AU21 ISE 6020 - FndDataDrvSusEngSy (33914)

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ISE 6020/AEDECON 6500/ENVENG 6020/FABENG 6020/PUBAFRS 6020/GEOG 6020: Foundations of Data-Driven Sustainable Energy Systems

Syllabus

Autumn, 2021

Class Meetings:

Lectures: TTh 11.10 AM—12.30 PM in 184 Baker Systems Engineering Building (https://odee.osu.edu/baker-sys-eng-184) and synchronously *via* Zoom (https://osu.zoom.us/j/91074772098?pwd=YkJ3UE96SGowc3djR3NXMVVIUWhkdz09)

Instructors of Record:

Rajiv Ramnath (http://web.cse.ohio-state.edu/~ramnath.6/)
Office: 291 Dreese Laboratories
Office Hours: by appointment
e-mail: ramnath.6@osu.edu (mailto:ramnath.6@osu.edu)

Ramteen Sioshansi (https://u.osu.edu/sioshansi.1/)
Office: 298 Baker Systems Engineering Building
Office Hours: T 2.10 PM—3.00 PM or by appointment
e-mail: sioshansi.1@osu.edu (mailto:sioshansi.1@osu.edu)

Course Description:

This course introduces students to issues that impact sustainable energy systems (*i.e.*, energy systems that depend on the resilience of natural and human systems and the ability of communities to recover, adapt, and flourish in the face of changing environmental, economic, and social conditions) across seven dimensions: technology, law and policy, business models, resilience, data, geospatial, and decision sciences.

Course Objectives:

As listed below, the course objectives align seven major dimensions that impact sustainable energy systems, to which students are introduced by this course.

- **Technology:** Students will understand how energy technologies operate individually and within a broader energy system.
- **Law and Policy:** Students will understand how the law and public and regulatory policy influence and shape the design and function of energy systems and energy system components. Students will gain exposure to

how the law and public and regulatory policy are shaped by externalities that are associated with energy production.

- **Business Models:** Students will understand the heterogeneity in players and market actors across the energy system, and key differences in their business models and practices.
- **Resilience:** Students will understand the factors that impact the resilience of energy systems, the role of environmental, social, and economic influences on system resilience, and the impact of energy systems on the resilience of environmental, social, and economic systems.
- **Geospatial:** Students will understand how social, environmental, and economic heterogeneity impacts, and is impacted by, energy systems across spatial and organizational scales. Students will assess the implications of energy systems on land, water, and resource use.
- **Decision Sciences:** Students will understand the roles of human and organizational behavior in influencing both supply- and demand-side considerations in energy systems.
- **Computation and Data:** Students will understand how to conceptualize how they would use computational techniques, as well as to find, get, or generate and analyze data to address core research questions in energy systems. Students will gain exposure to the development and use of computational models of energy systems.

Course Website:

The class website will be provided *via* The Ohio State University's Carmen system (https://carmen.osu.edu). Students are required to check Carmen regularly for, among other things, course announcements and updates. Do not email your instructors through the Carmen e-mail system. Please e-mail them directly through the university e-mail system at the e-mail addresses that are listed above. Your instructors seldom check the e-mail that is internal to Carmen.

Course Format:

This class meets twice a week for one hour and 20 minutes each meeting. Most class meetings are formatted as a hybrid lecture/seminar style. Unless stated otherwise, all lectures are held in-person in 184 Baker Systems Engineering Building (https://odee.osu.edu/baker-sys-eng-184). The course is divided into 14 modules (see the course schedule, below), which are led by different instructional teams. Assignments and readings that are associated with each module, including due dates, are indicated clearly in the course schedule.

Technical Support:

Carmen is supported by Office of Distance Education and eLearning (https://odee.osu.edu/). Support for University Libraries can be obtained at https://libanswers.osu.edu/q.php (https://libanswers.osu.edu/q.php).

Office Hours:

The instructors of record are available for office hours as listed above. Instructional teams that lead different modules are available for meeting by appointment as well.

Course Texts:

Required readings are provided in the course outline, which is below. All of the readings should be completed by the due dates that are indicated in the course outline. The readings are available publicly or for download through University Libraries (https://library.osu.edu/).

Course Requirements and Assessment:

Assessment is based upon attendance and weekly assignments, which constitute 40% of the course grade, and

an end-of-semester group project proposal, which constitutes 60% of the course grade. Most of the lectures have interactive components and attendance is mandatory. An excused absence should be discussed with the instructors as soon as possible in advance of the absence. Most of the weekly assignments are reflections or discussions of each module. In addition, teams of students must provide end-of-semester project proposals, which apply the tools that are covered in the course to studying or designing a sustainable energy system. For students who are enrolled in the Data-dRIVen sustainable Energy Systems (DRIVES) Graduate Interdisciplinary Specialization (GIS), the project proposal can (but does not have to) serve as the basis of a capstone project in PUBAFRS 8620 (Innovating for Sustainable Energy Systems), which is a required course in the GIS.

