U.S. Offshore Energy: Policy, Science and Technology

Spring 2017

Instructor: Amardeep Dhanju, Ph.D.

Instructor contact information: adhanju@jhu.edu; I will strive to respond to your emails within 24-48 hours of receipt. If you would like to speak over the phone or via a video link, we can try to work a suitable time.

Note: All emails from me to you will use the JHU system. If you use a different email system, make sure to forward your JHU account to that other address.

Course blackboard page: https://blackboard.jhu.edu
Assignments and course content (slides, student presentations, etc.) will be posted on the Blackboard.

Course Description
Offshore energy is progressively becoming a significant part of the U.S. energy mix. Oil from offshore platforms is a major source of U.S. domestic production and significant interest has emerged for developing renewable energy resources in the ocean and the Great Lakes. Large-scale offshore wind projects have been proposed along the East Coast, and there is also interest in wave energy off the West Coast and the Pacific islands. The first offshore wind project in the U.S. sited off Rhode Island began full-scale operations in December 2016 marking an important milestone in harnessing a significant renewable energy resource. Ocean current and tidal energy are the other emerging sources.

This course will take a multi-disciplinary approach to offshore energy analysis. We will discuss both renewable resources such as offshore wind, and conventional resources such as offshore oil and gas. We will also review case studies on the proposed Cape Wind project, the recently completed Block Island project, and the Deepwater Horizon oil spill. In addition, the course will discuss the ongoing National Ocean Policy initiative and its influence on offshore energy regulation and management.

Course Prerequisites
There are no prerequisites.
Course Learning Objectives
By the end of the course, students will be able to:

- explain policies and regulations governing offshore energy in the U.S.
- discuss the economics of resource development and technological drivers for harnessing the resources
- identify environmental impacts from energy production and describe scientific advances in assessing and mitigating impacts
- recognize complex stakeholder perspectives on offshore energy exploration, production and decommissioning
- analyze specific policy and technical challenges surrounding offshore energy and propose policy options to decision makers

Course Format
This course will consist of 15 modules that will include lecture presentations, readings, analytical exercises, and online discussions, all of which will help integrate materials that you will be learning. The course will also engage documentaries, external websites and other media on offshore energy topics as appropriate. The final module will involve student presentations on the term paper topics.

Course Materials
There is no required textbook for the course. All the course readings will be made available on EReserves which can be accessed under the left navigation tab.

Course Requirements
Class Participation: Students are expected to complete all the assigned readings, and each one will be expected to actively participate in discussion boards.

Assignments
There will be six assignments in the course. Some assignments contain multiple parts. Please make sure to complete all parts of an assignment. All assignments will be due 11:59 pm ET of the day of submission.

The instructor will strive to grade the assignments within two weeks of the submission deadline and provide feedback via Blackboard.

1. Online Discussion Forums (100 points – see dates below)
There will be four online discussion forums that students will be required to participate. The discussion questions will relate to the modules already covered in the course. Students will have six days to participate in the discussion forum after which the topic will be closed. Grading will be based on participation and the quality of engagement. Students are encouraged to use materials beyond the prescribed readings. Please make sure to properly reference the use of such materials.
Each online discussion will carry 25 points.

Discussion forum timeline:

- Discussion 1: January 30, closes February 5
- Discussion 2: February 22, closes February 28
- Discussion 3: March 15, closes March 26
- Discussion 4: April 12, closes April 18

2. MarineCadastre Assignment (40 points)

Available January 9 and due Jan 22

There are three parts to this assignment.

Students will review Marinecadastre.gov mapping portal and based on the instructions provided, identify specific data layers to create two maps, and a brief writeup. Submissions will be evaluated based on the requisite data layers identified in each of the maps and the writeup explaining the selection of specific data layers.

3. Seismic Survey Impact Assignment (40 points)

Available February 27 and due Mar 14

This assignment is designed to provide a representative and simplified example of the calculations that are typically made to assess the potential impacts to marine mammals from the use of a sonar system. The students will calculate impact of an airgun source on two marine species: bottlenose dolphins and sperm whales.

4. News Item Presentation (40 points)

On a pre-arranged, randomly determined date, each student will locate a news item on offshore energy using one of the sources listed here, and prepare a 7-10 min presentation in VoiceThread (using PowerPoint format) on the news item. You should utilize the direct source as well as other related sources, such as any scientific paper or policy decisions/discussions on which the article is based, or other articles/materials that relate to the news item. These presentations will start from the third week of the class - January 23.

