Renewable Energy: Basic Principles and Use in our Society

Department: **Date: 2023.04.04**

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<tr><td>Course Code</td><td colspan="7">ENVI170002</td></tr>
<tr><td>Course Title</td><td colspan="7">Renewable Energy: Basic Principles and Use in our Society</td></tr>
<tr><td>Credit</td><td>2</td><td>Experiment (including Computer) Credit</td><td>0</td><td>Practice Credit</td><td>0</td><td>Aesthetic Education Credit</td><td>0</td></tr>
<tr><td>Credit Hours Per Week</td><td>9</td><td>Education on The Hard-Working Spirit Credit Hours</td><td>0</td><td>Language of Instruction</td><td>English</td><td>Honors Course</td><td>□Yes
■No</td></tr>
<tr><td>Course Type</td><td colspan="3">□Core General Education Course
□Specific General Education Course
□Basic Course in General Discipline
■Others</td><td colspan="4">2+X Major ：
□Professional Core Course
□Professional Advanced Course
Non 2+X Major ：
□Professional Compulsory Course
□Professional Elective Course</td></tr>
<tr><td>Course Objectives</td><td colspan="7">（Including value, knowledge and ability objectives）
To introduce Chinese and international students to the general knowledge of renewable energy (RE), including global energy needs; RE sources and potential; processes for RE generation, usage, storage and transportation; local applicability; and current frontiers of developments. To then guide students to more specialized areas of technical, environmental or policy-based aspects, with special focus on system integration and sustainable development.</td></tr>
<tr><td>Course Description</td><td colspan="7">This course is designed for 1st-4th grades undergraduates of all disciplines and background. The contents of the course will include both general and specialized options, with the latter designed to accommodate students of non-science and technology backgrounds.
The general knowledge includes basic concepts in energy and energy systems, types of energy and their supply and demand, and major categories of RE sources and potential. Considering the varied background of the students, the contents will be more inclined towards overview instead of technical details. The course will then move on to bioenergy, introducing various categories such as energy crops, agricultural and industrial waste, municipal waste, and algae as RE feedstock, and outline the related thermal, physical, chemical and biological processes. The material will then be examined through integrated lenses such as i) process optimization, ii) integration into existing energy and economy network, and iii) balanced sustainable development objectives.</td></tr>
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Course Requirements:

The course will be taught by three lecturers, primarily in English but with Chinese learning aid if required. One guest lecturer might be invited to deliver some specialized contents, according to the course schedule and students' interest. Students from all disciplines will be accommodated, but it is recommended that they possess a basic knowledge in a natural science. Moderate-to-good English ability will also be helpful. The teaching team may be adjusted in the future according to the needs and interests of the students.

Teaching Methods:

The course credit will be 2, with a total teaching period of 36 credit hours, and an additional tutorial section of 3 hours. The main part of the course will be lectures using interactive class activities, including short discussions, questions and answers, and games. One off-campus visit or guest lecture might be arranged.

The course will contain one mid-term test on the content taught so far, in the form of open-ended questions. One open-scope and individualized assignment will be designed for each student, based on interactive discussions between the students and the lectures. The assignment will be due at the end of the term and taken as the final assessment. A written report and an oral presentation will be delivered by each student as a form of interactive learning.

Course Director's Academic Background:

The lead lecturer is Prof. Marie Harder, a Foreign Thousand Talent professor of Fudan since 2011. During her academic career at Brighton University, UK., Professor Harder has had extensive research and teaching experience in both natural and social sciences, including waste management and recycling, renewable energy, sustainable development, and values systems. Since she joined Fudan, her research interest has partly been focused on comprehensive municipal waste treatment and reutilization, including waste sorting, biogas production, and behavioral change. Her multi-disciplinary expertise and comprehensive experience will be an invaluable asset to the course.

Instructor's Academic Background:

Prof. Harder will be assisted and understudied by Assoc. Prof. Zhang Yi, who specializes in environmental engineering and biological processes, but is also of considerable experience in the field of renewable energy and biomass feedstock. She will focus on solar energy, algae and biodiesel, energy storage, and system integration, as well as provide Chinese teaching aid and organize class activities.

Prof. Xiuping Zhu will further expand the course with her research experience on water/wastewater treatment and renewable energy recovery. She joined Fudan University in September, 2021, as a Young Thousand Talent professor. She will teach the contents on wind, hydro and ocean energy, energy from waste, and electricity and grid.

Members of Teaching Team

Name	Gender	Professional Title	Department	Responsibility
Marie K. Harder	F	Professor	Environmental Science and Technology	Development of course syllabus, providing principle teaching materials, teaching the main contents in the first year
ZHAGN Yi	F	Associate Professor	Environmental Science and	Furnishing the teaching materials with Chinese

			Technology	perspectives, teaching some of the specialized contents, student liaison, preparing to take over as main teacher in subsequent years
ZHU Xiuping	F	Professor	Environmental Science and Technology	Providing expertise on electricity, saline gradient and heat-focused energy, and various contributions to teaching and assessment

Course Schedule (Please supply the details about each lesson)**:**

Week I:

Session 1: Introduction and overview (Marie Harder)

General background on energy, energy generation and usage (historical, and current): How renewables can help sustainability problems; explanation on course evaluation