Grading Disputes:

Grading errors, mistakes, and omissions can occur. To facilitate an orderly process for the settlement of grading disputes, students must notify the instructors of record of the dispute in writing within one week of the assignment being graded. The preferred method for submitting grading disputes is e-mail (addresses are provided above). The written correspondence should detail the reason for the dispute and thorough reasoning for the correction that is requested.

Assignment Submission:

All assignments must be submitted using Carmen by the stated submission deadline. Late assignments are not accepted generally. Exceptions are given on a case-by-case basis if sufficient grounds are provided.

Originality of Work:

Plagiarism is defined as the submission of material authored by another person but represented as the student's own work, whether that material is paraphrased or copied in *verbatim* or near-*verbatim* form. This includes the improper acknowledgment of sources in essays or papers. Culpability is not diminished when plagiarism occurs in drafts which are not the final version. Software to check for plagiarism may be used to maintain academic integrity.

The Ohio State University and Committee on Academic Misconduct (COAM) (https://oaa.osu.edu/academic-integrity-and-misconduct) expect that all students have read and understand Code of Student Conduct (https://trustees.osu.edu/bylaws-and-rules/code) , and that all students will complete all academic and scholarly assignments with fairness and honesty. Failure to follow the rules and guidelines established in Code of Student Conduct may constitute academic misconduct. Sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from The Ohio State University.

Originality means that the student is the sole author of the work. Thoughts and ideas taken from other sources or from official content are permitted, but this must not constitute the bulk of the student's submission. This means that it is not acceptable for a student simply to submit work completed by another person or institution (such as an online paper-purchasing site) and cite it as the source of the work. A student's work must be his or her own. Ignorance of Code of Student Conduct is never considered an excuse for academic misconduct.

Cases of cheating or academic dishonesty will be reported promptly to COAM and handled according to policy (https://trustees.osu.edu/bylaws-and-rules/code) .

Questions regarding this policy or what constitutes academic misconduct should be directed to the instructors of record.

Disabilities:

If you would like to request academic accommodations based on the impact of a disability qualified under Americans with Disabilities Act and Section 504 of Rehabilitation Act of 1973, contact the instructors of record as soon as possible to discuss your specific needs. Discussions are confidential.

In addition to contacting the instructors of record, please contact Student Life Disability Services (https://slds.osu.edu/) at +1-614-292-3307 or slds@osu.edu (mailto:slds@osu.edu) to register for services or to co-ordinate any accommodations that you might need in your courses at The Ohio State University.

Mental Health:

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol or drug problems, feeling down, difficulty concentrating, or lack of motivation. These mental-health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns that you may be experiencing. If you or someone whom you know is suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus *via* Office of Student Life Counseling and Consultation Services (CCS) (https://ccs.osu.edu/) by calling +1-614-292-5766. CCS is located in Lincoln Tower and on the fourth floor of Younkin Success Center. When CCS is closed, you can reach an on-call counselor at +1-614-292-5766. 24-hour emergency help also is available through the 24/7 National Suicide Prevention Hotline (https://suicidepreventionlifeline.org/) at 1-800-273-TALK. Also, Student Advocacy Center (http://advocacy.osu.edu/) is a resource to help students navigate and resolve issues that they encounter at The Ohio State University.

Diversity and Inclusion:

The Ohio State University promotes a welcoming and inclusive environment for all students and staff, regardless of race, gender, ethnicity, national origin, disability, or sexual orientation. There is no tolerance for hateful speech or actions. All violations of this policy should be reported to Office of Institutional Equity (https://equity.osu.edu/). The Ohio State University encourages diversity at all levels, particularly among the next generation of colleagues.

Syllabus Revision:

During the course of the semester, the instructional team will review student progress, and may revise the syllabus to meet class needs, if necessary. This may result in changes of due dates, scheduled course content, or deadlines for assignments. The instructional team will make every possible effort to provide advance notice of any changes to the course content or schedule.