Students will post the presentation within the course VoiceThread tool in Blackboard (https://blackboard.jhu.edu) available on the left menu within the course. A schedule of the presentations will be shared within Blackboard on the News Item Presentation wiki. The wiki includes instructions for posting the title and a PDF or link of your article. Your choice of the article is due to me via email (see Instructor contact information above) including the title and link or copy of the article by 11:59 PM ET the Monday before the presentation. Once approved, you will post the title and upload a copy of the article on the wiki page.

Your article should preferably have been published within the last 3 years. Presentations will be evaluated based on the following metrics: clarity (which includes organization) [8 points], timing...
(keep it to ten minutes) [4 points], demonstrated knowledge of the topic [24 points], and ability to engage class with materials and presentation [4 points].

**News article presentation resources**

Energy + Environmental Policy Databases @ Johns Hopkins Libraries
[http://databases.library.jhu.edu/databases/subject/energy-environmental-policy](http://databases.library.jhu.edu/databases/subject/energy-environmental-policy)

Environmental News Network [http://www.enn.com/](http://www.enn.com/)


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5. **Stakeholder Position Paper (50 points)**

(2-4 pages, double spaced, 12 pt font size)

Students will be randomly assigned a stakeholder identity (e.g. fishing community, energy developer etc.) in **Week 4** of the course, **January 30** (Stakeholder Assignments will be posted within the **Assignment Guidelines** section of Blackboard) Based on the stakeholder identity, students will prepare a position paper to communicate stakeholder equity, interests and opinions on technical and policy issues regarding a hypothetical offshore energy development scenario that will be presented by the instructor. The paper will be due via Blackboard **Wednesday March 8**.

After the submission, students will be expected to participate in an online forum to discuss the assignment. The discussion forum will open on the Blackboard from **March 8 – March 15**.

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6. **Final Term Paper and Presentation (130 points) [Term Paper: 100 pts; Presentation 30 pts]**

(12-15 pages, double spaced, 12 pt font size)

Students will prepare a term paper on an offshore energy topic. This paper is an opportunity for students to explore in-depth a policy, science or technology issue of interest. Students can assume the role of a policy maker, and use the paper to advocate for a specific policy or technical approach. The goal is to prepare a final report of 10-15 double-spaced pages exclusive of abstract, references and appendices. Students will follow these steps:

   **A. Term Paper Topic Proposal**

   Submit a brief (1-paragraph) topic proposal identifying a problem/issue that will be analyzed in the term paper to the instructor for approval by Sunday, **January 29**
B. Term Paper Outline
Create a full outline of the term paper and submit it to the instructor by Sunday, March 5.

C. Final Term Paper will be due in Blackboard in PDF format on Friday, April 28.

D. PowerPoint Presentation (30 points)
Based on the term paper, students will present their research and findings to the class via a PowerPoint presentation. These presentations should be uploaded on the Blackboard using VoiceThread by Sunday April 30 for the class to access and review. We will explore the option of students presenting via live Adobe Connect session.

Grading

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Discussions (4 @25 points each)</td>
<td>100</td>
</tr>
<tr>
<td>MarineCadastre Assignment</td>
<td>40</td>
</tr>
<tr>
<td>Seismic Survey Impact Assignment</td>
<td>40</td>
</tr>
<tr>
<td>News Topic Presentation</td>
<td>40</td>
</tr>
<tr>
<td>Stakeholder Position Paper</td>
<td>50</td>
</tr>
<tr>
<td>Final Term Paper</td>
<td>100</td>
</tr>
<tr>
<td>Final Term Paper Presentation</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>400</strong></td>
</tr>
</tbody>
</table>

The following grading scale will be used in this class (the JHU-AAP grading scale):

- 98–100%       A+
- 94–97.9%      A
- 90–93.9%      A-
- 88–89.9%      B+
- 84–87.9%      B
- 80–83.9%      B-
- 70–79.9%      C
- <70%          F

Extra credit will not be available.

Course etiquette
Students are expected to behave professionally and be respectful of the learning process during the course. Communication in discussion groups with classmates and any communication with the instructor should be conducted in a professional manner. Emailing the course instructor or fellow students is not the same as sending text messages to your friends. Please follow proper format (salutation, text with proper grammar, and closure) in all your correspondence. Feel free to reach out to me and other resources available in the program for assistance. As your instructor, I want to ensure you have all the assistance available to make the most out of this course.
Late Assignment Policy
If a student is unable to complete an assignment on time, please contact the instructor immediately. Points will be deducted from the assignments submitted after due date without prior approval from the instructor. Three (3) points will be subtracted from the assignment grade for every day an assignment is turned in after the due date.
Readings
Instructor will make reading available via Blackboard. Any changes and updates to the reading list will be communicated via email and Blackboard to the class.

