NRES 442/642: Sustainable Energy: Resources, Technologies, and Policies

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Spring 2019
University of Wisconsin-Stevens Point
College of Natural Resources

3 credits
Class Room: TNR 271
Tues & Thu 12:30-1:45 pm

INSTRUCTOR

Dr. Shiba Kar
Office: TNR 180B; Meeting hours: T 10-11 am, Wed. 2-3 pm or by appointment
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COURSE DESCRIPTION AND OBJECTIVE

Can technology solve energy problem to secure a sustainable future? Finding potential sustainable energy solutions warrants assessment of current and potential energy technologies, resources and integrated policy approach. Energy technologies ranging from extraction, conversion, storage, distribution, and use of various energy resources have a significant impact on our living standards, economy and environment. However, often, there are concerns about lack of strong policy support to improve, innovate and implement technologies for efficient use of different energy resources. In this course, we examine the energy challenges from technology, resources, and policy perspectives. Course goals include (1) evaluate scientific and engineering potential and challenges of current and future energy technologies in relation to various available energy resources, and (2) analyze the connections and challenges between energy technologies, resources and policies in existing energy landscapes to ensure sustainable energy supply for our current and future generations. Lecture and discussion topics include energy resources and technology, energy carriers, energy management and storage, energy efficiency technologies in transportation, buildings and industries, energy- land use nexus, integrated policy for future energy technology.

In this course, students will investigate status and challenges of current energy technologies and resources and utilize various tools to formulate a portfolio of policies for each sustainable technology to drive deployment. The class will become familiar with the breadth of energy technology-policy discussion and challenges through development of assessment tools, methods and perspectives to analyze them. The students will develop skills with hands-on training on alternative energy technology and have enhanced understanding of opportunities and policy challenges of large-scale adoption and implementation of the renewable technologies.

COURSE LEARNING OUTCOME

Upon successful completion of this course, you will be able to:

1. Evaluate status and challenges of current energy technologies and resources.
2. Identify and address policy challenges for better integration of energy technologies and resources.
3. Examine and apply a comprehensive energy-planning framework that considers various energy resources, technologies and policy challenges from local to international levels.
4. Collaborate with peers in a team environment and apply diverse sets of ideas, values, beliefs, and world views.
5. Communicate ideas in writing and orally to your peers formally and informally.

INSTRUCTOR'S TEACHING APPROACH

I strongly believe that excellent teaching facilitates lifelong learning and inspires intellectual exchanges that help create a better and informed society. My strategies about teaching include creating a trustworthy and enjoyable teaching-learning environment to nourish the learning process, challenging student curiosity and be challenged, and applying practical examples and experiences from interdisciplinary perspectives that are necessary to solve real-world problems. I believe the purpose of teaching is not to teach students how to memorize facts, or how to come up with right answers; rather understanding the concepts being examined. I look forward to seeing my students become competent natural resource and energy professionals with sound scientific knowledge, skills and real-world experience to better serve the society and contribute to achieving sustainability goals.

READINGS AND OTHER COURSE MATERIALS

There is no required textbook for the course. I have carefully selected the readings and other learning materials to represent the best available science and information on the topics we will be discussing. The readings will form the basis for our discussions and debates in class. I expect you to complete the assigned readings before coming to class and be able to explain, interpret, apply, analyze, and evaluate the material in the class, exams and other assignments. I will post PDF copies of the readings and links to websites and videos on D2L. The readings are a work-in-progress and I may amend and/or supplement the list throughout the semester. I will use lectures to emphasize and facilitate your learning on key concepts and theories, but I expect you to learn more from the readings and assignments.

EVALUATION

This course will rely upon a variety of evaluation methods to provide you an opportunity to understand and synthesize semester's work, and achieve the expected learning outcomes:

Assignments/Exams	**Percent of Grade**	**Points**	**Due date/ week** (All assignments must be submitted to D2L unless otherwise stated)
Home energy survey -Team survey presentation (50 points) -Team Report (50 points)	10%	100	 Week 3 Week 3, Thu 5pm
Short assignments -Topic 1 (50 points) -Topic 2 (50 points)	10%	100	 Week 5, Thu 5pm Week 7, Thu 5pm
Midterm exam	10%	100	Week 8, Tue
MREA assessment	15%	150	Week 12, Fri
Group project -Draft submission (50 points) -Project Report (100 points) -Presentation (50 points) -Team collaboration (50 points)	25%	250	 Week 11, Thu 5pm Week 14, Thu 5pm Week 15 Week 15, Thu 5pm
Final exam	15%	150	May 16th, Thu 12:30 to 2:30 pm
Class participation	15%	150	Throughout the semester
Total	**100%**	**1,000**	

Final grades will be based on the percentage of the total 1,000 points that you earn on your assignments. The grading scale listed below indicates what percentages are required to earn a certain grade. The percentage decimal points will be rounded up to the closest number in the grading range. Grades will not be curved.

