

ENERGY 590-5: Introduction to Solar Project Development Syllabus

Course Logistics

Class Time:	Wednesday, 3:30 PM – 6:00 PM
Location:	Zoom
Number of Credits:	3 (graduate), 1 (undergraduate)
Instructor:	Jackson Naftel (jackson.naftel@duke.edu)
Office Hours:	Wednesdays, 2:30 PM – 3:30 PM, Zoom
Teaching Assistant:	Chris Lazinski (chris.lazinski@duke.edu)
Office Hours:	Upon request (please email Chris)

Course Overview

While most of the electricity in the U.S. is generated using fossil-based fuels, there is growing demand for power from renewable sources. Market factors and societal pressures are pushing electric utilities to consider, and in some cases, embrace renewable power generation throughout the U.S. Increased regulatory costs threaten the coal industry, while public awareness of climate change drives corporations and municipalities to demand clean electricity. Meanwhile the installed cost of solar power has plummeted over the last ten years. In this course, we will explore these drivers of change while examining how utility-scale solar energy projects are developed, financed and built. The intent is to provide a practical introduction to the process of developing utility-scale solar projects in the U.S. by examining the major players and steps in a complex process. Students will learn that professionals with expertise in law, engineering, real estate, public policy, regulation, finance, environmental consulting, and construction must work together over a period of years to get a solar generation facility built.

The class will cover project siting, how site control is established, and how land use permitting can affect timelines and budgets. We will explore how utilities oversee the interconnection study process, and why uncertainties related to this can make project management difficult. Students will learn about the necessary real estate due diligence steps required to satisfy investors, including title, environmental and cultural resource assessments. We will touch on how states regulate the construction of power generation facilities, and we will explore the financing mechanisms commonly used to provide the capital required to construct a facility. Students will learn the roles of the major stakeholders involved with the development process, with a focus on the “Developer.”

Learning Objectives

This course will provide a foundation of knowledge and a set of tools useful for students interested in solar development, corporate sustainability or the energy industry at large. At the end of the class, students will be able to:

- Understand how public policy affects utility-scale solar development
- Define the role of developer, EPC (Engineering, Procurement, Construction) provider, lender, and tax equity investor
- Apply the tools used in siting and infrastructure evaluation
- Describe the major steps in an interconnection process
- Describe key steps in real estate due diligence

- Describe the critical elements of legal contracts including Power Purchase Agreements, Interconnection Agreements, and EPC agreements
- Describe the commonly used project financing structures, and how solar system value is split amongst stakeholders
- Build a basic financial model to calculate project IRR

Course Requirements and Grading

This course is designed such that students will have a deliverable prior to every class, either in the form of an assignment or a reading summary.

Assignments (70%)

The bulk of the grading from this course will come from four assignments that will be done in teams. Assignments will be released one week prior to the due date and are due by 11:59 PM on the given date:

- Assignment #1: Site, Land, and Production Analysis | 15% | due Tuesday, 2/23
- Assignment #2: Interconnection and Permitting Analysis | 15% | due Tuesday, 3/2
- Assignment #3: PPA and Financial Analysis | 15% | due Tuesday, 3/23
- Final Presentation | 25% | due Tuesday, 4/13

All team members will receive the same score on the assignment. However, to ensure balanced contribution, I reserve the right to adjust individual grades based on level of contribution, which will be assessed via a peer feedback survey due prior to the last class of the semester.

Reading Summaries (15%)

Six reading summaries are due before lectures 2, 3, 4, 5, 8 and 11. These summaries are to be completed individually and consist of 300-word write-ups in responses to questions provided on 2-3 brief readings. These assignments will be available one week prior to their due date on Sakai.

Reading summaries will be scored along the following guidelines:

- 2 points (max): summary answers all provided questions thoroughly and thoughtfully
- 1 point: summary does not address all provided questions and/or misses the point of the questions
- 0 points: reading summary not turned in or turned in late

Attendance & Participation (15%)

With only one class session per week, attendance is critical for learning the ins and outs of renewable project development. While class sessions will be recorded, the recordings are not a substitute for live attendance. Please email Chris ahead of class if you are unable to attend class.

Late Policy

Assignments must be uploaded to Sakai by the posted due date. Assignments handed in after the posted deadline will incur a 25 percent penalty for each 24-hour period they are late. Assignments submitted more than 3 days after the posted due date and time will receive a grade of zero.

Reading summaries turned in after the deadline will be given zero credit.

Duke Community Standard:

Duke University is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect, and accountability. Citizens of this community commit to reflect upon and uphold these principles in all academic and nonacademic endeavors, and to protect and promote a culture of integrity. **The Pledge:** Students affirm their commitment to uphold the values of the Duke University community by signing a pledge that states: **To uphold the Duke Community Standard:** I will not lie, cheat, or steal in my academic endeavors; I will conduct myself responsibly in all my endeavors; and I will act if the Standard is compromised.