Relevant Websites

- [http://boemoceaninfo.com/](http://boemoceaninfo.com/) Final Programmatic EIS for 2017-2022 OCS Oil and gas leasing program
- [http://dwwind.com/project/block-island-wind-farm/](http://dwwind.com/project/block-island-wind-farm/) Block Island Wind Farm
- [http://www.onrr.gov/](http://www.onrr.gov/) Office of Natural Resources Revenue
- [http://ocean.si.edu/gulf-oil-spill](http://ocean.si.edu/gulf-oil-spill) Deepwater Horizon Oil Spill (Smithsonian Portal)

Databases, Mapping Tools and Knowledge Management Systems

- [https://marinecadastre.gov/espis/#/](https://marinecadastre.gov/espis/#/) BOEM Environmental Studies Program Information System (ESPIS)

Instructor will provide additional web links and materials through the course.
Course Topics, Activities and Schedule

Note: This schedule is subject to change, and changes will be provided via an Announcement, with at least one week’s advanced notice.

January 9 (Week 1): Introduction to offshore energy, course outline, assignments and grading
- Course introduction
- Offshore Energy: Introduction and history
  - Conventional resources: oil and gas
  - Renewable resources: offshore wind, wave, tidal, ocean current, OTEC, osmotic power, and marine biomass
- Units and Metrics – Oil, gas and electricity
- Maritime boundaries – State, federal and international waters

January 16 (Week 2): State, Federal and International Regulatory Framework
- Ocean and Great Lakes as a common resource
- Federal-state jurisdictional framework and implications on offshore energy development
- Offshore oil & gas
  - Regulatory framework history and evolution
  - Outer Continental Shelf Lands Act (OCSLA) and amendments
- Offshore renewable energy
  - BOEM offshore wind intergovernmental task force and leasing framework
  - Transmission line ‘right of way’
- International Regulatory Framework
  - UNCLOS Article 82 and Deep Seabed Mining
  - MarineCadastre.gov Assignment – (due Sunday, January 22)

January 23 (Week 3): Resource Assessment and Exploration
- Oil and gas formation and classification
- Offshore oil and gas resource exploration: seismic survey and other techniques
- Offshore wind power resource assessment methodologies
- US offshore wind resource assessments
  - News article presentations 1 and 2
  - Final Paper Topic Proposal (due Sunday, January 29)

January 30 (Week 4): Extraction, Production, Transportation and Decommissioning
- Oil and gas drilling and production
  - Shallow, deepwater and ultra-deep water drilling
- Offshore Arctic oil and gas drilling and production
- Oil and gas pipelines – Gulf of Mexico and California
- Decommissioning regulations and requirements

- Offshore wind installation and decommissioning
  - Wind turbine foundation types
  - Transmission cable installation
  - Offshore electrical transmission
  - Decommissioning

- Levalized Cost of Energy (LCOE)
- **Stakeholder Position Paper Exercise (Due Wednesday, March 8)**
- **Online Discussion 1: Begins Jan 30/closes Feb 5**
- **News article presentations 3 and 4**

**February 6 (Week 5): Offshore Oil & Gas Leasing Framework, Fair Market Value Determination and Economics of Resource Development**
- Developing the 5-year offshore oil and gas program
- Planning for specific lease sale and lease terms
- Current leases on the U.S. OCS
- Project timeline: from leasing to production
- Bid adequacy and fair market valuation
- Economics of offshore oil development
- Crude oil export from the US – historical restrictions and current trends
- **News article presentations 5 and 6**

**February 13 (Week 6): Offshore wind and marine minerals (sand and gravel) leasing frameworks**
- Offshore wind power leasing process – Stages of offshore wind authorization
- Offshore wind competitive lease sale auction and lease terms
- Transmission cable right of way
- Sand & gravel leasing through cooperative agreements
- **News article presentations 7 & 8**

**February 20 (Week 7): Environmental Impacts**
- Oil and gas
  - Drilling and production impacts – air and water emissions
  - Impact mitigation measures
- Offshore wind power
  - Installation and electricity generation impacts
  - Monitoring and mitigation strategies
News article presentations 9 & 10

Online Discussion 2 – Begins Feb 22/closes Feb 28

February 27 (Week 8): Seismic Surveys for Resource Exploration
- Noise sources in the ocean
- Underwater acoustics – introduction
- Impacts from seismic surveys for oil and gas exploration

News article presentations 11 & 12
Term Paper Outline (due Sunday, March 5)