93-100 =A	87-89 = B+	77-79 = C+	67-69 = D+
90-92 = A-	83-86 = B	73-76 = C	60-66 = D
	80-82 = B-	70-72 = C-	00-59 = F

I will post the grades and feedback in D2L with each assignment so that you can track your progress as the course goes along. If at any point you have questions or concerns about your grade or any of your assignments, send me an email (writing "NRES 442" in subject line), I am happy to help!

1. Home Energy Survey (100 points)

To gain some first-hand experience in identifying and analyzing various energy technologies and resources, you will conduct a home energy survey as a team. Each student will do at least 2 household energy surveys- one from your own family household and another household of your choice. The survey will include various types of energy devices/technologies, appliances, equipment, electronics, automobiles or other machineries that are used at the household level. You will make an inventory list, identify most and least energy consuming devices/technologies/ appliances/ electronics/equipment, and analyze their sources of energy resources. Explore what alternative energy efficient technologies and sources of energy could be used but currently are not being used. Also, list if there are any energy-related incentives that households are aware of and/or receiving now. Then state what kind of incentives could help the households switch to more sustainable alternative energy sources and technologies. Each team will present their initial comparative survey findings to class and will submit a team report (1,500 words) on the survey.

2. Short Assignments (50+50= 100 points)

As we progress on learning about various energy sources in detail, you need to think *why* or *why not* people use various sources of energy and technology. To enhance your understanding and ability to analyze, I want you to compare *pros* and *cons* of using different sources of energy and relevant technologies. You will then share your thoughts and arguments in a written format as a short report on 2 assigned topics. Each topic report (1,500 words) deserves 50 points. I will provide more details when introducing this assignment in class.

3. Mid-term Exam (total 100 points)

There will be a midterm exam based on class lectures and reading materials delivered and discussed until the week before the exam. More details on the exam will be shared as class progresses.

4. MREA Assessment (150 points)

You will learn more in detail on Solar and Wind energy technologies through several online modules, guest lecture and a full-day hands-on workshop at MREA (Midwest Renewable Energy Association). There will be several quizzes and a test on learning from the workshop that would total 150 points. More details will be provided as we progress through those modules and the workshop.

5. Group Project Assignment (250 points)

I will assign you to a group for the semester in first few weeks of the class. I expect you to actively collaborate with your team and work on group project including presentation and report writing.

To strengthen your understanding and skills on various energy resources and technologies and to give you the opportunity to summarize a particular energy resource and any relevant technology topic that you will learn throughout the semester, your group must select an energy topic from a given list. As a group, you will collaborate and investigate various types of energy sources/technologies within each broad category; identify barriers and challenges in adopting alternatives, relate how energy policy could play an effective role to integrate various sources of energy and technology to secure a sustainable energy future. Each group will submit a draft report and make a group presentation to share their findings and policy recommendations with the class. The group should incorporate suggestions from the instructor and other students in class when writing a detailed project report (about 4,000 words). I will provide more details on the assignment when introducing this in class.

No Late Assignments are expected. To receive full credit, all assignments must be uploaded to the drop-box on the course D2L site or otherwise turned into me prior to the stated date (by 5 pm). Assignments turned in after the deadline will be considered late and will be subject to 10% per day late penalty. For example, a 100-point assignment that is two days late will, at most, be worth 80 points. Written work presented in an improper manner (see plagiarism discussion below) will result in you having to rewrite the assignment, and/or a reduction in points earned.

6. Final exam (150 points)

The final exam will be based on class lectures and reading materials covered throughout the semester. More details on the exam will be shared as class progresses.

7. Class attendance and participation (150 points)

Attendance of class lectures and active participation in class discussion is mandatory and represents 15% of your grade. Your absence must be excused not to lose the attendance/participation points. An excused absence is defined as an absence for which you have provided me with written notice by email of your intent to be absent and the valid reason for the absence prior to the start of the lecture period for which you will be absent. Valid reasons for an excused absence include absences due to illness, compelling family needs, work demands, and job interviews.