Session 2: Renewable energy from the Sun-Solar energy (Zhang Yi)

Basic physical concepts in energy and energy systems; Solar radiation and insolation, passive solar, solar thermal and solar PV; centralized and decentralized systems; China perspective

Session 3: Renewable energy from the Sun-Hydro and wind energy (Zhu xiuping)

Hydropower, Large hydro and pumped storage, wind turbine and wind farm; China perspective

Week II:

Session 4: Renewable energy from the Ocean (Zhu Xiuping)

Wave, tidal, salinity gradient, ocean current and thermal energy

Session 5: Renewable energy from the Earth (Zhang Yi)

Geothermal energy for heat and power generation; nuclear fission and fusion, nuclear waste disposal and social concern; China perspective; a brief introduction to biomass

Session 6: Overview on bioenergy (Marie Harder)

Biomass and waste, photosynthesis and energy crops, thermal processes for bioenergy generation; initiation of the major assignment

Week III:

Session 7: Algae and its conversion to biodiesel (Zhang Yi)

Algae and its growth, algae lipids, algae harvest, processing and conversion to biodiesel

Session 8: Energy crop, farm waste and municipal sludge to biofuel (Zhu Xiuping)

Fermentation and production of bioethanol from energy crops; anaerobic digestion and production of biogas from municipal waste and farm waste

Session 9: System integration and mid-term (Marie Harder)

Municipal solid waste and its reutilization, hybrid systems, social and environmental concerns; mid-term test and updates on the major assignment

Week IV:

Tutorial (Zhang Yi and Zhu Xiuping)

Session 10: Electricity generation, transmission, distribution and storage (Zhu Xiuping)

Power generation in thermal plants, electricity grid and transmission, battery and supercapacitor for

electricity storage; China perspective

Session 11: Energy carrier, transportation, storage and conversion (Zhang Yi)

Traditional energy carriers, fossil fuels and their characteristics; energy transportation in solid, liquid and gaseous forms; RE storage as heat and electricity; energy conversion for RE storage

Session 12: Final assessment based on the major assignment

The form of assessment will be explained in the 1st session, and its topic gradually shaped during the course through interactive discussions. A presentation and a written report will be delivered in the last session.

The design of class discussion or exercise, practice, experience and so on:

Short discussion sessions will be integrated into the lectures, and one off-campus visit might be arranged, to renewable energy related facilities like biogas plants and wind farms. Questions might be given at the end of a session, to be answered and discussed in the next one. Teaching aids, both real and virtual, might be used. One major assignment will be given to all the students, which is to be finished by the end of the term. In the last session, students will give presentations on their assignments, to introduce their classmates to various topics of renewable energy.

If you need a TA, please indicate the assignment of assistant:

Yes, an assistant has been assigned.

Grading & Evaluation (Provide a final grade that reflects the formative evaluation process)**:**

Class attendance and participation in discussions will make up for 25% of the total mark, and one **mid-term test** in written form will constitute 15%. The test will be on the contents taught so far, in the form of open-ended questions.

The rest 60% of the total credit will be given based on the quality of the **major assignment**. The form of the assignment will be in introduced the 1st session, and explained again at the end of the 2nd week. The topic of the assignment will be renewable energy related, contemporary and forward thinking. An example is given as: the recent history, current application and future development of certain RE type in certain country/industry. The students will propose an intended topic and start interactive discussions with the lecturers after the 2nd week. In the next week, the topic will be reviewed and updated, and finally determined by the individual student and the lecturers together, after the mid-term test at the end of the 3rd week.

The assignment will include a written report and an oral presentation, making up for 40% and 20% of the total credits, respectively. The students will conduct in-depth research on the proposed or assigned RE related topic, and produce a report mainly containing a portfolio. The portfolio will include 5 articles that the students consider most relevant and chosen to represent the topic. A short summary will be written on these articles, to provide the most critical information in this area. The students will also explain why, among all the literature they have reviewed, they chose these 5 articles. The sources of these literature will be appended in the report, and the students will also answer several critical-thinking questions posed by the instructors. Checks of the report's progress will be conducted every session, and the final assessment held at the end of the term. In the final form, the assignment will include a presentation to the whole class, the written answers to the questions, and the written summary, and the portfolio including the sources of the various literature.

Usage of Textbook： ☐Yes (complete textbook information form below) ■No

Textbook Information (No more than two textbooks) **:**

Title	Author	ISBN	Publishing Time	Publisher	Type I	Type II

Teaching References (Including author, title, publisher, publishing time, ISBN)**:**

Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Oxford University Press, 3rd edition, 2012, 978-0199545339

David JC MacKay, Sustainable Energy-without the Hot Air, UIT Cambridge Ltd., 2009 with free online updates, 7030384431

John Twidell and Tony Weir, Renewable Energy Resources, Routledge, 2015, 3rd edition, 978-0415584388

Charles Kutscher, Jana Milford, and Frank Kreith, Principles of Sustainable Energy Systems, 2019, CRC Press, 3rd edition, 978-1498788922

Aldo da Rosa and Juan Ordonez, Fundamentals of Renewable Energy Processes, 2021, Elsevier Academic Press, 4th edition, 978-0128160367

Table column size can be adjusted according to the content.