Course Schedule

Lecture	Date	Topic	Reading/Assignment
1	1/20	Introduction, Industry & Technology Overview	<ul style="list-style-type: none"> National Renewable Energy Laboratory (NREL): Facility-Scale Solar Photovoltaic Guidebook, Section 3 on PV System Components (pg. 8-17)
2	1/27	Public Policy <i>Guest Speaker:</i> Katherine Ross, Partner Parker Poe <i>Guest Speaker:</i> John Knight, President Amasa Advisory Services	<ul style="list-style-type: none"> State Enticed Them to Invest in NC - N&O Article Lawrence Berkeley National Laboratory (LBNL): 2017 RPS Annual Status Report (slides 1-10, 27-31) Solar Energy Industries Association (SEIA): Depreciation of Solar Energy Property in MACRS Solar Energy Industries Association (SEIA): ITC Fact Sheet Reading Summary #1 Due
3	2/3	Regulatory <i>Guest Speaker:</i> Karen Kamerait, Partner Fox Rothschild LLP	<ul style="list-style-type: none"> North Carolina Utilities Commission (NCUC): Rules and Regulations - Electric Light and Power North Carolina Administration: State Environmental Policy Act FAQs Reading Summary #2 Due
4	2/10	Siting & Land Control	<ul style="list-style-type: none"> Broker's Guide: How to Find a Suitable Solar Site Klavens Law Group: Know Your Title - Managing Real Estate Title Risks in Project Development Realtors Land Institute: The Top Three Real Estate Title Issues Realtors Need to Know Solar Energy Industries Association (SEIA): Guide to Land Leases for Solar Sample Ground Lease Agreement (<i>reference only – will be used in class</i>) Reading Summary #3 Due
5	2/17	Due Diligence, Interconnection & Project Engineering	<ul style="list-style-type: none"> Sandia National Laboratories: Utility-Scale Photovoltaic Procedures and Interconnection Requirements (pages 18-26) FERC: The Federal Energy Regulatory Commission's Open Access Rule Reading Summary #4 Due
6	2/24	Land Use Permitting <i>Guest Speaker:</i> Tom Terrell, Partner Fox Rothschild LLP	<ul style="list-style-type: none"> Town of Farmville Solar Overlay District A Battle is Raging Over the Largest Solar Farm East of the Rockies - NPR Concerned Citizens of Spotsylvania Website Assignment #1 Due

7	3/3	EPC & Financial Modeling <i>Guest Speaker:</i> John Morrison, COO Ecoplexus	<ul style="list-style-type: none"> ● VA DEQ Settles with Essex Solar ● Essex Solar WTVR Article ● Akin Gump: A Legal and Commercial Checklist for Bankable Solar EPC Contracts ● Assignment #2 Due
8	3/17	Power Purchase Agreements <i>Guest Speaker:</i> Bill DuFour, Partner DuFour Conapinski <i>Guest Speaker:</i> Will Fadrhonic, CCO Hyde Engineering Services	<ul style="list-style-type: none"> ● Environmental Protection Agency (EPA): Solar Power Purchase Agreements ● Overseas Private Investment Corporation (OPIC): Important Features of Bankable Power Purchase Agreements for Renewable Energy Power Projects ● Reading Summary #5 Due
9	3/24	Project Management <i>Guest Speaker:</i> Class Alumni Panel	<ul style="list-style-type: none"> ● Assignment #3 Due
10	3/31	Project Finance <i>Guest Speaker:</i> Patrick McConnell, Co-Founder and Partner Lacuna Sustainable Investments <i>Guest Speaker:</i> Sam Judd, Development Manager Strata Solar	<ul style="list-style-type: none"> ● The Impact of Financial Structure on the Cost of Solar Energy - NREL (pages 4-10)
11	4/7	Developer Landscape & Trends <i>Guest Speaker:</i> Latham Grimes, Principal & Co-Founder Cooperative Solar <i>Guest Speaker:</i> Cullen Morris, Principal & Co-Founder Cooperative Solar	<ul style="list-style-type: none"> ● U.S. Solar Market Insight, Executive Summary, Q4 2020 - Wood Mackenzie ● Reading Summary #6 Due
12	4/14	Energy Storage & Final Presentations <i>Guest Speaker:</i> Ron DiFelice, Co- Founder & Managing Partner Energy Intelligence Partners	<ul style="list-style-type: none"> ● U.S. Energy Storage Monitor, Executive Summary, Q4 2020 - Wood Mackenzie ● Final Presentation Due
13	4/21	Final Presentation	