ACADEMIC INTEGRITY

I do not tolerate plagiarism or cheating. Plagiarism of any type in your work is academic misconduct and unacceptable – consequences for plagiarism may range from an oral reprimand to expulsion from the University. Plagiarism is defined as deliberate or accidental use of ideas, research or words of another person without fully attributing them to their original sources. According to the *Merriam-Webster Online Dictionary*, to "plagiarize" means 1) to steal and pass off (the ideas or words of another) as one's own 2) to use (another's production) without crediting the source 3) to commit literary theft 4) to present as new and original an idea or product derived from an existing source. Obvious examples of plagiarism include turning in someone else's work as your own, cutting and pasting website text into a paper, or failing to properly cite another author's work. Less obvious forms of plagiarism involve paraphrasing the

work of another author (or student) by simply rearranging a few words. All work must be your own. Do not copy or hand in the work of other students, authors, sources. When using other sources in your writing, be sure to credit those sources both within the text and at the end of your reports/papers. If you have any questions about what constitutes plagiarism, please review the resources available at http://library.uwsp.edu/guides/vrd/plagiarism.htm and talk with me.

All assignments submitted via a dropbox in D2L are automatically linked to turnitin.com (software designed to detect plagiarism). I have set up the drop box to allow you to submit assignments multiple times after reviewing the score provided by the TURNITIN software. Please designate the one you want me to grade by starting the document title with the word "Final". If it appears to me that potential plagiarism or academic misconduct has occurred, I will initiate the disciplinary process outlined in Chapter 14 of the University of Wisconsin System Code. If the potential plagiarism or academic misconduct has occurred in relation to a group project, I will initiate the disciplinary process for all the students in the group.

ACCESSIBILITY STATEMENT

If you have a learning or physical challenge which requires classroom accommodation, please contact the UWSP Disability Services office with your documentation as early as possible in the semester. 103 Student Services Center, (715) 346-3365; TTY (715) 346-3363; www.uwsp.edu/special/disability/studentinfo.htm

TENTATIVE CLASS SCHEDULE

The instructor reserve the right to make changes to the syllabus and schedule when necessary to meet the learning needs of the students, compensate for canceled classes or other unforeseen circumstances.

Week/Date	Modules	Lecture Topics	Readings & Assignments
Week 1: Jan 22-24	**Module 1: Introduction- overview of energy resources and technologies**	Lecture 1: Introduction, review syllabus, & ice-breaker Lecture 2: An overview on energy resources, technologies and policies	**Introduce course syllabus; Form groups and introduce Home energy survey** ➢ Energy Resources: http://energy.gov/science-innovation/energy-sources ➢ DOE Energy Technology Transitions https://energy.gov/technologytransitions/office-technology-transitions
Week 2: Jan 29-31	**Module 2: Energy resources and technologies**	Lecture 3: Finite non-renewable energy resources: Coal and nuclear Lecture 4: Non-renewable energy resources: Oil and natural gas	➢ Tester et a. 2012, Ch. 8 ➢ DOE Coal: https://www.energy.gov/coal ➢ Sustainable energy: Nuclear? ➢ http://www.world-nuclear.org/information-library/energy-and-the-environment/sustainable-energy.aspx ➢ Natural gas abundance https://www.nytimes.com/2014/12/23/science/natural-gas-abundance-of-supply-and-debate-.html?_r=0 ➢ Natural gas technology http://naturalgas.org/environment/technology/#resources ➢ Oil Prices: What's Behind the Volatility? https://www.nytimes.com/interactive/2016/business/energy-environment/oil-prices.html?_r=0
Week 3: Feb 5-7		Lecture 5: Renewable energy: Solar and wind Lecture 6: Renewable energy: Hydro, Geothermal, Tide/wave	**Groups present survey observations** ➢ Tester et a. 2012, Ch. 2 ➢ Renewable Energy sources: ➢ http://energy.gov/science-innovation/energy-sources/renewable-energy ➢ Types of Renewable Energy: https://www.eia.gov/energyexplained/?page=renewable_home http://www.renewableenergyworld.com/index/tech.html http://www.altenergy.org/renewables/renewables.html **Due: Home energy team survey report Thursday 5pm.**