Course Schedule:

Module	Lecture Dates	Instructional Team	Reading Assignments		Lecture Material
01: Course Overview, Modeling Techniques, and Conducting Paper Reviews and Discussions	24, 26 August	Rajiv Ramnath (mailto:ramnath.6@osu.edu) and Ramteen Sioshansi (mailto:sioshansi.1@osu.edu)	01		01
02: Energy System Overview (Upstream and Downstream)	26 August, 2	Jeff Bielicki (mailto:bielicki.2@osu.edu)	02	Reflection	02

	September				
03: Energy Technologies and Components	31 August, 7 September	Jay Sayre (mailto:sayre.17@osu.edu) and Serdar Tufekci (mailto:serdar.tufekci@engie.com)	03	Assignment Reflection	03
04: Theory of, Assessing, and Measuring Resilience and Sustainability	9, 14 September	Daniel Gingerich (mailto:gingerich.62@osu.edu) and Elena Irwin (mailto:irwin.78@osu.edu)	04	Reflection	04
05: Sustainable Energy Systems	16, 21 September	Jeff Bielicki (mailto:bielicki.2@osu.edu)	05	Assignment Reflection	05
06: Background and History of Energy and Environmental Law and Policy	28, 30 September	Cinnamon Carlarne (mailto:carlarne.1@osu.edu)	06	Assignment Reflection	06
07: Energy Regulation and Markets: Principles and Theories	23 September, 5 October	Ramteen Sioshansi (mailto:sioshansi.1@osu.edu)	07	Reflection	07
08: Energy and Environmental Policy and Instruments: Cap and Trade, Coasean Markets, Taxation	7, 12 October	Daniel Gingerich (mailto:gingerich.62@osu.edu)	08	Reflection	08
09: The Energy Transition and Just Transition	19, 21 October	Jeffrey Jacquet (mailto:jacquet.8@osu.edu)	09 (Part 1) 09 (Part 2)	Assignment (Part 1) Assignment (Part 2) Reflection	09
10: Demand Side: Behavioral Decision Making; Equity Issues	26, 28 October	Nicole Sintov (mailto:sintov.2@osu.edu)	10	Assignment Reflection	10
11: The Nexus of Energy, Land, and Human-Environmental Systems	2, 4 November	Elena Irwin (mailto:irwin.78@osu.edu)	11	Assignment Reflection	11
12: Environmental and Human-Impacts of Energy Use	9, 16 November	Steven Quiring (mailto:quiring.10@osu.edu)	12	Assignment Reflection	12
13: Energy-System Optimization Modeling, Management, and	18, 23 November	Ramteen Sioshansi (mailto:sioshansi.1@osu.edu)	13	Assignment (Part 1)	13

Analysis				Reflection Assignment (Part 2)	
14: Computational, Statistical, and Data-Driven Energy-System Modeling, Management, and Analysis	30 November, 2, 7 December	Rajiv Ramnath (mailto:ramnath.6@osu.edu)	14	Assignment (Part 0) Assignment (Part 1) Assignment (Part 2) Reflection	14

Course Summary:

Date	Details	Due
Tue Aug 24, 2021	Reading 01: Course Overview, Modeling Techniques, and Conducting Paper Reviews and Discussions (https://osu.instructure.com/courses/108992/assignments/2394752)	due by 11:10am
Thu Aug 26, 2021	Reading 02: Energy System Overview (Upstream and Downstream) (https://osu.instructure.com/courses/108992/assignments/2394754)	due by 11:10am
Tue Aug 31, 2021	Reading 03: Energy Technologies and Components (https://osu.instructure.com/courses/108992/assignments/2394755)	due by 11:10am
Mon Sep 6, 2021	Assignment 03: Energy Technologies and Components (https://osu.instructure.com/courses/108992/assignments/2395224)	due by 11:59pm
Thu Sep 9, 2021	Reading 04: Theory of, Assessing, and Measuring Resilience and Sustainability (https://osu.instructure.com/courses/108992/assignments/2394756)	due by 11:10am

Date	Details	Due
	Reflection 02: Energy System Overview (Upstream and Downstream) (https://osu.instructure.com/courses/108992/assignments/2395449)	due by 11:59pm
Tue Sep 14, 2021	Reflection 03: Energy Technologies and Components (https://osu.instructure.com/courses/108992/assignments/2395450)	due by 11:59pm
Thu Sep 16, 2021	Reading 05: Sustainable Energy Systems (https://osu.instructure.com/courses/108992/assignments/2394778)	due by 11:10am
Mon Sep 20, 2021	Assignment 05: Sustainable Energy Systems (https://osu.instructure.com/courses/108992/assignments/2395227)	due by 5pm
Tue Sep 21, 2021	Reflection 04: Theory of, Assessing, and Measuring Resilience and Sustainability (https://osu.instructure.com/courses/108992/assignments/2395451)	due by 11:59pm
Thu Sep 23, 2021	Reading 07: Energy Regulation and Markets: Principles and Theories (https://osu.instructure.com/courses/108992/assignments/2394789)	due by 11:10am
Tue Sep 28, 2021	Reading 06: Background and History of Energy and Environmental Law and Policy (https://osu.instructure.com/courses/108992/assignments/2394788)	due by 11:10am
	Reflection 05: Sustainable Energy Systems (https://osu.instructure.com/courses/108992/assignments/2395452)	due by 11:59pm
Thu Sep 30, 2021	Assignment 06: Background and History of Energy and Environmental Law and Policy (https://osu.instructure.com/courses/108992/assignments/2395230)	due by 11:10am

