

EEM390 Introduction to Natural Resources and Energy

1st and 2nd quarters, Senior

Instructor OISO SHINICHI

Style of Class Lecture

Number of Credits 2

Day and Period To be advised

Course Description

The aim of this course is to think about the serious energy problems faced by Japan—a resource-poor country. Japan relies on other countries for over 90% of its energy. This leaves Japan with few options. In this course, students will learn about the origins of specific types of energy such as petroleum, natural gas, nuclear, coal, water, and renewable energy, and the systems for using them as energy resources and as industrial raw materials. Based on this, students will examine the current state and issues of each type of energy. In the first class meeting, students will choose a research topic from a list of topics. Students should come to class with a mindset to find a solution to the topic, read literature they find on their own in addition to the reference materials, and, based on their findings and the knowledge gained from the lectures, compile their ideas for a solution in a final report. In addition to using their knowledge of energy resources gained in the course, students must also examine their research topic from the perspectives such as the origin of energy resources, and of international problems such as the use of energy as industrial raw materials, the environmental impact of their use, and transportation to consumers from the place of production, in addition to geopolitical, environmental and historical perspectives. This will provide students with the tools to continue the lifelong study of various subjects including the natural sciences, industrial technology, and international affairs, and continuously think about what they mean, while considering “sustainability” from a holistic perspective—which includes historical, geopolitical, and ethnological perspectives—and encourage them to have their own opinions as individuals and as members of society.

Course Objectives:

Nearly every day we see stories about energy problems in the newspaper, on TV, and on the internet. Sometimes they include technical terms and are difficult to understand. This course aims to give students the skills to think for themselves, rather than simply accepting everything the media says.

Energy is an essential part of our lives. In this course students will...

- (1) examine what types of energy there are, how they are utilized, and the issues in using energy in our lives
- (2) gain understanding of the principles of systems which use energy, such as electricity generation and heat engines, and examine the environmental impacts of their use and measures to address them
- (3) consider the balance between different types of energy, their usability in the future, and regional characteristics, and examine measures to enable future generations of the world to live continuously in peace (sustainable development)
- (4) examine what perspectives are needed to use energy resources in the future, while comparing what problems there are from perspectives such as countries' distribution of resources, political situation, climate and geography, and ethnic traits
- (5) through examining these issues, recognize the importance of having the mindset to examine information from a variety of different angles including natural science, engineering, and social science
- (6) research and write a final report to enable them to explain in their own words and in easy-to-understand way to people with different experiences and no specialized knowledge about the principles, methods of use, and origins of energy resources

Prerequisites

None in particular.

Class Materials

No textbooks will be used, but handouts will be used in the lectures.

References:

- (1) Japan Atomic Energy Relations Organization. (Dec. 2016). *Genshiryoku sogo panfuletto* 2016 [General pamphlet on atomic energy 2016].
- (2) Ministry of Economy, Trade and Industry. (Aug. 2016). *Energy White Paper 2016*.
- (3) Agency for Natural Resources and Energy, METI. (Apr. 2014). *Basic Energy Plan*.

Course Method

The course will be in a lecture format. No textbook will be used, but handouts will be passed out each class meeting.

And through the process of researching for and writing reports, students will deepen their understanding by examining issues surrounding different types of energy. In order to ensure students participate in the course with an awareness of these issues, in the first class meeting students will select a final research report topic. By taking this course, students will gain knowledge, think about problems concerning natural resources and energy by reading the designated reference materials and through their own research, and acquire the mindset to continuously study and think, which is needed to build sustainable communities.

Grading

- 30% reports
- 70% final research report

Course Schedule

Week 1:

In this lecture students will think about energy problems as a whole. As a basic approach for the course, students will analyze problems based on four keywords (S+3E): safety, economic efficiency, environment, and energy security. Students will also acquire the basic knowledge needed for the subsequent lectures. Also, students will be shown a list of possible final research report topics to choose from. Students must submit their chosen topic with their reason for selecting it at the next class meeting.

Week 2:

Petroleum (1)

Making up just under 50% of primary energy, petroleum is one the most important types of energy, and is often the cause of energy crises. In this lecture students will learn about the basics of petroleum, including how it is produced, where it is located, where it is imported from, how it is used as an energy source, and what kind of industrial raw materials it is used in.