March 6 (Week 9): Cape Wind and Block Island Offshore Wind Projects
- Cape Wind Project – history, permitting and financing
- Block Island Project – proposal, permitting, construction and operation
- Cape Wind vs. Block Island offshore wind projects
- Multimedia: Cape Spin! An American Power Struggle (Documentary)

News article presentations 13 & 14
Stakeholder Position Paper (due Wednesday, March 8)
Stakeholder Position Paper discussion (March 8 through March 15)
Seismic Survey Assignment (due Tuesday, March 14)

March 13 (Week 10): Regional Electricity Markets and Renewable Integration
- Regional Interconnections (PJM ISO, NY ISO)
- Electricity Market Pricing: Least Cost Dispatch and Locational Marginal Pricing (LMP)
- Planning for Reliability and Transmission Expansion

News article presentations 15 & 16
Online Discussion 3- Begins Mar 15/closes Mar 26

Week 11 (March 20): Spring Break

March 27 (Week 12): Deepwater Horizon Incident
- Unfolding of events and Deepwater Horizon rig explosion
- The aftermath
- Damage assessment, litigation and settlement
- Implications on regulatory and environmental assessment practices
News article presentations 17 & 18

April 3 (Week 13): National Ocean Policy and Marine Planning
- Ocean policy evolution in the US
- Formulation of first National Ocean Policy (NOP)
- NOP goals and objectives
- Marine Planning initiatives – focus on Northeast and Mid-Atlantic
- Multimedia – Ocean Frontier II (Documentary)
- Multimedia – Video: United States Ocean Plans, Maine to Virginia

News article presentations 19 & 20

April 10 (Week 14): Offshore Energy in a Carbon Constraint Future
- Climate change implications of offshore hydrocarbon production, and mitigation potential of offshore renewables
- Role of offshore renewable energy in carbon constraint future

Online Discussion 4 – Begin Apr 12/closes Apr 18

April 17 (Week 15): Course Synthesis

April 24 (Week 16) Student Presentations and Discussion

Final Paper Due Friday, April 28
Final Paper Presentation Due Sunday, April 30. We will explore the option of students presenting via live Adobe Connect session

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Course Readings

**Note:** Readings and handouts will be provided via Blackboard at least a week in advance. Readings in the list are subject to change.

Jan 9 (Week 1) Introduction to offshore energy, course outline, assignments and grading


Jan 16 (Week 2): State, Federal and International Regulatory Framework

- **Offshore oil & gas leasing framework**

- **Offshore renewable energy leasing framework**
  2. BOEM Offshore Renewable Energy State Activities http://www.boem.gov/Renewable-Energy-State-Activities/ (Browse through various state activities on this page)

- **International Regulatory Framework**
  1. Ribeiro, M. C. (2013). What is the Area and the International Seabed Authority? Institut

Additional Readings

January 23 (Week 3): Resource Assessment and Exploration

• Offshore oil and gas
1. Petroleum resources classification system and definitions. Society of Petroleum Engineers. Available at http://www.spe.org/industry/petroleum-resources-classification-system-definitions.php

• Offshore wind power

Additional Readings:
January 30 (Week 4): Drilling, Production/Generation, Transportation and Decommissioning

- Offshore Oil and gas drilling, production, transportation and decommissioning


2. Decommissioning Offshore Platforms
   *(Browse through the page, including under ‘Related Link(s)– FAQs, Idle Iron, Reef in Place and Statistics)*

- Offshore wind installation and decommissioning


February 6 (Week 5): Offshore Oil & Gas Leasing Framework, Fair Market Value Determination and Economics of Resource Development

   *(Read Sections: 1.3: Program Development Process (Pg. 1-9 to 1-12); 1.5: Lease Sale Process (Pg. 1-15 to 1-16); 1.6: Exploration and Development Process (Pg 1-16 to 1-17); 4.2: Gulf of Mexico Program Area History (pg 4-6 to 4-10); and 10.3.2: Fiscal and Lease Terms (Pg. 10-19 to 10-23))*

   *(Read ‘Summary Chapter’ S1-S10)*


5. Review BOEM webpage on ‘Fair Market Value Determination’,
   http://www.boem.gov/Fair-Market-Value-Determination/
   (Review the webpage, specifically link on ‘BOEM Energy Economics Fair Market Value
   Determination’)

   http://www.boem.gov/Final-NOS-235-Package/
   (Skim through pages 12-15 and 19-27)

February 13 (Week 6): Offshore wind and marine minerals (sand and gravel) leasing
frameworks