Date	Details	Due
Thu Oct 7, 2021	Reading 08: Energy and Environmental Policy and Instruments: Cap and Trade, Coasean Markets, Taxation (https://osu.instructure.com/courses/108992/assignments/2394792)	due by 11:10am
	Reflection 06: Background and History of Energy and Environmental Law and Policy (https://osu.instructure.com/courses/108992/assignments/2395453)	due by 11:59pm
Tue Oct 12, 2021	Reflection 07: Energy Regulation and Markets: Principles and Theories (https://osu.instructure.com/courses/108992/assignments/2395454)	due by 11:59pm
Tue Oct 19, 2021	Assignment 09 (Part 1): The Energy Transition and Just Transition (https://osu.instructure.com/courses/108992/assignments/2395305)	due by 11:10am
	Reading 09 (Part 1): The Energy Transition and Just Transition (https://osu.instructure.com/courses/108992/assignments/2394793)	due by 11:10am
	Reflection 08: Energy and Environmental Policy and Instruments: Cap and Trade, Coasean Markets, Taxation (https://osu.instructure.com/courses/108992/assignments/2395455)	due by 11:59pm
Thu Oct 21, 2021	Assignment 09 (Part 2): The Energy Transition and Just Transition (https://osu.instructure.com/courses/108992/assignments/2395307)	due by 11:10am
	Reading 09 (Part 2): The Energy Transition and Just Transition (https://osu.instructure.com/courses/108992/assignments/2394802)	due by 11:10am
Tue Oct 26, 2021	Assignment 10: Demand Side: Behavioral Decision Making; Equity Issues (https://osu.instructure.com/courses/108992/assignments/2395334)	due by 11:10am

Date	Details	Due
	Reading 10: Demand Side: Behavioral Decision Making; Equity Issues (https://osu.instructure.com/courses/108992/assignments/2394794)	due by 11:10am
Thu Oct 28, 2021	Reflection 09: The Energy Transition and Just Transition (https://osu.instructure.com/courses/108992/assignments/2395456)	due by 11:59pm
Tue Nov 2, 2021	Reading 11: The Nexus of Energy, Land, and Human-Environmental Systems (https://osu.instructure.com/courses/108992/assignments/2394795)	due by 11:10am
Wed Nov 3, 2021	Assignment 11: The Nexus of Energy, Land, and Human-Environmental Systems (https://osu.instructure.com/courses/108992/assignments/2477446)	due by 11:59pm
Thu Nov 4, 2021	Reflection 10: Demand Side: Behavioral Decision Making; Equity Issues (https://osu.instructure.com/courses/108992/assignments/2395458)	due by 11:59pm
Tue Nov 9, 2021	Reading 12: Environmental and Human-Impacts of Energy Use (https://osu.instructure.com/courses/108992/assignments/2394796)	due by 11:10am
	Assignment 14 (Part 0): Computational, Statistical, and Data-Driven Energy-System Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2395368)	due by 11:59pm
Thu Nov 11, 2021	Reflection 11: The Nexus of Energy, Land, and Human-Environmental Systems (https://osu.instructure.com/courses/108992/assignments/2395459)	due by 11:59pm
Thu Nov 18, 2021	Reading 13: Energy-System Optimization Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2394797)	due by 11:10am

Date	Details	Due
Tue Nov 23, 2021	Assignment 12: Environmental and Human-Impacts of Energy Use (https://osu.instructure.com/courses/108992/assignments/2395362)	due by 11:59pm
	Reflection 12: Environmental and Human-Impacts of Energy Use (https://osu.instructure.com/courses/108992/assignments/2395461)	due by 11:59pm
Tue Nov 30, 2021	Reading 14: Computational, Statistical, and Data-Driven Energy-System Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2394798)	due by 11:10am
	Assignment 13 (Part 1): Energy-System Optimization Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2395365)	due by 11:59pm
	Reflection 13: Energy-System Optimization Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2395460)	due by 11:59pm
Tue Dec 7, 2021	Assignment 13 (Part 2): Energy-System Optimization Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2395366)	due by 11:59pm
Fri Dec 10, 2021	Assignment 14 (Part 1): Computational, Statistical, and Data-Driven Energy-System Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2395369)	due by 11:59pm
Mon Dec 13, 2021	Assignment 14 (Part 2): Computational, Statistical, and Data-Driven Energy-System Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2395370)	due by 11:59pm
Tue Dec 14, 2021	Project Proposal (https://osu.instructure.com/courses/108992/assignments/2395425)	due by 11:59pm

Date	Details	Due
	Reflection 14: Computational, Statistical, and Data-Driven Energy-System Modeling, Management, and Analysis (https://osu.instructure.com/courses/108992/assignments/2395457)	due by 11:59pm