Week 4: Feb 12-14		Lecture 7: Renewable energy: Bioenergy, conversion technologies, CHP Lecture 8: Renewable energy resources: Biogas, algae	**Introduce short assignment 1 and 2** ➢ Bioenergy technologies https://www.energy.gov/eere/bioenergy/bioenergy-technologies-office ➢ Biogas Technology http://www.epa.gov/agstar/documents/chapter1.pdf ➢ Where are we with algae biofuels? http://www.biofuelsdigest.com/bdigest/2014/10/13/where-are-we-with-algae-biofuels/ ➢ Algae Biofuels Review 2016 http://www.qibebt.cas.cn/xwzx/kydt/201608/P020160830539214682611.pdf
Week 5: Feb 19-21		Lecture 9: Guest lecture and lab-based experience of Biomass to biofuels (UWSP biofuels lab, TBD) Lecture 10: Industry-based conversion and use of alternative/mixed sources of energy (Field trip, TBD)	**Introduce group project assignment** ➢ Biofuels technology http://www.advancedbiofuelsassociation.com/page.php?sid=2&id=5 **Due: Short assignment- Topic 1 Thursday 5pm**
Week 6: Feb 26-28	**Module 3: Energy carriers and grid systems**	Lecture 11: Electric power, hydrogen fuel Lecture 12: Grid systems and micro grid, smart grid and automation	➢ Tester et al. 2012, Ch. 16 ➢ Electricity basics: https://www.energy.gov/ne/downloads/lesson-2-electricity-basics ➢ Hydrogen fuel basics: https://www.energy.gov/eere/fuelcells/hydrogen-fuel-basics ➢ Smart Grid: http://energy.gov/oe/services/technology-development/smart-grid

Week 7: Mar 5-7	**Module 4: Energy management: Storage, transportation and distribution**	Lecture 13: Energy storage technologies Lecture 14: Energy transportation and distribution	➢ Tester et al. 2012, Ch. 17 ➢ New Battery Material Could Help Wind and Solar Power Go Big http://www.technologyreview.com/news/523251/new-battery-material-could-help-wind-and-solar-power-go-big/ ➢ Energy Storage and Distributed Resources http://eetd.lbl.gov/about-us/organization/energy-storage-and-distributed-resources **Due: Short Assignment- Topic 2, Thursday 5pm**
Week 8: Mar 12-14	**Module 5: Energy efficiency technologies**	Lecture 15: Exam time! Lecture 16: Green Building and Industry	**Mid-term Exam** ➢ Green building: http://www.epa.gov/greenbuilding/ ➢ Industrial energy efficiency: http://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants
Spring Break!			
Week 9: Mar 19-21		Lecture 16: Sustainable design Lecture 17: Transportation- cars, bus, trains, planes, mass transit	➢ Tester et al. 2012, Ch. 18 ➢ Sustainable energy design: http://www.gsa.gov/portal/content/104462 http://labs21.lbl.gov/DPM/Assets/vangeet-renewables.pdf ➢ Future of sustainable design: http://www.forbes.com/sites/rahimkanani/2014/03/07/the-future-of-sustainable-design/ ➢ Vehicle technologies http://energy.gov/eere/vehicles/vehicle-technologies-office **Group project discussion**
Week 10: Apr 2-4	**Module 6: Renewable energy technology- online modules by MREA**	Lecture 18: MREA Solar online module 1 Lecture 19: MREA Solar online module 2	**Introduce online modules** **Group project work**

Week 11: Apr 9-11	**Guest speaker (MREA)**	Lecture 20: MREA Wind technology module 1 Lecture 21: MREA Guest speaker- Nick Hylla, Q &A	**Review module learnings** **Group project work** **Group project draft due Thursday 5pm**
Week 12: Apr 16-18	**MREA workshop**	**Whole day** hands-on energy workshop at MREA (Friday, Apr 19) (No classes this week)	**MREA Test/assessment**
Week 13: Apr 23-25	**Module 7: Synergistic complex energy systems**	Lecture 22: Energy and land use Lecture 23: Energy and climate change Carbon sequestration technologies	➢ Outka 2012 J. of land use Article : Energy-land use nexus ➢ Energy, water and land: http://nca2014.globalchange.gov/report/sectors/energy-water-and-land ➢ Tester et al. 2012, Ch. 21 ➢ DOE Carbon capture and storage http://energy.gov/fe/science-innovation/carbon-capture-and-storage-research; http://sequestration.mit.edu/
Week 14: Apr 30- May 2	**Module 8: Policies for future energy technology innovation, improvement and integration**	Lecture 24: Energy technology, research and development, and policy Lecture 25: Policy for better integration of energy resources and technology.	**Discussion on group presentation** ➢ Littlefield 2013. Security, independence, and sustainability: Imprecise language and the manipulation of energy policy in the United States, *Energy Policy*. ➢ Manley et al. 2013. A survey of energy policy priorities in the United States: Energy supply security, economics, and the environment, *Energy Policy*. **Due: Group project paper Thursday, 5 pm**
Week 15: May 7-9	**Student presentations**	Group presentation Group presentation/wrap- up	**Group 1 and 2** **Group 3**
Final Exam: Thursday, May 16th, 12:30-2:30 pm in TNR 271			