Offshore Wind Power:
2. BOEM Renewable Energy Program https://www.boem.gov/BOEM-RE-Programs-Fact-
   Sheet/
3. Wind Energy Commercial Leasing Process (BOEM Fact Sheet)
   https://www.boem.gov/Commercial-Leasing-Process-Fact-Sheet/
   (Read program page and explore links on the page)

Marine Minerals Program (Sand and Gravel):
1. Marine Minerals Program (browse and explore links in the program webpage)
   https://www.boem.gov/Marine-Minerals-Program/
3. Atlantic Sand Assessment Project
   https://www.boem.gov/Marine-Minerals-Program-offshore-sand-resources/

February 20 (Week 7) Environmental Impacts

- Offshore Oil and Gas
  1. OSPAR Commission (2009). Assessment of impacts of offshore oil and gas activities in
     the North-East Atlantic
     http://qsr2010.ospar.org/media/assessments/p00453_OA3-BA5_ASSESSMENT.pdf
Read section 2.2: Pressures on the marine environment from oil and gas activities (pages 13-17)


- **Offshore Wind Power**

**Additional Readings**


**February 27 (Week 8): Seismic Surveys for Resource Exploration**

1. Access Audio and Videos galleries on the Discovery of Sound in the Sea (DOSITS)

2. Skim Paper titled: “Multivariate analysis of behavioral response experiments in humpback whales”
   http://jeb.biologists.org/content/216/5/759.full.pdf+html

This will give you an idea of the efforts that scientist must go through to begin to
understand the behavior effects of sound on marine mammals.

3. Skim Paper on Masking:
This is a relatively long (> 50 pages) overview paper on the masking of signals by one of the experts in the field. The intent is for the student to skim over the material and see the complexity of the issue.

Other sites to check out:
Joint Industry Program (JIP) http://www.soundandmarinelife.org/
Discovery of Sound in the Sea (DOSITS) http://dosits.org/
SEA, Inc. http://sea-inc.net/

March 6 (Week 9): Cape Wind and Block Island Offshore Wind Projects


6. Multimedia: Cape Spin! An American Power Struggle (Documentary)
March 13 (Week 10): Regional Electricity Markets and Renewable Integration

1. PJM Renewable Integration Study, Executive Summary
   http://www.pjm.com/~media/committees-groups/subcommittees/irs/postings/pris-executive-summary.ashx

2. Recent two-part study from UD/Princeton w/ help from PJM


3. PJM Interconnection: Model of a Smooth Operator.

Week 11 (March 20): Spring Break

March 27 (Week 12): Deepwater Horizon Incident

   (Read Chapters 4, 5 & 6 pages 87-195)


April 3 (Week 13): National Ocean Policy and Marine Planning


   (Read Introduction, Chap 1 & 2, pg. 1-29)
   https://www.boem.gov/MidARegionalOceanActionPlan_November2016/
   (Read Chapter 1, pg. 1-27)

4. Browse Northeast ocean data portal (https://www.northeastoceandata.org/) and Mid-Atlantic ocean data portal (http://portal.midatlanticocean.org/portal/)

5. Browse the West Coast (http://www.westcoastmarineplanning.org/) and the Pacific Islands Regional Planning Body (https://pacificislandsrpb.org/) webpages

6. Multimedia – Ocean Frontier II (Documentary)

   http://keeptheoceanworking.com/video-united-states-ocean-plans-maine-to-virginia/

April 10 (Week 14): Offshore Energy in a Carbon Constraint Future
1. The Solutions Project: thesolutionsproject.org
2. Oil-Climate Index: oci.carnegieendowment.org

April 17 (Week 15): Course Synthesis

April 24 (Week 16): Student Presentations and Discussion
UNIVERSITY POLICIES

General
This course adheres to all University policies described in the academic catalog. Please pay close attention to the following policies:

Students with Disabilities
Johns Hopkins University is committed to providing reasonable and appropriate accommodations to students with disabilities. Students with documented disabilities should contact the coordinator listed on the Disability Accommodations page. Further information and a link to the Student Request for Accommodation form can also be found on the Disability Accommodations page.

Ethics & Plagiarism
JHU Ethics Statement: The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Report any violations you witness to the instructor.

Read and adhere to JHU’s Notice on Plagiarism.

Dropping the Course
You are responsible for understanding the university’s policies and procedures regarding withdrawing from courses found in the current catalog. You should be aware of the current deadlines according to the Academic Calendar.

Getting Help
You have a variety of methods to get help. Please consult the help listed in the "Blackboard Help" link in the online classroom for important information. If you encounter technical difficulty in completing or submitting any online assessment, please immediately contact the designated help desk listed on the AAP online support page. Also, contact your instructor at the email address listed atop this syllabus.

Copyright Policy:
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