexual misconduct. If you have experienced sexual misconduct, or know someone who has, the University can help.

If you are seeking help and would like to talk to someone confidentially, you can make an appointment with:
i. The Sexual Assault Crisis Service (SACS) at 812-855-8900

ii. Counseling and Psychological Services (CAPS) at 812-855-5711
iii. Confidential Victim Advocates (CVA) at 812-856-2469
iv. IU Health Center at 812-855-4011

For more information about available resources: http://stopsexualviolence.iu.edu/help/index.html. It is also important to know that federal regulations and University policy require me to promptly convey any information about potential sexual misconduct known to me to our campus' Deputy Title IX Coordinator or IU's Title IX Coordinator. In that event, they will work with a small number of others on campus to ensure that appropriate measures are taken and resources are made available to the student who may have been harmed. Protecting a student's privacy is of utmost concern, and all involved will only share information with those that need to know to ensure the University can respond and assist. I encourage you to visit http://stopsexualviolence.iu.edu/help/index.html to learn more.

Commitment to Diversity: Find your home and community at IU
Asian Culture Center
Address: 807 East Tenth Street, Bloomington, IN 47408
Phone: 812-856-5361
Email: acc@indiana.edu
Website: https://asianresource.indiana.edu/index.html

First Nations Educational & Cultural Center
Address: 712 E 8th St., Bloomington, IN 47408
Phone: 812-855-4814
Email: fnecc@indiana.edu
Website: https://firstnations.indiana.edu/contact/index.html

LGBTQ+ Culture Center
Address: 705 E 7th St., Bloomington, Indiana 47408
Phone: 812-855-4252
Email: glbtserv@indiana.edu
Website: https://lgbtq.indiana.edu/contact/index.html

La Casa Latino Culture Center
Address: 715 E 7th St., Bloomington IN, 47408
Phone: 812-855-0174
Email: lacasa@indiana.edu
Website: https://lacasa.indiana.edu/

Neal Marshall Black Culture Center
Address: 275 N Jordan Ave Bloomington, Indiana 47405
Phone: 812-855-9271
Email: nmgrad@indiana.edu
Website: https://blackculture.indiana.edu/index.html

Schedule

(R = Rupp, M = Meretsky, C = Carley, G = Graham, P= pair of student presenters/discussion leaders)

Date, Day	Topic	Activity
January 7, M	Organizational discussions	Lecture – R
January 9, W	Climate change, pollution and renewables	Lecture – R
January 14, M	Basic overview of low carbon energy systems	Lecture - R
January 16, W	Hydroelectric dams and pumped storage	Lecture – R
January 23, W	Hydroelectric energy case study	Discussion - Students
January 28, M	Wind energy: turbines	Lecture - R
January 30, W	Wind energy case study (Indiana?)	Discussion – Students
February 4, M	Solar energy: Photovoltaic cells, thermal panels,	Lecture - R
February 6, W	Solar energy case study	Discussion – Students
February 11, M	Geothermal energy	Lecture - R
February 13, W	Geothermal energy case study	Discussion – Students
February 18, M	Biofuels energy	Lecture - M
February 20, W	Biofuels energy case study	Discussion – students
February 25, M	Impacts of biofuel utilization on climate change	Lecture - M
February 27, W	RPSs to encourage renewables	Lecture- C
March 4, M	Midterm (take home – no class)	
March 6, W	E vehicles/green power policy implications	Lecture - G
March 18, M	Nuclear energy: generation	Lecture - R
March 20, W	Nuclear energy case study I (France or US)	Discussion – students
March 25, M	Nuclear energy: international relations and waste	Lecture - R
March 27, W	Nuclear energy case study II (Savannah River MOX)	Discuss – Students
April 1, M	Nuclear vs. renewables vs. some of these	Debate-Teams
April 3, W	Recommendations to states for RPSs	Meeting-Teams
April 8, M	Favorite R and N energy international development	Discussion-Ind.

April 10, W	Student Research Project Presentations
April 15, M	Student Research Project Presentations
April 17, W	Student Research Project Presentations
April 22, M	Student Research Project Presentations
April 24, W	Summary Discussions

Fieldtrips

April 3?	9:00 – 3:00	Electricity Storage – IPL – Indianapolis IN?
April 10?, Saturday	9:00 - 12:00	Solar array - Hoosier Energy – Bloomington IN