Week 3:

Petroleum (2)

In this lecture, students will think about petroleum problems as societal problems. Students will learn about its applications, including the current state of petroleum companies in Japan, participation in petroleum development outside of Japan, and what will happen if the Strait of Hormuz is blocked, taking into account international affairs.

Week 4:

Natural gas (1)

Japan imports natural gas in the form of liquid natural gas (LNG). Known in Japan as “city gas,” it is a commonly used energy in this country. However, most people know little about it. In this lecture students will learn how LNG is produced and manufactured, in what form it is imported, and how it is used as an energy source and as industrial raw materials. It will also cover related problems and issues.

Week 5:

Natural gas (2)

In this lecture students will learn about topics such as confirmed natural gas reserves by region around the world, natural gas output, and trade volume. Other topics discussed will be LNG receiving terminals in Japan and the use of highly efficient combined cycle power generation by power companies.

Week 6:

Nuclear power (1)

There are about 440 nuclear power plants in the world. It has several advantages including: it does not produce CO₂ or pollutants when generating power, once you import uranium it can be used for several years, and it is considered a semi-domestic energy source in Japan. In this lecture students will learn about the electricity generation mechanisms of nuclear power, including the principles of nuclear fission. Safety issues will also be examined.

Week 7:

Nuclear power (1)

With the nuclear plant accident in Fukushima, nuclear power has reached a difficult stage in Japan. This lecture will cover the current state and future outlook of nuclear power in Japan, and discuss the circumstances in other countries. It will also explain the nuclear fuel cycle, waste treatment process, and the principles behind them.

Week 8:

Coal (1)

Japan uses almost no domestic coal. However, coal is imported from politically stable countries such as Australia as an inexpensive thermal power fuel compared to petroleum and natural gas, and it is an important part of Japan’s energy mix. In this lecture students will study the origin of coal, the principles of coal thermal power generation, and its use as an industrial raw material.

Week 9:

Coal (2)

The biggest problem with coal-based power generation is that it emits vast amounts of CO₂. This lecture will discuss coal use that aims to reduce CO₂ emissions. Students will also think about, from multiple angles, the removal of substances that cause acid rain such as sulfur in coal and nitrogen oxide produced in power generation, and the conversion of waste to industrial raw materials, by studying successful environmental measures.

Week 10:

Hydropower

Hydropower is the most used renewable energy in Japan, but the number of suitable locations is limited. It is the starting point for power source development in Japan. In this lecture, students will examine various issues from multiple angles by looking at the history of hydropower development. Students will also learn about topics such as the principles of hydropower and construction of hydropower plants.

Week 11:**Renewable energy (1)**

Public interest in renewable energy is high. Solar power and wind power are also referred to as “natural energy” in Japan. It is highly promising, but there are many problems including cost, volume, and stability. And its capability needs to be properly assessed. In this lecture, students will be provided with an explanation of these principles, and consider what is needed to assess their capability.

Week 12:**Renewable energy (2)**

There are many types of renewable energy, including low head hydropower and geothermal energy. Due to factors such as high operational efficiency and abundant resources, such energy shows promise in Japan. This lecture will also touch on non-renewable types of energy—so-called “new energy” such as fuel cells, as well as the potential for hydrogen energy use in the future. Students will learn about the principles of these energy sources, including the causes of geothermal energy.

Week 13:**Environmental problems**

Environmental problems go hand in hand with energy problems. In this lecture, students will think about specific measures on how to use energy and eliminate CO₂ emissions, such as emissions trading. The lecture will also cover energy-efficiency.

Week 14:**Energy terminology**

Energy-related terminology is difficult, and often invites misunderstanding or insufficient understanding. This lecture will explain energy-related terms in an easy-to-understand way, to provide students with correct understanding and literacy. Students must submit their final research report.

Week 15:**Review**

The final lesson will consist of a review and summary of the entire course. It will also cover points for students to keep in mind the next time they see energy-related stories on the news, in order to acquire the foundation to enable them to think for themselves, rather than simply accepting everything the media says.

Preparation and Follow-up

Preparation: Before each class meeting, read the appropriate chapter of the energy white paper listed above (available from the Agency for Natural Resources and Energy, METI website).

Follow-up: After each class meeting, review your notes of the lecture to deepen your understanding and prepare any questions you may have for the next class.